REVIEW

The patient with severe traumatic brain injury: clinical decision-making: the first 60 min and beyond

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On behalf of all focus group participants

Purpose of review

There is an urgent need to discuss the uncertainties and paradoxes in clinical decision-making after severe traumatic brain injury (s-TBI). This could improve transparency, reduce variability of practice and enhance shared decision-making with proxies.

Recent findings

Clinical decision-making on initiation, continuation and discontinuation of medical treatment may encompass substantial consequences as well as lead to presumed patient benefits. Such decisions, unfortunately, often lack transparency and may be controversial in nature. The very process of decision-making is frequently characterized by both a lack of objective criteria and the absence of validated prognostic models that could predict relevant outcome measures, such as long-term quality and satisfaction with life. In practice, while treatment-limiting decisions are often made in patients during the acute phase immediately after s-TBI, other such severely injured TBI patients have been managed with continued aggressive medical care, and surgical or other procedural interventions have been undertaken in the context of pursuing a more favorable patient outcome. Given this spectrum of care offered to identical patient cohorts, there is clearly a need to identify and decrease existing selectivity, and better ascertain the objective criteria helpful towards more consistent decision-making and thereby reduce the impact of subjective valuations of predicted patient outcome.

Summary

Recent efforts by multiple medical groups have contributed to reduce uncertainty and to improve care and outcome along the entire chain of care. Although an unlimited endeavor for sustaining life seems unrealistic, treatment-limiting decisions should not deprive patients of a chance on achieving an outcome they would have considered acceptable.

Keywords

decision-making, end of life, medical ethics, prognosis, traumatic brain injury

INTRODUCTION

Many patients who sustain severe traumatic brain injury (s-TBI) die after trauma or survive with (severe) disabilities [1▪,2,3▪,4▪,5]. Performing lifesaving (surgical) interventions may result in survival, but there is neither a common opinion on how to define an unfavorable outcome, nor on the time horizon of assessing such outcome [5–8,9▪]. Treatment-limiting decisions likely result in clinical deterioration and death [10,11,12▪▪]. Most acute treatment decisions are poorly supported by high-quality evidence and prognostic algorithms, leaving shared decision-making complex [8,13▪,14,15▪]. Perhaps in light of such lack of clarity, nonadherence to guidelines and substantial treatment variation remains pervasive [16,17,18▪].

Therefore, we examine such treatment paradoxes by reviewing the literature and reporting on several interdisciplinary panel meetings that

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KEY POINTS

- Although multiple recent efforts have contributed to reduce uncertainty and to improve care and outcome for severe traumatic brain injury (s-TBI) patients along the entire chain of care, there remain many uncertainties and paradoxes and a lack of objective criteria in clinical decision-making after s-TBI.
- Although important for decision-making, well validated prognostic models predicting long-term outcome on quality of life and satisfaction with life after s-TBI are currently unavailable.
- Some of the most severely injured TBI patients have been reported to have achieved ‘favorable’ outcome and (surgical) interventions are generally considered beneficial for patient outcome.
- To further improve s-TBI care, future research should identify and decrease the existing selectivity and identify objective criteria in decision-making and reduce the impact of subjective valuations of predicted patient outcome.

focused on clinical decision-making in initiating or withholding (surgical) intervention to patients after s-TBI. This position paper was written following a series of discussions with an expert panel of professionals from different backgrounds, and should serve as a starting point for further discussions rather than constitute a final outcome process.

PROFESSIONAL CODE OF PHYSICIANS

Physicians practice medicine by working according to several codes of conduct and by following four universally accepted moral principles in medical ethics (Table 1) [19–23].

Autonomy of the patient is inherently compromised in patients with s-TBI, and proxies are often absent during the acute phase, improperly designated, or incapable of substitute informed decision-making [24■,25,26■■]. Physicians then are responsible for selecting a strategy they consider in line with a patients’ best interests, that is, *beneficence*. However, both medical and surgical or procedural interventions carry risks of inducing harm, creating a difficult equilibrium between beneficence and nonmaleficence [2,9■,27,28]. Lastly, justice requires the fair distribution of benefits, risks and limited medical goods and services. As such, resources should ethically be restricted when used on so-called ineffective and disproportional treatment efforts, as it will deprive other patients of potentially effective treatments.

TREATMENT-LIMITING DECISIONS

Treatment-limiting decisions, including withholding lifesaving (surgical) interventions or withdrawal of life-sustaining medical treatment, are sometimes made within the first 2 days after s-TBI, allowing for, and leading to consequences of death, further deterioration and depriving patients a chance for recovery [10,12■■,29■]. Furthermore, defining recovery is relative, as it may encompass the entire spectrum from saving a patients’ life, achieving good health-related quality of life, to entire satisfaction with one’s recovery [1■,4■,30,31■,32■].

