Vestibular Schwannoma Treatment:
from Quality of Life towards Quality of Care

Bibian van Leeuwen

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Vestibular Schwannoma Treatment: from Quality of Life towards Quality of Care

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The needs of the patient come first

William J. Mayo (1861-1939)

Aan Guido, Jade en Sera

Aan mijn vader

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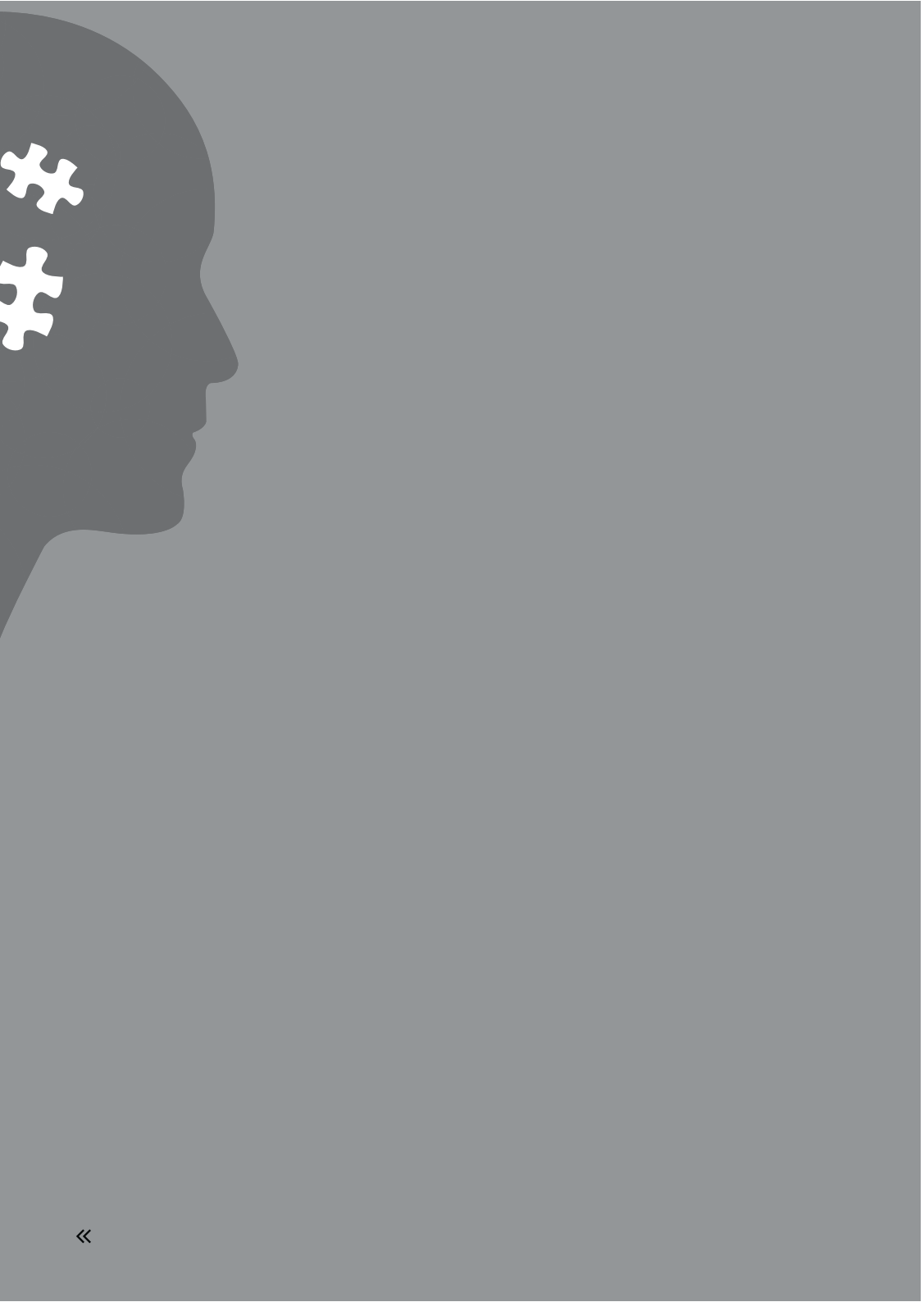

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General introduction and outline of the thesis

INTRODUCTION

Vestibular schwannomas are benign, often slow growing tumours recapitulating the differentiation repertoire of the Schwann cells in the neurilemma of the vestibulocochlear (eighth cranial) nerve. In the majority of cases the tumour arises from the superior vestibular part of this nerve.[1,2] Given the genesis of the tumour, the only correct terminology is vestibular schwannoma (VS)[3], although in the literature, misnomers such as acoustic neurinoma, acoustic neuroma and acoustic schwannoma have frequently been used over time.[4,5] In the current thesis the term VS will be used.

In 1777, Eduard Sandifort (1742-1814), professor of anatomy at Leiden University, the Netherlands, described an autopsy of a patient with unilateral right-sided deafness. He wrote about the causes of hearing impairment, and then more specifically about the individual patient he had examined:

> "Causarum; quae auditum obtundunt, maximum esse numerum, summam diversitatem, multiplicem sedem, quum plurimae partes sunt, & plures etiam singularum conditiones, quae, cum ad integritatem hujus sensus faciant, vitiari nequeunt, quin functio impediatur, recte monuerunt Pathologi (a), probarunt Anatomici (b), ac merito surditatem morbum unum & millecuplum vocare solebat Boerhavius (c). Investigatio autem harum causarum tanto difficilior est, quanto magis intricata auris internae fabrica, auditus enim organum inter omnia sensuum organa maxime compositum habetur (d). Sedem suam figere valent, vel in meatu auditorio & ante membranam tympani, vel in ipsa hac membrana, vel pone eandem in tympano, diversisque ipsius partibus, tuba Eustachiana, vestibulo, labyrintho, cochlea, aut & in ipso cerebri conceptaculo, sic ut organo inviolato apparatus nerveus, huic sensui dicatus, vario modo adficiatur.
>
> Probare & ulterius confirmare haec videntur, quae in capite foeminae vidi. In hoc quippe cerebri varias demonstrationes exhibiturus, ac basin encephali cum nervorum originibus examinans, corpusculum nervo auditorio dextro adhaerens, tantae duritei, ut ferme cartilaginem referret, perspexi (e)."[6]

This can be translated as: *The number of causes that weaken the sense of hearing is large, and they are of a high diversity and their location is variable. There are many parts and even more conditions that, because they are essential for the integrity of this sensory organ, cannot be damaged without impeding its function. Pathologists justly drew attention to this (a), anatomists examined this (b), and Boerhaave, to his merit, used to call the affliction of deafness one and thousand fold (c). But the investigation of these causes is so difficult as the fabric of the internal ear is so intricate; the auditory system is surely held to be the most composite of all the sensory organs (d). Locations that can be stricken are either in the ear canal and in front of the tympanic membrane, or in that membrane itself, or behind that membrane in the tympanic cavity and its various parts, the Eustachian tube, the vestibule, the labyrinth, the cochlea, or even in the receptacle of the brain, so that when the organ itself is unharmed the nervous system dedicated to this sense can be affected in various ways.*

What I have seen in the head of the woman seems to prove and further confirm these things. Indeed, I will deliver various proofs about the brain. I have found, while examining the base of the brain with the origin of the nerves, a small body adherent to the right auditory nerve, of such rigidness, that it almost seems to be cartilage (e).

Most likely the "small body adherent to the right auditory nerve" which he discovered was the first description of what is nowadays called a vestibular schwannoma (VS). [6-9]

Figure 1. Eduard Sandifort (1742-1814)
Bron: Leendert Springer Sr., Collectie Bodel Nijenhuis
BN 1226 (http://socrates.leidenuniv.nl)

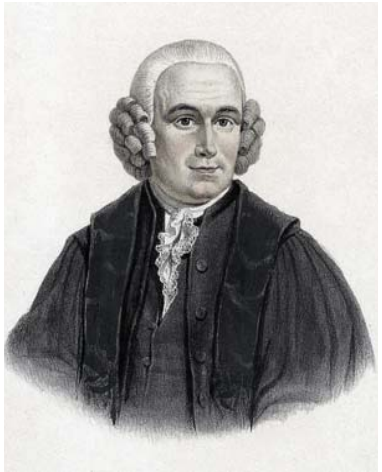
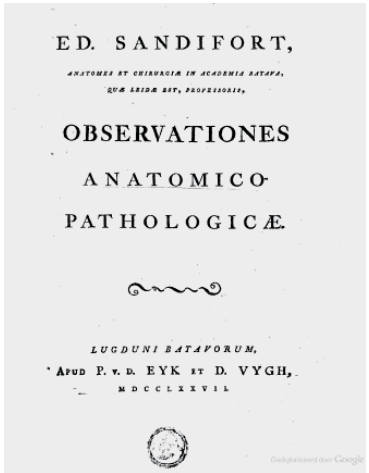


Figure 2. Publication with first description of a vestibular schwannoma



Vestibular schwannomas are the most common tumours in the cerebellopontine angle and account for 90% of all tumours in this region. Meningiomas come second most common, and account for 5-10% of cases.[10,11] Due to a more frequent use of magnetic resonance imaging (MRI) and better accessible audiologic testing capacities, an increase in incidence of VS has been observed over the last decades.[12-14] This increase is mainly due to a rise in detection of small and asymptomatic tumours in elderly patients.[2,14-17] However even though they are the most common tumour in this region, vestibular schwannomas are still rare. Currently, after years of increases in incidence, occurrences appear to be stabilizing annually at about 1-2 incidences per 100,000 a year.[14,17-20] Nevertheless the true prevalence of VS may still be much higher (0.8-0.9%), according to studies of temporal bone dissections in cadavers.[21,22]

The majority (95%) of the vestibular schwannomas arise unilaterally and sporadically. Only in 5% of cases do vestibular schwannomas occur bilaterally in the context of neurofibromatosis type 2 (NF2) which is caused by a mutation in chromosome 22q.[23,24] NF2 has an autosomal dominant inheritance with an annual incidence of about 1 per 50,000. In addition to bilateral vestibular schwannomas, patients with NF2 can also develop cranial meningiomas and peripheral schwannomas.[25-28]

To date, the genetic profile of sporadic vestibular schwannoma has not been fully identified. It is presumed that the tumours arise due to a mutation in the NF2 gene, located on chromosome 22q12. Probably, it is a second hit of this gene. NF2 is a gene encoding the tumour suppressor protein Merlin. If the NF2 gene is turned off it will lead to tumour growth.[29]

The studies in this thesis focus on patients with unilateral vestibular schwannomas. The clinical presentation and treatment choice differ significantly between patients with NF2 and patients with unilateral sporadic vestibular schwannomas.

Clinically, patients with a VS often present with unilateral sensorineural hearing loss and associated tinnitus, vertigo, or imbalance.[30] Occasionally the tumour can interfere with the trigeminal nerve (fifth cranial nerve) causing facial numbness, or with the facial nerve (seventh cranial nerve), causing facial weakness or paralysis. Fortunately these complications are very uncommon. Owing to their benign character and slow growing behaviour, vestibular schwannomas has a long duration, are irreversible, and implies a significant burden on the patient and their families, as well as on the health care system. Therefore vestibular schwannomas could be considered as a chronic illness.[31]

MANAGEMENT OF VESTIBULAR SCHWANNOMA

There are three management options available for vestibular schwannomas; observation (watchful waiting, wait-and-scan), microsurgical resection and radiation therapy.[30,32,33] To date, pharmacological therapy is barely used, but rapid development is ongoing in this area.[29]

Observation

Due to a more frequent use of magnetic resonance imaging (MRI), vestibular schwannomas are usually discovered as an incidental finding. These tumours are usually asymptomatic, and smaller then symptomatic tumours.[13] Given the majority of the tumours show little or no growth, there are even tumours that never become symptomatic.[11,22] Therefore, there is a large group of patients in whom observation (also called watchful waiting, wait and scan) is a rational management option. Also in elderly patients, and in those with coexisting morbidities that preclude invasive treatment (microsurgical resection or radiation therapy), observation seems to be an evidence-based treatment strategy.[30,32-34] During observation the VS is monitored with annual MRI (magnetic resonance imaging). The annual MRI will be compared with scans of previous years to monitor the potential of growth of the VS. Without established growth, observation of the tumour will be continued. In case of significant increase of symptoms or significant progression of the tumour conversion to invasive treatment could be considered.[34-37] In the literature, the observational approach is widely supported in selected cases as mentioned above. Radiological and clinical follow-up is required throughout the life of the patient, although the annual interval between the MRI scans could be extended to once every two years if patients' complaints remain stable, and the tumour shows little or no growth.

Microsurgical resection

Microsurgical resection aims for total or near-total tumour resection. The position of the VS in the posterior fossa, near delicate and important structures like cranial nerves and brainstem makes microsurgical resection of these tumours challenging. Due to the damage that has already been done to the vestibulocochlear nerve, and in some cases to the facial nerve or trigeminal nerve, symptom relief is not expected, except for vertigo which can improve after surgery. In 1894, the first successful surgical treatment in a patient with progressive unilateral sensorineural hearing loss, vomiting, ataxia and papilledema was performed by Sir Charles Ballance (1856-1936).[9,38,39] Complications, such as cranial nerve damage and high mortality rates, were not rare at that time.[9,40,41]

Subsequently, surgery for vestibular schwannomas developed further. New operating techniques with reduced mortality rates and complete tumour removal were described.[42] Improved control over intraoperative hemorrhage came about with the use of vascular clips (1911) and electrocautery (1925), both introduced by Cushing.[43] In the 1960s Sir William House and William Hitselberger introduced the use of an operation microscope and new microsurgical techniques, which resulted in cranial nerve preservation, more radical tumour removal and decreased mortality.[41,44,45] Preservation of the cranial nerve was reinforced with the application of cranial nerve monitoring in 1979. Later on it became the gold standard for intraoperative facial nerve monitoring.[46,47] At the present time, the mortality risk due to VS surgery is below 1%.[48] Likewise, morbidity rates are low, although the risk of intracranial bleeding, cerebrospinal fluid leak and meningitis remains potential complications. In the majority of the patients the preoperative facial nerve function can be maintained. There are, however, still significant risks with regard to preservation of the preoperative hearing status.[49,50]

Radiation therapy

The aim of radiation therapy in patients with vestibular schwannomas is to gain control over the tumour growth by the use of radiation beams which cause irreversible damage to the tumour cells. Radiation therapy for vestibular schwannomas was introduced in 1951 by Lars Leksell (1907-1986), Professor of Neurosurgery at the Karolinska Institute, Stockholm, Sweden. In 1969, Gamma Knife radiosurgery was described by Leksell as treatment in patients with a VS. The advantage of Gamma Knife over regular radiation therapy is the ability to form a very precise region for the radiation while there is minimal damage to the surrounding tissue. This development is very interesting in the use of intracranial radiation therapy to prevent damage to surrounding brain tissue.[51] A relatively new type of radiation is irradiation using proton beam therapy. With this type of radiation therapy the dose distribution can be determined very precisely and the healthy tissue surrounding the tumour can be spared as much as possible. For vestibular schwannomas, which occur close to the brain stem, this is an attractive type of radiation. The local tumour control and preservation of cranial nerve function with proton beam therapy is comparable to conventional radiation therapy.[52] Nowadays, radiation therapy is associated with high rates of preservation of hearing and facial nerve function, and low morbidity.[49]

Pharmacological treatment

To date, pharmacological treatment of vestibular schwannomas is still experimental. However, through research on tumour biology, targets for pharmacological therapy are being sought. Some important developments will be discussed briefly.

One of the most successful targets for therapy seems to be inhibition of angiogenesis. Although vestibular schwannomas are slow-growing tumours, angiogenesis is still necessary, for it to grow beyond a certain size.[29,53] Confirming is that is the fact that vestibular schwannomas factors that promote angiogenesis, such as VEGF, were found.[54,55] The first pharmacological treatment option therefore appears to be inhibition of angiogenesis, for example with Bevacizumab. At this moment, Bevacizumab is used in particular for the treatment of cancer. However, there are studies in which this agent was used in patients with Neurofibromatosis type 2, whereby shrinkage of the tumour and hearing improvement were found in the majority of patients.[56-58]

In addition, macrophages have also been associated with angiogenesis, cell growth, and suppression of the immune response.[59] The COX-2 enzyme in particular, appears to play an important role here.[60] In fast-growing vestibular schwannomas more COX-2 expression was found. Therefore, Aspirin, which has an inhibiting effect on COX-2 could be effective in the treatment of vestibular schwannoma, although evidence is lacking.

The development of pharmacological therapy helps to reduce the need for surgical and radio therapeutic treatment in the future.

OVERVIEW OF MANAGEMENT STRATEGIES

The choice between the different treatment modalities remains a controversial one, and consensus is lacking, particularly for tumours smaller than 30 mm in diameter.[30,61-63] There is a wealth of literature available, describing the outcomes, advantages and disadvantages of these three treatment modalities. Usually just one modality is described, or two modalities are compared to each other. Occasionally the three modalities are compared at the same time. Current studies comparing treatment modalities are based on level 2 evidence at best, as no randomized trials on the subject have been conducted successfully.[64] Randomization does not seem justified for two major reasons. First of all, because the tumour is benign, patients should not be exposed to unnecessary risks. But moreover, each of the three treatment modalities comes with different targets and risks, and has potential negative effects on Quality of Life. Patients may assign different values to these effects; and therefore, one treatment may be beneficial for one patient, but

harmful for the next, regardless of the specific tumour characteristics. Unfortunately, if the three different treatments are compared without randomization, skewing of the results might occur due to confounding by indication. Actually it is not inconceivable that patients differ from each other before a treatment modality is chosen, which makes them more eligible to recommend one or the other modality.

An important development in the treatment of vestibular schwannomas was the awareness in health care providers that not all patients need active treatment. In general, for small and some medium-sized tumours, for elderly patients, and for those with coexisting morbidities that preclude invasive treatment, observation with serial magnetic resonance imaging (MRI) scans has proved to be an evidence-based treatment strategy.[30,32,33]

Tumours over 30 mm could be too large for conventional radiation therapy, so the only available active treatment in these cases is microsurgical resection. The discussion about which treatment is the 'best' is focused on medium-sized tumours, especially up to 25 mm, in which the management of choice depends on clinical factors, patient factors and tumour factors. Prospectively conducted studies comparing radiation therapy and microsurgical resection have demonstrated no major differences between these treatment modalities. Some studies have reported better short-term hearing and facial nerve outcomes for patients undergoing radiation therapy,[1,49,62,64] however it may take up to ten years for the effects of radiation therapy on hearing to reach its full impact.[65,66]

In some cases all treatment options are open to discussion and therefore the personal preferences of both physician and the patient seem to be of major importance. The final treatment choice could be very difficult, often even more difficult than with head and neck malignancies. In order to make an informed decision on treatment it is important that patients are informed about the consequences of each of the plausible treatment modalities. To achieve this, it is important for physicians to establish 'the best treatment choice' and to find tools to support patients in taking this very difficult decision.

The bottom line is that for every single patient with a VS a decision has to be made regarding their treatment. In addition to medical considerations, it has to be taken into account that each of the three treatment modalities has its impact on the patients' Quality of Life. The decision on what treatment strategy to take is complex, patient's preferences are of the utmost importance, and the physician's preference could differ from the patient's wishes. Up to now, it is unclear how the decision for one of the three treatments is made, and to what extent the preference of the patient concerns. In this thesis a study

was performed on the decision making process in a tertiary referral center in the Netherlands.

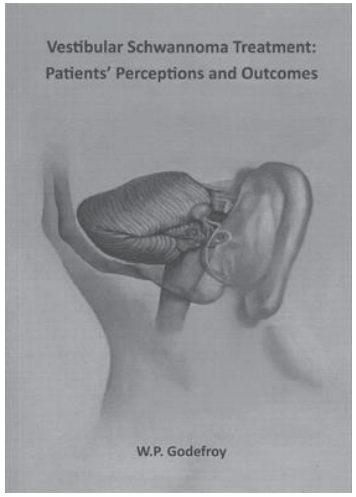
VESTIBULAR SCHWANNOMA RESEARCH OUTCOMES

Quality of Life (QoL)

In modern day medicine, more and more attention is paid to self-reported outcomes when evaluating the effect of medical treatment (i.e., patient reported outcome measures, PROM), rather than physicians interpreting patients' responses.[67,68] QoL is the best known PROM, and has evolved into an important outcome by which the effect of medical treatment is determined. QoL is defined as "the functional effect of an illness and its consequent therapy upon a patient, as perceived by the patient".[69]

Since VS is considered a benign condition, it could be argued that because survival is not the issue, QoL becomes all the more important. QoL was introduced in the medical and behavioural literature in the early 70's.[i.e.,70,71] QoL in patients with vestibular schwannomas has been under-researched for a long time, and it has been a topic of increasing interest over the last decades, starting at the beginning of the 90's.[72] In the clinical center where studies of the present thesis were performed, Pim Godefroy graduated on this subject in 2010.[73,74] (Figure 3)

Figure 3. Thesis of Pim Godefroy (ISBN 978-90-9025068-7)



Most studies focus on QoL after treatment, to assess the effect of treatment on QoL. Only a few studies focus on QoL before (the proposal of) treatment.[1,73-80] QoL is assessed with generic, disease-specific measures, and domain specific measures.[69] The most widely used generic measure that assesses QoL is the Short Form-36 Questionnaire (SF-36). This questionnaire was used in several studies concerning QoL in patients with a VS.[i.e.,74,81,82] In 2010, Shaffer et al.'s study group[83] developed and validated the Penn Acoustic Neuroma Quality-of-Life (PANQOL) scale for American (USA) patients. This is the first disease-specific QoL instrument for patients with a VS. In this thesis the translation and validation of the PANQOL for Dutch patients is described and its use is elucidated.

An interesting topic pertains to QoL in patients with a VS after treatment, and in particular to find out whether there is any difference in the QoL after the three different treatment options. It would be helpful if information was available on the basis of which patients could be informed about what they could expect from observation, radiation therapy or microsurgical resection.

In currently available literature there are three studies in which the PANQOL scale was used to evaluate the long-term course of QoL after the three different treatment options, but mostly with relatively small samples.[66,84,85] Another remark is that these studies were not randomized, making it unclear whether the comparison groups differ with regard to the (unknown) baseline characteristics.[64] In this thesis a study with the largest sample size until now was performed to examine QoL in patients with a VS having undergone observation, radiation therapy, or microsurgical resection. In addition, the relationship between QoL and time since diagnosis was assessed. With the aim of correcting for potential confounding a propensity score was calculated and used in a multiple linear regression analysis,[86] and results were stratified according to tumour size.

Illness perceptions

Illness perceptions can be defined as: "a distinct, meaningfully integrated cognitive structure that encompasses, (a) a belief in the relatedness of a variety of physiological and psychological functions, which may or may not be objectively accurate; (b) a cluster of sensations, symptoms, emotions, and physical limitations in keeping with that belief; (c) a naïve theory about the mechanisms that underlie the relatedness of the elements identified in (b), and (d) implicit or explicit prescriptions for corrective action" (Lacroix 1991, p.197)[87]

Patients' illness perceptions are significantly associated with physical, psychological and social functioning.[88] Illness perceptions can be subdivided into five dimensions; 1) identity: patients' description of the illness and its associated symptoms; 2) cause: patients' personal thoughts about the cause(s) of the illness; 3) timeline: expected duration of the illness, according to the patient; 4) consequences: patients' personal thoughts about the impact and the outcome of the illness, 5) cure/control: perceptions about the extent to which the patient is curable or able to control the illness.[89] It appears that illness perceptions play an important role in the variation of the severity of diseases experienced by patients and therefore their QoL.[90].

Illness perceptions are assessed mainly by means of surveys such as the Illness Perception Questionnaire (IPQ, Brief-IPQ and IPQ-revised; www.uib.no\ipq)[89,91,92] or in an increasingly popular way by means of patients' drawings of their illness.[93-102]

Drawings of their illness made by patients have been successfully applied in various medical conditions. These drawings reveal the patients' perception of their illness, and it seems that patients find it easier to illustrate these perceptions than they can express them with words.[93,103,104] Moreover, positive perceptions patients have of their medical condition represented in their drawing were found to be related to positive illness outcomes, such as faster recovery, earlier return to work and a more favorable QoL.[94,95] These results were found with illness perception questionnaires as well. [i.e.105,106]

The only drawings-study in patients with a VS was a pilot study in 2011. Patients were asked to draw their VS before and after treatment. This study demonstrates that patients are willing and able to draw their tumours. The authors of this study hypothesized that drawings could be used as an outcome measure of patients' perceptions of their tumour.[107]

In the current study, the use of drawings and their association with illness perceptions and QoL in patients who have been recently diagnosed with VS is described.

Emotional intelligence

''The ability to experience emotions is innate to every human being. However people differ in the way they are able to identify, express, utilize and regulate their feelings and those of others. The concept of Emotional Intelligence (EI) has been proposed to account for this variability'' (Mikolajczak et al., 2006, p. 79).[108] Emotional intelligence can be seen as a strong predictor of the impact of stressful events in life.[108-113] An instrument which has been validated for the assessment of Emotional intelligence is the Trait Emotional Intelligence Questionnaire (TEIQue).[112,113]

During the last two decades emotional intelligence has been receiving increased attention within scientific research.[114] In previous studies using the TEIQue, a positive correlation was found between the level of emotional intelligence and the way people cope with

stress. Also, there are indications that a higher emotional intelligence is related to a more favourable QoL.[108-110] Furthermore, emotional intelligence is a plausible predictor of health.[115]

The current thesis contains a study in which the association between emotional intelligence and QoL was studied.

BEHAVIOURAL VIEWS

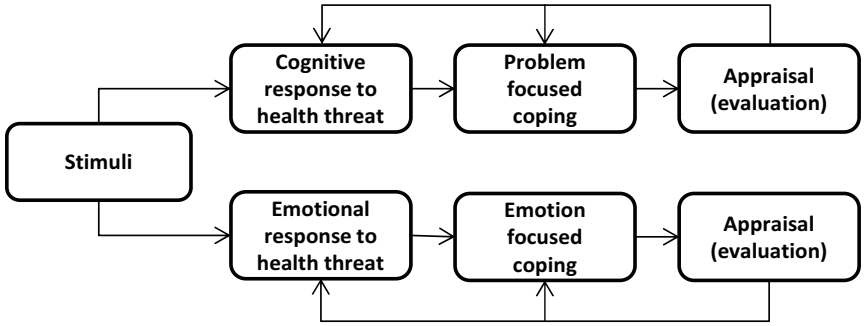
Self-regulation

Self-regulation refers to "a systematic process involving conscious efforts to modulate thoughts, emotions, and behaviours in order to achieve goals within a changing environment".[116] This change in environment can be caused by health threats. Patients' responses to these health threats are extremely important in understanding the way patients manage their illness.[88] Leventhal et al.[117] developed the Common Sense Model of Self-Regulation (CSM). This model provides a representation of people's reaction to stimuli (i.e., symptoms) caused by their illness, and the way they develop coping strategies.

Therefore, it is one of the best models to examine the association between illness, coping, and health outcomes. The model consists of two parallel pathways in which both emotion and cognition are represented in three layers. In the first layer, the cognitive and emotional response to a health threat is formed. In the second layer, the coping strategies (e.g., seek social support, avoid thoughts of the illness, worrying about the illness) determined by these responses are displayed. In the third layer, an appraisal (i.e., QoL) on these coping efforts is made, which could result in a change in the responses or the coping strategies (Figure 4).

In QoL research, investigating which factors or determinants stimulate both cognitive and emotional patients' responses that influence patients' QoL is relevant. Physicians' understanding of these determinants, the impact of having a VS and the patients' responses to this condition, enable physicians to respond in a more suitable way to the needs of the patients. Additional knowledge about these factors provides the opportunity to incorporate these factors in the decision making process; by including these factors in patient information, or in self-management programmes, and addressing these factors in treatment proposals.

Figure 4. Common Sense Model of Self-Regulation (adapted from Leventhal et al.)[117]



In literature a wealth of publications is available on self-management programs for patients with chronic illnesses that improve patients' QoL.[118-121] So far however, there are no studies measuring the effect of self-management on the QoL in patients with a VS. In the present thesis there are two studies in which potential determinants (illness perceptions and emotional intelligence) of QoL were studied and, therefore, these studies could support future development of such intervention studies in this specific group of patients.

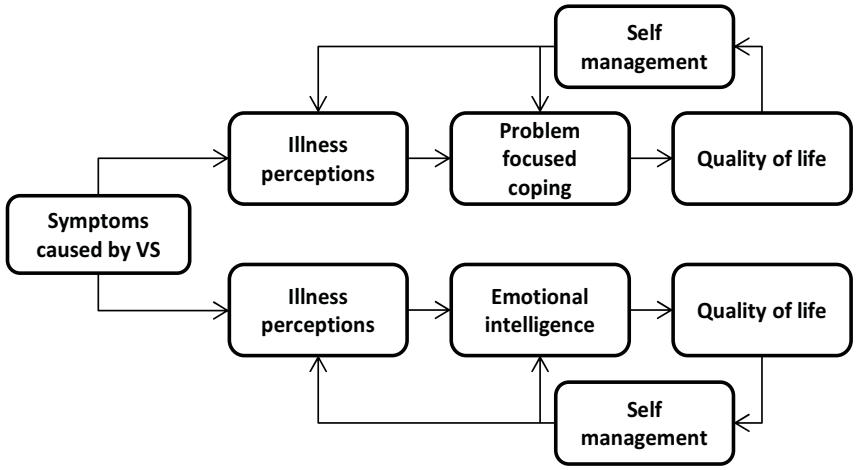
The studies in the current thesis were focused on illness perceptions and emotional intelligence. QoL, measured with the disease-specific PANQOL scale was used as an outcome measure.

Common Sense Model of self-regulation (CSM) in present thesis

Making use of the above-mentioned information, it should be possible to create a customized CSM. This adapted model is presented in Figure 5. We are aware that there will be other factors that could be of influence in this model, and that the model is probably (much) more extensive. However, such a more extensive model has not been studied in this thesis.

In this model illness perceptions as a response to symptoms caused by the VS are represented in both the cognitive and emotional pathway. Emotional intelligence determines the emotion focused coping strategies. QoL was the outcome measure. Self-management is considered to be part of the feedback loop in which it is determined whether there are changes needed to improve the QoL, with the ultimate goal to find a well balance between the symptoms caused by the illness and the QoL.

Figure 5. Common Sense Model of Self-Regulation in the present thesis (adapted from Leventhal et al.)[117]



SHARED DECISION MAKING

As described above there are three different modalities in the treatment of vestibular schwannomas: observation, radiation therapy and microsurgical resection. In many cases the choice of treatment is not that difficult considering the benign and slow-growing nature of the tumour. The balance of advantages and disadvantages is in most cases pretty obvious from a medical point of view. This leads to the modality 'observation' in the vast majority of the patients, for example those with a small tumour. In case of a large tumour the most reasonable treatment option in the majority of patients is microsurgical resection, since there are limitations to the size of a VS that is still suitable for radiation therapy, and observation could increase the risk of problems caused by further tumour progression.[30,61,122] The most difficult decision is which treatment option is the best in patients with medium-sized tumours, because in these cases both radiation therapy and microsurgical resection, but even observation, are all feasible opportunities. It seems that in these cases the choice for the 'best' treatment will depend on the patients' preferences and expectations. For patients, however, it seems an almost impossible task to choose between these options.

In clinical situations where there is more than one reasonable management strategy, such as with medium-sized VS, it seems favourable to involve patients through a shared decision making process regarding their treatment.[123,124] The physician is the expert on the best available medical evidence and clinical implications of the reasonable management options, and the patient is the expert on his/her own preferences and expectations. Integrating both types of information often helps to decide which option is 'the best' for an individual patient. To date, it is unclear to what extent shared decision making occurs in patients with a VS. Also, there is little insight into how often physicians recommend one or the other management option, and their underlying reasoning. In addition, it is unknown what patients consider important when it comes to a choice of treatment, and whether there could be possible divergences between physicians' recommendations and the final treatment choice.

To implement shared decision making, it seems important to learn more of all the above mentioned factors. Firstly, gaining insight into the reasoning of physicians will help understand the grounds for their recommendation and in what cases the actual received treatment received diverges from the recommended one. Secondly, it is important to investigate the role of the patient in the decision making process.

The present thesis contains a study to assess what treatment physicians' recommend, their considerations for those recommendations, and how often physicians' recommendations and the final treatment choice were identical. A possible reason why the final treatment choice might be different from the recommended one is that patients would make another choice, due to for us yet unknown reasons.

Hopefully, the present thesis will contribute to the improvement of the quality of life, and possibly provides for a better quality of care, in patients with vestibular schwannoma.

OUTLINE OF THE THESIS

This thesis concerns the themes illness perceptions, emotional intelligence and Quality of Life (QoL) of patients with a vestibular schwannoma (VS) in the context of the Common Sense Model. In addition, the formation of the treatment choice, and QoL after different treatments were analysed in an analogue design. Hopefully, the results presented in this thesis contribute to an optimization in the information provision for patients, and an improvement in physician-patient communication during the decision making process, which could improve the QoL and the quality of care for these patients in the future.

Chapter 2 presents the results of the translation and validation of the first disease-specific QoL measure, the PANQOL scale, in a sample of Dutch patients with vestibular schwannoma. QoL research conventionally aims at assessing QoL with generic and disease-specific measures, which underlines the relevance of this study.

Chapter 3 presents the results on a study about the use of drawings of patients with a VS to measure illness perceptions, and the impact of VS on the QoL affected. Drawings made by patients could be an easy and interesting way to measure QoL in patients with a VS.

Chapter 4 concerns a study about emotional intelligence as a possible determinant of QoL in patients with a VS.

Chapter 5 reports on long-term QoL after the three different treatment modalities of vestibular schwannomas. Knowledge about effects of treatment options over years could be valuable in the counselling of patients on the treatment choices.

Chapter 6 concerns a study about the process in which a choice of treatment is made by physicians for each patient. The study reports the physicians' recommendations for treatment, the considerations for these recommendations, and how often the recommendations and the final treatment choice were identical. This information can be of value to the establishment of shared decision making.

Chapter 7 contains a general discussion in which the major results and conclusions of the studies in this thesis are presented, followed by clinical implications and suggestions for future research.

Chapter 8 summarizes chapters 1 to 7 in English.

Chapter 9 summarizes chapters 1 to 7 in Dutch.

