Rehabilitation after Resuscitation

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Chapter 5

Rehabilitation after Cardiac Arrest: Integration of Neurologic and Cardiac Rehabilitation

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Seminars in Neurology 2017 37:94–102

Abstract

Cognitive impairments are common after resuscitation. Severe cognitive impairments are easily recognised. Mild cognitive impairments are much more difficult to spot. Given the influence of cognitive problems in daily functioning it is important to identify cognitive impairments in an early stage. Also emotional problems, mainly depression and fear, are common in this group of patients.
To optimise the care for patients after an out-of-hospital cardiac arrest the rehabilitation should focus on the physical approach through cardiac rehabilitation and on the brain injury and the associated cognitive impairments.
The goal of rehabilitation after a cardiac arrest is to provide excellent patient-centred cardiac and cognitive rehabilitation to all patients and their spouses in order to achieve optimal participation in society, with minimal burden for spouses and society.
To achieve this, cardiac and cognitive rehabilitation needs to be coordinated in an integrated care path.
Out of-hospital cardiac arrest (OHCA) is one of the main causes of death around the globe. A systematic review including 67 peer-reviewed studies published from 1990 to 2008 concludes that the global average incidence is 55 adult OHCAs of presumed cardiac cause per 100.000 person-years.[1] Based on this systematic review an average survival following adult OHCA of 7% was found. In Europe the incidence of emergency medical service- (EMS-) attended OHCA is 86.4 per 100,000 inhabitants per year. The review reports that 60% of the patients in Europe are treated by EMS after OHCA and 9% of these patients survive to hospital discharge. Overall the most common cause of CA is cardiovascular disease and coronary ischemia.[2,3]
After surviving an OHCA patients often experience physical exercise problems as result of the event. Another potential consequence of the CA is the interruption of blood circulation to the brain. This can lead to brain injury. Irreversible damage to the brain already occurs after several minutes. The brain injury can be very diffuse and therefore the neurological consequences are diverse. To decrease the severity of the brain injury patients receive targeted temperature management (TTM) in the hospital. Despite the measures in the (sub) acute phase an estimated 40%-50% of all survivors have still cognitive problems half a year after the CA.[4]
The majority of patients that survive an out-of-hospital cardiac arrest

(OHCA) are –according to European guidelines- eligible for cardiac rehabilitation.[5,6] We advocate that besides a physical approach through cardiac rehabilitation, also the brain injury and the associated cognitive problems should be taken into account through cognitive rehabilitation.

Cardiac consequences after Cardiac Arrest

Due to the cardiac cause of the OHCA, the majority of patients spend the rest of their lives as cardiac patients. After lifesaving interventions such as percutaneous coronary intervention, coronary artery bypass grafting, and TTM, patients might have to take medication, live with an implantable cardioverter defibrillator, have a decreased exercise span, or are advised to make major life changes to optimize their health and to prevent recurrence.

Emotional problems and fatigue after Cardiac Arrest

Besides physical problems, patients also experience emotional problems. Of all patients after a CA, 75% develop emotional problems. Depression is present in 14 to 45% of survivors, anxiety in 13 to 61%, and symptoms of posttraumatic stress in 19 to 27%.[7,8]

Fatigue is also often reported after CA. Even several years after a CA, 56% of the survivors suffer from severe fatigue.[9]

Emotional problems and fatigue have a significant impact and can affect a patient's daily functioning, return to work, and quality of life. The prognosis for cardiac patients who live on their own is even worse. The literature reveals that social support is an important precondition for physical and mental recovery of the heart patient.[10,11]

Cognitive impairments after Cardiac Arrest

Most of the CA survivors seem to have a good neurologic outcome. However, besides the emotional problems and fatigue, cognitive impairments are also common.[4,8,9,12] Half of the survivors report cognitive impairments.[4] Memory, attention, and executive functioning are most affected.4 The cognitive impairments can be severe, but are mostly mild. Mild cognitive problems are often not recognized in time by health care professionals. Cognitive problems cause a negative effect on participation/autonomy and quality of life.[13]

A well-known predictor of cognitive functioning after traumatic brain injury is coma duration.[14] However, for survivors of OHCA, evidence on the relation between coma duration and outcome is scarce.[15] The

question whether TTM protects against cognitive disabilities is not yet solved.[16,17] One might even argue that cognitive impairments are not necessarily caused by CA alone but by cardiovascular disease in general. Lilja et al compared outcome of CA survivors with an age- and gender-matched control group with similar cardiovascular risk factors, but with acute myocardial infarction instead of CA. Surprisingly, they found only very minor differences between groups.[18]
It is important that patients, relatives, and health care providers are aware of potential
cognitive and emotional problems after CA because both cognitive and emotional problems have significant impacts and can affect a patient's daily functioning, return to work, and quality of life.[19]

Spouse/caregiver
Not only the patients experience problems after the CA. Spouses and caregivers quite often feel highly burdened and have emotional problems, including symptoms of posttraumatic stress.[13,20] One of the changes that decreases the quality of life of spouses is the difficulty the patient has resuming his or her old life. The change of personality and behaviour and the need for lifestyle changes of the patient also may cause the partner stress.[10,21] Spouses feel the need for emotional support regarding partner relationships and regaining daily activities.[22]