Although withdrawal of life-sustaining measures can be morally justified, and in line with patients’ and proxies’ preferences and values, it should be noted that such decisions are typically based on nondate-driven clinical prognostication, the goal of achieving survival with an imprecisely defined ‘favorable’ outcome [33■■]. As ‘favorable’ outcome has been reported in even some of the most severely injured patients, treatment-limiting decisions in patients that might have achieved ‘favorable outcome’ must, therefore, arguably be difficult to uphold on ethical and moral grounds [2,4■].

REASONS FOR TREATMENT-LIMITING DECISIONS

Several recent studies have aimed to identify what specific reasons or values constitute decision-making in severe brain injuries by medical teams, proxies or patients, but much remains unexplained [10,12■■,18■,34■,35,36]. Physicians are likely to

Table 1. Moral principles in medical ethics

Principle	Description
Autonomy	A norm of respecting and supporting autonomous decisions.
Beneficence	A group of norms pertaining to relieving, lessening, or preventing harm and providing benefits and balancing benefits against risks and costs.
Nonmaleficence	A norm of avoiding the causation of harm.
Justice	A group of norms for fairly distributing benefits, risks, and costs.

Table 2. Reasons, including potential outcome perspectives, to strongly consider treatment-limiting decisions

Number	Proposed reasons
1	Brain death, from a patient perspective (not considering interests regarding organ donation procedures) [38,39]
2	(chronic) Unresponsive wakefulness syndrome [40▪▪,41▪▪]
3	Minimally conscious state – (minus) (i.e. visual pursuit, localization of noxious stimuli, appropriate smiling or crying to emotional stimuli) [40▪▪,42]
4	An available, unquestionable, written and signed specific advance directive of the patient that prohibits treatment in a specific situation (possibly related to expected outcome)
5	A proxy opinion that is unquestionably based on patient preferences and that is not in conflict with the attending medical teams' considerations, that prohibits treatment in a specific situation (possibly related to expected outcome)
6	A patient's view (or when necessary a reconstructed vision through surrogates) on life and quality of life is contrary to the outcome that can be expected from the best available prognostic models.
7	Treatment costs along the whole chain of care that are not cost-effective and higher than the maximum amount that has been decided by national legislation

Reasons are reported in random order.

include their personal valuation of predicted patient outcome in their treatment considerations based on a mix of factors, such as religious background, personal and clinical experience, culture, national legislation, and even the socioeconomic status of the patient [18▪,37]. This introduces the risk of selectivity and is not evidence-based medicine [18▪].

To elaborate on this, the authors, specialists in neurosurgery, intensive care medicine, rehabilitation, chronic care, anthropology and medical ethics, executed a multiple occasion professionally led focus group discussion. We explored and described the process and reasoning of decision-making in this manuscript and propose several reasons that would legitimize treatment-limiting decisions (Table 2).

'ACCEPTABLE' VERSUS 'UNACCEPTABLE' OUTCOME

Valuation of outcome is probably one of the most important aspects in decision-making, but exact definitions of acceptable or unacceptable outcome after s-TBI remain elusive [18▪,43]. In literature, 'upper severe disability' (Glasgow Outcome Scale-Extended) and 'the inability to walk' or 'functionally dependent' (Modified Rankin Scale of 4) are sometimes considered favorable outcomes, whereas most physicians and researchers would classify this outcome degree as unfavorable [43,44]. Most competent individuals, irrespective of age, religion or background, consider survival with unfavorable outcome on the Glasgow Outcome Scale (GOS) unacceptable. However, survivors with so-called 'unfavorable outcome' after decompressive craniectomy for s-TBI and caregivers of patients after decompressive craniectomy appear to change their definition of 'a good quality of life' (QOL) and would have provided retrospective consent for the intervention [9▪,32▪]. Clearly, the favorable/unfavorable cut-off point used in prognostic models and TBI studies does not necessarily represent an acceptable/unacceptable outcome for patients [9▪,43].

Healthy individuals are generally unable to predict accurately what future QOL would be acceptable or unacceptable to them, because they often underestimate their ability to adapt to levels of disability they previously considered unacceptable [45]. The absence of a linear connection between disabilities and experienced QOL known as the disability paradox is seen in patients with severe disabilities reporting a good QOL (i.e. s-TBI, locked-in syndrome, Duchenne) [9▪,46,47]. This does not validate lifesaving/sustaining interventions in all patients, but suggests that physicians should acknowledge that an unacceptable outcome in their opinion may not necessarily be unacceptable to patients.