REFERENCES

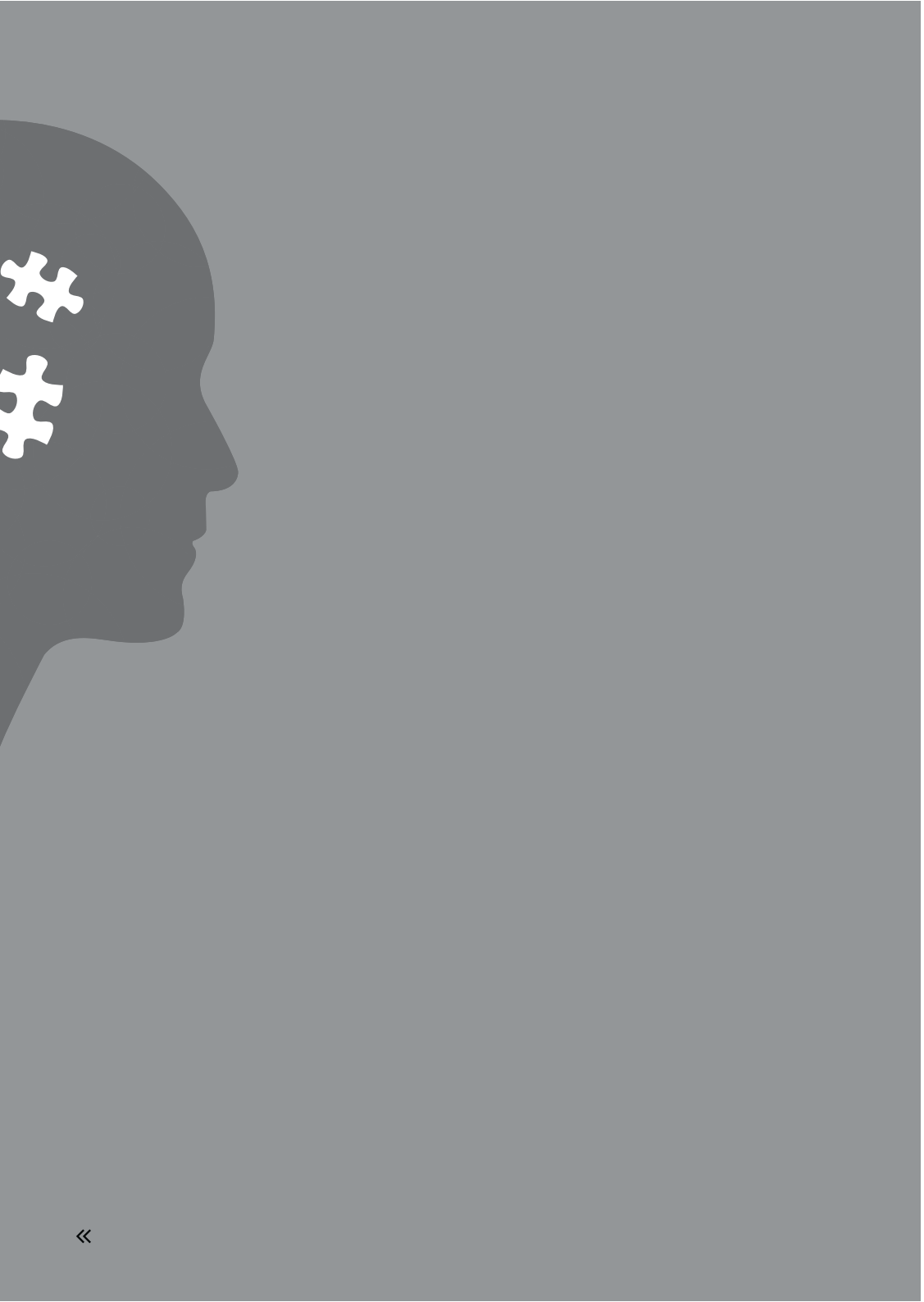
1. Pollock BE, Driscoll CL, Foote RL, et al. Patient outcomes after vestibular schwannoma management: a prospective comparison of microsurgical resection and stereotactic radiosurgery. *Neurosurg.* 2006;59:77-85.
2. Stangerup SE, Caye-Thomasen P, Tos M, Thomsen J. The natural history of vestibular schwannoma. *Otol Neurotol.* 2006;27:547-552.
3. *World Health Organisation Classification of Tumours of Soft Tissue and Bone*. Lyon: IARC; 2013.
4. Murray MR, Stout PA. Demonstration of the formation of reticulin by schwannian tumor cells in vitro. *Am J Pathol.* 1941;18:585-593.
5. Pineda A, Feder BH. Acoustic neuroma: a misnomer. *Am Surg.* 1967;33:40-43.
6. Sandifort E. Observationes anatomico-pathologicae. Lugduni Batavorum: Apud vd Eyk and Vygh; 1777:116-120.
7. Machinis TG, Fountas KN, Dimopoulos V, Robinson JS. History of acoustic neurinoma surgery. *Neurosurg Focus.* 2005;18:e9.
8. Glasscock ME 3rd. History of the diagnosis and treatment of acoustic neuroma. *Arch Otolaryngol.* 1968;88:578-585.
9. Koerbel A, Gharabaghi A, Safavi-Abbasi S, Tatagiba M, Samii M. Evolution of vestibular schwannoma surgery: the long journey to current success. *Neurosurg Focus.* 2005;18:e10..
10. Kohan D, Downey LL, Lim J, Cohen NL, Elowitz E. Uncommon lesions presenting as tumors of the internal auditory canal and cerebellopontine angle. *Am J Otol.* 1997;18:386-392.
11. Bonneville F, Sarrazin JL, Marsot-Dupuch K, et al. Unusual lesions of the cerebellopontine angle: a segmental approach. *Radiographics.* 2001;21:419-438.
12. Schwartz MS, Fisher LM. Incidence and clinical characteristics of acoustic neuroma in Beverly Hills. In: Garcia-Ibanez E, Tran Ba Huy P, eds. *Proceedings of the 5th international conference on Vestibular shwannoma and other CPA lesions*. Bologna, Italy: Medimond; 2007:111–113.
13. Tos M, Stangerup SE, Cayé-Thomasen P, Tos T, Thomsen J. What is the real incidence of vestibular schwannoma? *Arch Otolaryngol.* 2004;130:216-220.
14. Stangerup SE, Tos M, Thomsen J, Caye-Thomasen P. True incidence of vestibular schwannoma? *Neurosurg.* 2010;67:1335-1340.
15. Mirz F, Brahe Pedersen C, Fiirgaard B, Lundorf E. Incidence and growth pattern of vestibular schwannomas in a Danish country 1977-98. *Acta Otolaryngol.* 2000;Suppl 543:30-33.
16. Stangerup SE, Tos M, Caye-Thomasen P, Tos T, Klokker M, Thomsen J. Increasing annual incidence of vestibular schwannoma and age at diagnosis. *J Laryngol Otol.* 2004;118:622-627.
17. Stepanidis K, Kessel M, Caye-Thomasen P, Stangerup SE. Socio-demographic distribution of vestibular schwannomas in Denmark. *Acta Otolaryngol.* 2014;134:551-556.
18. Kshettry VR, Hsieh JK, Ostrom QT, Kruchko C, Barnholtz-Sloan JS. Incidence of vestibular schwannomas in the United States. *J Neurooncol.* 2015;124:223-228.
19. Moffat DA, Jones SEM, Mahendran S, Humphriss R, Baguley DM. Referral patterns in vestibular schwannomas - 10 years on. *Clin Otolaryngol.* 2004;29:515-517.
20. Babu R, Sharma R, Bagley JH, Hatef J, Friedman AH, Adamson C. Vestibular schwannomas in the modern era: epidemilogy, treatment trends, and disparities in management. *J Neurosurg.* 2013;119:121-130.
21. Leonard JR, Talbot ML. Asymptomatic acoustic neurilemoma. *Arch Otolaryngol.* 1970;91:117-124.
22. Stewart TJ, Liland J, Schuknecht HF. Occult schwannomas of the vestibular nerve. *Arch Otolaryngol.* 1975;101:91-95.
23. Warren C, James LA, Ramsden RT, et al. Identification of recurrent regions of chromosome loss and gain in vestibular schwannomas using comparative genomic hybridisation. *J Med Genet.* 2003;40:802-806.
24. Tumors of the central nervous system. Meningiomas and schwannomas. In: Hayat MA, ed. Vol 7. New York: Springer; 2008:218.
25. Constantino PD, Friedman CD, Pelzer HJ. Neurofibromatosis type II of the head and neck. *Arch Otolaryngol.* 1989;115:380-383.
26. Glasscock MEr, Hart MJ, Vrabec JT. Management of bilateral acoustic neuroma. *Otolaryng Clin N Am.* 1992;25:449-469.
27. Abaza MM, Makariou E, Armstrong M, Lalwani AK. Growth rate characteristics of acoustic neuromas associated with neurofibromatosis type 2. *Laryngoscope.* 1996;106:684-699.
28. Goutagny S, Kalamarides M. Meningiomas and neurofibromatosis. *J Neurooncol.* 2010;99:341-347.

29. de Vries M, van der Mey AGL, Hogendoorn PCW. Tumor Biology of Vestibular Schwannoma: A Review of Experimental Data on the Determinants of Tumor Genesis and Growth Characteristics. *Otol Neurotol.* 2015:1128-1136.
30. Myrseth E, Pedersen PH, Moller P, Lund-Johansen M. Treatment of vestibular schwannomas. Why, when and how? *Acta Neurochir.* 2007;149:647-660.
31. Kaptein AA, Prins JB, Collette EH, Hulsman RL. Chronisch ziek-zijn [Chronic illness]. In: Kaptein AA, ed. *Medische psychologie [Medical psychology].* Vol Tweede herziene druk. Houten: Bohn Stafleu van Loghum, Springer media; 2010:143.
32. Brooker JE, Fletcher JM, Dally MJ, et al. Quality of life among acoustic neuroma patients managed by microsurgery, radiation, or observation. *Otol Neurotol.* 2010;31:977-984.
33. Bederson JB, von Ammon K, Wichmann WW, Yasargil MG. Conservative treatment of patients with acoustic tumors. *Neurosurg.* 1991;28:646-650.
34. Raut VV, Walsh RM, Bath AP, et al. Conservative management of vestibular schwannomas - second review of a prospective longitudinal study. *Clin Otolaryngol Allied Sci.* 2004;29:505-514.
35. Breivik CNV, J. K., Wentzel-Larsen T, Vassbotn F, Lund-Johansen M. Conservative management of vestibular schwannoma - a prospective cohort study: treatment, symptoms, and quality of life. *Neurosurg.* 2012;70:1072-1080.
36. Surayanaravanan R, Ramsden RT, Saeed SR, et al. Vestibular schwannoma: role of conservative management. *J Laryngol Otol.* 2010;124:251-257.
37. González-Orús Álvarez-Morujo RJ, Álvarez-Palacios I, Martin-Oviedo C, Scola-Yurrita B, Arístegui-Ruiz MÁ. Conservative management of vestibular schwannoma. *Acta Otorrinolaringol Esp.* 2014;65:275-282.
38. Stone JL. Sir Charles Ballance: pioneer British neurological surgeon. *Neurosurg.* 1999;44:610-631.
39. Rosenberg SI. Natural history of acoustic neuromas. *Laryngoscope.* 2000;110:497-508.
40. Reidel C, Post KD. *Complications in the treatment of acoustic neuromas*. New York: Thieme; 1993.
41. Akard W, Tubbs RS, Seymour ZA, Hitselberger WE, Cohen-Gadol AA. Evolution of techniques for the resection of vestibular schwannoma: from saving life to saving function. *J Neurosurg.* 2009;110:642-647.
42. Dandy WE. Removal of cerebellopontine tumors through a unilateral approach. *Arch Surg.* 1934;29:337-344.
43. Ellis H. Harvey Cushing and electrosurgery. *Contemp Surg.* 1981;19:73–75.
44. House WF. Middle cranial fossa approach to the petrous pyramid. Report of 50 cases. *Arch Otolaryngol.* 1963;78:460-469.
45. House WF. Transtemporal bone microsurgical removal of acoustic neuromas. Evolution of transtemporal bone removal of acoustic tumors. *Arch Otolaryngol.* 1964;80:731-742.
46. Delgado TE, Buchheit WA, Rosenholtz HR, Chrissian S. Intraoperative monitoring of facial muscle evoked responses obtained by intracranial stimulation of the facial nerve: a more accurate technique for facial nerve dissection. *Neurosurg.* 1979;4:418-421.
47. Prass RL, Lüders H. Acoustic (loudspeaker) facial electromyographic monitoring: Part 1. Evoked electromyographic activity during acoustic neuroma resection. *Neurosurgery.* 1986;19:392–400.
48. Mahboubi H, Ahmed OH, Yau AY, Ahmed YC, Dialilian HR. Complications of surgery for sporadic vestibular schwannoma. *Otolaryngol Head Neck Surg.* 2014;150:275-281.
49. Golfinos JG, Hill TC, Rokosh R, et al. A matched cohort comparison of clinical outcomes following microsurgical resection or stereotactic radiosurgery for patients with small- and medium-sized vestibular schwannomas. *J Neurosurg.* 2016 [Epub ahead of print].
50. Slattery WH 3rd, Francis S, House KC. Perioperative morbidity of acoustic neuroma surgery. *Otol Neurotol.* 2001;22:895-902.
51. Leksell L. A note on the treatment of acoustic tumours. *Acta Chir Scand.* 1971;137:763-765.
52. Vernimmen FJAI, Mohamed Z, Slabbert JP, Wilson J. Long-term results of stereotactic proton beam radiotherapy for acoustic neuromas. *Radiother Oncol.* 2009;90:208-212.
53. Hanahan D, Folkman J. Patterns and emerging mechanisms of the angiogenic switch during tumorgenesis. *Cell.* 1996;86:353-364.
54. Caye-Thomasen P, Werther K, Nalla A, et al. VEGF and VEGF receptor-1 concentration in vestibular schwannoma homogenates correlates to tumor growth rate. *Otol Neurotol.* 2005;26:98-101.
55. Uesaka T, Shono T, Suzuki SO, et al. Expression of VEGF and its receptor genes in intracranial schwannomas. *J Neurooncol.* 2007;83:259-266.
56. Mautner VF, Nguyen R, Kutta H, et al. Bevacizumab induces regression of vestibular schwannomas in patients with neurofibromatosis type 2. *Neuro Oncol.* 2010;12:14-18.

57. Plotkin SR, Stemmer-Rachamimov AO, Barker FG 2nd, et al. Hearing improvement after bevacizumab in patients with neurofibromatosis type 2. *N Engl J Med.* 2009;361:358-367.
58. Plotkin SR, Merker VL, Halpin C, et al. Bevacizumab for progressive vestibular schwannoma in neurofibromatosis type 2: a retrospective review of 31 patients. *Otol Neurotol.* 2012;33:1046-1052.
59. Allen M, Louise JJ. Jekyll and Hyde: the role of the microenvironment on the progression of cancer. *J Pathol* 2011;223:162-176
60. Hong B, Krusche CA, Schwabe K, et al. Cyclooxygenase-2 supports tumor proliferation in vestibular schwannomas. *Neurosurg.* 2011;68:1112-1127.
61. Arthurs BJ, Fairbanks RK, Demakas JJ, et al. A review of treatment modalities for vestibular schwannoma. *Neurosurg Rev.* 2011;34:265-279.
62. Maniakas A, Saliba I. Microsurgery versus stereotactic radiation for small vestibular schwannomas: a meta-analysis of patients with more than 5 years' follow-up. *Otol Neurotol.* 2012;33:1611-1620.
63. Thakur JD, Banerjee AD, Khan IS, et al. An update on unilateral sporadic small vestibular schwannoma. *Neurosurg Focus.* 2012;33:E1.
64. Myrseth E, Moller P, Pedersen PH, Lund-Johansen M. Vestibular schwannoma: surgery or gamma knife radiosurgery? A prospective, nonrandomized study. *Neurosurg.* 2009;64:654-663.
65. Roos DE, Potter AE, Zacest AC. Hearing preservation after low dose linac radiosurgery for acoustic neuroma depends on initial hearing and time. *Radiother Oncol.* 2011;101:420-424.
66. Carlson ML, Tveiten OV, Driscoll CL, et al. Long-term quality of life in patients with vestibular schwannoma: an international multicenter croos-sectional study comparing microsurgery, sterotactic radiosurgery, observation, and nontumor controls. *J Neurosurg.* 2015;122:833-842.
67. Wiklund I. Assessment of patient-reported outcomes in clinical trials: the example of health-related quality of life. *Fundam Clin Pharmacol.* 2004;18:351-363.
68. Valderas JM, Alonso J. Patient reported outcome measures: a model-based classification system for research and clinical practice. *Qual Life Res.* 2008;17:1125-1135.
69. Schipper H, Clinch JJ, Olweny CLM. Quality of life studies: definitions and conceptual issues. In: Spilker B, ed. *Quality of life and pharmacoeconomics in clinical trials*. second ed. Philadelphia: Lippincott-Raven; 1996:11-23.
70. Beard BH. The quality of life before and after renal transplantation. *Dis Nerv Syst.* 1971;32:24-31.
71. Carlens E, Dahlström G, Nöu E. An attempt to include “quality of life” in evaluation of survival in bronchial cancer therapy. *Bronches.* 1971;21:215-219.
72. Wiegand DA, Fickel V. Acoustic Neuroma - The Patient's Perspective: a subjective assessment of symptoms, diagnosis, therapy, and outcome in 541 patients. *Laryngoscope.* 1989;99:179-187.
73. Vogel JJ, Godefroy WP, van der Mey AGL, le Cessie S, Kaptein AA. Illness perceptions, coping, and quality of life in vestibular schwannoma patients at diagnosis. *Otol Neurotol.* 2008;29:839-845.
74. Godefroy WP, Kaptein AA, Vogel JJ, van der Mey AGL. Conservative treatment of vestibular schwannoma: a follow-up study on clinical and quality-of-life outcome. *Otol Neurotol.* 2009;30:968-974.
75. Godefroy WP, Hastan D, van der Mey AG. Translabyrinthine surgery for disabling vertigo in vestibular schwannoma patients. *Clin Otolaryngol.* 2007;32:167-172.
76. Varughese JK, Breivik CN, Wentzel-Larsen T, Lund-Johansen M. Growth of untreated vestibular schwannoma: a prospective study. *J Neurosurg.* 2012;116:706-712.
77. Di Maio S, Akagami R. Prospective comparison of quality of life before and after observation, radiation, or surgery for vestibular schwannomas. *J Neurosurg.* 2009;111:855-862.
78. Park SS, Grills IS, Bojrab D, et al. Longitudinal assessment of quality of life and audiometric test outcomes in vestibular schwannoma patients treated with gamma knife surgery. *Otol Neurotol.* 2011;32:676-679.
79. Sandooram D, Hornigold R, Grunfeld B, Thomas N, Kitchen ND, Gleeson M. The effect of observation versus microsurgical excision on Quality of Life in unilateral vestibular schwannoma: a prospective study. *Skull Base.* 2010;20:47-54.
80. Myrseth E, Moller P, Wentzel-Larsen T, Goplen F, Lund-Johansen M. Untreated vestibular schwannomas: vertigo is a powerful predictor for health-related quality of life. *Neurosurg.* 2006;59:67-76.
81. Martin HC, Sethi J, Lang D, Neil-Dwyer G, Lutman ME, Yardley L. Patient-assessed outcomes after excision of acoustic neuroma: postoperative symptoms and quality of life. *J Neurosurg.* 2001;94:211-216.
82. MacAndie C, Crowther JA. Quality of life in patients with vestibular schwannomas managed conservatively. *Clin Otolaryngol Allied Sci.* 2004;29:215-218.

83. Shaffer BT, Cohen MS, Bigelow DC, Ruckenstein MJ. Validation of a disease-specific quality-of-life instrument for acoustic neuroma: the Penn Acoustic Neuroma Quality-of-Life Scale. *Laryngoscope.* 2010;120:1646-1654.
84. Robinett ZN, Walz PC, Miles-Markley B, Moberly AC, Welling DB. Comparison of long-term quality-of-life outcomes in vestibular schwannoma patients. *Otolaryngol Head Neck.* 2014;150:1024-1032.
85. McLaughlin EJ, Bigelow DC, Lee JY, Ruckenstein MJ. Quality of Life in Acoustic Neuroma Patients. *Otol Neurotol.* 2015;36:653-656.
86. Spreeuwenberg MD, Bartak A, Croon MA, et al. The multiple propensity score as control for bias in the comparison of more than two treatment arms: an introduction from a case study in mental health. *Medical care.* 2010;48:166-174
87. Lacroix JM. Assessing illness schemata in patient populations In: Skelton JA, Croyle RT, eds. *Mental representation in health and illness*. New York: Springer; 1991:197.
88. Leventhal H, Meyer D, Nerenz D. The common sense representation of illness danger. In: Rachman S, ed. *Contributions to medical psychology*. New York: Pergamon Press; 1980:7-30.
89. Broadbent E, Petrie KJ, Main J, Weinman J. The brief illness perception questionnaire. *J Psychosom Res.* 2006;60:631-637.
90. Fischer M, Scharloo M, Abbink J, et al. The dynamics of illness perceptions: testing assumptions of Leventhal's Common Sense Model in a pulmonary rehabilitation setting. *Br J Health Psychol.* 2010;15:887-903.
91. Weinman J, Petrie KJ, Moss-Morris R, Horne R. The Illness Perception Questionnaire: a new method for assessing the cognitive representation of illness. *Psychol Health.* 1996;9:241-252.
92. Moss-Morris R, Weinman J, Petrie KJ, Horne R, Cameron LD, Buick D. The revised Illness Perception Questionnaire (IPQ-R). *Psychol Health.* 2002;17:1-16.
93. Broadbent E, Ellis CJ, Gamble G, Petrie KJ. Changes in patients drawings of the heart identify slow recovery after myocardial infarction. *Psychosom Med.* 2006;68:910-913.
94. Reynolds L, Broadbent E, Ellis CJ, Gamble G, Petrie KJ. Patients' drawings illustrate psychological and functional status in heart failure. *J Psychosom Res.* 2007;63:525-532.
95. Broadbent E, Petrie KJ, Ellis CJ, Ying J, Gamble G. A picture of health - myocardial infarction patients' drawings of their hearts and subsequent disability. A longitudinal study. *J Psychosom Res.* 2004;57:583-587.
96. Daleboudt GMN, Broadbent E, Berger SP, Kaptein AA. Illness perceptions in patients with systemic lupus erythematosus and proliferative lupus nephritis. *Lupus.* 2011;20:290-298.
97. Broadbent E, Niederhoffer K, Hague T, Corter A, Reynolds L. Headache sufferers' drawings reflect distress, disability and illness perceptions. *J Psychosom Res.* 2009;66:465-470.
98. Tiemensma J, Daskalakis NP, van der Veen EM, et al. Drawings reflect a new dimension of the psychological impact of long-term remission of Cushing's syndrome. *J Clin Endocrinol Metab.* 2012;97:3123-3131.
99. van Stralen G, van Stralen-Ruijten LLM, Spaargaren CF, Broadbent E, Kaptein AA, Scherjon SA. Good quality of life after emergency embolisation in postpartum haemorrhage. *J Psychosom Obs & Gyn.* 2010;31:285-288.
100. Hatano Y, Yamada M, Nakagawa K, Nanri H, Kawase M, Fukui K. Using drawing tests to explore the multidimensional psychological aspects of children with cancer. *Jpn J Clin Oncol.* 2014;44:1009-1012.
101. Cooper A, Petrides KV. A psychometric analysis of the Trait Emotional Intelligence Questionnaire-Short Form (TEIQue-SF) using item response theory. *J Pers Assess.* 2010;92:449-457.
102. Lok SW, Menahem S. Children's and adolescents' understanding of their small ventricular septal defects. *Pediatr Int.* 2012;54:824-828.
103. Guillemin M. Understanding illness: using drawings as a research method. *Qual Health Res.* 2004;14:272-289.
104. Craddick RA. Size of Santa Claus drawings as a function of time before and after Christmas. *J Psychol Stud.* 1961;12:121-125.
105. Vaske I, Kenn K, Keil DC, Rief W, Stenzel NM. Illness perceptions and coping with disease in chronic obstructive pulmonary disease: effects on health-related quality of life. *J Health Psychol.* 2016 [Epub ahead of print]
106. Knowles SR, Wilson JL, Connell WR, Kamm MA. Preliminary examination of the relations between disease activity, illness perceptions, coping strategies, and psychological morbidity in Crohn's disease guided by the Common Sense Model of Illness. *Inflamm Bowel Dis.* 2011;17:2551-2557.

107. Kaptein AA, Zandstra T, Scharloo M, et al. 'A time bomb ticking in my head': drawings of inner ears by patients with vestibular schwannoma. *Clin Otolaryngol.* 2011;36:183-184.
108. Mikolajczak M, Luminet O, Menil C. Predicting resistance to stress: Incremental validity of trait emotional intelligence over alexithymia and optimism. *Psicothema.* 2006;18:79-88.
109. Mikolajczak M, Luminet O. Trait emotional intelligence and the cognitive appraisal of stressful events: an exploratory study. *Pers Individ Dif.* 2008;44:1445-1453.
110. Mikolajczak M, Roy E, Verstrynge V, Luminet O. An exploration of the moderating effect of trait emotional intelligence on memory and attention in neutral and stressful conditions. *Br J Psychol.* 2009;100:699-715.
111. Petrides KV, Furnham A. Trait emotional intelligence: behavioural validation in two studies of emotion recognition and reactivity to mood induction. *Eur J Pers.* 2003;17:39-57.
112. Petrides KV, Furnham A. Technical manual of the Trait Emotional Intelligence Questionnaire (TEIQue). [Manual]: London: University of London, Institute of Education.; 2004.
113. Rieffe C, Petrides KV. TEIQue-SF Dutch version [Manual]. http://www.psychometriclab.com.
114. Petrides KV, Furnham A. Trait emotional intelligence: psychometric investigation with reference to established trait taxonomies. *Eur J Pers.* 2001;15:425-448.
115. Martins A, Ramalho N, Morin E. A comprehensive meta-analysis of the relationship between emotional intelligence and health. *Pers Individ Dif.* 2010;49:554-564.
116. Zeidner M, Boekaerts M, Pintrich PR. Self-regulation: directions and challenges for future research. In: Boekaerts M, Pintrich PR, Zeidner M, eds. *Handbook of self-regulation*. San Diego: Academic Press; 2000:750-768.
117. Leventhal H, Brissette I, Leventhal E. The common-sense model of self-regulation of health and illness. In: Cameron LD, Leventhal H, eds. *The self-regulation of health and illness behaviour*. London: Routledge; 2003:42-65.
118. Ditewig JB, Blok H, Havers J, van Veenendaal H. Effectiveness of self-management interventions on mortality, hospital readmissions, chronic heart failure, hospitalization rate and quality of life in patients with chronic heart failure: a systematic review *Patient Education Counseling.* 2010;78:297-315.
119. Labrecque M, Rabhi K, Laurin C, et al. Can a self-management education program for patients with chronic obstructive pulmonary disease improve quality of life? *Can Respir J.* 2011;18:e77-81.
120. Stanley MA, Calleo J, Bush AL, et al. The peaceful mind program: a pilot test of a cognitive-behavioral therapy-based intervention for anxious patients with dementia. *Am J Geriatr Psychiatry.* 2013;21:696-708.
121. Conley S, Redeker N. A systematic review of self-management interventions for inflammatory bowel disease. *J Nurs Scholarsh.* 2016;48:118-127.
122. Hasewaga T, Kida Y, Kobayashi T, Yoshimoto M, Mori Y, Yoshida J. Long-term outcomes in patients with vestibular schwannomas treated using gamma knife surgery: 10-year follow up. *J Neurosurg.* 2005;102:10-16.
123. Elwyn G, Laitner S, Coulter A, Walker E, Watson P, Thomson R. Implementing shared decision making in the NHS. *BMJ.* 2010;341:c5146.
124. Stiggelbout AM, van der Weijden T, de Wit MP, et al. Shared decision making: really putting patients at the centre of healthcare. *BMJ.* 2012;344:e256.



2

Validating the Penn Acoustic Neuroma Quality of Life scale in a sample of Dutch patients recently diagnosed with vestibular schwannoma

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ABSTRACT

Objective

To examine the validity of the Penn Acoustic Neuroma Quality-of-Life Scale (PANQOL) in a sample of Dutch patients recently diagnosed with vestibular schwannoma.

Study design and setting

Cross-sectional study in a university tertiary referral center.

Methods

Between April 2011 and March 2012 consecutive patients (mean age = 56.4, range 17 – 85 yr) diagnosed with vestibular schwannoma (n = 155) were included. The PANQOL was translated into Dutch according to the accepted rules of forward-backward translation. Quality of Life at diagnosis was measured with the generic SF-36 and the disease-specific PANQOL. Factor analysis was used to explore the factor structure of the PANQOL. The scores of the patients in the current study were compared with those of patients from the United States of America. Correlations between SF-36 and PANQOL were examined to study psychometric characteristics of the PANQOL.

Results

One hundred nineteen patients (76.8%) completed the questionnaires. SF-36 scores are comparable to previously published studies measuring Quality of Life at diagnosis. Factor analysis on our data confirmed the original 7-dimension structure of the PANQOL. The PANQOL scores from the Dutch and the USA patients are comparable. Correlations between PANQOL and SF-36 dimensions corroborate the validity of the Dutch PANQOL version.

Conclusion

Vestibular schwannoma patients experience a reduced Quality of Life, immediately after the diagnostic process. The PANQOL seems to be a valid disease-specific measure of Quality of Life in Dutch patients who have recently been diagnosed with vestibular schwannoma.

INTRODUCTION

Quality of Life (QoL) has evolved into an important outcome by which the effect of medical treatment is determined in modern medicine. As a consequence of this development, the multidimensional nature of disease is emphasized, which is particularly visible in patients with chronic somatic illness. These patients have to deal with the emotional, cognitive, behavioral, and social consequences of their illness and its medical management. The consequences translate into QoL, defined as ''the functional effect of an illness and its consequent therapy upon a patient, as perceived by the patient''[1]

Patients with vestibular schwannoma (VS) often present with unilateral sensorineural hearing loss and associated tinnitus, vertigo, or imbalance.[2] As a result of the slow growing behavior and benign character of the tumor, VS is a chronic illness, which is irreversible, has a long duration, and implies a significant burden on the health system. In small- and medium-sized tumors, for elderly patients, and for those with coexisting morbidities that preclude invasive treatment, watchful waiting (wait-and-scan) has proved to be an evidence-based treatment strategy.[2-4] However, vestibular schwannoma can cause brainstem compression, and microsurgical resection or irradiation therapy can have serious consequences as well.[5,6] Each of the 3 modalities has its impact on patients' QoL. In fact, VS patients experience diminished QoL from the moment of diagnosis. Studies have shown that the QoL of patients with VS is lower than that found in patients with other chronic illness[3,7-16], such as head and neck cancer.[2,17] Only few studies focus on QoL in VS patients before (proposal of) treatment.[5,17-24] This current study contributes to the body of literature on disease-specific QoL in patients recently diagnosed with VS.

Several studies assessing QoL in VS patients have used the Short Form-36 Health Survey (SF-36). This is the most widely used generic questionnaire that assesses QoL. However, as a generic instrument used for VS patients, the SF-36 has, by definition, limitations concerning auditory and vestibular function and surgical interventions because these factors are disease-specific problems in VS patients.[18] Recently, the Penn Acoustic Neuroma Quality-of-Life Scale (PANQOL) was developed and validated for American (USA) patients. This is the first disease-specific QoL instrument for patients with VS.[23] Shaffer et al.[25] reported data that seem to corroborate its validity and reliability.

QoL research conventionally aims at assessing QoL with generic and disease-specific measures.[1] Therefore, the aim of this study has been to translate and to validate the disease-specific PANQOL to assess disease-specific QoL in a sample of Dutch patients recently diagnosed with VS. The advantage of a disease-specific questionnaire is the

inclusion of symptoms caused by VS in the determination of the QoL. Factors associated with VS are instrumental in decision making, informing patients, and choice of treatment.

MATERIALS AND METHODS

Patients

During the period of April 2011 and March 2012, a crosssectional study was performed on 155 consecutive new patients who were diagnosed with VS in the Leiden University Medical Center, Department of Otorhinolaryngology and Head and Neck Surgery. Patients with a cerebellopontine angle growth other than a vestibular schwannoma (i.e., meningioma) that was confirmed by radiologic examination or patients with a diagnosis of neurofibromatosis Type II were excluded for medical reasons. Patients who could not read Dutch or who were otherwise unable to complete a written questionnaire were also excluded. Patient characteristics and tumor characteristics were obtained from the patients' clinical charts and are summarized in Table 1. The tumor size was measured according to common[26] as the longest cerebellopontine, also called extracanalicular, dimension of the vestibular schwannoma. The intracanalicular component was not included in the tumor size. Hearing was classified according to the classification system of the Committee on Hearing and Equilibrium.[27] Class A was defined as normal hearing, Class B as moderate hearing loss, and Class C and D as severe hearing loss.

Materials

The Short Form-36 Health Survey

The SF-36 consists of 36 multiple choice questions that assess 8 dimensions: Physical Functioning (PF), Social functioning (SF), Physical Role Limitations (PR), Emotional Role Limitations (ER), Mental Health (MH), Vitality (VT), Bodily Pain (BP), and General Health (GH). A higher score on the SF-36 indicates a status of better health. Dutch population norms are available for referential purposes.[28,29]

The Penn Acoustic Neuroma Quality-of-Life Scale

The PANQOL consists of 26multiple choice questions on signs and symptoms associated with vestibular schwannoma. Participants are asked to rate each item from 1 (strongly disagree) to 5 (strongly agree). The PANQOL has 7 dimensions: Balance (6 items), Hearing (4 items), Anxiety (4 items), Energy (6 items), Pain (1 item), Face (3 items), and General Health (2 items).[25]

Table 1. Patient characteristics (N = 119)

No. of participants	119
Age, mean in years (range)	56.4 (17-85)
Gender, male – *n* (%)	58 (48.7)
Initial tumor size – *n* (%)	
Small, <11 mm	72 (60.5)
Medium, 11-20 mm	25 (21.0)
Large, >20 mm	21 (17.6)
Unknown	1 (0.8)
Degree of hearing loss - *n* (%)	
Class A, normal hearing	15 (12.6)
Class B, moderate hearing loss	33 (27.7)
Class C or D, severe hearing loss	69 (58.0)
Unknown	2 (1.7)
Symptoms (patients could report > 1 symptom) – *n* (%)	
Tinnitus	87 (73.1)
Balance disorders	64 (53.8)
Vertigo	14 (11.8)
Cranial nerves dysfunction - *n* (%)	
Trigeminal nerve (N V) affected	11 (9.2)
Facial nerve (N VII) affected	2 (1.7)

Procedure

The Medical Ethics Committee of the Leiden University Medical Center granted permission for the study. Patients received a package with the SF-36, PANQOL, and questions on sociodemographic characteristics. They were asked to return their completed questionnaires in a prepaid envelope.

The PANQOL questionnaire was translated into Dutch according to the accepted rules of forward-backward translation.[30] No divergence between the original and translated items was found, so this was used as the questionnaire in this study.