Rehabilitation after OHCA: the missing link
As noted above, patients after CA often need both cardiac and cognitive rehabilitation. However, cardiac rehabilitation and cognitive rehabilitation most often are located in different teams and in different institutions.
In general, therapists at the cardiac wards have no experience in dealing with patients with cognitive deficits. Therapists might find these patients less trying, and patients seem to be unmotivated. Information has to be repeated regularly. There also seem to be more patients lost to follow-up when compared with myocardial infarction patients. Patients have difficulty picking up their lives, for example, when resuming work or in their relationship. Also, spouses become more protective and are afraid to leave the patient alone, afraid to let the patient perform certain activities, and afraid to participate in social events in fear of recurrence.[23]
On the other hand, cognitive rehabilitation therapists often see only

patients with very severe cognitive problems after a CA. This specific group of patients lacks insight into their deficits, which hampers cognitive rehabilitation. Patients with relatively mild cognitive deficits, who profit most from a cognitive rehabilitation intervention, are often not referred.[24] Even more important, cognitive therapists feel unsure about the physical training of the OHCA patients, especially the cardiopulmonary exercise capacity and possible limitations. In addition, patients who receive only cognitive rehabilitation receive no information on the psychological, social, and lifestyle factors as given in the regular cardiac rehabilitation programs.
Some patients receive both cardiac and cognitive rehabilitation. In that case, the advice may be contradictory and the amount of training may exceed the possibilities of the patient. The provided care is not centred around the patient.

Goal of rehabilitation after cardiac arrest
The goal of rehabilitation after CA is to provide excellent patient-centred cardiac and cognitive rehabilitation to all patients and their spouses/carers to achieve optimal participation in society, with minimal burden on spouses and society.
In 2011 in Leiden, The Netherlands, the Rijnlands Rehabilitation Centre developed a care path, "Rehabilitation after Resuscitation."

Integrated clinical care path
In this article we will outline the prerequisites as used in the care path, Rehabilitation after Resuscitation to develop a local clinical pathway to reach the above mentioned goal based upon the best available evidence. The main principles of the clinical pathway are:

- Adequate referral to rehabilitation for all patients after successful resuscitation
- Simple screening for cognitive impairments
- Screening for emotional problems
- Information on possible cognitive and emotional consequences to all patients and spouses
- Cardiac rehabilitation for all patients with cardiac cause of CA
- Cognitive rehabilitation when needed
- One integrated rehabilitation program
- Support and information to spouse, caregiver and/or family
- Aftercare

Adequate referral for all patients after successful resuscitation
All patients with a cardiac cause of CA should, according to international guidelines, be referred for cardiac rehabilitation.[7,9] The European Cardiac Rehabilitation Inventory Survey found that many patients are not adequately referred for cardiac rehabilitation.[25] Patients who have been resuscitated frequently follow more complex routes through the hospital due to multiple medical interventions in several departments. This results in an increased likelihood that survivors after CA are not adequately referred for rehabilitation. Considering the high incidence of cognitive impairments due to hypoxic brain injury after CA, we also argue that patients with a non-cardiac cause of CA should be referred for rehabilitation.
It is recommended to make strict referral agreements between local hospitals and the rehabilitation centre(s) in the area. The Rijnlands Rehabilitation Centre follows CA patients from the moment the ambulance service presents patients at the emergency department. A specialized nurse of the rehabilitation centre follows the patients throughout the hospital. This ensures that all eligible patients will get the opportunity to follow a rehabilitation program after discharge from the hospital. As soon as the patient is dismissed from the hospital, the rehabilitation process starts automatically.

Recommendation 1
Make referral agreements. Start following the CA-patients in an early hospital phase, so patients are not missed. Describe who is responsible for the referral to the rehabilitation centre.

Simple screening for cognitive impairments
Cognitive problems after OHCA are often mild. Extensive neuropsychological tests are able to detect mild cognitive problems. However, these assessments take approximately 3 hours, which makes them not suitable as a screening instrument for clinical daily practice. One could argue to use the Cerebral Performance Category (CPC), part of the Utstein Template, for screening.[26] The CPC is a classification system that roughly estimates the functioning of the patient at the time of hospital discharge. Torgersen et al showed that the CPC is not capable of detecting mild cognitive problems and therefore not suitable as a screening instrument.[27] A study by Cronberg et al used four perspectives in their study: clinician reported, performance measures,

observer reported, and patient reported. They concluded that subtle cognitive dysfunction can be missed when using clinician-reported measures (CPC and modified Rankin Scale).[28] At the moment, there is no uniformity as to which short cognitive screening would be best for this specific patient group. As long as no consensus is available, we advise the use of locally available screening instruments that measure at least aspects of memory, attention, and executive functioning. Some commonly used cognitive tests and questionnaires are described below.