Determining cut-off points of acceptability is highly arbitrary and nearly impossible because of countless outcome possibilities and substantial variation in peoples' ever-changing desires and interpretations of a 'good life'. For instance, a life could be worth sustaining regardless of any favorability classifications because it has intrinsic value to relatives and friends, or because of cultural or religious reasons [48▪].

PROGNOSTIC UNCERTAINTY

Accurate outcome prediction remains unavailable, although it has huge consequences on decision-making and it is crucial for patients, proxies and physicians [18▪,35,45,49,50]. Physicians are frequently unable to make accurate predictions and although prognostication may be considered straightforward at the extremes of the spectrum, it remains difficult in the middle [29▪,36,45]. This is disturbing, as a physician's perception on long-term prognosis likely influences treatment decisions. The long-term physical, cognitive, emotional and behavioral outcome after TBI is determined by injury characteristics as well as by contextual factors of the patient and the caregiver. Such issues are not covered in the CRASH and IMPACT prognostic models that focus on mortality and severe disability at 6 months' post injury. Although helpful in estimating survival, these models do not cover outcomes, such as independence in daily living and ultimately perceived satisfaction with life [45,51,52,53▪,54▪▪].

The reasons for failure of prediction are: the heterogeneous nature of s-TBI and concurring comorbidities and their unknown effect on outcome [50,55,56▪,57]; unclear/incomplete clinical information, including a patient's neurological state or level of consciousness [58,59]; largely unknown pathophysiological mechanisms of brain injury and inherent degree of plasticity [50,60▪▪,61▪,62, 63,64▪]; prediction models do not include long-term (health-related) QOL, although long-term outcome changes have been reported and patients/proxies value this outcome [3▪,28,31▪,65,66]; prediction models are based on large retrospective data sets that do not necessarily reflect current or future treatment strategies [8,67,68▪,69].

Balancing between beneficence and nonmaleficence in clinical decision-making after s-TBI is a process of weighing the chance between favorable and nonfavorable outcome based on clinical expertise and subjective evaluations with ill-defined clinical endpoints [45]. Yet, it is considered common sense that lifesaving interventions should be withheld when the predicted risk of 'unfavorable' outcome is high, whereas depriving a patient of a possible favorable outcome can be seen as inappropriate care. The approach to treat all patients with the potential to survive inherently includes the risk of survival with an unacceptable outcome. All physicians should appreciate and communicate the existing multidimensional uncertainty, and decisions should not be guided by assumptions that falsely confer a sense of certainty [29▪,33▪▪].

The risk of selection bias and self-fulfilling prophecies should be noted. Assumptions on poor prognosis that lead to treatment-limiting decisions and probably contribute to a worse outcome and possibly death in selected cases [12▪▪,33▪▪,70].

IMPROVING PROGNOSTICATION

In clinical care the estimated prognosis is based on clinical characteristics, subjective evaluation of the clinician and contextual information at a short interval post onset. However, prognosis after s-TBI is dynamic in which the passage of time changes the predicted probability of a favorable outcome [71▪,72]. In case of prognostic uncertainty and a small chance of 'acceptable' outcome, full critical care treatment should be initiated and continued to allow for best possible recovery. Information on clinical progress, neurological recovery, the patient's treatment and outcome preferences (when necessary through proxies), and multidisciplinary discussion (ideally with moral council) need to be included in decision-making – and this information only becomes available with time.

Striving for personalized care is promising and allows for appreciation of the general injury applied in an individualized context [73]. In the subacute phase, frequent re-evaluation and communication are essential; when treatment has become disproportionate, given the outcome, withdrawal of life-sustaining measures can be considered even at later moments in time. Despite the associated increased healthcare consumption and costs, the survival of patients with severe disabilities and the longer period of suffering for patients/proxies can be legitimized if more patients survive with acceptable outcome.

PATIENT, PROXY OR SHARED DECISION-MAKING

Values, preferences and treatment wishes of patients (when necessary obtained through proxies) are to be respected and should be incorporated in clinical decision-making. Patient with s-TBI are incapable to decide, and their preferences have rarely been discussed with proxies or recorded in an (written) advance directive [18▪,48▪]. Proxies are then confronted with difficult treatment dilemmas, but information as desired by proxies is not always provided and a patients' social circumstances and preferences are not always included in physicians' decision-making process [34▪,35]. Proxies might also misjudge or deliberately misrepresent patients' preferences [24▪,74].