To compare our study to previously published studies, scores on the SF-36 dimensions at baseline in our study were compared with the results of Godefroy et al.[18], Pollock et al.[5], and Vogel et al.[17], all in patients with VS. This comparison was performed because the same inclusion criteria were used in these studies, and the scores of the SF-36 dimensions at baseline were clearly reported. Other studies with SF-36 results at baseline in this patient category used other inclusion criteria [21] and/or did not report detailed scores on the SF-36.[19,20,22-24]

Statistical analyses

Data analysis was performed with the Statistical Package for the Social Sciences (SPSS version 17.0 for Windows). Means and standard deviations for the SF-36 and PANQOL were calculated. SF-36 scores were compared with previously published studies using independent t tests. Level of significance was calculated with a 99% confidence interval ($p < 0.01$). Exploratory factor analysis was performed using a varimax rotation on principal components. Loadings with a minimum of 0.40 were considered relevant. Factor analysis is a statistical method used to describe variability among observed and correlated variables in terms of a potentially lower number of unobserved variables called factors or dimensions. There are 2 types of factor analysis: confirmatory and exploratory. Confirmatory factor analysis is a method of determining whether the dimensions confirm to what is expected on the basis of previous studies. Exploratory factor analysis is a method used to explore the underlying structure between measured variables. It reduces a large set of variables to a limited number of underlying dimensions. In this article, exploratory factor analysis was performed to examine whether the underlying structure as published by Shaffer et al.[25] could also be identified in the current sample of patients[31,32] Reliabilities of the PANQOL dimensions were calculated with Cronbach's alpha. Cronbach's alpha is a measure of the internal consistency of questionnaire items. The value of alpha is an indication of the extent to which a number of items in a test measure the same concept. A commonly accepted interpretation of Cronbach's alpha is excellent (≥ 0.9), good (0.8 - 0.9), acceptable (0.7 - 0.8), questionable (0.6 - 0.7), poor (0.5 - 0.6), or unacceptable (< 0.5).[32]

The PANQOL dimensions in our sample were compared with the PANQOL scores of the USA patients by independent t tests. Correlations between scores on SF-36 dimensions and PANQOL dimensions were analyzed using Pearson's correlation coefficients.

RESULTS

The 155 patients who were diagnosed with VS between April 2011 and March 2012 were included in the study group. One hundred nineteen of these patients completed and returned the questionnaires (76.8%). Seven patients refused because of personal problems (4.5%), and 29 did not respond at all (18.7%). The baseline characteristics are shown in Table 1. Patient characteristics of nonresponders were not significantly different from responding patients.

Table 2. Comparison of SF-36 scores in current study to three comparable samples.[5,17,18]

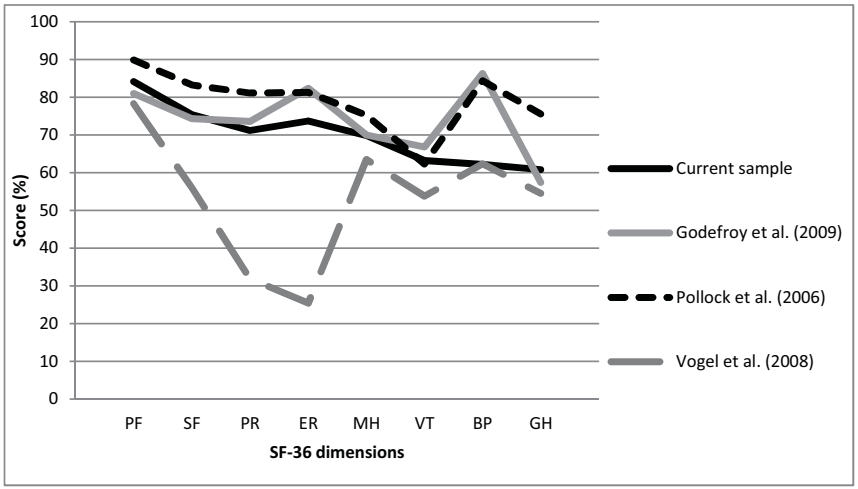
	Current study	Godefroy et al.[18]	Pollock et al.[5]	Vogel et al.[17]
SF-36 domains	N = 119	N = 70	N = 82	N = 80
Physical functioning (PF)	84.2 (20.7)	**81.0 (23.9) ***	**89.9 (16.6) ***	**78.3 (26.1) ***
Social functioning (SF)	75.4 (25.5)	74.3 (28.3)	83.3 (17.3)	**56.1 (19.5) ***
Physical role limitations (PR)	71.2 (36.8)	73.6 (39.7)	81.1 (36.4)	**31.9 (40.4) ***
Emotional role limitations (ER)	73.7 (37.2)	82.4 (31.0)	81.3 (32.8)	**25.4 (39.4) ***
Mental health (MH)	69.9 (15.3)	70.0 (15.7)	75.3 (21.8)	**63.5 (13.2) ***
Vitality (VT)	63.2 (18.8)	66.8 (15.8)	62.3 (18.2)	**53.8 (13.7) ***
Bodily pain (BP)	62.2 (16.6)	**86.3 (18.8) ***	**84.4 (19.0) ***	62.4 (38.4)
General health (GH)	60.8 (18.5)	57.4 (18.3)	**75.6 (20.8) ***	54.5 (15.6)

Mean (standard deviation). Differences between means were tested with Student's t-tests.
* $p < 0.01$ compared with current study.

The means and standard deviations of the SF-36 dimensions at baseline in the current study and in the 3 comparable samples are given in Table 2. [5,17,18] The current study has shown significant differences with all studies on the domain of Social Functioning and with 2 studies on the domain of Bodily Pain.[5,18] Both current study and the studies of Godefroy et al.[18] and Pollock et al.[5] have shown significant differences to the study of Vogel et al.[17] on the domains Physical Functioning, Physical Role Limitations, Emotional Role Limitations, Mental Health, and Vitality as shown in Table 2. On the other SF-36 dimensions, no major differences were observed.

Figure 1 shows the SF-36 dimensions in the current study (black line) and the three comparable samples.[5,17,18]

Figure 1. Comparison of SF-36 scores in current study compared to three other VS samples.[5,17,18]

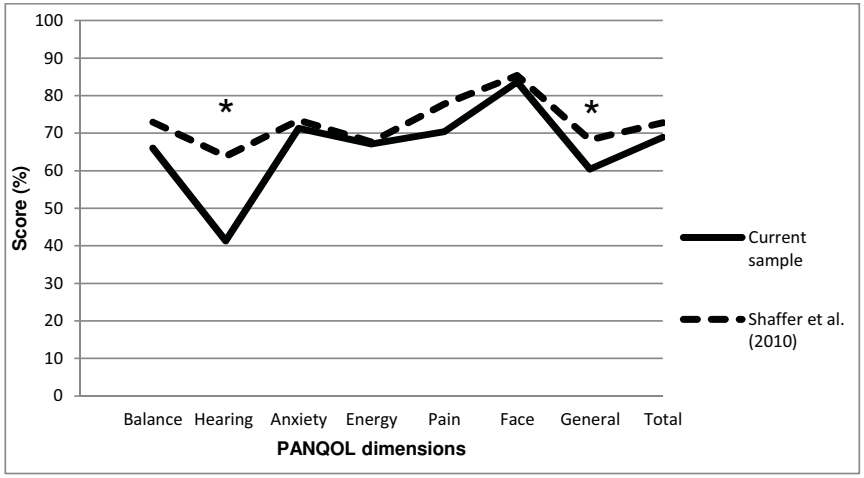


PF: Physical Functioning; SF: Social Functioning; PR: Physical role limitations; ER: emotional role limitations; MH: Mental Health; VT: Vitality; BP: Bodily pain; GH: General Health

Exploratory factor analysis was performed on the PANQOL data, using a varimax rotation on principal components based on a fixed number of 7 factors to maintain the 7-dimensional scale, as published by Shaffer et al.[25] All the 6 Balance items contribute to the same dimension. The Energy items and the Face items form their own dimensions in our sample similarly to the findings of Shaffer et al.[25] Three of 4 Hearing items contribute to 1 dimension. The fourth Hearing item (''I often feel isolated as a result of my diagnosis of acoustic neuroma'') contributes with all 4 Anxiety items on another dimension. We decided to include this Hearing item in the Anxiety dimension because this question can be explained as an Anxiety item. The first General item (''My health is excellent'') contributes as a single item on a dimension. The second General item (''I expect my health to get worse the coming year'') contributes, together with the Pain item, on a subsequent dimension. For these 3 questions, we decided to maintain the structure as Shaffer et al.[25] with the 2 General items in 1 dimension and the single Pain item in another dimension. This was decided because in this way, the factor structure of the PANQOL established by Shaffer et al.[25] is maintained in the Dutch version.

Figure 2 shows a comparison of the PANQOL-scores of our sample and the PANQOL sample, described in the original PANQOL study.[25] In the figure, the mean scores on the dimensions are shown for the USA PANQOL population and for our sample. Significant differences were found in the Hearing and General dimension, with our sample scoring lower than the USA sample.

Figure 2. Comparison of PANQOL-scores in current sample and USA sample.[25]



* significant difference, $p < 0.01$ compared with current study.

The scores of VS patients in the current sample on the PANQOL dimensions are shown in Table 3. The means, the standard deviations, and the reliabilities of the 7 dimensions in our sample and the USA sample were calculated using the dimensions as described previously.

Table 3. Means and standard deviations, and internal consistency (Cronbach's Alpha) of PANQOL dimensions of vestibular schwannoma patients (N = 119) in current study and those in the original USA PANQOL study by Shaffer et al.[25]

PANQOL dimension	Mean *(SD)* current study	Mean *(SD)* USA study[25]	Internal consistency current study	Internal consistency USA study[25]
Balance	66.0 (29.4)	72.9 (20.5)	0.94	0.88
Hearing	41.3 (27.3)	63.8 (22.2)	0.75	0.77
Anxiety	71.3 (25.2)	73.5 (20.4)	0.88	0.81
Energy	66.2 (28.9)	67.6 (23.0)	0.91	0.88
Pain	70.4 (35.9)	77.7 (28.7)	NA	NA
Face	83.6 (21.3)	85.4 (18.9)	0.65	0.71
General	60.4 (22.1)	68.3 (21.3)	0.31	0.73

NA: not applicable, because only one item is included in this dimension.

Correlations between SF-36 dimensions and PANQOL dimensions are shown in Table 4. The strongest correlations (given bold) were found between the PANQOL dimensions Balance, Hearing, Anxiety, Energy, Pain and General, and the SF-36 dimensions Physical Functioning, Social Functioning, Mental Health, Vitality, Bodily Pain and General Health, respectively. The PANQOL domain Face did not correlate strongly with any SF-36 domain.

DISCUSSION

Patients diagnosed with VS have shown an impaired QoL from the moment of diagnosis, measured with the generic SF-36 and the disease-specific PANQOL. Factor analysis has shown a 7-dimensional structure as published in the original USA PANQOL sample.[25] This finding is a substantiation of the validity of this questionnaire.

For almost all PANQOL dimensions, we found significant correlations with the SF-36 domains (Table 4). Overall, the PANQOL seems to be a valid and relevant QoL questionnaire for VS patients.

Table 4. Intercorrelations between dimensions on SF-36 and PANQOL in current study (N= 119).

PANQOL dimensions	SF-36 dimensions							
	PF	SF	PR	ER	MH	VT	BP	GH
Balance	**.64**	.39	.45	.43	.38	.52	.27	.47
Hearing	.32	**.54**	.45	.42	.43	.51	.30	.34
Anxiety	.36	.41	.31	.36	**.61**	.42	.31	.43
Energy	.54	.56	.62	.56	.59	**.70**	.46	.43
Pain	.42	.44	.31	.21	.32	.38	**.58**	
Face	.40	.44	.30	.35	.41	.43	.37	.37
General	.39	.44	.41	.43	.41	.46	.24	**.53**

PF: Physical Functioning; SF: Social Functioning; PR: Physical role limitations; ER: Emotional role limitations; MH: Mental Health; VT: Vitality; BP: Bodily pain; GH: General Health; Only statistically significant correlations (*p* .01 or lower), are given. Correlations are Pearson's product-moment correlation coefficients.

Because strong correlations between the SF-36 and the PANQOL were found in this study, one may wonder about the advantages of the PANQOL. The SF-36 as a generic QoL measurement has, by definition, limitations concerning disease-specific problems, such as sensorineural hearing loss, associated tinnitus, vertigo, or imbalance. The PANQOL focuses on these disease-specific life-limiting aspects and measures specifically VS induced QoL. As a result, we obtain a QoL related to VS, not influenced by coexisting morbidity and factors that are not associated with VS. Because of this, the PANQOL is clinically more relevant than the SF-36 in patients with VS when one wants to assess disease specific QoL in patients with VS.

In this study, SF-36 scores of patients recently diagnosed with VS are comparable to previously published studies measuring QoL at diagnosis before treatment, indicating a severely reduced QoL.[5,17,18] We compared the results from the current study with those of the PANQOL study sample by Shaffer et al.[25] When the exploratory factor analysis was applied to our results, we found some differences compared with Shaffer et al.[25] The factor analysis implies that most questions point to specific dimensions. One item of the hearing dimension (''I often feel isolated as a result of my diagnosis of acoustic neuroma'') showed a (high) load on the anxiety dimension. It is probable that anxiety, rather than hearing loss, is influential in the feelings of isolation.

Measuring QoL becomes increasingly important in modern medicine as a factor in determining the effects of medical treatment. Perhaps QoL is just as meaningful to people as being healthy. Yet it remains striking that QoL in VS patients is worse than patients with other chronic illnesses, even those with head and neck cancer.[17] Most physicians anticipate that the diagnosis of head and neck cancer in patients will have a much larger impact as this condition will (most likely) require major surgery and patients will face possible death. Patients with any choice of treatment (i.e., watchful waiting, microsurgical removal or stereotactic irradiation therapy) may have difficulty in making such a decision. Another explanation is that VS patients feel misunderstood; physicians have diagnosed them with a tumor inside their head, and the vast majority follows a watchful waiting policy. A wait-and-scan policy may make people feel uncomfortable or scared because they feel they have a ''time bomb'' in their head, and physicians just wait and do not remove it. It seems important to know what impact our approach has on the QoL of patients, as well as when and how we should measure QoL. Identifying QoL is essential because once we know the factors which are relevant, then we can anticipate the effects of treatment and make adjustments to that treatment. QoL should be taken into consideration during decision making and in the proposal of treatment.

QoL is about a person's sense of well-being, arising from satisfaction or dissatisfaction with the domains of life that he or she considers important. Therefore, QoL inventory will be interpreted from a personal point of view (i.e., subjective)[1,33] The question remaining is whether patients are influenced by either conversations with their physician or nurse practitioners on their tumor, or whether they are influenced by more widely available information (e.g., internet).

A drawback of the PANQOL is the reliability of the dimension General, which is psychometrically unacceptable (Cronbach's alpha value of 0.31). This is explained by the fact that there are only 2 questions about General Health in this questionnaire. Another drawback is that the Pain dimension consists of only 1 item.

Studies examining factors that influence the QoL in VS patients show that illness perceptions and coping are major determinants.[17] Therefore, the key question in further VS research is how patients cope with their disease and which factors contribute to this coping mechanism. If these factors are known, we can address them in the proposal for treatment and in optimizing decision making and in information provision for patients. QoL may be used as a warning tool for proactive anticipation of needs of the patient and on whether reconsidering treatment or the need for physical, physiologic, or social support. In recent literature, a wealth of publications is available on self-management education programs for patients with chronic illnesses that improve patients QoL.[33-35]

Our research group will use the PANQOL in further studies to evaluate factors contributing to the QoL of VS patients. In addition, we aim at developing interventions that focus on changing illness perceptions and assessing the effect of these interventions on QoL. In similar studies, encouraging results have already been achieved.[36]

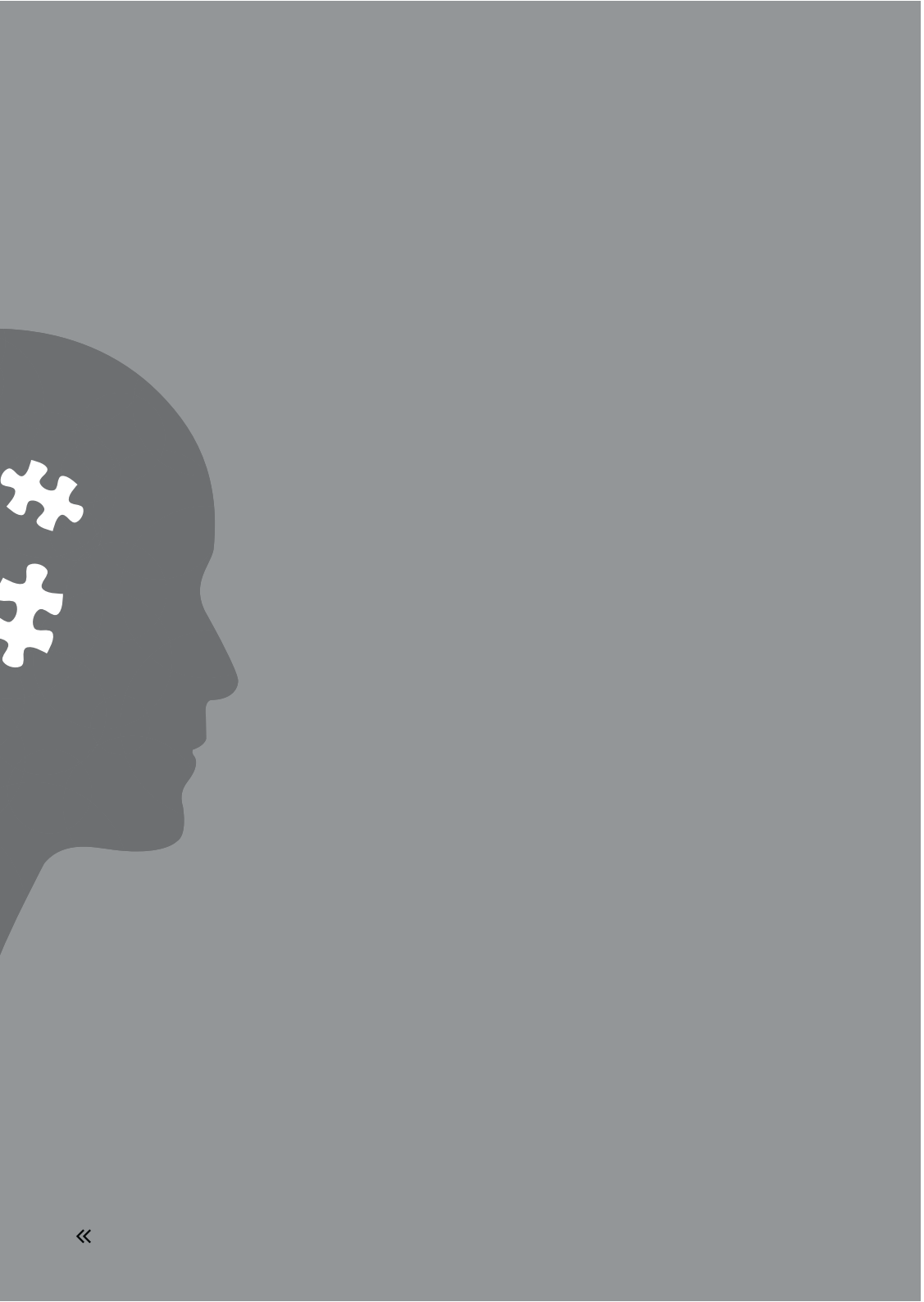
CONCLUSION

This study is the first in which the PANQOL is used to measure QoL of VS patients in patients outside the USA at the moment of diagnosis. A significantly impaired QoL was found in patients recently diagnosed with VS, both when using the PANQOL as the SF-36. In our sample, evidence to confirm the 7-dimensional structure of the original PANQOL was found.

The PANQOL seems to be a valid measure of QoL in our sample of VS patients and correlates with all the dimensions of the SF-36. The issue of which determinants contribute to the reduced QoL in these patients needs further exploration. QoL should be included in any study in patients with vestibular schwannoma, both as a descriptive measure and in intervention studies as an outcome variable.

REFERENCES

1. Schipper H, Clinch JJ, Olweny CLM. Quality of life studies: definitions and conceptual issues. In: Spilker B, ed. *Quality of life and pharmacoeconomics in clinical trials*, 2nd ed. Philadelphia, PA: Lippincott-Raven, 1996:11-24.
2. Myrseth E, Pedersen PH, Moller P, Lund-Johansen M. Treatment of vestibular schwannomas. Why, when and how? *Acta Neurochir (Wien)* 2007;149:647-60.
3. Brooker JE, Fletcher JM, Dally MJ, et al. Quality of life among acoustic neuroma patients managed by microsurgery, radiation, or observation. *Otol Neurotol* 2010;31:977-84.
4. Bederson JB, von Ammon K, Wichmann WW, Yasargil MG. Conservative treatment of patients with acoustic tumors. *Neurosurgery* 1991;28:646-50; discussion 650-51.
5. Pollock BE, Driscoll CL, Foote RL'et al. Patient outcomes after vestibular schwannoma management: a prospective comparison of microsurgical resection and stereotactic radiosurgery. *Neurosurgery* 2006;59:77-85.
6. Myrseth E, Moller P, Pedersen PH, Vassbotn FS, Wentzel-Larsen T, Lund-Johansen M. Vestibular schwannomas: clinical results and quality of life after microsurgery or gamma knife radiosurgery. *Neurosurgery* 2005;56:927-35.
7. Baumann I, Polligkeit J, Blumenstock G, Mauz PS, Zalaman IM, Maassen MM. Quality of life after unilateral acoustic neuroma surgery via middle cranial fossa approach. *Acta Otolaryngol* 2005;125:585-91.
8. da Cruz MJ, Moffat DA, Hardy DG. Postoperative quality of life in vestibular schwannoma patients measured by the SF36 Health Questionnaire. *Laryngoscope* 2000;110:151-5.
9. Irving RM, Beynon GJ, Viani L, Hardy DG, Baguley DM, Moffat DA. The patient's perspective after vestibular schwannoma removal: quality of life and implications for management. *Am J Otol* 1995;16:331-7.
10. Kelleher MO, Fernandes MF, Sim DW, O'Sullivan MG. Health-related quality of life in patients with skull base tumours. *Br J Neurosurg* 2002;16:16-20.
11. MacAndie C, Crowther JA. Quality of life in patients with vestibular schwannomas managed conservatively. *Clin Otolaryngol Allied Sci* 2004;29:215-8.
12. Tufarelli D, Meli A, Alesii Aet al. Quality of life after acoustic neuroma surgery. *Otol Neurotol* 2006;27:403-9.
13. Sandooram D, Grunfeld EA, McKinney C, Gleeson MJ. Quality of life following microsurgery, radiosurgery and conservative management for unilateral vestibular schwannoma. *Clin Otolaryngol Allied Sci* 2004; 29:621-7.
14. Nikolopoulos TP, Johnson I, O'Donoghue GM. Quality of life after acoustic neuroma surgery. *Laryngoscope* 1998;108:1382-5.
15. Martin HC, Sethi J, Lang D, Neil-Dwyer G, Lutman ME, Yardley L. Patient-assessed outcomes after excision of acoustic neuroma: postoperative symptoms and quality of life. *J Neurosurg* 2001;94:211-6.
16. Cheng S, Naidoo Y, da Cruz M, Dexter M. Quality of life in postoperative vestibular schwannoma patients. *Laryngoscope* 2009;119:2252-7.
17. Vogel JJ, Godefroy WP, van der Mey AGL, le Cessie S, Kaptein AA. Illness perceptions, coping, and quality of life in vestibular schwannoma patients at diagnosis. *Otol Neurotol* 2008;29:839-45.
18. Godefroy WP, Kaptein AA, Vogel JJ, van der Mey AGL. Conservative treatment of vestibular schwannoma: a follow-up study on clinical and quality-of-life outcome. *Otol Neurotol* 2009;30:968-74.
19. Breivik CN, Varughese JK, Wentzel-Larsen T, Vassbotn F, Lund-Johansen M. Conservative management of vestibular schwannoma - a prospective cohort study: treatment, symptoms and quality of life. *Neurosurgery* 2011;70:1072-80.
20. Di Maio S, Akagami R. Prospective comparison of quality of life before and after observation, radiation, or surgery for vestibular schwannomas. *J Neurosurg* 2009;111:855-62.
21. Godefroy WP, Hastan D, van der Mey AG. Translabyrinthine surgery for disabling vertigo in vestibular schwannoma patients. *Clin Otolaryngol* 2007;32:167-72.
22. Park SS, Grills IS, Bojrab Det al. Longitudinal assessment of quality of life and audiometric test outcomes in vestibular schwannoma patients treated with gamma knife surgery. *Otol Neurotol* 2011;32:676-9.
23. Sandooram D, Hornigold R, Grunfeld B, Thomas N, Kitchen ND, Gleeson M. The effect of observation versus microsurgical excision on quality of life in unilateral vestibular schwannoma: a prospective study. *Skull Base* 2010;20:47-54.
24. Myrseth E, Moller P, Wentzel-Larsen T, Goplen F, Lund-Johansen M. Untreated vestibular schwannomas: vertigo is a powerful predictor for health-related quality of life. *Neurosurgery* 2006;59:67-76.
25. Shaffer BT, Cohen MS, Bigelow DC, Ruckenstein MJ. Validation of a disease-specific quality-of-life instrument for acoustic neuroma: the Penn Acoustic Neuroma Quality-of-Life Scale. *Laryngoscope* 2010;120:1646-54.
26. Kanzaki J, Tos M, Sanna M, Moffat D, Monsell E, Berliner K. New and modified reporting systems from the consensus meeting on systems for reporting results in vestibular schwannoma. *Otol Neurotol* 2003;24:642-9.
27. American Academy of Otolaryngology-Head and Neck Surgery Foundation I. Committee on Hearing and Equilibrium guidelines for the evaluation of hearing preservation in acoustic neuroma (vestibular schwannoma). *Otolaryngol Head Neck Surg* 1995;113:179-80.
28. Aaronson NK, Muller M, Cohen PDet al. Translation, validation, and norming of the Dutch language version of the SF-36 Health Survey in community and chronic disease populations. *J Clin Epidemiol* 1998;51:1055-68.
29. van der Zee KI, Sanderman R. *Het meten van de algemene gezondheidstoestand met de RAND-36: een handleiding [Manual RAND-36].* Rijksuniversiteit Groningen, The Netherlands: Noordelijk Centrum voor Gezondheidsvraagstukken, 1993.
30. Acquadro C, Conway K, Giroudet C. *Linguistic Validation Manual for Patient-Reported Outcomes (PRO) Instruments.* Lyon, France: Mapi Research Institute, 2004.
31. Norris M, Lecavalier L. Evaluating the use of exploratory factor analysis in developmental disability psychological research. *J Autism Dev Disord* 2010;40:8-20.
32. George D, Mallery P. *SPSS for Windows Step by Step: A Simple Guide and Reference.* 4th ed, Vol 11.0 update. Boston, MA: Allyn & Bacon, 2003.
33. Stanley MA, Calleo J, Bush ALet al. The peaceful mind program: a pilot test of a cognitive-behavioral therapy-based intervention for anxious patients with dementia. *Am J Geriatr Psychiatry* 2012 [Epub ahead of print].
34. Labrecque M, Rabhi K, Laurin Cet al. Can a self-management education program for patients with chronic obstructive pulmonary disease improve quality of life? *Can Respir J* 2011;18:e77-81.
35. Ditewig JB, Blok H, Havers J, van Veenendaal H. Effectiveness of self-management interventions on mortality, hospital readmissions, chronic heart failure hospitalization rate and quality of life in patients with chronic heart failure: a systematic review. *Patient Educ Couns* 2010;78:297-315.
36. Petrie KJ, Weinman J. Patients' perceptions of their illness: the dynamo of volition in health care. *Curr Dir Psychol Sci* 2012;21:60–5.



3

Emotional Intelligence in association with Quality of Life in patients recently diagnosed with vestibular schwannoma

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ABSTRACT

Objective

The objective of this study was two-fold. First, to examine the levels of emotional intelligence in patients recently diagnosed with vestibular schwannoma, in comparison to those of healthy individuals and patients with other physical illness. Second, to evaluate the correlation between emotional Intelligence and quality of life.

Study Design

Cross sectional study in a university tertiary referral center.

Methods

Consecutive patients (mean age [range], 56.4 [17-85] yr) diagnosed with vestibular schwannoma between April 2011 and October 2012 (N = 254). Sociodemographic characteristics, clinical characteristics, disease-specific quality of life (PANQOL), and emotional intelligence (TEIQue-SF) were assessed by questionnaire before the start of medical treatment.

Results

Levels of emotional intelligence in patients with vestibular schwannoma (N = 178; response rate 70.1%) were significantly lower compared with healthy individuals and patients with cancer. Emotional intelligence was highly positively correlated to disease-specific quality of life. Balance disorders and cranial nerve dysfunction made a significant negative contribution to the quality of life. For educational level, a significant positive contribution was found as well.

Conclusion

The substantial impact of a vestibular schwannoma diagnosis on a psychological measure (i.e., emotional intelligence) in the affected patients as demonstrated in our study has important clinical and research implications when developing guidelines about counselling of these patients. This also has to be taken into account when making clinical decisions about the proposed treatment. Addressing emotional intelligence may be helpful in the development of a self-management program for patients with vestibular schwannoma.

INTRODUCTION

Studies on Quality of Life (QoL) in patients with vestibular schwannoma (VS) have shown that many of these patients experience a lower QoL than healthy individuals and sometimes lower compared with patients with other chronic illnesses.[1-15] Increasingly, attention is being paid to self-reported outcomes when evaluating the effect of medical treatment, rather than physicians interpreting the patients' responses (i.e., patient reported outcome measures, PROM).[16,17] QoL is perhaps the best known PROM and has evolved into an important outcome in modern medicine where it is seen as the representation of ''the functional effect of an illness and its consequent therapy upon a patient, as perceived by the patient''.[18] It can also be defined as the ''individual's perceptions of the person's position in life and in the context of the culture, and the value system in which they live and in relation to their goals, expectations, standards, and their concerns''.[19]

With regard to VS, many articles have been published on the outcomes of medical treatment. [e.g., 20-23] However, only a few studies have evaluated the patients' perspective using PROM. In QoL research on patients with VS, the role of psychological factors has not clearly been considered.[3,4,6-10,12,24-28] Recently, a systematic review in this area was provided by Gauden et al.[29] According to their conclusion, there are methodologic weaknesses in the currently available literature on QoL of patients with VS. Further research is advocated with a disease-specific QoL measure in well-designed, prospective research. In our current study, the PANQOL (Penn Acoustic Neuroma Quality of Life scale) was used as the first available disease-specific QoL measure in patients with VS.[13,14]

To acquire a better understanding of QoL in these patients, it is of major importance to gain more insight into the determinants that impact QoL. An active coping style and a considerable degree of social support have been shown to be helpful in diminishing the potentially serious consequences of being diagnosed with VS.[12,30] These factors, therefore, seem to be important in maintaining a more favorable QoL.[12] The prevailing idea is that certain patient characteristics as well as tumor characteristics but also psychological factors are determinants of QoL in these patients.

In current literature, male sex, balance problems, vertigo, hearing loss, facial nerve dysfunction, microsurgical resection, psychological factors (low optimism, low control), and poor social support are identified as determinants of a diminished QoL in VS patients before, during, or after treatment.[3,5,10,25-27,31,32] The role of other psychological factors in determining QoL in this specific patient group has been understudied.[25] Research into the possible association of these determinants of QoL with regard to VS will still need to be

performed more thoroughly to give more insight into the distress of the disease process and the determinants that could predict QoL.

During the last two decades, emotional intelligence (EI) has been receiving increased attention within scientific research, which has been started by Petrides and Furnham.[33] EI could be a determinant of QoL in patients with VS, but this has not been investigated extensively. ''The ability to experience emotions is innate to every human being. However people differ in the way they are able to identify, express, utilize and regulate their feelings and those of others. The concept of EI has been proposed to account for this variability'' (Mikolajczak et al., 2006, p. 79). EI can be subdivided into Ability EI and Trait EI (TEI). Ability EI is considered as a competence, similar to intelligence and can be assessed by performance tests (like an intelligence quotient (IQ) test). TEI is the way in which someone would cope with pressures and demands and can be seen as a strong predictor of the impact of stressful events in life.[34,35] TEI can be assessed with self-report measures.[34-37] An instrument, which has been validated for this purpose is the Trait Emotional Intelligence Questionnaire (TEIQue).[38,39] Studies using this instrument have shown that TEI correlates positively with the way people cope with stress, which is important in the context of our study. Individuals with a higher TEI show greater self-efficacy in coping with stress, making it probable that their QoL is more favorable compared with people with lower TEI scores who show a lower self-efficacy.[34-36] A study on patients with urologic cancer concludes that patients with a lower TEI score are more at risk of psychological impairment and that TEI is a major predictor of psychological adaptation for which patients can be helped professionally, both psychologically and socially.[40] These results are in line with a meta-analysis on the relationship between TEI and health performed by Martins et al., which has shown that TEI could be a predictor of health.[41]

The aim of our study was to explore the association between TEI and disease-specific QoL in patients who have recently been diagnosed with VS, before the start of their treatment. The expectation is that people with lower TEI will have more difficulty regulating their emotions, and therefore, they will have more difficulty in dealing with the diagnosis of VS, compared with healthy individuals and cancer patients, which will result in a lower QoL. If our study confirms the association between a lower TEI and a diminished QoL, this finding is instrumental in patient care because psychological support (e.g., cognitive behavioral interventions).[42,43] can be proposed in patients who experience problems regulating their emotions. Moreover, this study creates awareness of possible problems concerning the diagnosis and thereby provides the opportunity of early anticipation on these problems. It will therefore contribute to optimal patient care.

Table 1. Patient characteristics and tumor characteristics of participating patients.

No. of participants	178
Age, mean in years (range)	56.4 (17 – 85)
Gender, male - *n* (%)	85 (47.8)
Initial tumor size - *n* (%)	
Small (<11 mm)	106 (59.4)
Medium (11-20 mm)	40 (22.5)
Large (>20 mm)	30 (16.9)
Unknown	2 (1.1)
Degree of hearing loss - *n* (%)	
Class A, normal hearing (<30 dB)	24 (13.5)
Class B, moderate hearing loss (30-50 dB)	54 (30.3)
Class C or D, severe hearing loss (>50 dB)	97 (54.5)
Unknown	3 (1.7)
Symptoms (patients could report > 1 symptom) - *n* (%)	
Tinnitus	133 (74.7)
Balance disorders	91 (51.1)
Vertigo	24 (13.5)
Cranial nerves dysfunction – *n* (%)	
Trigeminal nerve (N V) affected	18 (10.1)
Facial nerve (N VII) affected	4 (2.2)

MATERIALS AND METHODS

Participants

During the period of April 2011 to October 2012, a cross-sectional study was performed in 254 consecutive patients who were diagnosed with VS in the Leiden University Medical Center, Department of Otorhinolaryngology and Head and Neck Surgery. Patient characteristics and tumor characteristics were acquired from the patients' clinical charts and are summarized in Table 1. The tumor size was measured according to the common consensus[44] as the longest cerebellopontine, also called extracanalicular, dimension of the

VS. Hearing was classified according to the classification system of the Committee on Hearing and Equilibrium. Class A was defined as normal hearing, Class B as moderate hearing loss, and Class C and D as severe hearing loss.[45] Patients who could not read Dutch or who were otherwise unable to complete the questionnaire were excluded. Patients with a cerebellopontine angle growth other than VS (i.e., meningioma) that was confirmed by radiologic examination and patients with the diagnosis of neurofibromatosis Type 2 were excluded because of medical reasons.