The Montreal Cognitive Assessment

The Montrean Cognitive Assessment (MoCA) is a screening instrument for mild cognitive impairment.[29] It assesses attention and concentration, executive functions, memory, language, visuo-constructive skills, conceptual thinking, counting and orientation. The test takes approximately 10 minutes. The maximum score is 30. A score is considered deviant if < 26. In that case, further analysis should be considered. The MoCA showed already reasonable sensitivity and specificity in heart failure patients (64% and 66%, respectively).[30] The MoCA is freely available in many languages at http://www.mocatest.org. The test can be administered after a short instruction by almost all care providers. The interpretation of the results is preferably done by a health professional with expertise in the cognitive field.

The Mini-Mental State Examination

The Mini-Mental State Examination (MMSE) is a short, 11-item cognitive scale ranging from 0 to 30 points.[31] The test assesses multiple domains of cognitive functioning: orientation, memory, concentration, language and praxis. A cut off score of <28 indicates possible cognitive deficits. It takes ~10 minutes to conduct the MMSE. Unfortunately patients with minimal cognitive deficits score maximal due to a ceiling effect.[32] Therefore we have chosen only to use the MMSE when the MoCA is too difficult for the patient.

The Informant Questionnaire on Cognitive Decline of the Elderly

The Informant Questionnaire on Cognitive Decline of the Elderly (IQCODE), the only validated test for partners, is filled out by the spouse or other close relative to measure the patient's decline in cognitive functioning.[33] The survey compares the current cognitive functioning with past cognitive decline. For this group of patients, the functioning

before the CA is taken as a reference point. A score ≥ 3.6 indicates cognitive problems. When using the IQCODE, it is important to keep in mind that the outcome can be affected by the partners' mental state. A partner can feel worried or anxious after the CA. Therefore, they might give too much weight to the problems they experience. Another possibility is that cognitive impairments are not yet visible to the partner due to euphoria about the patient still being alive.

The Cognitive Failures Questionnaire

The Cognitive Failures Questionnaire (CFQ) is a self-reporting questionnaire that provides insight into the experienced cognitive problems of the patient.[20] The items relate to memory and attention. A score of > 32 indicates that the patient might have cognitive problems. However, the CFQ outcome should be handled with care. A low score might be related to lack of insight in the cognitive problems. A high score could be caused by worries for cognitive problems or depression instead of cognitive deficits. Therefore, we advise mainly to use the CFQ if there seems to be a discrepancy between the burden of the patient and the MoCA screening.

Recommendation 2

Screen all survivors for cognitive impairments. The MoCA is a simple and concise instrument for this purpose.

Screening for emotional problems

To assess emotional problems like depression, anxiety and PTSD the following questionnaires can be considered.

Hospital Anxiety and Depression Scale

The Hospital Anxiety and Depression Scale (HADS) is a 14-item self-report screening scale to indicate symptoms of anxiety and depression.[11] It is a short questionnaire and easy to use. The HADS contains two 7-item scales: one for anxiety and one for depression, both with a score range of 0 to 21. For the subscales, a score ≤ 7 signifies that it is unlikely that there is an anxiety disorder or a depression, and a score of 8 to 10 represents a possible anxiety disorder or depression. Scores of ≥ 11 indicate a definite anxiety disorder or depression.[11] Further assessment regarding an anxiety disorder or depression is needed when the patient scores ≥ 8 on the subscale(s).

Patient Health Questionnaire
In case of an positive depression score on the HADS, one can consider further exploration with the Patient Health Questionnaire (PHQ-9). The PHQ-9 is a multipurpose instrument to screen, monitor and measure the severity of depression.[34] A score of >5 indicates depression and further action is recommended: The higher the score, the more severe the depression.

Generalised Anxiety Disorder Assessment
In case of a positive anxiety score on the HADS, one can consider further exploration with the Generalized Anxiety Disorder Assessment (GAD-7). The GAD-7 is a self-administered patient questionnaire screening tool and severity measure for generalized anxiety disorder. [35] A score of >5 indicates more than average anxiety: The higher the score, the more severe the anxiety. When the score is ≥10, further evaluation is recommended.

Recommendation 3
Screen all survivors for emotional complaints. The HADS is one of the possible short and easy instruments for this purpose.

Information on cognitive and emotional consequences to patients and spouses
Patients and spouses are in need of information on the possible consequences of the CA.
Recently, an intervention called 'Stand still. . ., and move on' was developed by V. Moulaert which provides information on possible cognitive and emotional consequences after the CA. The intervention supports patients and their partners to promote self-management. It improves overall emotional state, anxiety, and quality of life; it also results in faster return to work.[36] The intervention is feasible and useful for patients and spouses.[37] The intervention can be given at the time of the screening.

The following items are addressed:
- Information on and explanation of possible cognitive problems
- Relationship between CA and lack of brain oxygenation
- Possible effect on cognition: forgetfulness, decreased concentration, mental slowness, difficulty following conversations (especially in

noisy places), and irritability
- Advice on how to deal with cognitive problems
- Information on other possible consequences for both
- patient and spouse
- Information about the normal process of emotional recovery of patient and caregiver
- Possible emotional changes (e.g., anxiety, depression)
- Physical and mental fatigue
- Advice on how to deal with emotional problems
- Fear of recurrence, dealing with death, fear for implantable cardioverter-defibrillator shocks (if relevant), social isolation
- Stress and burden of the caregiver
- Information about the rehabilitation care pathway
- Information about goals and possibilities at cardiac rehabilitation
- Information about goals and possibilities at cognitive rehabilitation

At the Rijnlands Rehabilitation Centre, the intervention is performed by a specialized nurse 4 weeks after patients are discharged from the hospital. During this visit, the screening is also performed. Instead of the specialized nurse, the intervention can also be performed by a physician assistant
or a therapist.