Sociodemographic data are summarized in Table 2.

Table 2. Socio-demographic characteristics of participating patients.

Marital stage – *n* (%)	
Single	30 (16.9)
Married	120 (67.4)
Divorced / living separately	15 (8.4)
Widow / widower	12 (6.7)
Unknown	1 (0.6)
Living situation – *n* (%)	
Living alone	35 (19.7)
Living with partner	80 (44.9)
Living with partner and children	52 (29.2)
Other living situation	10 (5.6)
Unknown	1 (0.6)
Educational level – *n* (%)	
Low	61 (34.2)
Moderate	39 (21.9)
High	76 (42.7)
Unknown	2 (1.1)
Occupation – *n* (%)	
Fulltime	85 (47.8)
Parttime	13 (7.3)
Running a household	21 (11.8)
Student	1 (0.6)
Out of work or work disability	7 (3.9)
Retired	50 (28.1)
Unknown	1 (0.6)

Materials

Penn Acoustic Neuroma Quality of Life Scale - Dutch Version

The Dutch version of the PANQOL is a self-report questionnaire with 26 items concerning symptoms associated with VS. The PANQOL is a measure that assesses the disease-specific QoL in patients with VS.

The PANQOL was developed by Shaffer et al.[14] and translated into Dutch by the current authors.[13] Each item is answered on a Likert-scale of 1 (strongly disagree) to 5 (strongly agree). The PANQOL has 7 dimensions: Balance (6 items), Hearing (3 items), Anxiety (5 items), Energy (6 items), Pain (1 item), Face (3 items), and General Health (2 items). A total PANQOL score is also available, by adding scores on all items.

Trait Emotional Intelligence Questionnaire - Short Form

The TEIQue-SF is a patient-completed questionnaire that consists of 30 items designed to measure TEI. The short form (SF) version is based on the full form of the TEIQue developed by Petrides and Furnham in 2003.[37] From each of the 15 subscales of the TEIQue, 2 items were selected for inclusion in the Short Form, which was validated by the developers of the TEIQue in 2006.[46] Each item is scored on a 7-point Likert scale of 1 (strongly disagree) to 7 (strongly agree). The total score on the 30 items is called the total TEIQue-SF score. The global EI score is calculated by dividing the total TEIQue-SF score by the total number of items.[47] Petrides and Furnham[46] derived factor scores from the TEIQue-SF whereby 4 dimensions become available: Well-Being, which covers happiness, optimism, and self-esteem (example item: ''I generally believe that things will work out fine in my life''); Self-Control, which covers emotional regulation, impulse control, and stress management (example item: ''I'm usually able to find ways to control my emotions when I want to''); Emotionality, which covers empathy, emotional perception, emotional expression, and relationships (example item: ''Expressing my emotions with words is not a problem for me''); and Sociability, which covers emotional management, assertiveness, and social awareness (example item: ''I often find it difficult to stand up for my rights''). The Dutch translation of the TEIQue-SF was performed by Rieffe et al. and published on the official Web site of the London Psychometric Laboratory (http://www.psychometriclab.com).[39]

Procedure

The Medical Ethics Committee of the Leiden University Medical Center granted permission for the study. Patients received a booklet that contained the PANQOL, TEIQue-SF, Short-Form 36 health questionnaire (SF-36), and questions about sociodemographic

characteristics. The results of the SF-36 are not reported in this study because in this article, we use the disease-specific QoL measure PANQOL.[13] Patients were asked to return their completed booklet in a stamped envelope.

Levels of TEI of the patients in this study were compared with the results of healthy individuals from previously published studies. Reference groups from the studies of Petrides et al.[48], Arora et al.[49], and Cooper and Petrides[47] were used for comparing our patients with other disease samples. Another reference group in this study was patients in the diagnostic pathway with urologic cancer described by Smith et al.[50] The results of the TEI questionnaire of these patients are comparable to our sample because they both filled out the questionnaire before start of medical treatment. The mean age of the patients with cancer was 64.6 years, and 70.3% of the participants were male. To explore the association between TEI and QoL, the scores on the TEIQue-SF were correlated to the scores on the PANQOL dimensions.

Statistical Analysis

Means and standard deviations for the total TEIQue-SF score and its 4 dimensions were calculated. Independent t tests were carried out to compare of the TEIQue-SF scores between the current study and the samples of previous published studies. Level of significance was calculated with a 2-sided t test, with 95% confidence interval ($p < 0.05$). Associations between scores of the seven PANQOL dimensions, four TEIQue-SF dimensions, patient characteristics, and the socioeconomic characteristics were analyzed using Spearman correlation coefficients with living situation divided into two groups: living alone or with someone else (e.g., partner, children, friends). Educational level was defined as high, moderate, or low. Marital stage was also divided into 3 groups: married (or living together), single (or living alone), and widow(er). Furthermore, multiple linear regression analyses were performed using forward stepwise selection to examine the relationship between the independent variables sociodemographics, clinical characteristics, EI, and the dependent variable QoL, operationalized as the total PANQOL score. Only the variables that were significant in univariate analysis at the 0.05 level were used in the regression analyses. The aim of multiple regression analysis is to find out whether, based on the correlation of multiple independent variables with one dependent variable, an association with this dependent variable can be found with each of the single independent variables. The program Statistical Package for the Social Sciences version 20.0 was used.

Table 3. Comparison of levels of Trait Emotional Intelligence in current study, compared to healthy individuals and cancer patients using the TEIQue-SF [mean ± standard deviation].[46-49]

	Current study			**Petrides et al.**[47]			**Arora et al.**[48]	**Cooper et al.**[46]		**Smith et al.**[49]
	VS patients			Healthy control group			Healthy students	Healthy people		Cancer patients
	(N = 178)			(N = 43)			(N = 17)	(N = 866)		(N = 64)
	Men	Women	Men & Women	Men	Women	Men & Women		Men	Women	Men & Women
	m (SD)	m (SD)	m (SD)	m (SD)	m (SD)	m (SD)		m (SD)	m (SD)	m (SD)
Total TEIQue	121.8 (23.4)	127.8 (21.6)	124.9 (22.5)	NA	NA	159.2 (13.4)**		NA	NA	143.2 (22.62)**
Global EI	4.06 (0.78)	4.26 (0.72)	4.16 (0.75)	4.80 (0.58)**	4.72 (0.44)**	NA		5.05 (0.69)**	4.94 (0.67)**	NA
Factors:										
Well being	4.52 (0.93)	4.78 (0.92)	4.65 (0.92)	5.16 (0.81)**	5.06 (0.58)	5.77 (0.53)**		NA	NA	NA
Self-control	3.86 (0.93)	3.93 (0.98)	3.90 (0.95)	4.37 (0.75)*	4.23 (0.58)	4.86 (0.77)**		NA	NA	NA
Emotionality	3.87 (1.02)	4.28 (0.95)	4.08 (1.00)	4.87 (0.70)**	5.01 (0.61)**	5.10 (0.70)**		NA	NA	NA
Sociability	3.81 (0.89)	3.80 (0.93)	3.80 (0.90)	4.92 (0.60)**	4.60 (0.63)**	5.35 (0.73)**		NA	NA	NA

Note; * $p < .05$; ** $p < .01$; NA: not applicable.

RESULTS

All 254 patients who were diagnosed with VS between April 2011 and October 2012 were included in the study group. Of these patients, 178 completed and returned the questionnaires (70.1%). Seventy-six patients did not respond or declined to complete the questionnaire (29.9%). The sociodemographic and clinical characteristics of the participating patients at baseline are shown in Tables 1 and 2. Clinical characteristics of nonresponders did not differ significantly from responding patients. The means and standard deviations of the total TEIQue- SF score, the global EI, and the four dimensions in the current study are given in Table 3, compared with samples of healthy individuals and patients with urologic cancer.

Both male and female patients with VS reported a significantly lower TEI score than three available reference groups of healthy respondents found in the literature.[47-49] This is shown in the total TEIQue score and Global EI score. Compared with the reference groups, significant lower scores were found on all four dimensions in men with VS ($p < 0.01$). For women, significant lower scores were found on the dimensions Emotionality and Sociability ($p < 0.01$).

Furthermore, the results show that patients in the current study who have recently been diagnosed with VS have a significantly lower TEI when compared with patients in a diagnostic cancer pathway.[50]

The PANQOL scores of current sample are given in Table 4.

Table 4. Scores on the PANQOL dimensions [mean ± standard deviation] in current sample of patients with VS (N = 178).

PANQOL dimension	Mean *(SD)*
Balance	66.3 (30.5)
Hearing	41.3 (26.5)
Anxiety	71.0 (24.9)
Energy	67.9 (26.8)
Pain	69.9 (36.0)
Face	84.2 (20.6)
General	59.8 (21.6)
Total PANQOL score	69.4 (21.4)

Correlations between the scores of our sample of VS patients on the TEIQue-SF and the PANQOL are shown in Table 5. The correlations between the total PANQOL score and the patient characteristics and sociodemographic data are shown in the same Table. A correlation of 0.48 ($p < 0.01$) in the expected direction was found between the total PANQOL score and the total TEIQue-SF score. For the four TEIQue-SF dimensions, a significant positive correlation with the total PANQOL score at the 0.01 level was found as well. For hearing loss, balance disorders, vertigo, and cranial nerve dysfunction, a significant negative correlation was found with the total PANQOL score. For educational level, we also observed a correlation, albeit a positive one.

Table 5. Correlations between the total PANQOL score and the Emotional Intelligence, patients characteristics and socio-demographic characteristics (N = 178).

	Total PANQOL score
Emotional Intelligence	
TEIQue-SF total score	.48**
TEIQue-SF wellbeing	.43**
TEIQue-SF self-control	.41**
TEIQue-SF emotionality	.36**
TEIQue-SF sociability	.33**
Patient characteristics	
Age	.02
Gender	-.05
Tumor size	-.12
Hearing loss	-.19*
Tinnitus	-.13
Balance disorders	-.44**
Vertigo	-.21**
Cranial nerve dysfunction	-.27**
Socio-demographic characteristics	
Marital stage	-.01
Living situation	-.07
Educational level	.32**

** p<.01; *p<.05.

All variables given in Table 5 that had a significant association with the total PANQOL score were included in the multiple regression analyses. The variables were simultaneously entered into a multivariate analyses model. The outcome of the regression analyses is given in Table 6 and shows that TEI makes a significant positive contribution to QoL-scores in patients who have been recently diagnosed with VS. Balance disorders and cranial nerve dysfunction showed a significant negative contribution to the QoL. Educational level showed a significant positive contribution to the QoL as well. These four factors together explained 38% of the variation in PANQOL scores.

Table 6. Multiple regression analysis for patient characteristics, symptoms and EI on QoL in VS patients (N = 178)

Variable	R^2adj	B	95% CI		*p*
Model 1	*.23****				
Total TEIQue score		.46	.33	.60	<.001
Model 2	*.33****				
Total TEIQue score		.39	.26	.52	<.001
Balance disorders		-14.0	-19.9	-8.1	<.001
Model 3	*.37****				
Total TEIQue score		.37	.24	.50	<.001
Balance disorders		-13.9	-19.6	-8.3	<.001
Cranial nerve dysfunction		-14.6	-23.1	-6.1	<.001
Model 4	*.38****				
Total TEIQue score		.33	.20	.46	<.001
Balance disorders		-13.4	-19.0	-7.7	<.001
Cranial nerve dysfunction		-14.1	-22.6	-5.7	<.01
Educational level		3.2	.08	6.3	<.05

Note. *** p<.001

DISCUSSION

Understanding of the determinants of QoL in patients with VS may help clinicians in their information provision to patients, decision making, and follow-up care. Moreover, it may give a more precise prediction of the QoL, thereby facilitating the opportunity to improve it.[51] The aim of this study was to examine the contribution of TEI on QoL in patients who have recently been diagnosed with VS.

As expected, TEI is associated with QoL in patients with VS. In addition, levels of TEI in patients who have recently been diagnosed with VS were significantly lower compared with healthy individuals on the total TEI score and on three of the 4 dimensions, namely, Well-Being, Emotionality, and Sociability. Because patients were included before start of treatment, the modality of treatment did not influence TEI, and apparently, TEI is reduced independently of the choice of treatment in these patients. The current study suggests that balance
disorders, cranial nerve dysfunction, and educational level are the only factors among an extensive set of patient characteristics and clinical characteristics with an additional contribution on the QoL in patient with VS.

Recently the Penn Acoustic Neuroma Quality-of-Life scale (PANQOL) has been validated in American and Dutch patients as the first disease-specific QoL instrument for patients with VS.[13,14] Regarding disease-specific QoL, our study is comparable to the study of Shaffer et al.[14] In our study, a diminished QoL directly after diagnosis is found, which is comparable to the findings in the study of Shaffer et al.[13,14]

In the current study, TEI was significantly correlated to the dimensions of the disease-specific QoL. This correlation was found for the Total TEIQue-SF score and also for its four dimensions (Well-Being, Self-Control, Emotionality, and Sociability). Multiple regression analysis showed TEI to have a statistically significant contribution to the QoL in these patients, whereas sociodemographic characteristics and tumor characteristics did not enter the regression analyses. Results of this analysis show that TEI has contributed 23% of the variance in the QoL of VS patients. Balance disorders (10% explanation) and cranial nerve dysfunction (4% explanation) showed a significant negative contribution. This can be explained while balance disorders and dysfunction of the facial nerve or trigeminal nerve have a profound impact on the social functioning of individuals.

Educational level was shown to make a significant positive contribution as well (1% explanation). A possible explanation could be that individuals who have received higher education will generally possess higher levels of intelligence. This allows them to better

oversee their options and the information provided to them. A better understanding of their situation could eliminate uncertainties and therefore lead to a higher QoL.

Surprisingly, VS patients were shown having a significantly lower TEI than patients who are in a diagnostic cancer pathway.[50] This is a remarkable finding as most physicians would expect cancer to have a much larger impact on TEI, as patients with cancer will (most likely) require major treatment (including surgery) and might face strongly diminished life span and possible death. The explanation for this remains speculative. Physicians might not be very experienced in estimating the QoL of patients they manage medically. Studies concerning this subject will hopefully provide further knowledge about QoL among physicians and medical students. It could also help professionals in monitoring the QoL of patients during the disease process. Patients with VS have a tumor at the base of their skull. Although benign and slow growing, it might be considered as a brain tumor or a ''time bomb in the head'' [52], which is very threatening to patients. The urologic malignancies are usually well treatable. Neither in our study nor in literature there is a clear explanation for the difference in TEI compared with patients with cancer and other chronic illness. Then, again, we could state that the diagnosis of cancer is kind of definitive, patients will undergo treatment or accept consequences (including diminished life span and death) of the malignant tumor. In case of a benign brain tumor, it is not clear whether treatment is necessary at all. This causes an amount of uncertainty among patients.

Although QoL is strongly diminished in patients with VS, Brooker et al. describe that anxiety and depression in patients with VS did not differ significantly from general population norms and no significant differences were found across the three treatment options; microsurgical resection, radiation therapy, and watchful waiting.[53] In the study of Brooker et al. no description of intervention options for improving QoL are given.[53]

There are some limitations in the current study. This study is limited by its cross-sectional design, which rules out statements about causal relationships. We can only assume certain cause and effect directions, further theoretical model that forms the basis for this study (i.e., common sense model of illness, Leventhal et al.).[54] Furthermore, it should be noted that additional variables concerning emotional functioning could be relevant in this respect. For example, selfesteem, anxiety and illness perceptions could contribute.[12,53,55] Another limitation is the use of reference groups to compare the results of the TEI questionnaire. Because it is unknown whether TEI changes over time within the same patient (because of medical or other factors), the only possible comparison is with patients who are prior to treatment as well. Unfortunately, a study of patients with urologic cancer has shown to be the only available reference group in literature, where patients filled out the questionnaire before the start of medical treatment. Although this group is small in number, it is the only available reference group as only a few studies focused on this particular determinant of QoL.

According to cognitive adaptation models, for example, the Common Sense Model of illness[54] individuals who experience traumatic events (i.e., diagnosis of disease) construct illness perceptions, and employ cognitive and emotional strategies to support self-esteem and regain a sense of control.[56] Because we find evidence for a diminished TEI in patients with VS, our study offers a suggestion for interventions with regard to dealing with emotions and cognitions of these patients at the moment of counseling. If patients indicate they experience difficulties in dealing with emotions in their daily life, psychological support by a psychologist, physician assistant, or social worker can be offered.[42,43,55] They can help patients find a way to improve management of their emotions. Social support and psychological support seem to be helpful to improve the emotional impairment in patients with, for example, cancer.[40] A future goal of the current research group is to start a cognitive behavior therapy program focused on the psychosocial consequences of the medical condition and evaluate its effects.

Vittuci emphasizes the importance of social support groups in patients with VS.[30] There is a study that showed impaired illness perception in patients with VS.[12] For patients with other chronic diseases, for example Crohn's disease, results of intervention studies focusing on psychological factors with a remarkable improvement of the QoL are available.[51] Compared with patients with other chronic illnesses (i.e., cancer), the area of psychological support in patients with VS is seriously under researched.[57,58] Future research is urgently needed to investigate which psychological intervention options are useful and available for VS patients.[25]

Because we find a significant correlation between TEI and QoL in patients with VS, possible improvement of the emotional impairment may lead to a higher QoL.We should also note that patients with balance disorders or cranial nerve dysfunction are more prone to a diminished QoL. In literature, some more studies are available concerning dizziness, which is the most significant audiovestibular predictor of QoL in patients with VS.[23,26] Future research is needed to find out which psychological intervention methods are usable in patients with VS, particularly as no studies of psychological interventions for these patients are currently available. Our results may also have clinical implications regarding medical management of patients with VS. Understanding the risk factors of a diminished QoL may be important when choosing between the three possible therapeutic interventions: microsurgical resection, radiation therapy, and watchful waiting.

CONCLUSION

This study is the first to examine the association between TEI and disease-specific QoL in patients who have recently been diagnosed with VS. Compared with healthy individuals and patients with urologic cancer, a significantly lower TEI was observed in the current sample of VS patients. Furthermore, a significant positive correlation between TEI and disease-specific QoL was found.

On the basis of our results, an intervention program for VS patients could focus on the improvement of emotional behavior because these strategies seem to have an association with the QoL in these patients. We need patients to recognize, acknowledge, and accept their emotions with the therapeutic goal to change their emotions and cognitions, which can lead to a reduction of the intensity of it. Hopefully, these findings will assist in the implementation of improved counseling and will provide clinicians information that may be instrumental in their choice of the proposed treatment for patients with VS in the future as this vulnerable group of patients seems to be prone to a diminished QoL.

REFERENCES

1. Brooker JE, Fletcher JM, Dally MJ, et al. Quality of life among acoustic neuroma patients managed by microsurgery, radiation, or observation. *Otol Neurotol.* 2010;31:977-984.
2. Baumann I, Polligkeit J, Blumenstock G, Mauz PS, Zalaman IM, Maassen MM. Quality of life after unilateral acoustic neuroma surgery via middle cranial fossa approach. *Acta Otolaryngol.* 2005;125:585-591.
3. da Cruz MJ, Moffat DA, Hardy DG. Postoperative quality of life in vestibular schwannoma patients measured by the SF-36 health questionnaire. *Laryngoscope.* 2000;110:151-155.
4. Irving RM, Beynon GJ, Viani L, Hardy DG, Baguley DM, Moffat DA. The patient's perspective after vestibular schwannoma removal: quality of life and implications for management. *Am J Otol.* 1995;16:331-337.
5. Kelleher MO, Fernandes MF, Sim DW, O'Sullivan MG. Health-related quality of life in patients with skull base tumours. *Br J Neurosurg.* 2002;16:16-20.
6. MacAndie C, Crowther JA. Quality of life in patients with vestibular schwannomas managed conservatively. *Clin Otolaryngol Allied Sci.* 2004;29:215-218.
7. Tufarelli D, Meli A, Alesii A, et al. Quality of life after acoustic neuroma surgery. *Otol Neurotol.* 2006;27:403-409.
8. Sandooram D, Grunfeld EA, McKinney C, Gleeson MJ. Quality of life following microsurgery, radiosurgery and conservative management for unilateral vestibular schwannoma. *Clin Otolaryngol Allied Sci.* 2004;29:621-627.
9. Nikolopoulos TP, Johnson I, O'Donoghue GM. Quality of life after acoustic neuroma surgery. *Laryngoscope.* 1998;108:1382-1385.
10. Martin HC, Sethi J, Lang D, Neil-Dwyer G, Lutman ME, Yardley L. Patient-assessed outcomes after excision of acoustic neuroma: postoperative symptoms and quality of life. *J Neurosurery.* 2001;94:211-216.
11. Cheng S, Naidoo Y, da Cruz M, Dexter M. Quality of life in postoperative vestibular schwannoma patients. *Laryngoscope.* 2009;119:2252-2257.
12. Vogel JJ, Godefroy WP, van der Mey AGL, le Cessie S, Kaptein AA. Illness perceptions, coping, and quality of life in vestibular schwannoma patients at diagnosis. *Otol Neurotol.* 2008;29:839-845.
13. van Leeuwen BM, Herruer JM, Putter H, Jansen JC, van der Mey AGL, Kaptein AA. Validating the Penn Acoustic Neuroma Quality of Life scale in a sample of Dutch patients recently diagnosed with vestibular schwannoma. *Otol Neurotol.* 2013;34:952-957.
14. Shaffer BT, Cohen MS, Bigelow DC, Ruckenstein MJ. Validation of a disease-specific quality-of-life instrument for acoustic neuroma: the Penn Acoustic Neuroma Quality-of-Life scale. *Laryngoscope.* 2010;120:1646-1654.
15. Godefroy WP, Kaptein AA, Vogel JJ, van der Mey AGL. Conservative treatment of vestibular schwannoma: a follow-up study on clinical and quality-of-life outcome. *Otol Neurotol.* 2009;30:968-974.
16. Wiklund I. Assessment of patient-reported outcomes in clinical trials: the example of health-related quality of life. *Fundam Clin Pharmacol.* 2004;18:351-363.
17. Valderas JM, Alonso J. Patient reported outcome measures: a model-based classification system for research and clinical practice. *Qual Life Res.* 2008;17:1125-1135.
18. Schipper H, Clinch JJ, Olweny CLM. Quality of life studies: definitions and conceptual issues. In: Spilker B, ed. *Quality of life and pharmacoeconomics in clinical trials*. 2nd ed. Philadelphia, PA: Lippincott-Raven; 1996:11-23.
19. WHOQOL-group, Harper A, Power M. Development of the World Health Organization WHOQOL-BREF Quality of Life assessment. *Psychol Med.* 1998;28:551-558.
20. Wang AC, Chinn SB, Than KD, et al. Durability of hearing preservation after microsurgical treatment of vestibular schwannoma using the middle cranial fossa approach. *J Neurosurg.* 2013;119:131-138.
21. Maniakas A, Saliba I. Microsurgery versus stereotactic radiation for small vestibular schwannomas: a meta-analysis of patients with more than 5 years' follow-up. *Otol Neurotol.* 2012;33:1611-1620.

22. Martin TP, Tzifa K, Kowalski C, Holder RL, Walsh R, Irving RM. Conservative versus primary surgical treatment of acoustic neuromas: a comparison of rates of facial nerve and hearing preservation. *Clin Otolaryngol.* 2008;33:228-235.
23. Godefroy WP, Hastan D, van der Mey AG. Translabyrinthine surgery for disabling vertigo in vestibular schwannoma patients. *Clin Otolaryngol.* 2007;32:167-172.
24. Pritchard C, Clapham L, Davis A, Lang DA, Neil-Dwyer G. Psycho-socio-economic outcomes in acoustic neuroma patients and their carers related to tumour size. *Clin Otolaryngol Allied Sci.* 2004;29:324-330.
25. Brooker J, Burney S, Fletcher J, Dally M. A qualitative exploration of quality of life among individuals diagnosed with an acoustic neuroma. *Br J Health Psychol.* 2009;14:563-578.
26. Lloyd SK, Kasbekar AV, Baguley DM, Moffat DA. Audiovestibular factors influencing quality of life in patients with conservatively managed sporadic vestibular schwannoma. *Otol Neurotol.* 2010;31:968-976.
27. Wiegand DA, Fickel V. Acoustic neuroma - the patient's perspective: a subjective assessment of symptoms, diagnosis, therapy, and outcome in 541 patients. *Laryngoscope.* 2002;99:179-187.
28. Pollock BE, Driscoll CL, Foote RL, et al. Patient outcomes after vestibular schwannoma management: a prospective comparison of microsurgical resection and stereotactic radiosurgery. *Neurosurgery* 2006;59(1):77-85.
29. Gauden A, Weir P, Hawthorne G, Kaye A. Systematic review of quality of life in the management of vestibular schwannoma. *J Clin Neurosci.* 2011;18:1573-1584.
30. Vitucci JB. Importance of local support groups for acoustic neuroma an neurofibromatosis patients. *Otolaryngol Clin N Am.* 2012;45:531-535.
31. Lynn SG, Driscoll CLW, Harner SG, Beatty CW, Atkinson EJ. Assessment of dysequilibrium after acoustic neuroma removal. *Am J Otol.* 1999;20:484-494.
32. Myrseth E, Moller P, Wentzel-Larsen T, Goplen F, Lund-Johansen M. Untreated vestibular schwannomas: vertigo is a powerful predictor for health-related quality of life. *Neurosurery.* 2006;59(1):67-76.
33. Petrides KV, Furnham A. Trait emotional intelligence: psychometric investigation with reference to established trait taxonomies. *Eur J Pers.* 2001;15:425-448.
34. Mikolajczak M, Luminet O, Menil C. Predicting resistance to stress: Incremental validity of trait emotional intelligence over alexithymia and optimism. *Psicothema.* 2006;18:S79-88.
35. Mikolajczak M, Luminet O. Trait emotional intelligence and the cognitive appraisal of stressful events: an exploratory study. *Pers Indiv Differ.* 2008;44:1445-1453.
36. Mikolajczak M, Roy E, Verstrynge V, Luminet O. An exploration of the moderating effect of trait emotional intelligence on memory and attention in neutral and stressful conditions. *Br J Psychol.* 2009;100:699-715.
37. Petrides KV, Furnham A. Trait emotional intelligence: behavioural validation in two studies of emotion recognition and reactivity to mood induction. *Eur J Pers.* 2003;17:39-57.
38. Petrides KV, Furnham A. *Technical manual of the Trait Emotional Intelligence Questionnaire (TEIQue).* [Manual]. London, UK: University of Londen, Institute of Education; 2004.
39. Rieffe C, Petrides KV. TEIQue-SF Dutch version [Manual]. Available at: http://www.psychometriclab.com. Accessed March 20, 2014.
40. Smith SG, Turner B, Pati J, Petrides KV, Sevdalis N, Green JSA. Psychological impairment in patients urgently referred for prostate and bladder cancer investigations: the role of trait emotional intelligence and perceived social support. *Support Care Cancer.* 2012;20:699-704.
41. Martins A, Ramalho N, Morin E. A comprehensive meta-analysis of the relationship between Emotional Intelligence and health. *Pers Indiv Differences.* 2010;49:554-564.
42. Aradilla-Herrero A, Tomás-Sábado J, Gómez-Benito J. Associations between emotional intelligence, depression and suicide risk in nursing students. *Nurse Educ Today.* 2013;22:S0260-6917.
43. Berking M, Wypperman P, Reichardt A, Pejic T, Dippel A, Znoj H. Emotion-regulation skills as a treatment target in psychotherapy. *Behav Res Ther.* 2008;46:1230-1237

44. Kanzaki J, Tos M, Sanna M, Moffat D, Monsell E, Berliner K. New and modified reporting systems from the consensus meeting on systems for reporting results in vestibular schwannoma. *Otol Neurotol.* 2003;24:642-649.
45. American Academy of Otolaryngology-Head and Neck Surgery Foundation I. Committee on Hearing and Equilibrium guidelines for the evaluation of hearing preservation in acoustic neuroma (vestibular schwannoma). *Otolaryngol Head Neck.* 1995;113:179-180.
46. Petrides KV, Furnham A. The role of trait emotional intelligence in a gender-specific model of organizational variables. *J Appl Soc Psychol.* 2006;36:552-569.
47. Cooper A, Petrides KV. A psychometric analysis of the Trait Emotional Intelligence Questionnaire-Short Form (TEIQue-SF) using item response theory. *J Pers Assess.* 2010;92:449-457.
48. Petrides K, Hudry K, Michalaria G, Swami V, Sevdalis N. A comparison of the trait emotional intelligence profiles of individuals with and without Asperger syndrome. *Autism.* 2011;15:671-682.
49. Arora S, Russ S, Petrides KV, et al. Emotional intelligence and stress in medical students performing surgical tasks. *Acad Med.* 2011;86:1311-1317.
50. Smith GM, Petrides KV, Green JSA, Sevdalis N. The role of trait emotional intelligence in the diagnostic cancer pathway. *Sup Care Cancer.* 2012;20:2933-2939.
51. van der Have M, van der Aalst KS, Kaptein AA, et al. Determinants of health-related quality of life in Crohn's disease: a systematic review and meta-analysis. *J Crohns Colitis.* 2014;8:93-106.
52. Kaptein AA, Zandstra T, Scharloo M, et al. 'A time bomb ticking in my head': drawings of inner ears by patients with vestibular schwannoma. *Clin Otolaryngol.* 2011;36:183-184.
53. Brooker JE, Fletcher JM, Dally MJ, et al. Factors associated with anxiety and depression in the management of acoustic neuroma patients. *J Clin Neurosci.* 2012;19:246-251.
54. Leventhal H, Meyer D, Nerenz D. Illness representations of coping with health threats. In: Baum A, Taylor SE, Singer JE, eds. *Handbook of psychology and health: social psychological aspects of health: Social Psychological Aspects of Health.* Vol 4. Hillsdale, NJ: Erlbaum; 1984:219-252.
55. Waldron B, Casserly LM, O'Sullivan C. Cognitive behavioural therapy for depression and anxiety in adults with acquired brain injury. What works for whom? *Neuropsychol Rehab.* 2013;23:64-101.
56. Taylor SE. Adjustment to threatening events. *Am Psychol.* 1983;38:1161-1173.
57. Almagro P, Castro A. Helping COPD patients change health behavior in order to improve their quality of life. *Int J Chron Obstruct Pulmon Dis.* 2013;8:335-345.
58. Berman MG, Askren MK, Jung M, et al. Pretreatment worry and neurocognitive responses in women with breast cancer. *Health Psychol.* 2014;33:222-231.

4

The art of perception: patients drawing their vestibular schwannoma

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ABSTRACT

Objectives/Hypothesis

Drawings made by patients are an innovative way to assess the perceptions of patients on their illness. The objective of this study, at a university tertiary referral center, on patients who have recently been diagnosed with vestibular schwannoma, was to examine whether patients' illness perceptions can be assessed by drawings and are related to their quality of life.

Study Design

Cross-sectional study.

Methods

Patients diagnosed with vestibular schwannoma (mean age [range], 55.4 [17–85] years) between April 2011 and October 2012 were included (N5253). Sociodemographics, illness perceptions (Brief Illness Perception Questionnaire [B-IPQ]), and disease-specific quality of life (Penn Acoustic Neuroma Quality of Life [PANQOL] scale) were assessed to evaluate the impact of being diagnosed with vestibular schwannoma. Furthermore, patients' drawings of their tumor were analysed to explore the association between illness perceptions, drawings, and quality of life.

Results

Comparison of the B-IPQ scores of the current sample (N5139; response rate 54.9%) with other disease samples shows a significantly lower score for patients with vestibular schwannoma on the Coherence dimension, indicating a low understanding of the illness. Illustration of emotions (N512) in the drawings gave a negative association with quality of life. Intercorrelations indicate a positive association between a low amount of physical and emotional consequences of the illness and a higher score on the Balance, Hearing, and Energy dimensions of the PANQOL.

Conclusions

Patients' drawings give an insight into their perception of the tumor inside their head. Use of drawings may be helpful when developing and offering self-management programs. Quality of life appears to be significantly affected by the diagnosis.

INTRODUCTION

Vestibular schwannomas (VS) are benign, often slow-growing tumors of the vestibulocochlear (eighth cranial) nerve.[1] However, patients who are diagnosed with VS may not perceive their tumor as benign at all. They often suffer from a great deal of anxiety and uncertainty regarding the tumor growing in their head and the possibility of (aggravated) hearing loss, tinnitus, vertigo, facial paralysis, and death.[2]

All of these factors may have a serious impact on the patients' illness perceptions (IPs) and quality of life (QoL). In the common sense model of self-regulation (CSM),[3] patients' responses to health threats determine how patients manage their illness.[4,5]

IPs are based on the patients' cognitions and emotions in relation to complaints, symptoms, causes, consequences, and their future perspective with reference to their illness. Patients' IPs are significantly associated with physical, psychological, and social well-being and functioning.[6] It seems that these perceptions play an important role in the variation of the severity of disease as experienced by the patients and therefore with their QoL.[7,8] According to current literature, patients with VS experience reduced QoL from the moment of diagnosis.[1,9-19] Recently, five studies have been published regarding QoL in patients with VS. All studies focused on (long-term) QoL after three different treatment options.[19-23] Recently, a systematic review was provided by Gauden et al.,[24] who advised further research using a disease-specific QoL measure. Until now, five study groups have used a disease-specific QoL questionnaire, the Penn Acoustic Neuroma Quality of Life (PANQOL) scale, to evaluate patients with VS.[9,10,19,21,25,26]

Patients' QoL depends on many determinants. In the context of the CSM, sociodemographic, clinical, and psychological factors (i.e., illness perceptions) are the main determinants, not only in patients with VS, but in any illness category. Identified determinants of QoL in patients with VS before, during, and after treatment are male gender, balance disorders, vertigo, hearing loss, facial nerve or trigeminal nerve dysfunction, microsurgical resection, psychological factors (i.e., optimism, control),emotional intelligence, and IPs.[18,27-33]

In the past decades, increased attention has been paid to patient reported outcome measures (PROM) when evaluating the effect of medical treatment, rather than physicians interpreting the patients' responses.[34,35]

Patients' perceptions are crucial in determining their QoL.[7,36] An innovative way in which the cognitive and emotional response of patients can be established is by asking them to make a drawing of their illness.[2,37] The concept of the drawings started in 1961, when

Table 1. Characteristics of drawings according to the literature.

First author	Publication, country	Number of patients and type of illness		Characteristics of drawings
Gabriels[41]	2000, USA	23	Asthma (children)	Drawn affect Verbalized affect Level of detail
Broadbent[42]	2004, New Zealand	74	Myocardial infarction	Size of drawing (area in percentages) Damage (yes/no) Size of damage (area in percentages) Number of blocked cardiac arteries (0/1/2/3) Expression of emotions (yes/no)
Guillemin[37]	2004, Australia	32	Heart disease	Exclusively heart or with other organs Correct anatomy of the heart or diptych Symptoms (yes/no) Expression of emotions Impact on society (yes/no) Use of colors (yes/no)
Reynolds[40]	2007, New Zealand	60	Heart failure	Size of drawing (area and height) Damage (yes/no)
Waweru[43]	2008, USA	6	HIV/AIDS (children)	Expression of emotions (Koppitz scoring)
Broadbent[44]	2009, New Zealand	27	Headache	Size of drawing (height and width) Location of pain, and number of places with pain Nature of pain (external/internal force) Expression of emotions (yes/no) Intensity of pen stroke
Daleboudt[45]	2011, The Netherlands	32	Systemic lupus erythematosus	Size of drawing (area) Number of kidneys (1/2) Size and distribution of damage (dots) Written explanation (yes/no)
Kaptein[2]	2011, The Netherlands	13	Vestibular schwannoma	Size of drawing and tumor (area) Exclusively tumor or with surrounding tissue Shape of the tumor (line/round)
Wang[46]	2011, Australia	60	Cardiac abnormality (children)	Correct anatomy of the heart (scale 1-4) Correct description problem (scale 1-4)
Besser[47]	2012, United Kingdom	14	Osteoporosis	Size and shape of drawing Symptoms (spine curvature, loss of height, pain) Understanding of disease
Hoogerwerf[48]	2012, The Netherlands	12	Lung cancer	Size of drawing and tumor (area) Location of the tumor (correct/incorrect) Shape of the lung (correct/incorrect) Level of detail (high/low)
Lauche[46]	2012, Germany	6	Chronic neck pain	Position of the shoulders Completeness of drawing
Lok[50]	2012, Australia	12	Ventricular septal defect (children)	Size and site of defect Anatomy of heart (correct/incorrect)
Tiemensma[51]	2012, The Netherlands	47	Cushing's syndrome	Size of drawing (height and width) Fat accumulation, skin laesions, changes in hair (yes/no) Expression of emotions (negative/positive/no)
Chong[52]	2013, New Zealand	52	Cerebral palsy (children)	Size of drawing and figure (height) Place of figure (inside/outside building)
Isla Pera[53]	2013, Spain	199	Diabetes mellitus (children)	Size of drawing (small/medium/large) Themselves / friends / family in drawing (yes/no) Health professionals / hospital in drawing (yes/no) Organs/elements/food related to diabetes/insulin (yes/no) Metaphoric / fantasy drawing (yes/no) Expression of emotions (sadness/worry/joy) Intensity of pen stroke and number of colors used
Luthy[54]	2013, Switzerland	32	Chronic obstructive pulmonary disease	Size of drawing (height and width) Body shape (partial/complete) Anatomical structures (yes/no) Obstruction of airflow (yes/no) Restriction of the lungs (yes/no) Dilatation of the lungs (yes/no)
Hatano[55]	2014, Japan	3	Cancer (children)	Size of drawing Place of drawing on the paper Level of detail (high/low) Expression of emotions (energy/anxiety/emptiness) Intensity of pen stroke, and use of colors (yes/no)

Craddick found that children's drawings of Santa Claus became larger as Christmas drew nearer.[38] Drawings made by patients have been successfully applied in a number of medical conditions and report that patients find it easier to illustrate their feelings more accurately by a drawing than they can express them with words.[37,39,40] Previous studies on patients' drawings in which drawing characteristics were scored were identified by a PubMed search (March 20, 2015) and resulted in 18 studies (Table 1).[2,37,40-55] These studies demonstrate that drawings made by patients reveal their perceptions on their illness.

Furthermore, positive patient perceptions of their medical condition represented in their drawing were found to be related to faster recovery, earlier return to work, and a higher QoL.[40,42] No significant correlations between size of the drawing and psychological factors such as anxiety or depression were found.[40,42]

With regard to patients with VS, a pilot study was done in 2011 to study their drawings before and after treatment. This study demonstrates that patients are willing and able to draw their tumors.[2] The authors hypothesized that drawings could be used as an outcome measure of patients' perceptions of their tumor, and that a comparison to objective measures could be made.[2,12,56]

In this study, we aimed to investigate the use of drawings and explore their associations with IPs and QoL in patients who have recently been diagnosed with VS. To achieve this, we evaluated whether scores on the Brief Illness Perception Questionnaire (B-IPQ) dimensions, PANQOL scale dimensions, and drawing characteristics were associated. In addition, it was our aim to compare IPs of patients with VS with IPs of patients suffering from different chronic illnesses, reported in the literature.

MATERIALS AND METHODS

Participants

A cross-sectional study was performed in consecutive, newly diagnosed patients with VS in the period from April 2011 to October 2012. Patients were diagnosed in the Leiden University Medical Center, Department of Otorhinolaryngology and Head and Neck Surgery, or were referred to this tertiary center from all over the Netherlands. Patient characteristics were obtained from the patients' clinical charts and are summarized in Table 2. According to the international Kanzaki guidelines,[57] the tumor size was measured as the extracanalicular (longest cerebellopontine) dimension of the VS. Hearing was classified on the basis of the classification system of the Committee on Hearing and Equilibrium.[58] Class A is defined as normal hearing, Class B as moderate hearing loss, and

Class C and D as severe hearing loss. Patients who could not read Dutch or otherwise were unable to complete the questionnaire were not included. Patients with a diagnosis of neurofibromatosis type 2 or a cerebellopontine angle growth other than VS (i.e., meningioma) confirmed by radiologic examination were excluded from the study due to medical reasons.

Table 2. Patient characteristics and tumor characteristics of participating patients.

No. of participants	139
Age mean in years (range*)*	55.4 (17-85)
Gender, male - *n* (%)	68 (48.9)
Initial tumor size - *n* (%)	
Small (<11 mm)	85 (61.2)
Medium (11-20 mm)	32 (23.0)
Large (>20 mm)	22 (15.8)
Degree of hearing loss - *n* (%)	
Class A, normal hearing (<30 dB)	21 (15.1)
Class B, moderate hearing loss (30-50 dB)	47 (33.8)
Class C or D, severe hearing loss (>50 dB)	70 (50.4)
Unknown	1 (0.7)
Symptoms (patients could report > 1 symptom) – *n* (%)	
Tinnitus	107 (77.0)
Balance disorders	68 (48.9)
Vertigo	19 (13.7)
Cranial nerves dysfunction – *n* (%)	
Trigeminal nerve (N V) affected	15 (10.8)
Facial nerve (N VII) affected	4 (2.9)

Materials

B-IPQ

The B-IPQ[59] is a nine-item scale designed to assess the cognitive and emotional representations of illness: Consequences, Time Line, Personal Control, Treatment Control,Identity, Concern, Coherence, Emotional Response, and Possible Causes of the Disease. A higher score reflects a more threatening view of the illness. The B-IPQ is a valid and reliable measure of illness perceptions in patients with a variety of illnesses.[60] Further details can be found at http://www.uib.no/ipq

PANQOL scale—Dutch version

The PANQOL questionnaire is the first disease-specific QoL instrument for patients with VS. It has been developed and validated by Shaffer et al.[9] and has been translated into Dutch by the current authors.[10] The questionnaire consists of 26 multiple-choice questions on symptoms associated with VS. Participants are asked to rate each item on a Likert scale of 1 (strongly disagree) to 5 (strongly agree). The PANQOL scale consists of seven dimensions: Balance (six items), Hearing (three items), Anxiety (five items), Energy (six items), Pain (one item), Face (three items), and General Health (two items). A total score arises by calculating the average of all domain scores.

Procedure

Permission for this study was granted by the medical ethics committee of the Leiden University Medical Centre. Patients received a booklet that contained the B-IPQ, the PANQOL, and an empty page with a square of 14 x 17 cm and the following instruction: “Please draw a picture of what you imagine your tumor looks like. What other parts of your head are in close proximity to the tumor? This task is not about artistic ability; we are interested in your perception of the tumor and your own ideas about what has happened to your head ever since receiving the diagnosis.” The patients were asked to fill in the booklet at home, and send it back to the hospital in a stamped addressed envelope.

Statistical Analysis

B-IPQ

Means and standard deviations for the B-IPQ were calculated. Independent t tests were carried out to compare the B-IPQ dimension scores of the current sample to samples from previously published studies (Daleboudt et al.,[45] Husson et al.[61] [patients without metastasis], Kaptein et al.,[62] and Zivkovic et al.[63]). Level of significance was calculated with a two-sided t test, with 95% confidence interval (P<.05).

Drawings

The drawings were scanned and analysed using the National Institutes of Health’s ImageJ software.[64] Two independent researchers (B.M.L., J.M.H.) measured the size of the tumor by following the drawn line that indicates the tumor. The ImageJ program enables accurate measuring and computing of the surface of the area that is measured. The same procedure was followed for the size of the total drawing by measuring the outer line of the drawing. The results of both researchers were averaged. In addition, the drawings in the current study were analysed for shape of the tumor (i.e., line or round shape), symptoms that are drawn (hearing, tinnitus, vertigo, unsteadiness), emotional expression

(yes or no), and level of details (high or low). Furthermore, a distinction was made between drawing the tumor exclusively or drawing the tumor including surrounding tissue. Three independent raters (B.M.L., A.G.L.M., A.A.K.) scored the drawings and reached consensus on each drawing characteristic.

PANQOL

Means and standard deviations for the PANQOL were calculated. Intercorrelations between the B-IPQ dimensions, drawing characteristics, and PANQOL dimensions were computed to explore associations between the IPs, drawings, and QoL. Data analysis was performed using the Statistical Package for the Social Sciences (SPSS version 20.0 for Windows; IBM, Armonk, NY).

RESULTS

Between April 2011 and October 2012, 253 patients presented with VS in the Leiden University Medical Center. One hundred thirty-nine patients (54.9%) completed and returned the questionnaires, including the drawing task, and were included in the study group. Baseline characteristics, which did not show significant differences compared to nonresponding patients, can be found in Table 2.

B-IPQ

The results of the comparison of the B-IPQ scores of the patients with VS and four other disease samples are given in Table 3. According to patients with VS, the illness does affect lives more than patients with colorectal carcinoma or melanoma think of their illness (Consequences dimension). Patients with lung cancer scored the highest on this dimension. The duration of the illness (Timeline dimension) is expected as longer by patients with VS than patients with colorectal carcinoma or melanoma expect of their illness, but shorter than patients with systemic lupus erythematosus (SLE) expect of their illness. The feeling of control over the illness (Personal Control dimension) in patients with VS is higher compared to patients with SLE or lung cancer, and lower compared to patients with melanoma. Patients with VS are more positive about the effect of treatment than patients with lung cancer or melanoma (Treatment Control dimension). Patients with SLE scored the lowest on this dimension. Patients with VS experience more symptoms than patients with colorectal carcinoma, lung cancer, or melanoma; however, patients with SLE experience the most symptoms from their illness (Identity dimension). On the Concern dimension, patients with VS scored lower than patients with SLE or lung cancer.

Table 3. Comparison of levels of Illness Perceptions [mean and standard deviation] in the current study, compared to other illnesses using the B-IPQ.[45,61-63]

	Current study	**Daleboudt et al.**[45]	**Husson et al.**[61]	**Kaptein et al.**[62]	**Zivkovic et al.**[63]
	VS (N=139)	SLE (N=106)	Colorectal cancer (N=1020)	Lung cancer (N = 24)	Melanoma (N = 120)
B-IPQ dimensions	m (*SD*)	m (*SD*)	m (*SD*)	m (*SD*)	m (*SD*)
Consequences	5.68 (2.85)	5.45 (2.58)	4.0 (2.5)**	7.50 (2.86)**	4.74 (3.00)**
Time line	7.07 (2.92)	8.44 (2.49)**	4.2 (3.3)**	6.13 (2.70)	5.78 (3.56)**
Personal control	5.85 (3.00)	4.88 (3.00)**	6.0 (3.1)	3.88 (3.60)**	6.61 (2.79)*
Treatment control	3.68 (2.74)	2.71 (2.23)**	3.5 (2.6)	6.82 (2.59)**	7.93 (2.12)**
Identity	5.24 (2.51)	6.14 (2.58)**	3.5 (2.6)**	3.70 (3.05)**	2.23 (2.62)**
Concern	6.02 (2.70)	6.90 (2.83)**	4.0 (2.5)**	7.83 (2.63)**	5.42 (3.21)
Coherence	2.64 (2.38)	3.29 (2.47)*	4.4 (3.0)**	5.58 (3.45)**	8.08 (2.21)**
Emotional response	5.28 (3.04)	5.50 (3.03)	3.6 (2.5)**	5.21 (3.09)	4.37 (2.91)*

Note; * $p < .05$; ** $p < .01$; NA: not applicable, VS: vestibular schwannoma, SLE: systemic lupus erythematosus, RA: rheumatoid arthritis.
Higher B-IPQ scores reflect a more threatening view of the illness.

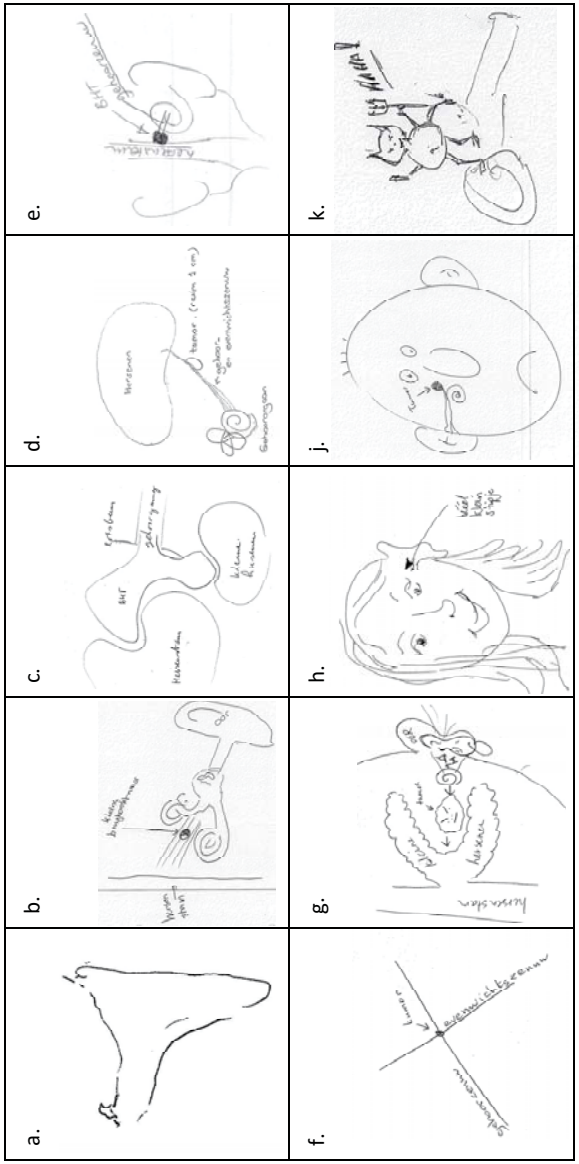


Figure 1. Examples of VS drawings.

Note; hersenstam (b,c,d,g) = brainstem; kleine brughoektumor (b) = small vestibular schwannoma; oor (b,g) = ear; BHT (c,d) = vestibular schwannoma; gehoorgang (c) = auditory canal; kleine hersenen (c,g) = cerebellum; rotsbeen (c) = petrosal bone; gehoorzenuw (d,e,f) = cochlear nerve; evenwichtszenuw (e,f) = vestibular nerve; gehoororgaan (e) = organ of hearing; heel klein stipje (h) = very tiny spot; tumor (e,f,g,i) = tumor; haha (k)= laughing loud.

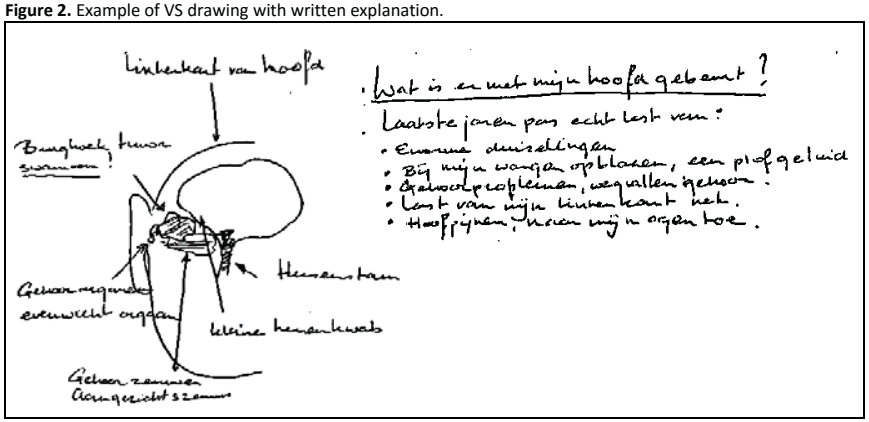
Patients with colorectal carcinoma scored the highest on this dimension. The most important significant differences were seen in the Coherence dimension (understanding of the illness), on which patients with VS scored significantly lower than patients in all the other disease samples. The score on the Emotional dimension response (fear response to an unknown health threat) is significantly higher than found in patients with colorectal carcinoma or melanoma.

What did the patients with VS draw?

A small number of patients (15.8%) made a drawing showing exclusively the tumor (Fig. 1a), whereas most patients (84.2%) drew the surrounding tissue as well (Fig. 1b,c). Most patients drew a tumor with a round shape (87%), other shapes (i.e., irregular, triangle) were rare. Forty-three patients (30.9%) drew the cochlear nerve (Fig. 1d–f). Thirty-three patients (23.7%) drew the vestibular nerve (Fig. 1e,f). Only five patients drew something pertaining to their tinnitus. The level of detail was low in the majority of the drawings (69.1%). Emotions were illustrated in only 12 (8.6%) drawings (Fig. 1g–k).

It is noteworthy that 73 patients placed written explanations on their drawing. An example is given in Figure 2.

Figure 2. Example of VS drawing with written explanation.



Note; brughoektumor = vestibular schwannoma; hersenstam = brainstem; gehoorsegment = organ of hearing; evenwichtsorgaan = organ of balance; kleine hersenkwab = cerebellum; gehoorzenuwen = cochlear nerve; aangezichtszenuw = vestibular nerve.Text: What has happened in my head? Only recently real problems: real dizziness, when inflating my cheeks a popping sound, hearing problems, hearing loss, pain on the left side of my neck, headaches towards my eyes.

PANQOL

The PANQOL scores of the current sample are given in Table 4. No statistically significant differences were found compared to previous published studies.[8,9]

Table 4. Scores on the PANQOL dimensions [mean and standard deviation] in current sample of patients with VS (N=139)

PANQOL dimension	Current study (N=139) m (SD)
Balance	68.6 (29.3)
Hearing	41.7 (26.8)
Anxiety	73.2 (24.5)
Energy	69.7 (26.8)
Pain	71.6 (36.0)
Face	85.3 (19.9)
General	60.7 (21.8)
Total PANQOL score	67.5 (18.9)

Associations between drawing characteristics, IPs, and QoL

Intercorrelations between the B-IPQ dimensions and the PANQOL dimensions are given in Table 5. High significant negative correlations (r>0.50; P<.01) were found between the B-IPQ dimensions Identity, Concern, and Emotional response and the PANQOL dimensions Balance, Hearing, and Energy, indicating an association between a low amount of physical and emotional consequences of the illness and a higher score on the Balance, Hearing, and Energy dimensions of QoL.

No significant correlations of at least a low strength (r>0.30)[65] were found between the B-IPQ dimensions, PANQOL dimensions, and the drawing characteristics

Table 5. Intercorrelations of PANQOL dimensions and B-IPQ dimensions (N=139).

B-IPQ	PANQOL						
	Balance	**Hearing**	**Anxiety**	**Energy**	**Pain**	**Face**	**General**
Consequences	-.32*	-.46*	-.42*	-.48*	-.17†	-.24*	-.32*
Time-line	.06	.08	.09	.19†	.21†	.14	.03
Personal control	-.13	.01	.00	-.09	.21†	-.08	-.09
Treatment control	-.05	.09	.10	.03	.16	.06	-.01
Identity	-.54*	-.51*	-.37*	-.57*	-.27*	-.31*	-.38*
Concern	-.32*	-.32*	-.63*	-.46*	-.15	-.23*	-.38*
Coherence	-.23*	-.19†	-.33*	-.30*	-.26*	-.28*	-.27*
Emotional response	-.42*	-.45*	-.63*	-.53*	-.21*	-.39*	-.41*

** p<.01; †p<.05.

DISCUSSION

The aim of this study was to examine the relationship between IPs, characteristics of patients' drawings of their own tumor, and QoL of patients who have recently been diagnosed with VS.

There are some remarkable findings in the scores on the B-IPQ dimensions in patients with VS compared to patients with different chronic illnesses. First, the most striking finding is that patients with VS had the lowest score on the B-IPQ dimension Coherence. This indicates a lesser understanding of their illness in patients with VS than in patients with other chronic diseases or several types of cancer. Second, it is fascinating that patients with VS are more concerned about their illness than patients with colorectal carcinoma, whereas this severe disease is associated with high mortality. This might be related to the limited understanding of patients with VS of their own illness, inadequate provision of information by their physicians, and the uncertainty on their future treatment. Third, patients with VS experience, in general, more symptoms than patients with colorectal carcinoma, lung cancer, or melanoma, although not as much as patients with SLE. It is understandable that melanoma patients experience minimal symptoms given that most of these patients have an isolated tumor on their skin. This is in contrast to patients with VS,

who experience problems with their balance and hearing, with a strong influence on their daily activities and their social life. SLE patients experience a lot of symptoms throughout the body, with many inconveniences in daily life. It is hard to explain why patients with VS scored worse than the two groups of patients with cancer, although this may have to do with the feeling of a "time bomb in their head."[2]

According to the analysis of the drawings, it is worth mentioning that the level of detail is low in most drawings. This may be explained by a low understanding of the illness or perhaps an inadequate explanation by the physicians. Furthermore, it is remarkable that only 12 patients (8.6%) illustrated their emotions in the drawing. This could be due to the study design, and perhaps we should have been clearer in our instructions and asked the patients explicitly to draw their emotions. Actually, 73 patients (52.5%) placed written explanations around their drawing, which indicates the ability and willingness to express their emotions about the illness.

Although only some weak significant correlations were found between the B-IPQ dimensions and the drawing characteristics, it seems worthwhile to pay attention to some of these trends. Positive correlations were found between the B-IPQ dimensions Consequences, Timeline, and Emotional response and the reflection of balance disorders or hearing in the drawings, which implies that if patients expect the illness to be more chronic in nature, and they experience a major impact of the tumor on their lives and mood, they are more inclined to represent balance disorders or hearing in their drawings. A possible explanation for this finding is that hearing and balance disorders have a major impact on daily life. This has already been established in previous research.[17,33,66] Another remarkable finding was the correlation between the reflection of negative emotions in the drawings and QoL. Patients who drew negative emotions perceived a significantly lower level of QoL compared to patients who reflected positive emotions or no emotions at all. This could be helpful in clinical practice.

Associations between drawings and IPs were found in earlier studies concerning other illnesses.[39,40,42,44,45] However, in this study we could not find strong evidence for the hypothesis that drawings could reflect IP. A possible explanation for our inability to find additional evidence supporting this association is the diversity of our patients. All of our patients had recently been diagnosed with VS, but the tumor size and clinical characteristics differed between patients. Some patients even had no symptoms at all. VS patients differ in this way from, for example, myocardial infarction and heart failure, where all patients suffer from an active state of their illness. Another explanation for these results is the way we instructed our patients to draw. This left much to individual interpretation, resulting in a difficult comparison between the drawings.

Another limitation is that most patients had already seen the radiological examination of the tumor and were given a picture of the ear by their clinicians to explain the place of the tumor inside the head. This might have resulted in an altered illness perception of the patients.

Based on our findings, we suggest that adding a drawing task to the disease-specific QoL questionnaire (PANQOL) might be helpful for clinicians and patients. The nature of the drawing could give clinicians insight into patients' perceptions about their illness and the impact on their daily life. The drawings showed very clear patients' perceptions of their VS. Some patients know, very precisely, which structures are involved, compressed, or malfunctioning, whereas others just think of their tumor as a "tiny dot." Furthermore, drawings are important to patients because it could be a way to express their emotions and feelings. If clinicians have an improved understanding of the perception of their patients (e.g., through drawings) it will help in providing information and encouraging self-management (e.g., awareness of the illness, knowledge about its treatment options, handling of symptoms caused by the illness, shared decision making by the patient and physicians). This form of self-management is important for daily care throughout the time the illness will last and will improve QoL in patients with chronic illness.[67-69]

CONCLUSION

Although VS is a benign, often slow-growing tumor, the symptoms patients experience can be very serious. Moreover, the knowledge of having a tumor in one's head on top of these symptoms can result in an enormous deterioration of QoL. Understanding of their illness can give patients coherence and support to cope with their illness. Drawings of patients could be an easy and fascinating way to gain insight into patients' perceptions about their illness at a glance. This will enable physicians the possibility of better understand the perceptions of their patients with VS. This knowledge will contribute in the overall care of patients with VS and may be helpful in self-management programs.

REFERENCES

1. Pollock BE, Driscoll CL, Foote RL, et al. Patient outcomes after vestibular schwannoma management: a prospective comparison of microsurgical resection and stereotactic radiosurgery. *Neurosurgery* 2006;59:77-85.
2. Kaptein AA, Zandstra T, Scharloo M, et al. 'A time bomb ticking in my head': drawings of inner ears by patients with vestibular schwannoma. *Clin Otolaryngol.* 2011;36:183-184.
3. Leventhal H, Benjamin Y, Brownlee S, et al. Illness representations: theoretical foundations. In: Petrie KJ, ed. *Perceptions of health and illness*. London: Harwood Academic Publishers; 1997:19-45.
4. Leventhal H, Meyer D, Nerenz D. The common sense representation of illness danger. In: Rachman S, ed. *Contributions to medical psychology*. New York, NY: Pergamon Press; 1980:7-30.
5. Fischer M, Scharloo M, Abbink J, et al. The dynamics of illness perceptions: testing assumptions of Leventhal's Common Sense Model in a pulmonary rehabilitation setting. *Br J Health Psychol.* 2010;15:887-903.
6. Howard C, Hallas CN, Wray J, Carby M. The relationship between illness perceptions and panic in chronic obstructive pulmonary disease. *Behav Res Ther.* 2009;47:71-76.
7. Petrie KJ, Weinman J. Why illness perceptions matter. *Clin med.* 2006;6:536-539.
8. Petrie KJ, Jago LA, Devcich DA. The role of illness perceptions in patients with medical conditions. *Curr Opin Psychiatr.* 2007;20:163-167.
9. Shaffer BT, Cohen MS, Bigelow DC, Ruckenstein MJ. Validation of a disease-specific quality-of-life instrument for acoustic neuroma: the Penn Acoustic Neuroma Quality-of-Life scale. *Laryngoscope.* 2010;120:1646-1654.
10. van Leeuwen BM, Herruer JM, Putter H, Jansen JC, van der Mey AGL, Kaptein AA. Validating the Penn Acoustic Neuroma Quality of Life scale in a sample of Dutch patients recently diagnosed with vestibular schwannoma. *Otol Neurotol.* 2013;34:952-957.
11. Godefroy WP, Hastan D, van der Mey AG. Translabyrinthine surgery for disabling vertigo in vestibular schwannoma patients. *Clin Otolaryngol.* 2007;32:167-172.
12. Godefroy WP, Kaptein AA, Vogel JJ, van der Mey AGL. Conservative treatment of vestibular schwannoma: a follow-up study on clinical and quality-of-life outcome. *Otol Neurotol.* 2009;30:968-974.
13. Breivik CN, Varughese JK, Wentzel-Larsen T, Vassbotn F, Lund-Johansen M. Conservative management of vestibular schwannoma - a prospective cohort study: treatment, symptoms and quality of life. *Neurosurgery* 2012;70:1072-1080.
14. Di Maio S, Akagami R. Prospective comparison of quality of life before and after observation, radiation, or surgery for vestibular schwannomas. *J Neurosurg.* 2009;111:855-862.
15. Park SS, Grills IS, Bojrab D, et al. Longitudinal assessment of quality of life and audiometric test outcomes in vestibular schwannoma patients treated with gamma knife surgery. *Otol Neurotol.* 2011;32:676-679.
16. Sandooram D, Hornigold R, Grunfeld B, Thomas N, Kitchen ND, Gleeson M. The effect of observation versus microsurgical excision on quality of life in unilateral vestibular schwannoma: a prospective study. *Skull Base.* 2010;20:47-54.
17. Myrseth E, Moller P, Wentzel-Larsen T, Goplen F, Lund-Johansen M. Untreated vestibular schwannomas: vertigo is a powerful predictor for health-related quality of life. *Neurosurgery* 2006;59:67-76.
18. Vogel JJ, Godefroy WP, van der Mey AGL, le Cessie S, Kaptein AA. Illness perceptions, coping, and quality of life in vestibular schwannoma patients at diagnosis. *Otol Neurotol.* 2008;29(6):839-845.
19. Robinett ZN, Walz PC, Miles-Markley B, Moberly AC, Welling DB. Comparison of long-term quality-of-life outcomes in vestibular schwannoma patients. *Otolaryngol Head Neck.* 2014;150:1024-1032.
20. Turel MK, Thakar S, Rajshekhar V. Quality of life following surgery for large and giant vestibular schwannomas: a prospective study. *J Neurosurg.* 2015;122:303-311.
21. McLaughlin EJ, Bigelow DC, Lee JY, Ruckenstein MJ. Quality of life in acoustic neuroma patients. *Otol Neurotol.* 2015;36:653-656.
22. Wangerid T, Bartek jr J, Svensson M, Förander P. Long-term quality of life and tumour control following gamma knife radiosurgery for vestibular schwannoma. *Acta Neurochir (Wien).* 2014;156:389-396.
23. Scheich M, Ginzkey C, Reuter E, Harnisch W, Ehrmann D, Hagen R. Quality of life after microsurgery for vestibular schwannoma via the middle cranial fossa approach. *Eur Arch Otorhinolaryngol.* 2014;271:1909-1916.
24. Gauden A, Weir P, Hawthorne G, Kaye A. Systematic review of quality of life in the management of vestibular schwannoma. *J Clin Neurosci.* 2011;18:1573-1584.
25. Carlson ML, Tveiten OV, Driscoll CL, et al. What drives quality of life in patients with sporadic vestibular schwannoma? [published online December 27, 2014]. *Laryngoscope.* doi: 10.1002/lary.25110.
26. Carlson ML, Tveiten OV, Driscoll CL, et al. Long-term quality of life in patients with vestibular schwannoma: an international multicenter croos-sectional study comparing microsurgery, sterotactic radiosurgery, observation, and nontumor controls. *J Neurosurg.* 2015;122:833-842.
27. Wiegand DA, Fickel V. Acoustic neuroma - the patient's perspective: a subjective assessment of symptoms, diagnosis, therapy, and outcome in 541 patients. *Laryngoscope.* 2002;99:179-187.
28. Irving RM, Beynon GJ, Viani L, Hardy DG, Baguley DM, Moffat DA. The patient's perspective after vestibular schwannoma removal: quality of life and implications for management. *Am J Otol.* 1995;16:331-337.
29. MacAndie C, Crowther JA. Quality of life in patients with vestibular schwannomas managed conservatively. *Clin Otolaryngol Allied Sci.* 2004;29:215-218.
30. Nikolopoulos TP, Johnson I, O'Donoghue GM. Quality of life after acoustic neuroma surgery. *Laryngoscope.* 1998;108:1382-1385.
31. Sandooram D, Grunfeld EA, McKinney C, Gleeson MJ. Quality of life following microsurgery, radiosurgery and conservative management for unilateral vestibular schwannoma. *Clin Otolaryngol Allied Sci.* 2004;29:621-627.
32. Tufarelli D, Meli A, Alesii A, et al. Quality of life after acoustic neuroma surgery. *Otol Neurotol.* 2006;27:403-409.
33. van Leeuwen BM, Borst JM, Putter H, Jansen JC, van der Mey AGL, Kaptein AA. Emotional Intelligence in association with quality of life in patients recently diagnosed with vestibular schwannoma. *Otol Neurotol.* 2014;35:1650-1657.
34. Wiklund I. Assessment of patient-reported outcomes in clinical trials: the example of health-related quality of life. *Fundam Clin Pharmacol.* 2004;18:351-363.
35. Valderas JM, Alonso J. Patient reported outcome measures: a model-based classification system for research and clinical practice. *Qual Life Res.* 2008;17:1125-1135.
36. Bonsaksen T, Lerdal A, Solveig Fagermoen M. Trajectories of illness perceptions in persons with chronic illness: an explorative longitudinal study. [published online October 18, 2013]. *J Health Psychol.* doi:10.1177/1359105313504235.
37. Guillemin M. Understanding illness: using drawings as a research method. *Qual Health Res.* 2004;14:272-289.
38. Craddick RA. Size of Santa Claus drawings as a function of time before and after Christmas. *J Psychol Stud.* 1961;12:121-125.
39. Broadbent E, Ellis CJ, Gamble G, Petrie KJ. Changes in patients drawings of the heart identify slow recovery after myocardial infarction. *Psychosom Med.* 2006;68:910-913.
40. Reynolds L, Broadbent E, Ellis CJ, Gamble G, Petrie KJ. Patients' drawings illustrate psychological and functional status in heart failure. *J Psychosom Res.* 2007;63:525-532.
41. Gabriels RL, Wamboldt MZ, McCormick DR, Adams TL, McTaggart SR. Children's illness drawings and astma symptom awareness. *J Asthma.* 2000;37:565-574.