Recommendation 4
Provide information to all CA survivors on possible cognitive and emotional consequences in an early phase after dismissal from hospital.

Cardiac rehabilitation for all patients with cardiac cause of CA
Cardiac rehabilitation focuses on the physical, psychological, and social functioning of the patient after a cardiac event. Measures are also taken to prevent recurrence of (coronary) artery disease. Cardiac rehabilitation consists of coherent programs with comprehensive medical evaluations and prescribed exercises. Psychological counseling, information, and advice on lifestyle and coping are given to reduce the risk of sudden death or new infarcts. The rehabilitation starts during the hospital stay, and should be followed by a program during an outpatient phase over the next 3 to 6 months, followed by lifelong maintenance in which physical training and reduction of risk factors are integrated in daily life with or without (minimal) supervision.[5]

Cardiac rehabilitation has proven to have a positive effect on secondary prevention and mortality.[38] It also increases psychosocial well-being and return to work.[13,39]

Recommendation 5
Provide adequate cardiac rehabilitation for all patients with a cardiac cause of CA, aiming at optimization of physical condition and secondary prevention. Do not forget to provide this care for patients with cognitive impairments.

Cognitive rehabilitation when needed
For patients with acquired brain injury, cognitive rehabilitation has proven to be effective.[40] During cognitive rehabilitation, people learn in an interdisciplinary setting how to compensate for their cognitive impairments and how to use resources to retain optimal participation in society. Cognitive
rehabilitation also comprises psychoeducation to help patients and their families learn how to cope with the cognitive and emotional consequences of the brain injury.[41] There are no studies to date on the effectiveness of cognitive rehabilitation for patients with hypoxic brain injury due to CA. However, it is highly likely that OHCA survivors with cognitive deficits also benefit from cognitive rehabilitation interventions in the same way patients with other types of acquired brain injury do.

Recommendation 6
The threshold for referring CA survivors for neuropsychological assessment and cognitive rehabilitation programs should be low.

One integrated rehabilitation plan
To provide appropriate care tailored to patients' specific
situations, the care path (►Fig. 1), Rehabilitation after Resuscitation consists of three routes: Patients without cognitive problems start with regular cardiac rehabilitation. For patients who score below the cutoff on the cognitive screening, two possible routes can be followed. Patients with severe cognitive
problems (MoCA < 19) are advised to follow an individual cognitive rehabilitation program. The route of patients with mild cognitive

problems depends mainly on the desired level of participation and the support from (family) caregivers. The severity of the cognitive complaints and the nature of the request of help is leading. Quite often there is the need for further exploration of the cognitive complaints. These patients are offered a combined cardiac and cognitive rehabilitation program of the care path. At the Rijnlands Rehabilitation Centre, ~50% of the patients with mild cognitive complaints follow a more-extensive cognitive rehabilitation process.

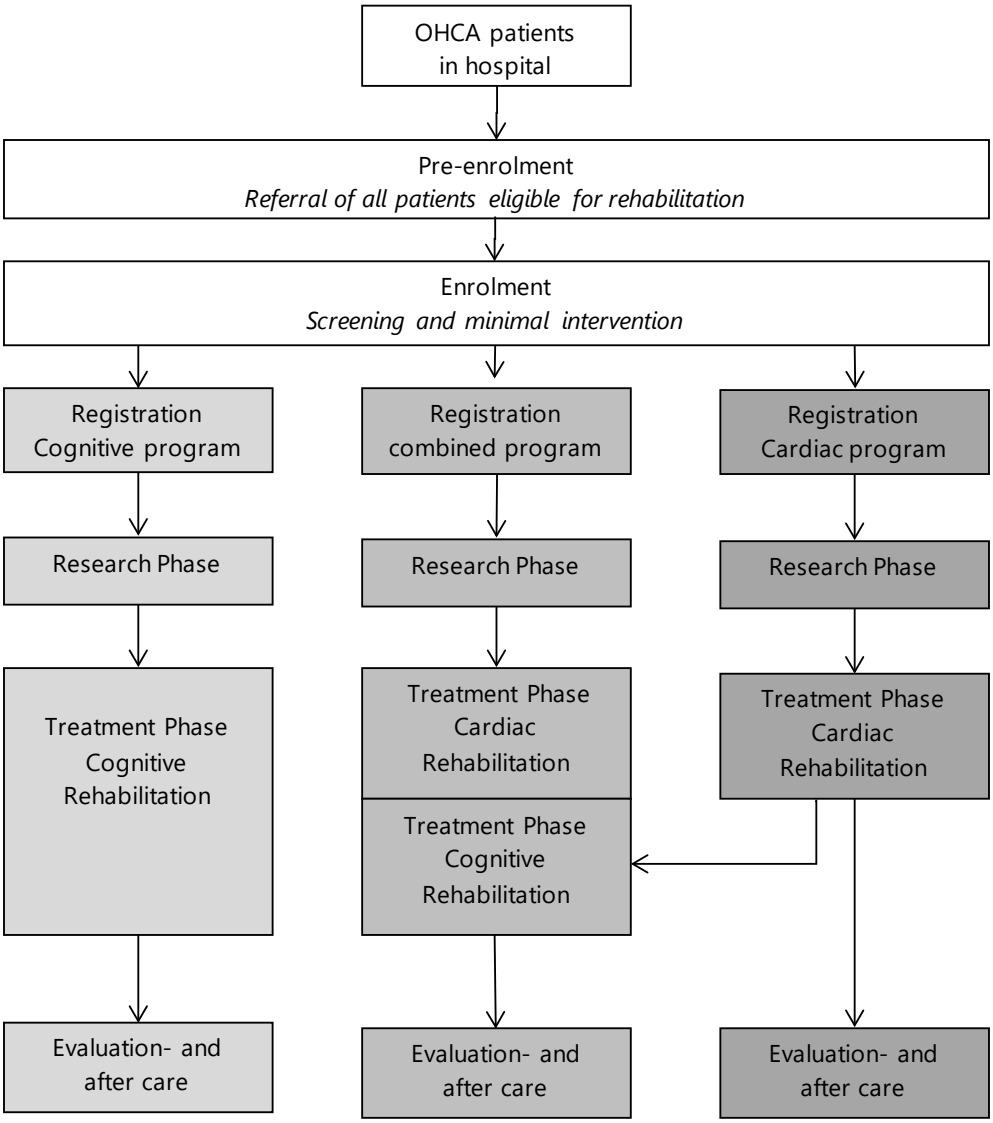

Fig 1 Care path of rehabilitation after resuscitation.
OHCA, out-of-hospital cardiac arrest.

Regular cardiac rehabilitation

Patients without cognitive complaints follow a cardiac rehabilitation program as recommended by international guidelines.[42–47] The core components of cardiac rehabilitation contain physical activity, health education, advice on cardiovascular risk reduction, and stress management.

Besides the cardiologist/physician, a physiotherapist, social worker, psychologist, and dietician are involved. Therapists should always be alert for symptoms of cognitive impairment. If any evidence of cognitive problems is detected during the cardiac rehabilitation process, a patient may be referred to a cognitive rehabilitation therapist for assessment. Additionally, the mental and emotional burden of the caregiver should be monitored more closely than for other patients in regular cardiac rehabilitation.

Individual cognitive rehabilitation

Patients with severe cognitive impairments start an individual rehabilitation program. The individual rehabilitation program is offered under the supervision of a rehabilitation specialist. The cardiologist, as consultant, gives advice on the cardiac training. The physiotherapist and rehabilitation physician of the cognitive rehabilitation ward should be aware of the training principles of cardiac rehabilitation.

Additionally, a neuropsychologist, social worker, and occupational therapist are part of the team. Individual goals are set in interdisciplinary team consultations depending on the need of the client and family and cognitive and physical possibilities.

The main goal of the therapy is to get the patient as independent as possible with optimal participation including social activities and return to work.

When possible and indicated, psychological, social, and lifestyle components of the cardiac rehabilitation program can be followed as part of the cardiologic rehabilitation department. If still needed, cardiac rehabilitation takes place after the cognitive rehabilitation.

Combined cardiac and cognitive rehabilitation

Patients with mild-to-moderate cognitive impairments follow a combined cardiac and cognitive rehabilitation program. They start with the cardiac rehabilitation program. Due to mild cognitive deficits, patients often suffer from sensory processing disorders. Therefore, we advise to offer the cardiac rehabilitation in a relatively small group (at the

Rijnlands Rehabilitation Centre, a maximum of eight patients), same staff every time, and low-volume level or no music. The physiotherapist from the cardiac rehabilitation team is trained to handle the consequences of cognitive problems. Near the end of the cardiac rehabilitation, an appointment is made with a cognitive rehabilitation specialist from the department of neurologic rehabilitation. On the basis of complaints and requests for help, the cognitive rehabilitation specialist assesses whether neuropsychological examination or cognitive rehabilitation is indicated.

Recommendation 7
Make both practical and formal agreements between cardiac and cognitive rehabilitation departments.

Support and information to spouse/family
After resuscitation, education about visible and invisible consequences of the CA is not only important for the patient, but also for relatives. This education begins during the screening for possible cognitive and emotional problems. During the cardiac and cognitive rehabilitation, specific attention needs to be paid to the spouse. We have had several instances in which spouses/family members experienced cardiac problems themselves in the period after the CA of the patient. Posttraumatic stress symptoms,
depression, and fear are common.[48] Often, supportive contact with a social worker is sufficient as intervention.
Sometimes, at the end of rehabilitation, the spouse still needs support. In The Netherlands, the Patient Partner Education Program 4All (PPEP4All) is offered for spouses of chronically diseased patients. This self-management program provides strategies for patients and spouses to manage the psychosocial consequences of the patient's disease from their own point of view. The program promotes the autonomy and self-reliance of both the patient and the spouse.[49]

Caregiver Strain Index
The Caregiver Strain Index (CSI) is a 13-item questionnaire designed to quickly identify partners with potential caregiving concerns. There is at least one item for each of the following major domains: employment, financial, physical, social, and time. Positive responses to seven or more items indicate a greater level of strain. The instrument can be used to

assess individuals of any age who are caregiver for an older adult.