42. Broadbent E, Petrie KJ, Ellis CJ, Ying J, Gamble G. A picture of health - myocardial infarction patients' drawings of their hearts and subsequent disability. A longitudinal study. *J Psychosom Res.* 2004;57:583-587.
43. Waweru SM, Reynolds A, Buckner EB. Perceptions of children with HIV/AIDS from the USA and Kenya: self-concept and emotional indicators. *Pediatr Nurs.* 2008;34:117-124.
44. Broadbent E, Niederhoffer K, Hague T, Corter A, Reynolds L. Headache sufferers' drawings reflect distress, disability and illness perceptions. *J Psychosom Res.* 2009;66:465-470.
45. Daleboudt GMN, Broadbent E, Berger SP, Kaptein AA. Illness perceptions in patients with systemic lupus erythematosus and proliferative lupus nephritis. *Lupus.* 2011;20:290-298.
46. Wang Q, Hay M, D. C, Menahem S. Adolescents' drawings of their cardiac abnormality. *Cardiol Young.* 2011;21:556-561.
47. Besser SJ, Anderson JE, Weinman J. How do osteoporosis patients perceive their illness and treatment? Implications for clinical practice. *Arch Osteoporos.* 2012;7:115-124.
48. Hoogerwerf MA, Ninaber MK, Willems LNA, Kaptein AA. "Feelings are facts": illness perceptions in patients with lung cancer. *Resp Med.* 2012;106:1170-1176.
49. Lauche R, Cramer H, Haller H, et al. My back has shrunk: the influence of traditional cupping on body image in patients with chronic non-specific neck pain. *Forsch Komplementmed.* 2012;19:68-74.
50. Lok SW, Menahem S. Children's and adolescents' understanding of their small ventricular septal defects. *Pediatr Int.* 2012;54:824-828.
51. Tiemensma J, Daskalakis NP, van der Veen EM, et al. Drawings reflect a new dimension of the psychological impact of long-term remission of Cushing's syndrome. *J Clin Endocrinol Metab.* 2012;97:3123-3131.
52. Chong J, Mackey AH, Stott NS, Broadbent E. Walking drawings and walking ability in children with cerebral palsy. *Health Psychol.* 2013;32:710-713.
53. Isla Pera P, Palacin Lois M, López Matheu C, et al. Perceptions of diabetes obtained through drawing in childhood and adolescence. *Patient Prefer Adher.* 2013;20:595-605.
54. Luthy C, Cedraschi C, Pasquina P, Uldry C, Junod-Perron N, Janssens JP. Perception of chronic respiratory impairment in patients' drawings. *J Rehabil Med.* 2013;45:694-700.
55. Hatano Y, Yamada M, Nakagawa K, Nanri H, Kawase M, Fukui K. Using drawing tests to explore the multidimensional psychological aspects of children with cancer. *Jpn J Clin Oncol.* 2014;44:1009-1012.
56. Tos T, Cayé-Thomasen P, Stangerup SE. Patients' fears, expectations and satisfaction in relation to management of vestibular schwannoma: a comparison of surgery and observation. *Acta Otolaryngol.* 2003;123:600-605.
57. Kanzaki J, Tos M, Sanna M, Moffat D, Monsell E, Berliner K. New and modified reporting systems from the consensus meeting on systems for reporting results in vestibular schwannoma. *Otol Neurotol.* 2003;24:642-649.
58. American Academy of Otolaryngology-Head and Neck Surgery Foundation I. Committee on Hearing and Equilibrium guidelines for the evaluation of hearing preservation in acoustic neuroma (vestibular schwannoma). *Otolaryngol Head Neck.* 1995;113:179-180.
59. Broadbent E, Petrie KJ, Main J, Weinman J. The brief illness perception questionnaire. *J Psychosom Res.* 2006;60:631-637.
60. Hagger MS, Orbell S. A meta-analytic review of the common-sense model of illness representations. *Psychol Health.* 2003;18:141-184.
61. Husson O, Thong MSY, Mols F, Smilde TJ, Creemers G, van de Poll-Franse LV. Information provision and patient reported outcomes in patients with metastasized colorectal cancer: results from the PROFILES registry. *J Palliat Med.* 2013;16:281-288.

62. Kaptein AA, Yamaoka K, Snoei L, et al. Illness perceptions and quality of life in Japanese and Dutch patients with non-small-cell lung cancer. *Lung Cancer.* 2011;72:384-390.
63. Zivkovic MV, Dediol I, Ljubicic I, Situm M. Sun behaviour patterns and perception of illness among melanoma patients. *J Eur Acad Dermatol Venereol.* 2012;26:724-729.
64. Rasband WS. Image J.: Bethesda, MD: U.S. National Institutes of Health. Available at: http://imagej.nih.gov.ij/; Accessed January, 2013.
65. Hinkle DE, Wiersma W, Jurs SG. *Applied Statistics for the Behavioral Sciences*. 5 th ed. Boston, MA: Houghton Mifflin; 2003.
66. Lloyd SK, Kasbekar AV, Baguley DM, Moffat DA. Audiovestibular factors influencing quality of life in patients with conservatively managed sporadic vestibular schwannoma. *Otol Neurotol.* 2010;31:968-976.
67. Ditewig JB, Blok H, Havers J, van Veenendaal H. Effectiveness of self-management interventions on mortality, hospital readmissions, chronic heart failure hospitalization rate and quality of life in patients with chronic heart failure: a systematic review. *Patient Educ Couns.* 2010;78:297-315.
68. Kaptein AA, Fischer MJ, Scharloo M. Self-management in patients with COPD: theoretical context, content, outcomes, and integration into clinical care. *Int J Chron Obstruct Pulmon Dis.* 2014;9:907-917.
69. Lorig KR, Holman HR. Self-management education: history, definition, outcomes, and mechanisms. *Ann Behav Med.* 2003;26:1-7.

5

Quality of Life in 807 patients with vestibular schwannoma: comparing treatment modalities

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ABSTRACT

Objective

In vestibular schwannoma treatment, the choice between treatment modalities is controversial. The first aim of this study was to examine quality of life in patients with vestibular schwannoma having undergone observation, radiation therapy, or microsurgical resection. The second aim was to examine the relationship between perceived symptoms and quality of life. Lastly, the association between quality of life and time since treatment was studied.

Study design and setting

Cross-sectional study in a tertiary referral center.

Methods

A total of 1208 patients treated for sporadic vestibular schwannoma between 2004 and 2014 were mailed the disease-specific Penn Acoustic Neuroma Quality of Life (PANQOL) questionnaire, and additional questions on symptoms associated with vestibular schwannoma. Total and domain scores were calculated and compared between treatment groups. Propensity scores were used and results were stratified according to tumor size to control for potential confounders. Correlations were calculated to examine the relationship between self-reported symptoms and quality of life, as well as between quality of life and time since treatment.

Results

Patients with small tumors (up to 10 mm) under observation showed a higher PANQOL score compared to the radiation therapy and microsurgical resection groups. A strong negative correlation was found between self-reported symptoms and quality of life, with balance problems and vertigo having the largest impact. No correlation was found between PANQOL score and time since treatment.

Conclusion

This study suggests that patients with small vestibular schwannomas experience better quality of life when managed with observation than patients who have undergone active treatment.

INTRODUCTION

A proportion of vestibular schwannomas exhibit rapid growth, yet the majority of tumors are slow-growing, and a significant proportion shows no detectable growth at all over a period of several years.[1-3] Observation, also known as wait-and-scan or watchful waiting, is therefore considered a safe treatment for patients with small, slow-growing tumors and a moderate display of symptoms. Other factors including age, concurrent medical risk, hearing status, and patient preference might also be taken into consideration.[2,4] However, in case of progressive growth or increasing symptoms, conversion to active treatment may be necessary.

The choice between treatment modalities is controversial and consensus is lacking, particularly for tumors smaller than 30 mm in diameter.[5-8] Over the years, studies have focused on traditional outcome measures such as tumor control, facial nerve function and hearing. Current studies comparing treatment methods are based on level 2 evidence at best, as no randomized trials on the subject have been conducted successfully.[9,10] Prospectively conducted studies comparing radiation therapy (RT) and microsurgical resection (MS) have demonstrated no major differences between these treatment modalities. Some studies have reported better short-term hearing and facial nerve outcomes for patients undergoing RT,[6,9,11] however it may take up to ten years for the effects of RT on hearing to reach its full impact.[12,13] Furthermore, to what extent these functional outcomes affect the patient's Quality of Life (QoL) is unclear.[14-17]

Because vestibular schwannoma (VS) is a benign condition, it could be argued that as survival is not the issue, QoL becomes all the more important. This is reflected in QoL having emerged as an increasingly important factor in the literature on VS treatment. Several study groups have evaluated the effect of the various treatments on patients' QoL, many using well-known, generic assessment instruments such as the Short Form-36 Questionnaire (SF-36) and the Glasgow Benefit Inventory (GBI).[9,16,18-21] Nevertheless, the use of disease-specific measures is essential for measuring small, clinically important changes caused by both the disease and its' different treatments.[22]

Until now, five study groups have used the disease-specific Penn Acoustic Neuroma Quality-of-Life (PANQOL) scale developed by Shaffer et al.[23-28] Three of these groups evaluated the QoL of patients with VS having undergone observation, RT or MS, but mostly with relatively small samples.[25,26,28] The first aim of this study was to examine the QoL of patients with VS having undergone observation, RT, or MS, according to tumor size. The second aim was to examine the relationship between perceived symptoms and QoL. Lastly, the association of QoL with time since diagnosis was studied.

METHODS

Participants

Participants were cross-sectionally recruited through a single, tertiary referral center located in the Netherlands. They were consecutively drawn from a database containing all patients at this center with VS. Patients included in the study had been diagnosed with unilateral VS and started treatment consisting either of observation, RT or MS in the period from January 2004 until January 2014. Exclusion criteria were defined as patients with skull base pathology other than VS, patients with neurofibromatosis type 2, those who had received multiple active treatments or had undergone active treatment less than one month prior to receiving the survey. Patients not proficient in the Dutch language or otherwise incapable of completing a written questionnaire were also excluded.

Materials

Penn Acoustic Neuroma Quality of Life scale (PANQOL) – Dutch version

The 26-item PANQOL scale is the only disease-specific QoL instrument for VS and was translated and validated for the Dutch population by the current study group in 2013.[24] Its seven domains comprise symptoms associated with VS: Balance, Hearing, Anxiety, Energy, Pain, Face and General wellbeing. Questions are rated on a scale from 1 *(strongly disagree)* to 5 *(strongly agree).* Internal consistency of the domains (Cronbach's alpha) was calculated to be 0.94, 0.75, 0.88, 0.91, 0.65 and 0.31 respectively (with the exception of the domain Pain, as it contains only one item).[24] A total instrument score is calculated as the unweighted average of the domain scores and reported on a scale from 0 to 100 (worst to best QoL).

Sociodemographics, symptoms and tumor characteristics

Participants also answered questions on sociodemographic characteristics comprising educational level, marital status, living situation and employment, as well as questions regarding the manifestation of symptoms associated with VS. Patients were asked to rate their hearing status, tinnitus, balance, vertigo, facial pain and facial weakness on a scale from 1 *(best imaginable)* to 5 *(worst).* A composite symptom score (cSYMP) was calculated as the unweighted average of self-reported symptom scores.

Through retrospective chart review, additional information was obtained regarding age, gender, date of diagnosis and treatment, tumor size at diagnosis, symptoms at diagnosis (reported at first consultation) and whether there was a cystic aspect to the lesion. Tumor size was measured and categorized according to the international Kanzaki consensus guidelines[29] as the largest cerebellopontine angle diameter on magnetic resonance imaging (MRI), with size small (S) comprising intrameatal and Grade 1 tumors (0-10 mm), size medium (M) consisting of Grade 2 tumors (11-20 mm) and size large (L) of tumors Grade 3 through 5 (>21 mm).

Procedure

Permission for the study was granted by the Medical Ethics Committee of the Leiden University Medical Center. Patients were mailed the questionnaires and asked to complete and return them in a postage free envelope. Patients were categorized according to their final treatment. Treatment date, used to determine time since treatment, consisted of the date of diagnosis of diagnosis for patients in the observation group. Patients were categorized in the RT or MS treatment group regardless of surgical approach or type of RT.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 21.0. Results were considered statistically significant at $p \leq 0.05$.

Treatment groups were compared regarding sociodemographic and tumor characteristics as well as symptoms at diagnosis using unpaired *t*-testing and ANOVA.

Based on the data, literature and expert opinion, gender, educational level, presence of a cystic aspect to the lesion and symptoms at diagnosis were identified as potential confounders. The probability of treatment assignment dependent on these observed confounders, the propensity score, was calculated and used in a multiple linear regression analysis to control for confounding in the comparison of the total PANQOL and domain scores for the different treatment arms.[30] Results were stratified based on tumor size according to the Kanzaki guidelines.[29] To detect possible cut-off levels for tumor size above which treatment had no further effect on QoL, a sensitivity analysis was performed stepwise, for increasing levels of tumor size.

The relationship between self-reported symptoms and QoL was examined using Pearson's correlation coefficient. This method was also used to detect a potential linear relationship between QoL and time since treatment.

Table 1. Characteristics by treatment group

						Adjusted P-value		
		OB (n=469)	**RT (n=81)**	**MS (n=257)**	**P-value**	**OB to RT**	**OB to MS**	**RT to MS**
Mean age (yrs)		63.6	60.1	57.0	<.001	.008	<.001	.042
Gender (% male)		58	53	47	.012	NS	.003	NS
Mean follow up (yrs)		4.0	2.6	4.5	<.001	<.001	.035	<.001
Tumour size (mm)		5.9	10.3	17.6	<.001	<.001	<.001	<.001
Cystic tumour (%)		9	22	41	<.001	<.001	<.001	.003
Educational level [3] (%)	*Primary education*	6	0	3	<.001	<.001	.013	.004
	(Post) secondary	61	47	65				
	Tertiary education	33	53	32				
Hearing loss >50dB (%)		58	50	58	NS	NS	NS	NS
Tinnitus (%)		76	83	83	.037	NS	.018	NS
Balance (%)		44	51	63	<.001	NS	<.001	.038
Vertigo (%)		15	22	26	.002	NS	<.001	NS
Facial nerve (%)		1.3	0	3.9	.021	NS	.021	NS

Note; OB: observation; RT: radiation therapy; MS: microsurgical resection; NS: non-significant

[3] Original survey containing equivalents from the Dutch educational system.

RESULTS

Baseline population data

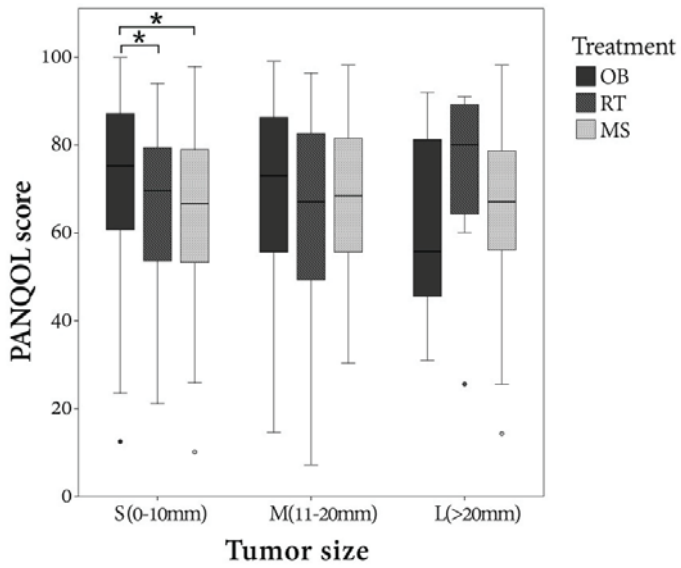
Of 1228 patients initially matching the inclusion criteria, 14 patients were excluded because they were living abroad and six patients because of incomplete or missing contact information. Out of 1208 potential participants, 919 returned the questionnaire (response rate 76%). A comparison of responders and non-responders revealed no significant differences in age, tumor size, symptoms at diagnosis and time since diagnosis. There were, however, more males among responders than non-responders (52.1% vs. 45.7%, *p = 0.049*) and more patients who had undergone surgery (31.5% vs. 23.7%, *p = 0.031*). Out of all returned questionnaires 112 were partially incomplete, rendering their total instrument score unattainable. These patients were excluded from analysis. Of the final 807 participants, 436 (54%) were male. With regard to treatment strategy, 469 (58%) patients had undergone observation, 81 (10%) RT and 257 (32%) MS. Table 1 presents sociodemographics as well as tumor characteristics and the presence of symptoms at diagnosis by treatment group.

Tumor size at diagnosis differed significantly between treatment groups, with the largest average size in the MS group. Treatment arms also differed significantly regarding educational level, with over half of the RT group having completed tertiary education as opposed to roughly one third of participants in observation and MS groups. Mean time since treatment was lowest in the RT group. Regarding symptoms at diagnosis, tinnitus, balance and vertigo were least affected in the observation group. The percentage of patients affected by severe hearing loss (>50 dB) did not differ at diagnosis, and facial nerve function was least often impaired in the RT group at diagnosis.

Treatment and QoL according to tumor size

Total PANQOL scores for the different treatment groups stratified according to tumor size are displayed in Figure 1. After correction for potential confounders, a statistically significant difference in total PANQOL score was detected for patients with small tumors (p = 0.019). Patients in the observation group had significantly higher QoL scores than patients in both RT and MS groups (b = -5.91, CI [-11.29, -0.53] and b = -4.64 CI [-8.76, -0.52] respectively). The effect was large enough to yield a significant treatment effect regardless of tumor size (p = 0.034, b = -4.70, CI [-9.05, -0.34] and b = -3.15 CI [-6.21, -0.08] for RT and MS respectively). Since the effect was statistically significant for all three categories of tumor size, we were unable to use sensitivity analyses to find a clinically relevant cut-off point for tumor size.

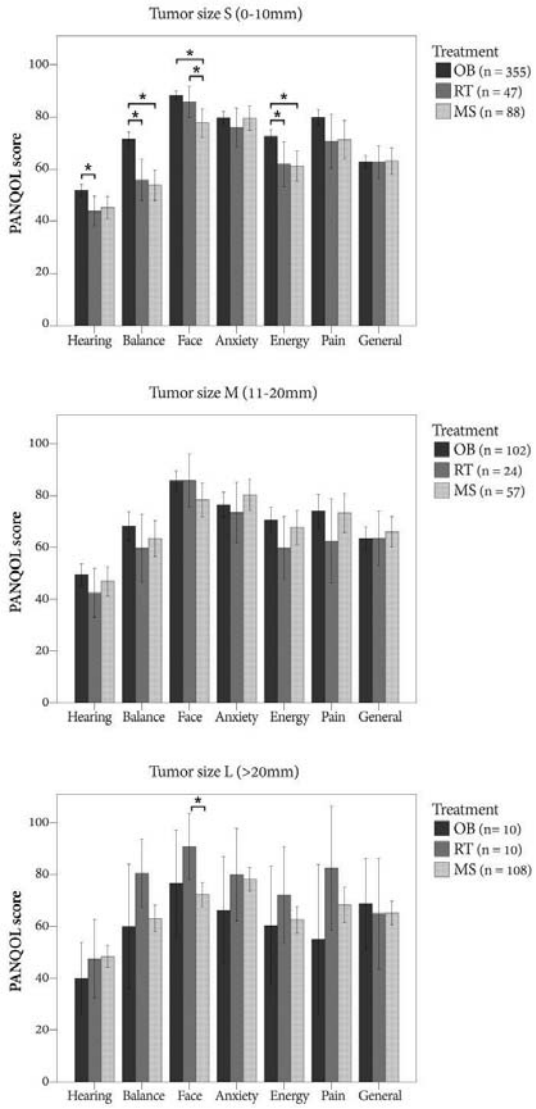
Figure 1. Mean PANQOL scores by treatment group according to tumor size.



Note; * $p \leq 0.05$, significance is shown after statistical correction; L: large, M: medium, MS: microsurgical resection, OB: observation, PANQOL: Penn Acoustic Neuroma Quality of Life scale, RT: radiation therapy, S: small.

Comparison of the PANQOL domain scores revealed statistically significant differences for patients with small tumors regarding the domains Hearing, where observation scores were higher than RT (b = -7.09, CI [-13.82, -0.36]), Balance, where observation outperformed both RT and MS (*b* = -13.75, CI [-22.03, -5.46 and *b* = -12.61, CI [-18.95, -6.27] respectively), Face, where both observation and RT performed better than MS (*b* = -8.65, CI [-13.11, -4.18] and *b* = -6.91, CI [-13.53, -4.18] respectively) and Energy, where observation scores were also higher than both RT and MS groups (*b* = -9.45, CI [-17.54, -1.36] and *b* = -7.82, CI [-14.02, -1.63] respectively). The stratified domain scores are shown in Figure 2.

Figure 2. PANQOL domain scores by treatment group for A. patients with small tumors (0-10mm), B. patients with medium sized tumors (11-20 mm), and C. patients with large tumors (>20 mm).



Note; * $p \leq 0.05$; significance is shown after statistical correction; L: large, M: medium, MS: microsurgical resection, OB: observation, PANQOL: Penn Acoustic Neuroma Quality of Life scale, RT: radiation therapy, S: small.

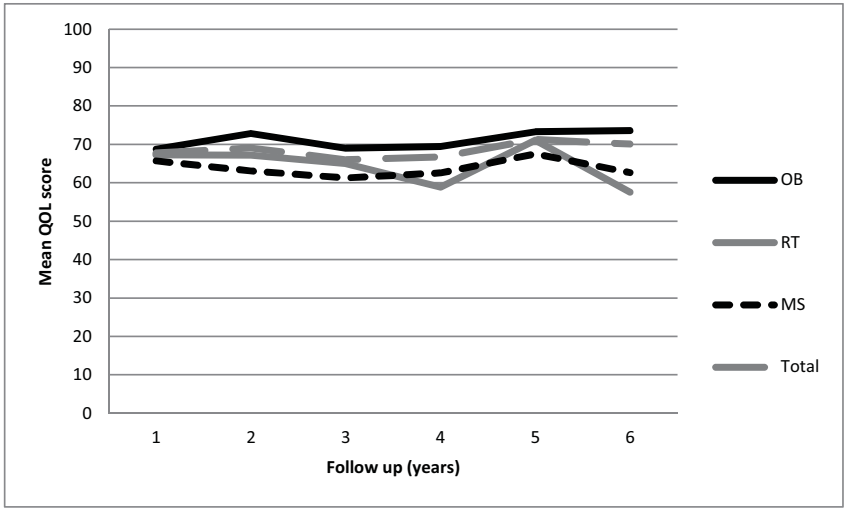
Self-reported symptoms

The relationship between self-reported symptoms and QoL was investigated using Pearson's correlation coefficient. All six symptoms were negatively correlated with the total PANQOL score. Balance problems and Vertigo proved to be most strongly correlated (r = -0.62 and -0.55 respectively, p = <0.001), however correlations with Hearing loss (r = -0.32), Tinnitus (r = -0.38), Facial nerve involvement (r = -0.30) and Trigeminal nerve involvement (r = -0.46) were also significant (p = <0.001), leading to a correlation of overall symptoms (as measured by cSYMP) and QoL of r = -0.73 (p = <0.001).

Time since treatment

To evaluate any trends in total QoL during the time after treatment, the number of years since treatment was plotted against the PANQOL score for the different treatment groups as well as for all groups combined (Figure 3). No clear pattern or significant differences between treatment groups emerged. Pearson's correlation coefficient showed no significant linear relationship between time and QoL.

Figure 3. Trends in PANQOL score by treatment group.



Note; MS: microsurgery, OB: observation, PANQOL: Penn Acoustic Neuroma Quality of Life scale, RT: radiation therapy, Total: OB, RT and MS combined.

DISCUSSION

Adequately measuring treatment outcome for patients with VS has proven to be challenging. Unfortunately, randomization does not appear to be a viable option for patients with this condition and treatment outcomes are difficult to compare due to inconsistently classified variables such as tumor size and hearing loss. Comparable treatment results on traditional endpoints such as tumor control and hearing have put the focus on patient reported outcomes in general, and QoL in particular.

The PANQOL scale has been used by two other study groups to compare long-term QoL for the three different treatment modalities.[25,28] For all dimensions, there is a high Cronbach's alpha, except for General Health (0.31). This is explained by the fact that there are only two questions about General Health in this questionnaire. Robinett et al. subdivided their study population into groups based on years of follow-up and found a statistically significant difference for the interval from one to five years, where the RT group had higher QoL scores.[25] In the study conducted by Carlson et al., both RT and observation groups had higher QoL scores compared to patients in the MS group.[28] Our study has not been able to reproduce these results and instead found a significantly better QoL for patients with small tumors (< 10 mm) undergoing observation. The current study is the first study to stratify results according to tumor size and correct for potential confounders. Nonetheless, differences in QoL were relatively small in all three studies and although statistically significant, may not be clinically relevant, as Carlson et al. demonstrated in their recent study about the minimal clinically important difference in VS QoL assessment.[31] As the minimal clinically important difference reported by Carlson et al. is only applicable to their population, and may vary by study population and clinical context, the data were not used in the current study. One cautionary remark with regard to stratification is that we used tumor size at diagnosis even though progression of the tumor could have been a reason to convert to active intervention.

When examining domain scores of the PANQOL, outperformance of the observation group compared to RT and MS in patients with small tumors was evident for the domains Balance and Energy. It could therefore be hypothesized that these domains are the areas most affected by active treatment. However, we cannot exclude the possibility that the RT and MS groups were more affected in these domains before starting active treatment. The only significant difference between the RT and MS groups was demonstrated for the subdomain Face, which is in accordance with the literature, describing 2-19% facial neuropathy in patients subjected to RT as compared to 14-29% in patients undergoing MS.[5]

A last noteworthy outcome when comparing treatment groups was the large amount of higher educated participants in the RT group, something that has not been previously published in VS literature. Previously identified predictors for choice of treatment were discipline of the attending physician, tumor size and age.[32] Research in patients with haematological malignancy has demonstrated lower educational level to be associated with a higher need for psychosocial information. That study also indicated that higher satisfaction with provided information was related to a more favorable QoL.[33] It might therefore be beneficial to further explore the relationship between educational level, information satisfaction and QoL in patients with VS.

In this study a strong correlation between PANQOL scores and self-reported symptoms was found, implying that the degree of perceived complaints is a strong indication of QoL. Significant negative correlations of varying degree were found for all reported symptoms, with balance and vertigo having the largest impact. Because of a high degree of correlation between these symptoms ($r = 0.65$, $p = <0.001$), it was not possible to adequately differentiate between these two symptoms. Other studies however, have also linked vestibular symptoms to a deterioration in QoL. There is little evidence of other symptoms associated with a change in health status as measured by the SF-36.[14-17,34] This might be attributed to the use of a generic tool, as it does not address bodily senses such as hearing.

No correlation between QoL and time since treatment was found. This is largely in line with the most recent prospective study of QoL in VS by DiMaio and Akagami (2009), in which QoL remained unchanged for both observation and RT groups throughout a mean follow-up of 31.8 months. The MS group in that study only reported a significant improvement at 24 months, after which the total score returned to baseline. The authors attributed this finding to MS patients reporting less frequently that VS affected their QoL, possibly due to a sense of definitive treatment and therefore less psychological burden.[20]

Given the uncertainty and ambivalence surrounding the evidence on traditional outcome measures, the aim of this study was to compare the association of different treatment modalities for VS with long-term QoL. The study was conducted using a cross-sectional design and it has the largest number of respondents when compared to previously reported studies using the PANQOL scale.[25,26,28] Limitations of the study include possible introduction of confounding factors (particularly confounding by indication) due to the observational design, and the non-prospective nature of the study, which prevents the inference of causality. To reduce confounding in observational studies, two general strategies can be applied.[35] One approach is to prevent confounding in the design phase of the study (e.g. by restriction or matching). This method was deemed inappropriate

because it would have severely limited the size of our treatment groups. Another method is to adjust for confounders through statistical analyses, for example by applying stratification or multivariable methods. In the current study, both stratification and a linear regression model were used to adjust the total PANQOL score for potential confounders. However, with regard to confounding by indication, this can only be completely prevented by randomization, which has proven to be impossible for patients with this condition.[9]

CONCLUSION

The findings of the current study indicate that patients with small tumors (≤ 10 mm) have a better QoL when undergoing observation compared to patients who have undergone active treatment. It has been argued that based on clinical reasoning alone, the decision not to initiate active therapy could be well defended for patients with small tumors.[2,4,36,37] Adding the outcome of the current study to the existing body of evidence only strengthens this conception as treatment is only to be justified when its outcome is more preferable than the uninterrupted progression of the disease. However, current studies examining disease-specific QoL are all cross-sectional in design, results vary and the reported differences are small and potentially clinically insignificant. To establish the superiority of one treatment over another with regard to QoL, more prospectively designed research is needed. The results of the current study can however, be of value in the communication with patients about their expectations regarding QoL after treatment and the effect that certain symptoms can have on their QoL.

REFERENCES

1. Bederson JB, von Ammon K, Wichmann WW, Yasargil MG. Conservative treatment of patients with acoustic tumors. *Neurosurg.* 1991;28:646-650.
2. Martin TP, Senthil L, Chavda SV, Walsh R, Irving RM. A protocol for the conservative management of vestibular schwannomas. *Otol Neurotol.* 2009;30:381-385.
3. Varughese JK, Breivik CN, Wetzel-Larsen T, Lund-Johansen M. Growth of untreated vestibular schwannoma: a prospective study. *J Neurosurg.* 2012;116:706-712.
4. Smouha EE, Yoo M, Mohr K, Davis RP. Conservative management of acoustic neuroma: a meta-analysis and proposed treatment algorithm. *Laryngoscope.* 2005;115:450-454.
5. Arthurs BJ, Fairbanks RK, Demakas JJ, et al. A review of treatment modalities for vestibular schwannoma. *Neurosurg Rev.* 2011;34:265-279.
6. Maniakas A, Saliba I. Microsurgery versus stereotactic radiation for small vestibular schwannomas: a meta-analysis of patients with more than 5 years' follow-up. *Otol Neurotol.* 2012;33:1611-1620.
7. Myrseth E, Pedersen PH, Moller P, Lund-Johansen M. Treatment of vestibular schwannomas. Why, when and how? *Acta Neurochir.* 2007;149:647-660.
8. Thakur JD, Banerjee AD, Khan IS, et al. An update on unilateral sporadic small vestibular schwannoma. *Neurosurg Focus.* 2012;33:E1.
9. Myrseth E, Moller P, Pedersen PH, Lund-Johansen M. Vestibular schwannoma: surgery or gamma knife radiosurgery? A prospective, nonrandomized study. *Neurosurg.* 2009;64:654-663.
10. Muzevic D, Legcevic J, Splavski B, Caye-Thomasen P. Stereotactic radiotherapy for vestibular schwannoma. *The Cochrane database of systematic reviews.* 2014:CD009897.
11. Pollock BE, Driscoll CL, Foote RL, et al. Patient outcomes after vestibular schwannoma management: a prospective comparison of microsurgical resection and stereotactic radiosurgery. *Neurosurg.* 2006;59:77-85.
12. Roos DE, Potter AE, Zacest AC. Hearing preservation after low dose linac radiosurgery for acoustic neuroma depends on initial hearing and time. *Radiother Oncol.* 2011;101:420-424.
13. Schmitt WR, Daube JR, Carlson ML, et al. Use of supramaximal stimulation to predict facial nerve outcomes following vestibular schwannoma microsurgery results from a decade of experience. *J Neurosurg.* 2013;118:206-212.
14. Wagner JN, Glaser M, Wowra B, et al. Vestibular function and quality of life in vestibular schwannoma: does size matter? *Front Neurol.* 2011;30:2-55.
15. Lloyd SK, Kasbekar AV, Baguley DM, Moffat DA. Audiovestibular factors influencing quality of life in patients with conservatively managed sporadic vestibular schwannoma. *Otol Neurotol.* 2010;31:968-976.
16. Godefroy WP, Kaptein AA, Vogel JJ, van der Mey AGL. Conservative treatment of vestibular schwannoma: a follow-up study on clinical and quality-of-life outcome. *Otol Neurotol.* 2009;30:968-974.
17. Breivik CN, Varughese JK, Wentzel-Larsen T, Vassbotn F, Lund-Johansen M. Conservative management of vestibular schwannoma - a prospective cohort study: treatment, symptoms, and quality of life. *Neurosurg.* 2012;70:1072-1080.
18. Breivik CN, Nilsen RM, Myrseth E, et al. Conservative management or gamma knife radiosurgery for vestibular schwannoma: tumor growth, symptoms, and quality of life. *Neurosurg.* 2013;73:48-57.
19. Brooker JE, Fletcher JM, Dally MJ, et al. Quality of life among acoustic neuroma patients managed by microsurgery, radiation, or observation. *Otol Neurotol.* 2010;31:977-984.
20. Di Maio S, Akagami R. Prospective comparison of quality of life before and after observation, radiation, or surgery for vestibular schwannomas. *J Neurosurg.* 2009;111:855-862.
21. Sandooram D, Hornigold R, Grunfeld B, Thomas N, Kitchen ND, Gleeson M. The effect of observation versus microsurgical excision on Quality of Life in unilateral vestibular schwannoma: a prospective study. *Skull Base.* 2010;20:47-54.
22. Patrick DL, Deyo RA. Generic and disease-specific measures in assessing health status and quality of life. *Med care.* 1989;27:S217-232.
23. Shaffer BT, Cohen MS, Bigelow DC, Ruckenstein MJ. Validation of a disease-specific quality-of-life instrument for acoustic neuroma: the Penn Acoustic Neuroma Quality-of-Life Scale. *Laryngoscope.* 2010;120:1646-1654.
24. van Leeuwen BM, Herruer JM, Putter H, Jansen JC, van der Mey AG, Kaptein AA. Validating the Penn Acoustic Neuroma Quality Of Life Scale in a sample of Dutch patients recently diagnosed with vestibular schwannoma. *Otol Neurotol.* 2013;34:952-957.
25. Robinett ZN, Walz PC, Miles-Markley B, Moberly AC, Welling DB. Comparison of long-term quality-of-life outcomes in vestibular schwannoma patients. *Otolaryngol Head Neck Surg.* 2014;150:1024-1032.
26. McLaughlin EJ, Bigelow DC, Lee JY, Ruckenstein MJ. Quality of life in acoustic neuroma patients. *Otol Neurotol.* 2015;36:653-656.
27. Carlson ML, Tveiten OV, Driscoll CL, et al. What drives quality of life in patients with sporadic vestibular schwannoma? *Laryngoscope.* 2015;125:1697-1702.
28. Carlson ML, Tveiten OV, Driscoll CL, et al. Long-term quality of life in patients with vestibular schwannoma: an international multicenter cross-sectional study comparing microsurgery, stereotactic radiosurgery, observation, and nontumor controls. *J Neurosurg.* 2015;122:833-842.
29. Kanzaki J, Tos M, Sanna M, Moffat D, Monsell E, Berliner K. New and modified reporting systems from the consensus meeting on systems for reporting results in vestibular schwannoma. *Otol Neurotol.* 2003;24:642-649.
30. Spreeuwenberg MD, Bartak A, Croon MA, et al. The multiple propensity score as control for bias in the comparison of more than two treatment arms: an introduction from a case study in mental health. *Med care.* 2010;48:166-174.
31. Carlson ML, Tveiten OV, Yost KJ, Lohse CM, Lund-Johansen M, Link MJ. The minimal clinically important difference in vestibular schwannoma Quality of Life assessment: an important step beyond *P* <.05. *Otolaryngol Head Neck Surg.* 2015;153:202-208.
32. Pogodzinski MS, Harner SG, Link MJ. Patient choice in treatment of vestibular schwannoma. *Otolaryngol Head Neck Surg.* 2004;130:611-616.
33. Rood JA, van Zuuren FJ, Stam F, et al. Perceived need for information among patients with a haematological malignancy: associations with information satisfaction and treatment decision-making preferences. *Hematol Oncol.* 2015;33:85-98.
34. Myrseth E, Moller P, Wentzel-Larsen T, Goplen F, Lund-Johansen M. Untreated vestibular schwannomas: vertigo is a powerful predictor for health-related quality of life. *Neurosurg.* 2006;59:67-76.
35. Jepsen P, Johnsen SP, Gillman MW, Sorensen HT. Interpretation of observational studies. *Heart.* 2004;90:956-960.
36. Lau T, Olivera R, Miller T, Jr., et al. Paradoxical trends in the management of vestibular schwannoma in the United States. *J Neurosurg.* 2012;117:514-519.
37. Morrison D. Management of patients with acoustic neuromas: a Markov decision analysis. *Laryngoscope.* 2010;120:783-790.