Recommendation 8
Take care of the spouse and use CSI to identify concerns of the caregiver!

After care
Sometimes, cognitive and emotional complaints are not dominant in the sub acute phase, but arise (somewhat) later, for instance, when people return to work or when family circumstances change. Our clinical pathway showed that ~ 10% of the patients experience problems one year after the CA. We therefore recommend a short screening one year after the CA. A short conversation (by telephone) could be enough to detect issues. If present, an outpatient consultation of the rehabilitation physician can be scheduled.

Recommendation 9
Cognitive and emotional problems also may arise in a later stage after CA. Be aware of this and ask your patient.

Prerequisites
In order to make an excellent clinical rehabilitation pathway for CA patients, it is important to make good agreements, both in practical terms and at logistic/ administrative level, for example, cooperation agreements.

- Who initiates inclusion in the care path? Who screens for cognitive impairments and provides first information on possible cognitive and emotional consequences?
- Who decides in which route of the care path the patient starts?
- To offer an integrated rehabilitation care path, therapists of the cardiac rehabilitation need to have basic knowledge of cognitive problems. Reciprocally, therapists from the cognitive team need sufficient knowledge of cardiac training principles.
- Agreements on transfer between cardiac and cognitive rehabilitation departments are a prerequisite for success. Which information is transferred and by whom?

At the Rijnlands Rehabilitation Centre, we decided that every (para) medical therapist transfers information to his or her own counterpart. Of course, training results are also shared between teams.

Results of the integrated rehabilitation care path

In Leiden, 75% of all patients after OHCA are referred for cardiac rehabilitation. Patients who are not referred live in an institution or suffer from a severe comorbidity that hinders participation in rehabilitation. So we reached our first goal: adequate cardiac rehabilitation care for all resuscitated patients. Education was provided to all CA survivors and their family and a simple screening for cognitive problems was performed. Of the patients who were referred for cardiac rehabilitation, 23% experienced cognitive problems. One month after the OHCA, all patients experienced a lower QoL. For patients with cognitive impairments, the QoL was even worse.[50]

An inventory of patients' experiences with the care path was done by means of two focus groups performed according to guidelines for qualitative research. Both patients with and without cognitive complaints were satisfied with the content of the cognitive screening. Patients who did not show any

cognitive problems on the screening reported that they had more confidence in resuming everyday tasks and work.

Patients who showed possible cognitive complaints on the screening were offered an appointment with the cognitive rehabilitation physician. In approximately half of them, explanation and instructions by the rehabilitation physician were sufficient. In the other half, an extensive cognitive rehabilitation program was started.

Conclusions

It is essential to be aware of the high incidence of cognitive impairments in CA survivors. The MoCA seems to be a good screening instrument for cognitive impairments. The threshold for referring CA survivors for neuropsychological assessment should be low. Health care providers must be aware that
rehabilitation programs are available and can be of benefit for patients with cognitive impairments after CA. Local care chain arrangements aid in streamlining both referral to cardiac rehabilitation and from cardiac care to cognitive rehabilitation services.

Recommendation 10
When starting a local rehabilitation care path in your region, feel free to contact the authors.

References

1 Berdowski J, Berg RA, Tijssen JGP, Koster RW. Global incidences of out-of-hospital cardiac arrest and survival rates: systematic review of 67 prospective studies. Resuscitation 2010;81(11): 1479–1487.
2 Spaulding CM, Joly LM, Rosenberg A, et al. Immediate coronary angiography in survivors of out-of-hospital cardiac arrest. N Engl J Med 1997;336(23):1629–1633.
3 Anyfantakis ZA, Baron G, Aubry P, et al. Acute coronary angiographic findings in survivors of out-of-hospital cardiac arrest. Am Heart J 2009;157(2):312–318.
4 Smith K, Andrew E, Lijovic M, Nehme Z, Bernard S. Quality of life and functional outcomes 12 months after out-of-hospital cardiac arrest. Circulation 2015;131(2):174–181
5 Piepoli MF, Corrà U, Benzer W, et al; Cardiac Rehabilitation Section of the European Association of Cardiovascular Prevention and Rehabilitation. Secondary prevention through cardiac rehabilitation: from knowledge to implementation. A position paper from the Cardiac Rehabilitation Section of the European Association of Cardiovascular Prevention and Rehabilitation. Eur J Cardiovasc Prev Rehabil 2010;17(1):1–17
6 Perk J, De Backer G, Gohlke H, et al; European Association for Cardiovascular Prevention & Rehabilitation (EACPR); ESC Committee for Practice Guidelines (CPG). European guidelines on cardiovascular disease prevention in clinical practice (version 2012). The Fifth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of nine societies and by invited experts). Eur Heart J 2012;33(13):1635–1701
7 Wilder Schaaf KP, Artman LK, Peberdy MA, et al; Virginia Commonwealth University ARCTIC Investigators. Anxiety, depression, and PTSD following cardiac arrest: a systematic review of the literature. Resuscitation 2013;84(7):873–877
8 Moulaert VRMP, Verbunt JA, van Heugten CM, Wade DT. Cognitive impairments in survivors of out-of-hospital cardiac arrest: a systematic review. Resuscitation 2009;80(3):297–305
9 Wachelder EM, Moulaert VRMP, van Heugten C, Verbunt JA, Bekkers SCAM, Wade DT. Life after survival: long-term daily functioning and quality of life after an out-of-hospital cardiac arrest. Resuscitation 2009;80(5):517–522
10 Brooks DN, McKinlay W. Personality and behavioural change after severe blunt head injury–a relative's view. J Neurol Neurosurg Psychiatry 1983;46(4):336–344
11 Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand 1983;67(6):361–370
12 Phelps R, Dumas F, Maynard C, Silver J, Rea T. Cerebral Performance Category and long-term prognosis following out-of-hospital cardiac arrest. Crit Care Med 2013;41(5): 1252–1257
13 Mateen FJ, Josephs KA, Trenerry MR, et al. Long-term cognitive outcomes following out-of-hospital cardiac arrest: a populationbased study. Neurology 2011;77(15):1438–1445
14 Singh B, Murad MH, Prokop LJ, et al. Meta-analysis of Glasgow Coma Scale and simplified motor score in predicting traumatic brain injury outcomes. Brain Inj 2013;27(3): 293–300
15 Lim C, Verfaellie M, Schnyer D, Lafleche G, Alexander MP. Recovery, long-term cognitive outcome and quality of life following out-of-hospital cardiac arrest. J Rehabil Med 2014;46(7):691–697
16 Tiainen M, Poutiainen E, Kovala T, Takkunen O, Häppölä O, Roine RO. Cognitive and neurophysiological outcome of cardiac arrest survivors

treated with therapeutic hypothermia. Stroke 2007; 38(8):2303–2308
17 Cronberg T, Lilja G, Rundgren M, Friberg H, Widner H. Long-term neurological outcome after cardiac arrest and therapeutic hypothermia. Resuscitation 2009;80(10):1119–1123
18 Lilja G, Nielsen N, Friberg H, et al. Cognitive function in survivors of out-of-hospital cardiac arrest after target temperature management at 33°C versus 36°C. Circulation 2015;131(15):1340–1349
19 Broadbent DE, Cooper PF, FitzGerald P, Parkes KR. The Cognitive Failures Questionnaire (CFQ) and its correlates. Br J Clin Psychol 1982;21(Pt 1):1–16
20 Pusswald G, Fertl E, Faltl M, Auff E. Neurological rehabilitation of severely disabled cardiac arrest survivors. Part II. Life situation of patients and families after treatment. Resuscitation 2000;47(3):241–248
21 Anderson CS, Linto J, Stewart-Wynne EG. A population-based assessment of the impact and burden of caregiving for longterm stroke survivors. Stroke 1995;26(5):843–849
22 Dougherty CM, Benoliel JQ, Bellin C. Domains of nursing intervention after sudden cardiac arrest and automatic internal cardioverter defibrillator implantation. Heart Lung 2000;29(2): 79–86
23 Doolittle ND, Sauvé MJ. Impact of aborted sudden cardiac death on survivors and their spouses: the phenomenon of different reference points. Am J Crit Care 1995;4(5):389–396
24 Cicerone KD, Langenbahn DM, Braden C, et al. Evidence-based cognitive rehabilitation: updated review of the literature from 2003 through 2008. Arch Phys Med Rehabil 2011;92(4):519–530
25 Bjarnason-Wehrens B, McGee H, Zwisler AD, et al; Cardiac Rehabilitation Section European Association of Cardiovascular Prevention and Rehabilitation. Cardiac rehabilitation in Europe: results from the European Cardiac Rehabilitation Inventory Survey. Eur J Cardiovasc Prev Rehabil 2010;17(4):410–418
26 Langhelle A, Nolan J, Herlitz J, et al; 2003 Utstein Consensus Symposium. Recommended guidelines for reviewing, reporting, and conducting research on post-resuscitation care: the Utstein style. Resuscitation 2005;66(3):271–283
27 Torgersen J, Strand K, Bjelland TW, et al. Cognitive dysfunction and health-related quality of life after a cardiac arrest and therapeutic hypothermia. Acta Anaesthesiol Scand 2010;54(6):721–728
28 Cronberg T, Lilja G, Horn J, et al; TTM Trial Investigators. Neurologic function and health-related quality of life in patients following targeted temperature management at 33°C vs 36°C after out-of-hospital cardiac arrest: a randomized clinical trial. JAMA Neurol 2015;72(6):634–641
29 Nasreddine ZS, Phillips NA, Bédirian V, et al. The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. J Am Geriatr Soc 2005;53(4): 695–699
30 Hawkins MA, Gathright EC, Gunstad J, et al. The MoCA and MMSE as screeners for cognitive impairment in a heart failure population: a study with comprehensive neuropsychological testing. Heart Lung 2014;43(5):462–468
31 Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12(3):189–198
32 Van Heugten CM, Walton L, Hentschel U. Can we forget the Mini Mental State Examination? A systematic review of the validity of cognitive screening instruments within one month after stroke. Clin Rehabil 2015;29(7):694–704
33 Jorm AF. The Informant Questionnaire on cognitive decline in the elderly (IQCODE): a review. Int