6

Physicians' recommendations on the management of vestibular schwannoma and correspondence to final treatment choices

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ABSTRACT

Objectives

Often, there is no best management for vestibular schwannoma. This study aimed to determine a) physicians' recommendations for management, b) the considerations thereof, and c) how often physicians' recommendations and final treatment choice were identical.

Study design

Retrospective chart review in a tertiary referral center.

Methods

Participants were diagnosed at, or referred to, our referral center from January 2008 until February 2015. The physicians' recommendation, the considerations thereof, and the treatment received were obtained from the multidisciplinary meeting records and the patients' clinical charts.

Results

The study group consisted of 790 patients diagnosed with vestibular schwannoma. Observation was recommended in 514 patients (65%), active intervention in 222 patients (28%), and in the remaining 7% both active intervention and observation were recommended as reasonable options. The main reasoning for these recommendations was the initial size or the progression of the tumor. The recommendation for observation was complied with in 94.9% of the patients, for radiation therapy in 79.5%, and for microsurgical resection in 81.3%. If both active intervention and observation were optional, the majority of the patients remained under observation. In case active intervention was deemed necessary, about 39% of the patients underwent radiation therapy and about 50% underwent microsurgical resection.

Conclusion

There is often no single recommendation for the management of vestibular schwannoma, especially in case of a medium-sized tumor. The recommendation for observation is complied with in the majority of the patients, and that for active intervention less often. It is unclear what determines the final decision for treatment.

INTRODUCTION

The majority of vestibular schwannomas (VS) are slow-growing tumors of the vestibulocochlear nerve with a benign character.[1] There are three different modalities in the management of VS; observation (also called watchful waiting or wait-and-scan), radiation therapy (RT) and microsurgical resection (MS). These three modalities each have their own advantages, but may also have adverse consequences for the patient. For small tumors, for elderly patients and for patients who are unfit for invasive treatment, observation is usually recommended because it has proven to be a safe option and the risks of active intervention (RT or MS) could be serious.[2-4] For tumors >30 mm the most reasonable option in the majority of patients is MS, since there are limitations to the size of VS that is still suitable for RT, and waiting (observation) could increase the risk of more serious problems, due to brainstem compression or mass effect as a result of further tumor progression.[3,5,6] In contrast, in cases with medium-sized tumors, both RT and MS, but also observation, are often reasonable options from a medical perspective.[3,7-9]

In clinical situations where more than one management strategy is valid, such as with medium-sized VS, it is recommended to involve patients in the treatment decision making through a shared decision making process. The physician is the expert on the best available evidence and clinical implications of possible management options, and the patient is the expert on his/her own expectations and preferences.[10,11] Integrating both types of information helps in making a decision on the 'best management' for each individual patient.

Up to now it is unclear to what extent shared decision making occurs in patients with VS. Two studies assessed satisfaction with, versus determinants for, treatment choice in patients with VS.[12,13] Hudgins et al.[12] conducted a survey in patients who underwent RT or MS to evaluate their satisfaction with either procedure, and assess which management patients prefer. The results favoured RT for almost all outcomes assessed (death, major complications, permanent facial weakness, residual tumor or recurrent growth, and preservation of useful hearing). Pogodzinski et al.[13] retrospectively studied determinants of the final treatment modality, and concluded that it was associated with age, tumor size and which specialists the patient had consulted. MS was positively correlated with younger age and larger tumors. Choice for observation was more often seen in patients with tumors <10 mm, patients older than 65 years, patients with severe hearing loss, or patients who had one or more comorbidities. When patients were only counseled by an otolaryngologist, the majority (84%) underwent observation. When only counseled by a radiation oncologist, almost all patients underwent RT. When patients were counseled by

several physicians about observation, RT and MS, 10% chose observation, 30% chose RT, and 60% chose MS. The current study elaborates on these results by determining physicians' management recommendations and reasoning.

To date, there is little insight into how often physicians recommend one or the other management modality, and the consideration of physicians thereof. Similarly, little is known about possible divergences between physicians' recommendations and the final treatment choice. Gaining insight into physician's consideration will help in understanding the grounds for their recommendation and in what cases physicians' recommendations are not likely to be complied with in the final treatment choice. This study aimed to determine a) physicians' recommendations for management, b) the considerations for these recommendations, and c) how often physicians' recommendations and final treatment choice were identical.

METHODS

Participants

Participants consisted of all patients diagnosed with VS at the Leiden University Medical Center, or referred to this tertiary center, between January 2008 and February 2015. They were consecutively drawn from a database containing all patients at this center with VS. Patients with neurofibromatosis type 2 were excluded.

Materials

Through retrospective chart review, patient age and gender, tumor characteristics, hearing quality and other symptoms related to the VS were collected. The physicians' recommendation for observation or active intervention (RT or MS), the consideration for the recommendation, and the recommendation for specifically RT or MS were obtained from the records of a multidisciplinary meeting of the tertiary referral center, and the patients' clinical charts.

Procedure

Permission for this study was granted by the local Medical Ethics Committee. Tumor size was measured and categorized according to the international Kanzaki consensus guidelines[14] as the largest extracanalicular diameter of the VS on magnetic resonance imaging (MRI). For this study, a distinction was made in intracanalicular, small (grade 1, <11 mm), medium (grade 2, 11-20 mm) and large tumors (grade 3 through 5, >20 mm). Hearing quality was classified according to the classification system of the Committee on Hearing and Equilibrium.[15] Class A is defined as normal hearing, Class B as moderate hearing loss, and Class C and D as severe hearing loss. The patients were all discussed in a multidisciplinary meeting, and afterwards informed about the optional managements in their specific case. A radiation oncologist informed patients about RT, and an otorhinolaryngologist (small and medium-sized tumors treatable with translabyrinthine approach) or neurosurgeon (medium and large-sized tumors in which retrosigmoid or middle cranial fossa approach is expected) about MS.

Statistical Analyses

Frequencies were calculated using the Statistical Package for the Social Sciences (SPSS version 21.0 for Windows). Means and standard deviations were calculated. Correlations between patients' age and treatment were analyzed using Pearson's correlation coefficients. Patient characteristics and tumor characteristics of the RT group and MS group were compared using independent *t*-tests. Results were considered statistically significant at $p \leq 0.05$.

Table 1. Frequency of patient and tumor characteristics by treatment recommendation.

Treatment indication	No	Yes	Optional
	N=514	N=222	N=54
Mean age, years (range)	59.8 (26-88)	54.2 (18-83)	55.9 (26-85)
Male gender, %	55.4	44.1	55.6
Tumor size and aspect at diagnosis, %			
Intracanalicular	52.3	14.0	31.5
Small (<11 mm)	29.4	29.3	20.4
Medium (11-20 mm)	16.7	20.7	29.6
Large (>30 mm)	1.6	36.0	18.5
Hearing quality, %			
Class A, normal hearing (<30 dB)	19.3	21.5	25.0
Class B, moderate hearing loss (30-50 dB)	24.8	25.1	30.8
Class C or D, severe hearing loss (>50 dB)	55.3	53.4	44.2
Symptoms (patients could report > 1 symptom), %			
Tinnitus	76.8	82.9	74.1
Balance disorders	47.5	57.7	57.4
Vertigo	18.0	23.6	22.2
Cranial nerves dysfunction, %			
Trigeminal nerve (N V) affected	3.7	17.6	13.0
Facial nerve (N VII) affected	1.2	2.3	0
Trigeminal and facial nerves not affected	95.1	82.4	88.9

Note: OB: observation; RT: radiation therapy; MS: microsurgical resection

RESULTS

Patient characteristics and treatment indication

Seven hundred and ninety patients were included in the study group. Overall, the patients were 58 (SD= 12.3, range 18-88) years old and 52.3% were male. Table I lists the patients' characteristics by physicians' treatment indication. As can be seen from Table I for the majority of the patients there was no treatment indication, and therefore observation was recommended (N=514; 65%). An indication for active intervention was given to 222 patients (28%), including 119 patients in whom both RT and MS were presented as reasonable options, in the other 103 patients there was a preference for one of the two active treatments. For a minority of patients, there was no strict treatment indication, and either observation or active treatment was offered as a plausible option (N=54; 7%). There were significantly fewer men in whom a treatment indication was given. Results from the current study additionally show that in cases of facial nerve dysfunction or trigeminal nerve dysfunction often active intervention is recommended.

Considerations for treatment recommendation

Table 2 shows the considerations that were recorded for the treatment indication. The small size of the tumor was the foremost argument for physicians to recommend

Table 2. Frequency (%) of reasoning for the physicians' treatment indication.

Treatment indication	No N=514	Yes N=222	Optional N=54
Reasoning for treatment choice			
Tumor size: IC or small	80.7	-	-
Tumor size: medium or large	16.9	34.7	24.1
Progression of tumor	-	54.1	40.7
Progression of tumor and symptoms	-	6.8	-
(progression of) Symptoms	-	4.1	9.3
Age: old patient	1.0	-	-
Age: young patient	-	0.5	-
Good hearing	0.8	-	25.9
Long history of symptoms	0.6	-	-

Note: IC: intracanalicular; OB: observation; RT: radiation therapy; MS: microsurgical resection; -: not given as argumentation in this group

observation. Interestingly enough, age was seldom mentioned as an argument to refrain from active intervention. However, a significant correlation was found in which independently of the size of the tumor, with increasing age more often observation was recommended. The main argument to recommend an active intervention was either the larger size of the tumor, or progression of the tumor. Other patients were told that both active intervention and observation might be a good option. The most frequently stated considerations for this advice were the larger size of the tumor, progression of the tumor, or good hearing status, aiming at hearing preservation with a surgical middle fossa approach.

Correspondence between treatment recommendation and final decision

In Table 3 the patients are ordered according to the treatment they eventually received. In this Table the recommended management is given. There were also groups of patients in whom more than one management option was plausible. Physicians' recommendations were complied with less often in patients who underwent one of the active interventions than in patients who remained under observation.

In 514 patients, observation was the only recommended management option, and of this group indeed 94.9% of the patients remained under observation. If either RT or MS were recommended, this advice was complied with by 79.5% and 81.3% of the patients respectively. In 119 patients, according to the physicians there was a treatment indication with a choice between RT and MS. Of this group 11.8% of the patients still remained under observation, 38.7% underwent RT and 59.6% underwent MS. In 54 patients, either one or two active interventions as well as observation were seen as a reasonable management option. Of these patients 64.8% opted for observation, and the other patients underwent one of the two active interventions (RT or MS).

In the group of patients in which both RT and MS were considered reasonable (n=119), a more detailed analysis was done with the aim of investigating whether there were significant differences between the patients in this group who underwent RT and the patients who underwent MS. This analysis showed that the age of the patients who underwent RT was significantly higher compared to the patients who underwent MS. In addition, there was an unequal distribution in gender, with significantly more women in the MS group. For the other patient characteristics, as well as tumor characteristics, as shown in Table 1, no differences between the two active treatment groups were found.

Table 3. Frequency (%) of recommended management by treatment undergone.

Received treatment		OB	RT	MS
		N=537	N=115	N=138
Recommended management	OB (514)	94.9	3.5	1.6
according to physicians, (n) %	RT (39)	-	79.5	20.5
	MS (64)	-	18.8	81.3
	OB / RT (6)	50.0	33.3	16.7
	OB / MS (19)	89.5	-	10.5
	RT / MS (119)	11.8	38.7	49.6
	OB / RT / MS (29)	51.7	20.7	27.6

Note: OB: observation; RT: radiation therapy; MS: microsurgical resection

DISCUSSION

In approximately 25% of the patients with VS there is more than one medically reasonable management option. As a starting point to support the implementation of shared decision making it is relevant to identify physicians' considerations for recommending or not recommending observation or active intervention in patients with VS. The aim of the current study was to determine which management options (observation, RT or MS) physicians recommend in patients with VS, and based on what reasoning. In addition, we were interested in whether the actual treatment received by patients corresponded with this recommendation.

As expected, in the majority of patients who had been diagnosed with VS, observation was both the most frequent recommended option as well as the most common final management. The current study shows that in our center tumor size is the main argument in deciding whether or not to recommend active intervention. In particular for small tumors, physicians often recommend observation. This is a very common recommendation worldwide as these tumors pose no health threat and active treatment poses a risk of injury. The patients in whom physicians advise to start active intervention generally have a larger tumor, or the tumor is progressing. Tumor size determines in general whether or not there is a risk of serious complications due to mass effect, which is an indication for the need to start active treatment.

It is remarkable that a treatment indication is significantly more often given to women. According to the current study, a treatment indication is mainly given to patients with a large tumor, this might be explained by women being more likely to have a large tumor. In literature, little is known about differences in tumor size by gender. In an earlier published study the opposite was found. In that study it was found that in the age group younger than 40 years, men had larger tumors than women. For patients over 40 years no differences in size of the tumor were found.[16] More research seems necessary to draw conclusions here.

A statistically significant correlation was found between patients' age and treatment, whereby independent of the size of the tumor, with increasing age observation was more often complied with. Although it was not given as a recommendation in this study, in our physicians' opinion patients' age could indeed be an important argument in the choice of a particular treatment. Seniority may be an argument in the advice of observation, especially if the patients' history of complaints is longer, suggesting that the tumor has been present for a long time and is growing slowly. In a young patient with an indication for active intervention physicians in our clinic are inclined to recommend MS in order to prevent further morbidity caused by the VS. Physicians in our center usually do not advise RT in young patients because evidence on long term consequences, such as tumor induction, of this modality in patients with VS is still lacking. In contrast, RT is more often advised in elderly patients because often co-morbidities may be a contraindication for MS in these patients, and the effects of RT in the short term are well-known and because of their shorter life expectancy, long-term effects are less relevant. There are some studies available regarding this issue with a maximum follow-up of about 10 years after RT. During this follow-up period no patients have developed delayed malignant transformation or a new radiation induced tumor.[17] In case of good tumor control during the first five years after treatment, no patient developed tumor recurrence or underwent further treatment.[i.e. 17,18] Possibly we could not find recommendations corresponding to this opinion in the current study because mostly patients' age is not the only or most important reason to recommend one or the other treatment. Consequently, considerations around patients' age may not always be noted in the records of the multidisciplinary meeting or the clinical chart.

In recommendations on the choice of treatment, the patients' symptoms are often used. For example, this could apply to hearing status. In cases of normal hearing physicians prefer to preserve this hearing, which may be a consideration to opt for observation or RT in patients with tumors that are too large for a surgical middle fossa approach. In general hearing preservation seems impossible with a translabyrinthine approach, although there are few published case reports since 1991 in which patients retain useful hearing after a

modified labyrintectomy.[19-21] A small tumor with cerebrospinal fluid in fundus is sometimes the argument to recommend RT or a surgical middle fossa approach, also with the aim of maintaining hearing. Balance problems can on the other hand be an argument to opt for MS since these complaints frequently improve after translabyrinthine surgery, and RT has no effect on it.

Another remarkable finding is that in more than half of the patients with an indication for active intervention, the physicians did not express a preference for RT or MS. In our center, these patients were informed about both RT, by a radiation oncologist, and MS, by an otorhinolaryngologist (small- and medium-sized tumors treatable with translabyrinthine approach) or neurosurgeon (medium- and large-sized tumors in which retrosigmoid or middle cranial fossa approach is expected). Of these patients approximately 11% of the patients remained under observation, approximately 39% underwent RT and 50% underwent MS. It is remarkable that there are so many patients who have to choose between the two active interventions, because there seems to be no medical preference for either one of the two treatments. The slight majority who in the end underwent MS possibly has to do with the focus on MS of our center, in which RT has been offered since 2006 compared to 1995 for MS. Striking is that if there is a treatment indication in which RT and MS both were considered reasonable, significantly more women than men eventually undergo MS. A proper explanation cannot be given for this. Also, the patients who ultimately choose RT are generally older than the patients who choose MS. A plausible explanation appears to be that the general idea is that it is more invasive to undergo MS than RT, and therefore patients prefer not to undergo surgery in old age.

If observation was recommended, this recommendation was complied with by the majority (94.9%) of the patients. For the active treatments, these percentages are lower, but still about 80% of patients will comply with the advice of their physicians. If both observation and active intervention were reasonable options according to physicians, more than half of these patients (64.8%) choose observation. According to this finding, it seems likely that it is easier for patients to comply with the physicians' recommendation when it comes to observation. When it comes to active intervention patients sometimes seem to be more cautious, and as a result in the active intervention groups less patients complied with the advice of their physician compared to patients to whom observation was recommended. Moreover, there are patients who were recommended observation who nevertheless underwent RT or MS.

The considerations why patients underwent another treatment than recommended by the physicians have not been recorded in the clinical chart and were therefore untraceable

with our study design. Apparently, the preference of the patient regarding the treatment is of importance in order to come to the best decision, and it would be interesting to examine their considerations. To gain more insight here, it will be important to understand the reasoning of why the final treatment differs from the physicians' recommendation which should be written in the clinical chart. This also applies to the arguments to choose for observation, RT or MS when more than one option was possible according to the physicians.

The main limitation of the present study is that it was a chart study. This makes it impossible to determine any reason for choosing one or the other option, and in particular what the patient's role was in the final decision for treatment, if this was not recorded in the medical chart.

According to our daily practice, the final treatment choice can be perceived as almost an impossible task to most patients. Findings from this study make it clear that patients often have to choose between RT and MS. In our experience, conversations about treatment options are time-consuming, which probably has to do with the difficulty of this choice. It seems appropriate to give guidance to patients in making this decision.

We propose that in order to improve the decision making process for patients, and to facilitate shared decision making, it is important to develop a decision aid. This is expected to support the physician-patient communication and might facilitate patients in making an informed choice, which we expect, will contribute to a better quality of life.

CONCLUSION

In many cases physicians do not have a clear recommendation to patients with VS for one or the other treatment option, but consider more than one option as medically reasonable. This is especially the case in patients with medium-sized tumors. The physicians' treatment recommendation does not always correspond to the final treatment choice, suggesting that other factors are of importance in determining the final decision for treatment. The role of patients' preferences in final decisions deserves further study.

REFERENCES

1. Pollock BE, Driscoll CL, Foote RL, et al. Patient outcomes after vestibular schwannoma management: a prospective comparison of microsurgical resection and stereotactic radiosurgery. *Neurosurg.* 2006;59:77-85.
2. Brooker JE, Fletcher JM, Dally MJ, et al. Quality of life among acoustic neuroma patients managed by microsurgery, radiation, or observation. *Otol Neurotol.* 2010;31:977-984.
3. Myrseth E, Pedersen PH, Moller P, Lund-Johansen M. Treatment of vestibular schwannomas. Why, when and how? *Acta Neurochir.* 2007;149:647-660.
4. Bederson JB, von Ammon K, Wichmann WW, Yasargil MG. Conservative treatment of patients with acoustic tumors. *Neurosurg.* 1991;28:646-650.
5. Hasegawa T, Kida Y, Kobayashi T, Yoshimoto M, Mori Y, Yoshida J. Long-term outcomes in patients with vestibular schwannoma treated using gamma knife surgery: 10-year follow up. *J Neurosurg.* 2005;102:10-16.
6. Arthurs BJ, Fairbanks RK, Demakas JJ, et al. A review of treatment modalities for vestibular schwannoma. *Neurosurg Rev.* 2011;34:265-279.
7. Boari N, Bailo M, Gagliardi F, et al. Gamma knife radiosurgery for vestibular schwannoma: clinical results at long-term follow-up in a series of 379 patients. *J Neurosurg.* 2014;121 Suppl:123-142.
8. Kaylie DM, Horgan MJ, Delashaw JB, McMenomey SO. A meta-analysis comparing outcomes of microsurgery and gamma knife radiosurgery. *Laryngoscope.* 2000;110:1850-1856.
9. Godefroy WP, van der Mey AGL, de Bruine FT, Hoekstra ER, Malessy MJA. Surgery for large vestibular schwannoma: residual tumor and outcome. *Otol Neurotol.* 2009;30:629-634.
10. Elwyn G, Laitner S, Coulter A, Walker E, Watson P, Thomson R. Implementing shared decision making in the NHS. *BMJ.* 2010;341:c5146.
11. Stiggelbout AM, van der Weijden T, de Wit MPT, et al. Shared decision making: realy putting patients at the centre of healthcare. *BMJ.* 2012;344:e256.
12. Hudgins WR. Patient's attitudes about outcomes and the role of gamma knife radiosurgery in the treatment of vestibular schwannomas. *Neurosurg.* 1994;34:459-463.
13. Pogodzinski MS, Harner SG, Link MJ. Patient choice in treatment of vestibular schwannoma. *Otolaryngol Head Neck.* 2004;130:611-616.
14. Kanzaki J, Tos M, Sanna M, Moffat D, Monsell E, Berliner K. New and modified reporting systems from the consensus meeting on systems for reporting results in vestibular schwannoma. *Otol Neurotol.* 2003;24:642-649.
15. American Academy of Otolaryngology-Head and Neck Surgery Foundation I. Committee on Hearing and Equilibrium guidelines for the evaluation of hearing preservation in acoustic neuroma (vestibular schwannoma). *Otolaryngol Head Neck Surg.* 1995;113:179-180.
16. Harun A, Agrawal Y, Tan M, Niparko JK, Francis HW. Sex and age associations with vestibular schwannoma size and presenting symptoms. *Otol Neurotol.* 2012;33:1604-1610.
17. Hasegawa T, Kida Y, Iizuka H, Kuramitsu S, Yamamoto T. Long-term safety and efficacy of sterotactic radiosurgery for vestibular schwannomas: evaluation of 440 patients more than 10 years after treatment with Gamma Knife surgery. *J Neurosurg.* 2013;118:557-565.
18. Roos DE, Potter AE, Bophy BP. Sterotactic radiosurgery for acoustic neuromas: what happens long term? *Int J Radiat Oncol Biol Phys.* 2012;15:1352-1355.
19. McElveen JT Jr, Wilkins RH, Erwin AC, Wolford RD. Modifying the translabyrinthine approach to preserve hearing during acoustic tumour surgery. *J Laryngol Otol.* 1991;105:34–37.
20. Springborg LK, Springborg JB, Thomsen J. Hearing preservation after classical translabyrinthine removal of a vestibular schwannoma: case report and literature review. *J Laryngol Otol.* 2007;121:76–79.
21. Ahsan SF, Bojrab D Jr, Standring R. Partial hearing preservation after translabyrinthine vestibular schwannoma resection: case report and review of the literature. *J Neurol Surg Rep.* 2015;76:e211-215.

7

General discussion and conclusion

INTRODUCTION

In this thesis, aspects of the Quality of Life (QoL) in patients with a vestibular schwannoma were explored. From literature on QoL in patients with vestibular schwannoma it is known that their QoL is diminished from the moment of the diagnosis.[1-9] Determinants which impact the QoL have been researched to a considerable extent, although there are still quite a few determinants left to explore.[3,10-17] Furthermore, there are many studies in which different treatments for vestibular schwannoma (observation, radiation therapy, and microsurgical resection) are described, although little is known about the long-term effect of each of these treatments on the QoL of patients. Finally, little is known about the decision making process regarding decision strategies by physicians about the treatment of these patients, and the role of the patient in the final choice of treatment.

The first aim of the study was to develop a disease specific QoL questionnaire for patients with vestibular schwannoma as a tool to measure QoL more specifically, independent of other factors (i.e., comorbidities) which may affect QoL. The second goal was to examine determinants of QoL in these patients. In this thesis emotional intelligence was described, as well as illness perceptions, as two potential determinants of QoL. It was attempted to measure illness perceptions by means of patients' drawings. The impact of both determinants on the QoL was described. Thirdly, the difference in QoL overtime in patients treated with observation, radiation therapy or microsurgical resection was examined. Finally, it was attempted to acquire more insight in the decision making process in a patient sample in an university medical centre in the Netherlands.

In the first paragraph of the text to follow, the main findings regarding each aim of this thesis are reported. In the second paragraph, the clinical relevance is discussed. Suggestions for future research are given in the third paragraph. Finally, a number of concluding remarks are provided in the last paragraph.

MAIN FINDINGS OF THIS THESIS

First aim

Development of a disease specific QoL *instrument*

QoL can be measured with (a) generic, (b) disease-specific, and (c) domain-specific measures. In QoL research, it is of additional value to use a disease-specific and domain specific questionnaire, instead of solely a generic questionnaire. With a disease-specific and domain-specific questionnaire the QoL, directly associated with the disease, is investigated. Possible influences of other diseases (i.e., comorbidity) that may affect QoL are disregarded. In the current study, the well-designed disease specific QoL questionnaire, the Penn Acoustic Neuroma Quality of Life scale, the PANQOL, developed and validated in the United States of America (USA) was used. To our knowledge, no other disease-specific QoL questionnaires for patients with vestibular schwannoma are available today. For the use of this questionnaire (in English) in the patient population of our clinic, where the studies were performed, it was necessary to translate it into Dutch. Yet, in the present study, compared to the USA study, the same distribution of questions on the different dimensions was found.[1-3,18] As described in Chapter 2, almost all of these studies have been using a generic questionnaire to assess QoL, such as the Short Form-36 Questionnaire. Although that questionnaire gives a good first impression of the QoL, it is - by definition - not specifically aimed at examining the specific condition of a vestibular schwannoma. Therefore, this thesis contributes to the current knowledge of the QoL of patients with vestibular schwannoma, by creating a validated disease-specific QOL measure in Dutch, whereby also with a disease-specific questionnaire a reduced QoL was found.

Second aim

Determinants of QoL

Since it is known that the QoL of patients with a vestibular schwannoma is diminished compared to patients with other chronic illness, it is interesting to know which factors, also referred to as determinants, are responsible for these differences. There have been many studies about determinants of QoL, also in this specific patient group.[3,10-15] However, there are also determinants which have not been researched, such as emotional intelligence. Illness perceptions as a potential determinant of QoL, have been examined previously in this patient group.[3] Drawings of the illness made by patients, which is an emerging field of research, were not used in order to measure illness perceptions before. In patients with a vestibular schwannoma, research with drawings made by patients was only used in a pilot.[19] The studies in this thesis, in which in addition to the measurement of illness perceptions via drawings of patients, emotional intelligence was investigated, contributes to the understanding of determinants of the QoL of patients with a vestibular schwannoma.

Third aim

Trajectories of QoL

A substantial number of studies have been published on the QoL of patients with a vestibular schwannoma after the three possible treatment modalities (observation, radiation therapy or microsurgical resection). However, only recently there became focus

on the long term effects of these treatments on the QoL.[20-22] To our knowledge, the study on the long term effects of these treatments on the QoL has never been done to such a large extent as the study presented in this thesis. The results are comparable to the other studies on this subject; patients with small tumors (< 10 mm) have a better QoL when undergoing observation compared to patients who have been subjected to active treatment for a tumor about the same size. Other reported differences are small and potentially clinically insignificant.

Fourth aim

Decision making process

An emerging research topic in modern medicine is shared decision making. To our knowledge no research on shared decision making has been done yet in patients with vestibular schwannoma. Physicians who are involved in treatment decisions about vestibular schwannoma need to make choices but may use different criteria. That is, often there are no clear cut off points to decide which treatment modality suits the patient best. As far as we know, the reasons physicians give to recommend one or the other treatment have not been investigated before. Also, there is little evidence on how decisions are made in current, routine clinical practice. The study in this thesis provides insight into how decisions in our clinic, where the studies were performed, are currently made. This is a first step towards the assessment and implementation of shared decision making with patients with vestibular schwannoma.

CLINICAL RELEVANCE

First aim

Development of a disease specific QoL *instrument*

In modern medicine QoL has become an important outcome measure. The Penn Acoustic Neuroma Quality of Life scale (PANQOL) is an easy understandable and short questionnaire about QoL, related to vestibular schwannoma. With this questionnaire it becomes possible to measure the QoL of these patients, related to their vestibular schwannoma. This tool is useful in daily practice but also for research. The translation of this tool in Dutch makes it possible to use it in the Dutch-speaking countries and facilitates research and clinical applications in this geographic area.

Second aim

Determinants of QoL

Because it is known that QoL is diminished in patients with vestibular schwannoma, it is interesting to know the factors (determinants) that are responsible for this observation. These determinants would be helpful in clinical practice as well. In this thesis it becomes clear that emotional intelligence has a significant impact on the QoL of patients with vestibular schwannoma. In other words, patients who indicate they are struggling to deal with their emotions in everyday life are at risk off a greater impact on their QoL when receiving the diagnosis vestibular schwannoma. If physicians are informed about the emotional intelligence of patients they could anticipate onto this by providing extra assistance in dealing with the diagnosis. For patients with a lower emotional intelligence, for example, it could be helpful to discuss their feelings about the diagnosis with a professional who can provide advices to regulate these feelings better. Another important finding in this thesis concerned illness perceptions. Patients with vestibular schwannoma turn out to exhibit a quite low level of 'coherence' (have little understanding) of their illness. Probably this is due to the (lack of) clarification of the illness by the physicians. Moreover, in the study it is found that patients with vestibular schwannoma are very concerned about their illness, and in general, experience a lot of symptoms. This study is an eye opener in that it is important to check patients' understanding of the given information and, if necessary, try to inform them better in another way. Probably this will also reduce the degree of concern of patients.

Third aim

Trajectories of QoL

It is important to be aware of the level of QoL in patients with VS after they have been treated. Including the current study group, three research groups investigated the long term effects of treatment on QoL in patients with vestibular schwannoma.[23-25] The current study is the first study to stratify results according to tumor size to correct for potential confounders. Besides, it is the study with the largest patient group up to now. In one of the studies better QoL in patients treated with radiation therapy or observation was found, compared to patients treated with microsurgical resection.[17] In the current study a significantly better QoL for patients with small tumors (< 10 mm) undergoing observation was found. Differences in QoL were relatively small in all three studies and although statistically significant, may not be clinically relevant. Since there are many patients in whom, from a medical perspective, there is no preferred treatment, it seems important that the patient is made a participant in deciding which treatment modality will be used. In other words, it seems there is no significant difference in QoL results over time,

regardless of treatment modality chosen. So the most important part is that the patient is a participant in the choice of treatment, augmenting the possibility of a sense of satisfaction about the final choice.

Fourth aim

Decision making process

In the literature, there is increasing emphasis on the need to involve patients in treatment decisions, as a means to provide patient centred care.[26,27] The ultimate goal is that a patient can make a decision about treatment in consultation with the physician, especially when two or more treatment options are medically equivalent. In vestibular schwannoma this is often the case, which makes it a very suitable case to implement shared decision making. The study presented in this thesis contributes to our knowledge of current decision making in clinical practice. This might help in the development of a decision aid to promote the actual occurrence of shared decision making.

FUTURE PERSPECTIVE

During conducting this research, many new research plans emerged. First, it would be interesting to examine other determinants of QoL in this specific group of patients. These determinants give insight into factors that are important for the QoL of patients with vestibular schwannoma. Examples of determinants which have not been researched and could be interesting in this group of patients could be body image, personality and social economic status.

Second, it would be helpful for patients to search for possibilities to develop a self-management program for patients with vestibular schwannoma. This program may for example include (a) techniques to deal with symptoms (i.e., hearing loss, unsteadiness, tinnitus, facial complaints) caused by the vestibular schwannoma, (b) techniques to deal with emotions (i.e., grief, frustration, anxiety, isolation) caused by the diagnosis, (c) techniques to deal with the daily decision-making concerning the effects of the chronic illness (i.e., maintaining social contacts despite hearing loss, go outside despite unsteadiness), (d) techniques to deal with decision-making concerning the treatment, (e) techniques how to find proper information about vestibular schwannoma, (f) techniques for effective communication with family, friend and physicians.[28]

Another topic for future research includes shared decision making. In Chapter 5 of this thesis, this term was briefly discussed. Vestibular schwannoma is a good example in this respect, because there are often several treatment modalities available, without one

modality being superior to another from a medical perspective. It is expected that in the future, physicians will become educators of the patient, who then can consider the advantages and disadvantages of treatments, based on the given information about the illness. During the consultation with the physician, the preferences of the patient will be explicitly included in making a treatment choice. The physicians and the patient will decide together which management is 'the best treatment option' depending on the clinical situation and the personal needs and preferences of the patient. Results from the current study underline the importance to develop a patient decision aid (in example an option grid or issue cards) to support patients in the best possible way in making this very difficult decision.

A fourth suggestion is to conduct future research on QoL of this patient group on a prospective basis. The best method theretofore would be a randomized controlled trial. In this way, more can be said about the causality of associations which are found.

A final suggestion is to look into possibilities of further development of pharmacological therapy, which will help to reduce the need for surgical and radio therapeutic treatment in the future. Possibly, the choice of treatment in this patient group can be facilitated by the introduction of pharmacological therapies, and therefore development in this area deserves attention.

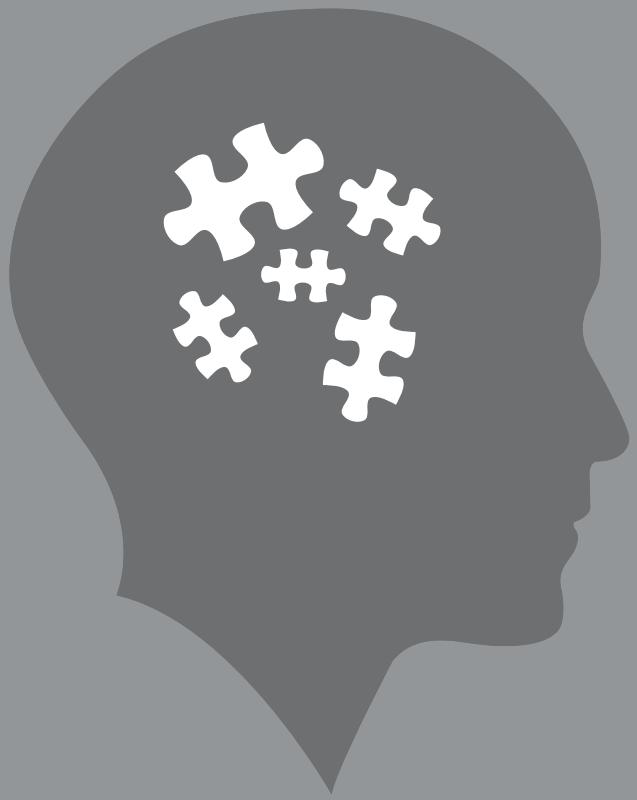
CONCLUSION

The results of this study have led to more awareness for the reduced Quality of Life in this group of patients in the clinic where the studies were performed. In addition, this study has been an impetus for the development of a decision aid for patients with vestibular schwannoma. This will hopefully ensure that the patients' struggle to come to a treatment choice will be reduced. In addition, it would be a good development if, by reducing the patients' struggle to make a treatment choice, this choice will actually be made by the patient, and not by the physicians. Ideally this will contribute to an improvement in the QoL.