Psychogeriatr 2004;16(3):275–293
34 Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med 2001;16(9):606–613
35 Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch Intern Med 2006;166(10):1092–1097
36 Moulaert VR, van Heugten CM, Winkens B, et al. Early neurologicallyfocused follow-up after cardiac arrest improves quality of life at one year: A randomised controlled trial. Int J Cardiol 2015;193:8–16
37 Moulaert VR, van Haastregt JC, Wade DT, van Heugten CM, Verbunt JA. 'Stand still …, and move on', an early neurologically-focused follow-up for cardiac arrest survivors and their caregivers: a process evaluation. BMC Health Serv Res 2014;14:34
38 Anderson L, Thompson DR, Oldridge N, et al. Exercise-based cardiac rehabilitation for coronary heart disease. Cochrane Database Syst Rev 2016;1(1):CD001800
39 Yohannes AM, Doherty P, Bundy C, Yalfani A. The long-term benefits of cardiac rehabilitation on depression, anxiety, physical activity and quality of life. J Clin Nurs 2010;19(19–20):2806–2813
40 van Heugten C, Gregório GW, Wade D. Evidence-based cognitive rehabilitation after acquired brain injury: a systematic review of content of treatment. Neuropsychol Rehabil 2012;22(5):653–673
41 Daviet JC, Bonan I, Caire JM, et al. Therapeutic patient education for stroke survivors: non-pharmacological management. A literature review. Ann Phys Rehabil Med 2012;55(9–10):641–656
42 Buckley JP, Furze G, Doherty P, et al; BACPR. BACPR scientific statement: British standards and core components for cardiovascular disease prevention and rehabilitation. Heart 2013;99(15):1069–1071
43 MI – secondary prevention: secondary prevention in primary and secondary care for patients following a myocardial infarction [CG172]. London, UK: National Institute for Health and Care Excellence; 2013 Available at: www.nice.org.uk/guidance/cg172. Accessed October 24, 2016
44 JBS3 Board. Joint British societies' consensus recommendations for the prevention of cardiovascular disease (JBS3). Heart 2014;100 (Suppl 2):ii1–ii67
45 Piepoli MF, Corrà U, Adamopoulos S, et al; Endorsed by the Committee for Practice Guidelines of the European Society of Cardiology. Secondary prevention in the clinical management of patients with cardiovascular diseases. Core components, standards and outcome measures for referral and delivery: a policy statement from the cardiac rehabilitation section of the European Association for Cardiovascular Prevention & Rehabilitation. Eur J Prev Cardiol 2014;21(6):664–681
46 Balady GJ, Williams MA, Ades PA, et al; American Heart Association Exercise, Cardiac Rehabilitation, and Prevention Committee, the Council on Clinical Cardiology; American Heart Association Council on Cardiovascular Nursing; American Heart Association Council on Epidemiology and Prevention; American Heart Association Council on Nutrition, Physical Activity, and Metabolism; American Association of Cardiovascular and Pulmonary Rehabilitation. Core components of cardiac rehabilitation/secondary prevention programs: 2007 update: a scientific statement from the American Heart Association Exercise, Cardiac Rehabilitation, and Prevention Committee, the Council on Clinical Cardiology; the Councils on Cardiovascular Nursing, Epidemiology and Prevention, and Nutrition, Physical Activity, and Metabolism; and the American Association of Cardiovascular and Pulmonary Rehabilitation.

Circulation 2007;115(20):2675–2682
47 Leon AS, Franklin BA, Costa F, et al; American Heart Association; Council on Clinical Cardiology (Subcommittee on Exercise, Cardiac Rehabilitation, and Prevention); Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity); American association of Cardiovascular and Pulmonary Rehabilitation. Cardiac rehabilitation and secondary prevention of coronary heart disease: an American Heart Association scientific statement from the Council on Clinical Cardiology (Subcommittee on Exercise, Cardiac Rehabilitation, and Prevention) and the Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity), in collaboration with the American
association of Cardiovascular and Pulmonary Rehabilitation. Circulation 2005;111(3):369–376
48 Jones C, Skirrow P, Griffiths RD, et al. Post-traumatic stress disorder-related symptoms in relatives of patients following intensive care. Intensive Care Med 2004;30(3):456–460
49 A'Campo LE, Wekking EM, Spliethoff-Kamminga NG, Le Cessie S, Roos RA. The benefits of a standardized patient education program for patients with Parkinson's disease and their caregivers. Parkinsonism Relat Disord 2010;16(2):89–95
50 Boyce-van der Wal LW, Volker WG, Vliet Vlieland TPM, van den Heuvel DM, van Exel HJ, Goossens PH. Cognitive problems in patients in a cardiac rehabilitation program after an out-of hospital cardiac arrest. Resuscitation 2015;93:63–68