For the future, we hope that research in the field of QoL of patients with vestibular schwannoma will continue. There are still many determinants that can be explored, and there is a big task for the development of a decision aid. The ultimate goal would be that the QoL, and therewith the quality of care, of patients with vestibular schwannoma could be improved and hopefully there will be more research groups that will help to develop the knowledge in this field.

REFERENCES

1. Pollock BE, Driscoll CL, Foote RL et al. Patient outcomes after vestibular schwannoma management: a prospective comparison of microsurgical resection and stereotactic radiosurgery. *Neurosurg* 2006;59:77-85.
2. Godefroy WP, Kaptein AA, Vogel JJ, van der Mey AGL. Conservative treatment of vestibular schwannoma: a follow-up study on clinical and quality-of-life outcome. *Otol Neurotol* 2009;30:968-974.
3. Vogel JJ, Godefroy WP, van der Mey AGL, le Cessie S, Kaptein AA. Illness perceptions, coping, and quality of life in vestibular schwannoma patients at diagnosis. *Otol Neurotol* 2008;29:839-845.
4. Breivik CN, Varughese JK, Wentzel-Larsen T, Vassbotn F, Lund-Johansen M. Conservative management of vestibular schwannoma - a prospective cohort study: treatment, symptoms and quality of life. *Neurosurg* 2012;70:1072-1080.
5. Di Maio S, Akagami R. Prospective comparison of quality of life before and after observation, radiation, or surgery for vestibular schwannomas. *J Neurosurg* 2009;111:855-862.
6. Godefroy WP, Hastan D, van der Mey AG. Translabyrinthine surgery for disabling vertigo in vestibular schwannoma patients. *Clin Otolaryngol* 2007;32:167-172.
7. Park SS, Grills IS, Bojrab D et al. Longitudinal assessment of quality of life and audiometric test outcomes in vestibular schwannoma patients treated with gamma knife surgery. *Otol Neurotol* 2011;32:676-679.
8. Sandooram D, Hornigold R, Grunfeld B, Thomas N, Kitchen ND, Gleeson M. The effect of observation versus microsurgical excision on Quality of Life in unilateral vestibular schwannoma: a prospective study. *Skull Base* 2010;20:47-54.
9. Myrseth E, Moller P, Wentzel-Larsen T, Goplen F, Lund-Johansen M. Untreated vestibular schwannomas: vertigo is a powerful predictor for health-related quality of life. *Neurosurg* 2006;59:67-76.
10. Wiegand DA, Fickel V. Acoustic Neuroma - The Patient's Perspective: a subjective assessment of symptoms, diagnosis, therapy, and outcome in 541 patients. *Laryngoscope* 2002;99:179-187.
11. Irving RM, Beynon GJ, Viani L, Hardy DG, Baguley DM, Moffat DA. The patient's perspective after vestibular schwannoma removal: quality of life and implications for management. *Am J Otol* 1995; 16:331-337.
12. MacAndie C, Crowther JA. Quality of life in patients with vestibular schwannomas managed conservatively. *Clin Otolaryngol Allied Sci* 2004;29:215-218.
13. Nikolopoulos TP, Johnson I, O'Donoghue GM. Quality of life after acoustic neuroma surgery. *Laryngoscope* 1998;108:1382-1385.
14. Sandooram D, Grunfeld EA, McKinney C, Gleeson MJ. Quality of life following microsurgery, radiosurgery and conservative management for unilateral vestibular schwannoma. *Clin Otolaryngol Allied Sci* 2004;29:621-627.
15. Tufarelli D, Meli A, Alesii A et al. Quality of life after acoustic neuroma surgery. *Otol Neurotol* 2006;27:403-409.
16. van Leeuwen BM, Borst JM, Putter H, Jansen JC, van der Mey AGL, Kaptein AA. Emotional Intelligence in association with quality of life in patients recently diagnosed with vestibular schwannoma. *Otol Neurotol* 2014;35:1650-1657.
17. Carlson ML, Tveiten OV, Driscoll CL et al. What drives quality of life in patients with sporadic vestibular schwannoma? *Laryngoscope* 2015;125:1697-1702.
18. Shaffer BT, Cohen MS, Bigelow DC, Ruckenstein MJ. Validation of a disease-specific quality-of-life instrument for acoustic neuroma: the Penn Acoustic Neuroma Quality-of-Life Scale. *Laryngoscope* 2010;120:1646-1654.
19. Kaptein AA, Zandstra T, Scharloo M et al. 'A time bomb ticking in my head': drawings of inner ears by patients with vestibular schwannoma. *Clin Otolaryngol* 2011;36:183-184.
20. Carlson ML, Tveiten OV, Driscoll CL et al. Long-term quality of life in patients with vestibular schwannoma: an international multicenter cross-sectional study comparing microsurgery, sterotactic radiosurgery, observation, and nontumor controls. *J Neurosurg* 2015;122:833-842.
21. Robinett ZN, Walz PC, Miles-Markley B, Moberly AC, Welling DB. Comparison of long-term quality-of-life outcomes in vestibular schwannoma patients. *Otolaryngol Head Neck* 2014;150:1024-1032.
22. McLaughlin EJ, Bigelow DC, Lee JY, Ruckenstein MJ. Quality of life in acoustic neuroma patients. *Otol Neurotol* 2015;36:653-656.
23. Robinett ZN, Walz PC, Miles-Markley B, Moberly AC, Welling DB. Comparison of long-term quality-of-life outcomes in vestibular schwannoma patients. *Otolaryngol Head Neck Surg* 2014;150:1024-1032.
24. McLaughlin EJ, Bigelow DC, Lee JY, Ruckenstein MJ. Quality of life in acoustic neuroma patients. *Otol Neurotol* 2015;36:653-656.
25. Carlson ML, Tveiten OV, Driscoll CL et al. Long-term quality of life in patients with vestibular schwannoma: an international multicenter cross-sectional study comparing microsurgery, stereotactic radiosurgery, observation, and nontumor controls. *J Neurosurg* 2015;122:833-842.
26. Elwyn G, Frosch D, Thomson R et al. Shared decision making: a model for clinical practice. *J Gen Intern Med* 2012;27:1361–1367.
27. Barry MJ, Edgman-Levitan S. Shared decision making - pinnacle of patient-centered care. *N Engl J Med* 2012;366:780-781.
28. Lorig KR, Holman HR. Self-management education: history, definition, outcomes, and mechanisms. *Ann Behav Med* 2003;26:1-7.



8

Summary

Vestibular schwannomas are often slow growing tumors of benign origin. They originate from the vestibulocochlear (eight cranial) nerve. Patients with a vestibular schwannoma (VS) often present with unilateral sensorineural hearing loss, tinnitus, vertigo, or imbalance. VS could be conceptualized as a chronic illness as it is reversible, has a long duration, and implies a substantial burden on the patient, their families and the health care system. The choice of treatment remains a topic of discussion, and each modality has its own advantages and disadvantages which have to be endured by and comped with the patient. Due to a more frequent use of magnetic resonance imaging (MRI) and better accessible audiologic testing capacities an increase in incidence of VS has been observed over the last decades. The increased incidence is mainly due to a rise in detection of small and asymptomatic tumors. For these patients survival is not the issue, but Quality of Life (QoL) becomes all the more important. Patient characteristics as well as tumor characteristics, and psychological factors are determinants of QoL in these patients. In the Common Sense Model of Self-Regulation (CSM) developed and applied in an abundant number of empirical studies by Leventhal et al. it has become clear that patients' responses to health threats (self-management) determine how they manage their illness. Physical, psychological and social well-being and functioning play an important role in the variation of the severity of disease as experienced by patients and therefore in their QoL. This thesis aims to a) contribute to the existing knowledge about QoL in patients with VS, and b) to provide tools for physicians in communicating with their patients about QoL in such a way that the quality of care for these patients can be further improved.

Chapter 1 gives a general introduction in the form of a short overview of the definition, epidemiology, treatment options for VS, and QoL. It is then discussed that the choice of the 'best management' can be complex for the individual patient. Each of the modalities (i.e., observation (wait-and-scan), radiation therapy and microsurgical resection) have a major impact on patients' QoL. The development of the pharmacological treatment is briefly described. The concept of QoL with respect to patients with VS is also addressed. After this, the theoretical background of the concept of self-regulation is outlined on the basis of the CSM, and attention is paid to illness perceptions and emotional intelligence as aspects of the cognitive and emotional pathway of this model. QoL was used as outcome measurement. Finally, shared decision making, and the goal of the study is discussed. Shared decision making is an important strategy in clinical situations where there is more than one reasonable management option. It is based on the integration of both the best available medical evidence (provided by the physician) and the preferences and expectations of the patient. In this way 'the best' treatment option for an individual patient can be determined.

QoL has evolved into an important outcome by which the effect of medical treatment is determined in modern medicine. Both physical as well as emotional consequences of the illness translate into patients' QoL, which is found to be diminished in patients with VS from the moment of diagnosis. Several studies assessing QoL in patients with VS have used the Short Form-36 questionnaire (SF-36), the most widely used generic questionnaire that assesses QoL. Given the limitations of a generic questionnaire, the disease specific Penn Acoustic Neuroma Quality-of-Life scale (PANQOL) was developed recently. **Chapter 2** describes the study in which the PANQOL was translated into Dutch and was then validated in a Dutch group of patients with VS. The Dutch results were comparable to those of the study in which the PANQOL was described for the first time. In addition, a significantly reduced QoL was found at the moment of diagnosis. Clinicians are advised to use the PANQOL in future studies in patients with VS, in order that they also consider QoL as an important treatment goal. However, little is known on the self-management skills of this group of patient, perhaps the PANQOL can be used in the development of self-management programs for patients with VS in order to measure the effect of the program on the QoL of patients.

To gain better understanding of VS patients' QoL, it is important to gain a better understanding of the determinants that affect QoL. Patient characteristics as well as tumor characteristics, and psychological factors (e.g., low optimism, low control regarding the illness) are determinants of QoL in these patients. Emotional intelligence account for the variability in the way people are able to identify, express, utilize and regulate their own feelings and those of others. Emotional intelligence can be seen as a strong predictor of the impact of stressful periods in life. Emotional intelligence has shown to be a determinant of QoL in patients with in example types of cancer. This led me to study the potential contribution of EI to QoL in patients with VS, because this has not been extensively investigated. The study in which the association between emotional intelligence and QoL in patients with VS was studied is described in **Chapter 3**. In this study the PANQOL and the Trait Emotional Intelligence Questionnaire-Short Form (TEIQUE-SF) were used. Results of this analysis show that 23% of the variance in QoL can be attributed to emotional intelligence. Balance disorders (10% explanation), cranial nerve dysfunction (4%) and educational level (1%) significantly influenced QoL as well. These results further underline that an intervention program with the focus on the improvement of emotion and stress management could be helpful for patients with VS. Hopefully, these findings will contribute to improved counselling of this patient group.

Although VS are benign tumors, patients who are diagnosed with VS may not perceive their tumor as 'benign' at all. They often suffer from a great deal of anxiety and uncertainty regarding their future perspective. This may have a serious impact on their illness perceptions and thereby on their QoL. Illness perceptions can be defined as: "a distinct, meaningfully integrated cognitive structure that encompasses, (a) a belief in the relatedness of a variety of physiological and psychological functions, which may or may not be objectively accurate; (b) a cluster of sensations, symptoms, emotions, and physical limitations in keeping with that belief; (c) a naïve theory about the mechanisms that underlie the relatedness of the elements identified in (b), and (d) implicit or explicit prescriptions for corrective action"(Lacroix JM. Assessing illness schemata in patient populations In: Skelton JA, Croyle RT, eds. *Mental representation in health and illness*. New York: Springer; 1991:197). **Chapter 4** describes a study wherein drawings of patients with VS were used to measure illness perceptions and their impact on QoL. In addition to the drawings the Brief Illness Perception Questionnaire (B-IPQ) was used to measure illness perceptions, The PANQOL was used to assess QoL. Most drawings were little detailed, and only a few patients represented their emotions in the drawing. Compared to patients with several types of cancer, patients with VS had the lowest score on the B-IPQ dimension Coherence, which indicates that of the studied groups, they have the lowest comprehension of their own illness. This study suggests that drawings of patients give clinicians some insight into patients' perceptions about their illness and its impact on their daily life. This will enable physicians to better understand their VS patients' perceptions, which will contribute to the overall quality of care for patients. In addition, a self-made drawing may also be enlightening for the patients themselves.

Since there often are several treatment options available in patients with VS choices have to be made between these options (observation, radiation therapy and microsurgical resection). It seems of importance that during counseling, physicians can portray what patients can expect, in the long-term, from each of these treatment options. This is true for both the effects of the various treatment options on clinical parameters, as well as for the effect of the treatment on QoL. To date, little is known about this subject. **Chapter 5** describes a study that maps the course of QoL after the three different management options. Propensity scores were used and results were stratified according to tumor size to control for potential confounders. The findings of the current study indicate that patients with small tumors (< 10 mm) have a better QoL when undergoing observation, compared to patients who have undergone active treatment (radiation therapy or microsurgical resection). Futhermore, for medium-sized or large tumors, no significant differences were found regarding QoL up to 10 years after the three treatment options.

Studying the symptoms experienced by the patients it becomes clear that balance disorders and vertigo appear to have the strongest influence on QoL. The results of the current study could be of value in the communication with patients about their expectations regarding QoL after treatment, and the effect that symptoms can have on their QoL.

For each individual patient a treatment choice will be made. According to the literature it becomes clear that, for patients with small tumors or very large tumors, the choice is least complicated, since in these patients there is often not more than one equivalent treatment modality. For these patients, physicians are able to provide thoroughly considered recommendations, suggesting either one of the treatment modalities. In contrast, in patients with medium-sized tumors there is often more than one medical equivalent treatment and in such cases, it is extremely important that the decision for treatment should be made together with the patient. Often it comes to the choice between radiation therapy and microsurgical resection. This decision is extremely difficult, sometimes almost impossible, for patients. It is important that physicians try to assist patients in making this choice, for example by means of a clear assessment of the advantages and disadvantages that can be expected from each of the treatment options. To achieve this, it is important to assess how a decision is currently reached regarding the choice of treatment. The study that gives insight into this subject was investigated in **Chapter 6**. In a retrospective chart study it was investigated which modality was recommended by the physicians and for what reasoning. The study demonstrates that there is a substantial group of patients in which the choice of treatment is left up to the patient, because medically there is no modality superior over another modality. This study sought to address this problem. It also called for more patient guidance to be better able to make this difficult decision. This way, they become an equal partner in the process of shared decision making.

Chapter 7 comprises a discussion of the main results and conclusions described in this thesis. Furthermore, future research perspectives and some important implications for clinical practice are discussed.

9

Samenvatting

Vestibularis schwannomen (ook wel brughoektumoren genoemd) zijn goedaardige, vaak langzaam groeiende tumoren, uitgaande van de achtste hersenzenuw, de gehoor- en evenwichtszenuw (nervus vestibulocochlearis). Patiënten met een vestibularis schwannoom presenteren zich meestal met een eenzijdig gehoorverlies veroorzaakt door schade aan die zenuw, en/of oorsuizen, duizeligheid of evenwichtsklachten. Vestibularis schwannomen kunnen worden beschouwd als een chronische ziekte aangezien ze onomkeerbaar zijn, een lange duur hebben, en een betekenisvolle invloed hebben op de patiënt, hun familie, en de gezondheidszorg. De behandelkeuze blijft onderwerp van discussie met bij elke modaliteit voor- en nadelen die door de patiënt moeten worden gedragen. Door veelvuldiger gebruikt van MRI scans (magnetic resonance imaging) en de betere toegankelijkheid van de mogelijkheden om het gehoor te laten testen worden de laatste jaren bij meer mensen per jaar een vestibularis schwannomen ontdekt. Hierbij gaat het voornamelijk om kleine tumoren die geen klachten geven. Bij deze patiënten gaat het niet om overleving, maar speelt Kwaliteit van Leven een steeds belangrijkere rol. De heersende gedachte is dat zowel bepaalde kenmerken van de patiënt, evenals kenmerken van de tumor, maar ook psychologische factoren voorspellers zijn van Kwaliteit van Leven bij deze patiënten. Volgens het Common Sense Model van zelfregulatie (het vermogen van mensen om het geestelijk functioneren zelf te beïnvloeden) door Leventhal en collega's, wordt de manier waarop mensen met hun ziekte omgaan (zelf-management) bepaald door onder meer de manier waarop zij hun ziekte beleven. Lichamelijk , geestelijk en sociaal welbevinden en functioneren spelen een belangrijke rol in de variatie van de ernst van de ziekte, zoals waargenomen door de patiënten, en daarmee ook op hun Kwaliteit van Leven. Dit proefschrift beoogt a) een bijdrage te leveren aan de kennis over Kwaliteit van Leven van patiënten met een vestibularis schwannoom, en b) handvatten te bieden voor artsen in de communicatie met hun patiënten over Kwaliteit van Leven om op deze manier de kwaliteit van de zorg voor deze patiënten te verbeteren.

In **hoofdstuk 1** wordt een algemene introductie met een kort overzicht van de definitie, klinische presentatie, vóórkomen en behandelmogelijkheden voor het vestibularis schwannoom, en de Kwaliteit van Leven. Daarna wordt besproken dat voor elke afzonderlijke patiënt de keuze voor de 'beste behandeling' ingewikkeld kan zijn. Hoe dan ook heeft elk van de behandelmogelijkheden (te weten, afwachten (wait-and-scan), bestraling en operatie) een grote impact hebben op de Kwaliteit van Leven van patiënten. De ontwikkeling van de behandeling met medicijnen kort beschreven. Het begrip Kwaliteit van Leven met betrekking tot patiënten met een vestibularis schwannoom wordt daarna uitvoerig besproken. Nadien wordt de theoretische achtergrond van het begrip zelfregulatie geschetst aan de hand van het Common Sense Model en wordt aandacht

besteed aan ziektebeleving en emotionele intelligentie als aspecten van de verstandelijke en emotionele paden van dit model. Kwaliteit van Leven werd gebruikt als uitkomstmaat. Aan het eind van het hoofdstuk wordt gesproken over gedeelde besluitvorming en wordt het doel van de studie behandeld. Gedeelde besluitvorming is een belangrijke strategie in klinische situaties waarin er, vanuit medisch perspectief, meer dan één redelijke behandelmogelijkheid is. Dit is gebaseerd op het samenvoegen van zowel de best beschikbare medische bewijsvoering (gegeven door de arts), en de voorkeuren van de patiënt. Op deze wijze kan de "beste" behandeling voor elke afzonderlijke patiënt worden vastgesteld.

Kwaliteit van Leven heeft zich in de moderne geneeskunde ontwikkeld tot een belangrijke uitkomstmaat waarmee het effect van medische behandelingen wordt weergegeven. Zowel lichamelijke als emotionele gevolgen van de ziekte vertalen zich in de Kwaliteit van Leven van de patiënt, die bij patiënten met een vestibularis schwannoom verminderd blijkt te zijn vanaf het moment van de diagnose. Tot op heden werd bij studies naar de Kwaliteit van Leven van patiënten met een vestibularis schwannoom voornamelijk gebruik gemaakt van een veel gebruikte algemene Kwaliteit van Leven vragenlijst, de Short Form-36 Vragenlijst (SF-36). Gezien de beperkingen die een algemene vragenlijst heeft, werd recent in de Verenigde Staten de Penn Acoustic Neuroma Quality-of-Life scale (PANQOL) ontwikkeld. In **hoofdstuk 2** wordt de studie beschreven waarin de PANQOL naar het Nederlands werd vertaald en werd gevalideerd in een Nederlandse groep patiënten met een vestibularis schwannoom. De resultaten waren vergelijkbaar met de studie waarin de PANQOL voor het eerste werd beschreven en er werd een duidelijk verlaagde Kwaliteit van Leven gevonden op het moment van de diagnose. Het advies voor artsen is om de PANQOL te gebruiken in toekomstige studies opdat zij Kwaliteit van Leven als behandeldoel opvatten. Hoewel het nog onduidelijk is hoe de zelf-management vaardigheden van deze groep patiënten zijn, kan de PANQOL mogelijk gebruikt worden bij het ontwikkelen van zelf-management programma's voor patienten met een vestibularis schwannoom, om het effect van het programma op de Kwalieit van Leven van patiënten mee te meten.

Om een beter begrip te krijgen van de Kwaliteit van Leven van de patiënten met een vestibularis schwannoom is het van belang om meer inzicht te krijgen in de factoren die invloed hebben op deze Kwaliteit van Leven. De heersende gedachte is dat zowel bepaalde kenmerken van de patiënt, evenals kenmerken van de tumor, maar ook psychologische factoren (bijvoorbeeld weinig optimisme, weinig controle) voorspellers zijn van Kwaliteit van Leven bij deze patiënten. Emotionele intelligentie staat voor de

variabiliteit in de manier waarop mensen in staat zijn hun eigen gevoelens, en die van anderen, te benoemen, uiten, gebruiken en reguleren. Emotionele intelligentie kan worden gezien als een sterke voorspeller van de impact van stressvolle periodes in het leven. Onderzoek heeft aangetoond dat emotionele intelligentie een factor van Kwaliteit van Leven is bij patiënten met bijvoorbeeld bepaalde vormen van kanker. Emotionele intelligentie zou ook een voorspeller van Kwaliteit van Leven van patiënten met een vestibularis schwanoom kunnen zijn, maar dit werd niet eerder onderzocht. De studie waarin het verband tussen emotionele intelligentie en Kwaliteit van Leven bij patiënten met een vestibularis schwanoom werd onderzocht wordt beschreven in **hoofdstuk 3.** Voor deze studie werd gebruik gemaakt van de PANQOL en de Trait Emotional Intelligence Questionnaire-Short Form (TEIQUE-SF). Volgens deze studie wordt de Kwaliteit van Leven voor 23% bepaald door de emotionele intelligentie. Daarnaast leveren evenwichtsstoornissen (10% verklaring), verstoorde werking van hersenzenuwen (4%) en opleidingsniveau (1%) een bijdrage aan de Kwaliteit van Leven. Deze resultaten benadrukken dat een interventieprogramma met de focus op het omgaan met emoties en stress zou kunnen helpen voor patiënten met een vestibularis schwanoom. Hopelijk dragen deze resultaten bij aan een verbeterde begeleiding an deze groep patiënten.

Hoewel een vestibularis schwannoom een goedaardige tumor is, ervaren veel patiënten dat helemaal niet zo. Zij zijn vaak angstig, en onzeker over wat de toekomst hen zal brengen. Dit kan een sterke invloed hebben op de ziektebeleving van patiënten en daarmee op hun Kwaliteit van Leven. Ziektebeleving kan worden omschreven als: "een uitgesproken, betekenisvol samengebrachte structuur van kennis die het volgende omvat: (a) een overtuiging van het samenhang tussen meerdere lichamelijke en geestelijke functies, die al dan niet vastgesteld juist is; (b) een verzameling van gevoelens, symptomen, emoties en lichamelijke beperkingen in lijn met deze overtuiging; (c) een eenvoudige theorie omtrent de mechanismen die ten grondslag liggen aan de vastgestelde elementen in (b), en (d) onuitgesproken of concrete voorschriften voor verbeterende maatregels" (Lacroix JM. Assessing illness schemata in patient populations In: Skelton JA, Croyle RT, eds. *Mental representation in health and illness*. New York: Springer; 1991:197). In **hoofdstuk 4** wordt de studie beschreven waarin tekeningen die patiënten hebben gemaakt van hun vestibularis schwannoom werden gebruikt om de ziektebeleving, en de invloed daarvan op de Kwaliteit van Leven, te meten. Naast de tekeningen werd gebruik gemaakt van Brief Illness Perception Questionnaire (B-IPQ) om ziektebeleving te meten, en de PANQOL om de Kwaliteit van Leven te meten. De tekeningen waren over het algemeen weinig gedetailleerd, en weinig patiënten hadden emoties in de tekening weergegeven. In vergelijking met patiënten met verschillende soorten kanker scoorden patiënten met een

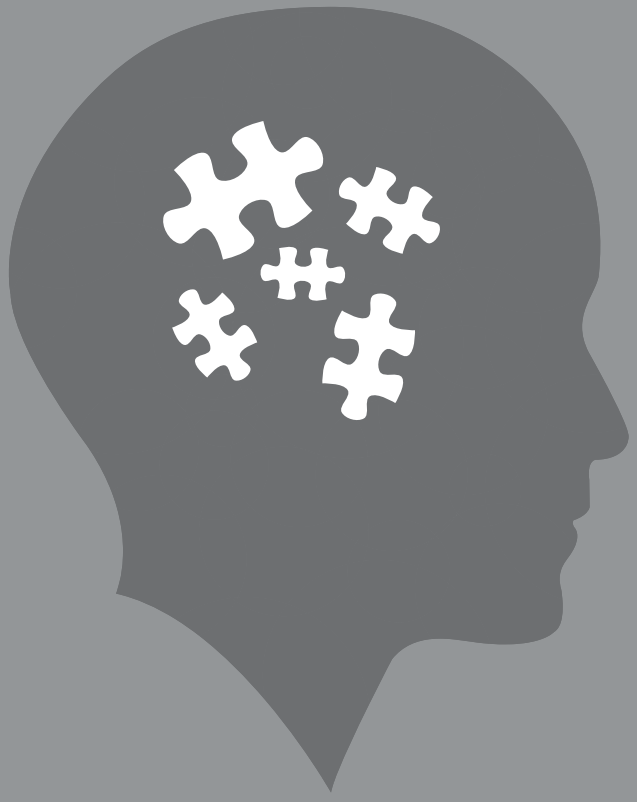
vestibularis schwannoom het laagste op de dimensie 'Coherence', wat aangeeft dat zij van alle onderzochte groepen het minste begrip hebben van hun eigen ziekte. Dit onderzoek geeft aanwijzingen dat het laten tekenen van de tumor door patiënten een duidelijk beeld geeft van de gedachten van de patiënt over het vestibularis schwannoom en de invloed daarvan op hun dagelijks leven. Hiermee kunnen artsen hun patiënten mogelijk beter begrijpen, wat bijdraagt aan een goede zorg voor de patiënten. Tevens kan het ook verhelderend zijn voor de patiënten zelf, wat van toegevoegde waarde kan zijn in zelf-management programma's.

Aangezien er bij patiënten met een vestibularis schwannoom vaak meerdere behandelmogelijkheden zijn moet er een keuze gemaakt worden tussen deze mogelijkheden (afwachten, bestraling en operatie). In de voorlichting naar patiënten toe lijkt het van belang dat de artsen kunnen weergeven wat een patiënt van elk van de drie behandelingen kan verwachten op de langere termijn. Dit geldt zowel voor klinische variabelen, als voor het effect van de behandeling op de Kwaliteit van Leven. Tot op heden is hier weinig over bekend. **Hoofdstuk 5** beschrijft de studie die het beloop van de Kwaliteit van Leven na de verschillende behandelingen in kaart brengt. Propensity scores (de kans op een bepaalde behandeling, gegeven bekende mogelijke verstorende factoren) werden gebruikt en de resultaten werden uitgesplitst naar de grootte van de tumor om te controleren voor mogelijke verstorende factoren. Uit deze studie blijkt dat patiënten met een kleine tumor (< 10 mm) een betere Kwaliteit van Leven hebben als er voor een afwachtend beleid is gekozen, vergeleken met patiënten die bestraald of geopereerd worden. Voor de middelgrote en grote tumoren werden, ook op de langere termijn (tot 10 jaar na behandeling), geen betekenisvolle verschillen gezien van de verschillende behandelmogelijkheden op de Kwaliteit van Leven. Tevens bleek uit deze studie dat van alle klachten die patiënten kunnen ervaren, evenwichtsklachten en duizeligheid de sterkste invloed hebben op de Kwaliteit van Leven. De resultaten van deze studie kunnen van waarde zijn in de communicatie met patiënten over de Kwaliteit van Leven na behandeling, en het effect dat klachten kunnen hebben op hun Kwaliteit van Leven.

Voor elke individuele patiënt moet een keuze voor een behandelmogelijkheid worden gemaakt. Vanuit de literatuur wordt duidelijk dat voor patiënten met kleine tumoren of zeer grote tumoren deze keuze het minst ingewikkeld is, gezien bij deze patiënten er niet meer dan één gelijkwaardige behandeling beschikbaar is. Voor deze patiënten is het voor artsen mogelijk om een duidelijk advies te geven voor de ene of de andere behandeling. Daarentegen wordt gezien dat bij middelgrote tumoren vaak meerdere behandelmogelijkheden medisch gelijkwaardige opties zijn, en bij deze patiënten is het

van groot belang dat de behandelkeuze gemaakt wordt in overleg met de patiënt. Vaak gaat het om de keuze tussen bestraling of operatie. Dit is voor patiënten een extreem moeilijke, en soms zelf bijna onmogelijke, keuze. Het is belangrijk dat artsen proberen de patiënten handvatten te bieden om deze keuze te maken, bijvoorbeeld door middel van een duidelijke uiteenzetting van de voordelen en nadelen die verwacht kunnen worden van elk van de drie behandelmogelijkheden. Allereerst is het daarvoor van belang om uit te vinden hoe de behandelkeuze op dit moment tot stand komt. De studie die inzicht geeft in dit onderwerp wordt beschreven in **hoofdstuk 6.** Door middel van een studie waarbij vanuit het patiëntendossier werd onderzocht met welke motivering artsen aangeven dat er een reden tot behandeling is, en waarom zij de voorkeur geven aan de ene of de andere behandelmogelijkheid. Vanuit deze studie wordt ook duidelijk dat er een aanzienlijke groep is bij wie de behandelkeuze wordt voorgelegd aan de patiënt omdat er medisch gezien geen sterke voorkeur bestaat. Middels deze studie wordt hier aandacht voor gevraagd. Tevens wordt gepleit voor meer handvatten voor de patiënt om deze moeilijke beslissing te maken zodat zij een waardige partner worden in het proces van de gedeelde besluitvorming.

In **hoofdstuk 7** worden de belangrijkste conclusies en resultaten beschreven in dit proefschrift bediscussieerd. Daarnaast worden een aantal belangrijke implicaties voor de klinische praktijk en een voorstel voor vervolgonderzoek gegeven.



Appendices

Abbreviations

List of contributing authors

Curriculum Vitae

Dankwoord

ABBREVIATIONS

ANOVA	Analysis Of Variance
B-IPQ	Brief Illness Perception Questionnaire
BP	Bodily Pain
CSM	Common Sense Model of self-regulation
cSYMP	Composite symptom score
EI	Emotional Intelligence; Emotionele Intelligentie
ER	Emotional Role limitations
GBI	Glasgow Benefit Inventory
GH	General Health
IP	Illness Perception
IPs	Illness Perceptions
KvL	Kwaliteit van Leven
M	Mean
MH	Mental Health
MRI	Magnetic Resonance Imaging
MS	Microsurgical resection
NF2	Neurofibromatosis type 2
OB	Observation
PANQOL	Penn Acoustic Neuroma Quality of Life scale
PF	Physical Functioning
PR	Physical Role limitations
PROM	Patient Reported Outcome Measures
QoL	Quality of Life
RT	Radiation therapy
SD	Standard Deviation
SF	Social Functioning
SF-36	Short Form-36 questionnaire
SLE	Systemic Lupus Erythematosus
SPSS	Statistical Packages for the Social Science
TEI	Trait Emotional Intelligence
TEIQue-SF	Trait Emotional Intelligence questionnaire – Short Form
USA	United States of America
VS	Vestibular Schwannoma; Vestibularis Schwannoom
VT	Vitality

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CURRICULUM VITAE

Bibian van Leeuwen (08-02-1984) was born in Hilversum, The Netherlands. In 2002 she graduated from the Comenius College in Hilversum (Gymnasium). The same year she was admitted to the medical school at the University of Utrecht. During this period she worked at the Wilhelmina Childrens Hospital in Utrecht. Besides she has been involved in student rowing at “Triton” where she rowed herself, but also had control of racing boats. During the holidays, she enthusiastically guided many holidays for young people with disabilities at “Stichting de Wielewaal” in Hilversum. The medical profession of Otorhinolaryngology attracted her and after completing her medical school in 2008, she started as a clinical resident at the department of Otorhinolaryngology, Head and Neck surgery of the Leiden University Medical Center under supervision of prof. dr. ir. J.H.M. Frijns and dr. A.G.L. van der Mey. Part of this training was followed at the Groene Hart Ziekenhuis in Gouda (supervisor: dr. H.A. Westerbeek and dr. J. Kemper) and the Diaconessenhuis in Leiden (supervisor: dr. C.J. Brenkman and dr. F.W.A. Otten). In 2014 she completed her ENT residency. During the residency she started research which resulted in this thesis. Currently she is working as otolaryngologist at the Groene Hart Ziekenhuis in Gouda and the Erasmus MC – Sophia kinderziekenhuis in Rotterdam.
Bibian has a relationship with Guido Bongers. Together they have two daughters, Jade (2014) and Sera (2015).

CURRICULUM VITAE

Bibian van Leeuwen (08-02-1984) werd geboren in Hilversum te Nederland. In 2002 behaalde zij haar eindexamen Gymnasium aan het Comenius College in Hilversum. In datzelfde jaar werd zij toegelaten tot de studie Geneeskunde aan de Universiteit Utrecht. Tijdens haar studietijd werkte zij in het Wilhelmina kinderziekenhuis. Daarnaast was zij tijdens haar gehele studietijd betrokken bij studentenroeivereniging Triton, waar zij zelf roeide, maar ook stuurvrouw was van wedstrijdboten. In de vakanties heeft zij met enthousiasme vele vakanties voor jongeren met een beperking begeleid als reisleidster bij Stichting de Wielewaal. Tijdens haar studie werd zij getrokken door de Keel-, Neus-, en Oorheelkunde (KNO) en na het behalen van haar artsexamen in 2008 werd zij aangenomen voor de opleiding tot KNO-arts in het Leids Universitair Medisch Centrum met als opleiders prof. dr. ir. J.H.M. Frijns en dr. A.G.L. van der Mey. Delen van deze opleiding werden genoten in het Groene Hart Ziekenhuis in Gouda (opleiders: dr. H.A. Westerbeek en dr. J. Kemper) en in het Diaconessenhuis in Leiden (opleiders: dr. C.J. Brenkman en dr. F.W.A. Otten). De opleiding werd afgerond in 2014. Tijdens de opleiding is zij begonnen met een onderzoek dat geleid heeft tot dit proefschrift. Momenteel is zij werkzaam als KNO-arts in het Groene Hart Ziekenhuis in Gouda en in het Erasmus MC – Sophia Kinderziekenhuis in Rotterdam.
Bibian heeft een relatie met Guido Bongers. Samen hebben ze twee dochters, Jade (2014) en Sera (2015).

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Bibian