Proxies are mostly unprepared, confused by uncertainty and hope, and unequipped to fully understand the uncertainties of prognostication and clinical decision-making [7,75].

This puts a high burden on the clinician's shoulders. Although medical paternalism is increasingly replaced by 'shared decision-making', the latter remains a difficult, if not impossible proposition when required in neurocritical care [26▪▪,76▪]. To improve conversations with proxies, it is recommended to provide early, frequent, understandable, honest, and consistent multidisciplinary communication about the patient's condition, consequences of actions, and prognosis, while acknowledging an acceptable level of uncertainty. Although specific needs are highly variable as perceptions are different and often inconsistent with reality, physicians must align unrealistic expectations with medical reality; in case of conflicts, moral deliberation could be helpful and otherwise professional judgement should prevail.

CONSIDERATIONS FROM A SOCIETAL PERSPECTIVE

'The rule of rescue' is a powerful ethical proclivity ingrained in human nature, possible even more in acute care physicians, to rescue those in immediate danger, regardless of risks or costs [77]. 'Performing against the odds' heroism is often in conflict with the utilitarian approach, which aims at the overall performance of the entire healthcare system instead of the entire focus being on the benefits of a single individual.

In this context, it is considered difficult to justify lifesaving neurosurgical interventions resulting in unacceptable outcome at enormous healthcare costs. The ethical question transcends from individual values to societal and political valuation of life related to costs. Studies assessing in-hospital costs after s-TBI, however, suggest rather an 'acceptable' degree of in-hospital treatment costs, although variation is high and study quality generally poor [2,78]. Studies on the long-term costs of patients after s-TBI or patients with severe disorders of consciousness are unfortunately scarce, prohibiting solid conclusions. Admittedly, money that has been spent cannot be used to treat other patients with possibly more effective treatments. This perspective, however, should not be a prominent variable in arguing for, or against early treatment-limiting decisions. Depriving some patients of recovery to an acceptable outcome should be absolutely minimized in societal decision-making.

Nonetheless, there must be a point where TBI is so severe and patient outcome so unacceptable as to justify the enormous associated healthcare costs. Establishing this point is necessary because healthcare costs increase and healthcare budgets are limited. Therefore, the cost-effectiveness of interventions should be evaluated, and weighted to the maximum amount. Limitations on costs to maintain life have already been set by politicians. For example, the cut-off of cost-effective treatments in The Netherlands is €80.000 per quality adjusted life year [79]. The justification and number of this cut-off should not be determined solely by politicians, but also involve the contributions of experienced physicians and other health-care professionals.

A commonly perceived advantage of including this economic perspective in decision-making is the objectivity of the criterion to decide whether or not to perform an intervention. We should, however, not forget that focusing on cost–benefit analyses fails to recognize individual aspects of care and the social utility of caring for those most in need. People obtain benefit from the belief that they live in a compassionate and humane society where patients in need will not be ignored merely on the basis of costs.

ACUTE AND CHRONIC CARE

Because of the chronic consequences of s-TBI, many patients and proxies need adequate lifelong care to optimize outcome [80,81]. Specialized rehabilitation, long-term care and patience are essential for recovery [14,82▪,83,84▪▪]. Caretakers and researchers of both subacute and chronic care should collaborate closely and become familiar with the needs, challenges and possibilities along the entire chain of care.

Regrettably, in some healthcare systems, patients without enough progress of recovery during rehabilitation are discharged to nursing homes lacking proper rehabilitation or diagnostic oversight, depriving them of opportunities to recover [75,85]. This seems unfair, as 'normal' recovery processes of patients and their brains still remain largely unknown, and subtle progress is known to be missed because of a physician's generally poor evaluation [1▪,28,59,60▪▪,61▪]. Many novel rehabilitation initiatives have been developed, and also improved coping interventions appear now to be more effective [62,64▪,85–87,88▪▪]. Until we really know what is best, providing appropriate care is something that we as a society morally owe to all patients, while not discounting that catastrophic conditions, such as unresponsive wakefulness syndrome or minimally conscious state are accompanied by severe disabilities and enormous challenges [41▪▪,89]. Although the gravity of the outcome could be obscured by the gratitude of survival, many will doubt this is a life worth living [75].

FUTURE RESEARCH

Future research initiatives will focus on the effectiveness of new diagnostic and treatment modalities including short-term and long-term functional outcome and health-related QOL, along the whole chain of care [90,91]; the measurement of well being and impact on proxies and society; establishing values of dignified existence (i.e. with ex-patients, proxies, physicians); specialized education programs for professionals and patients/proxies on the topic of s-TBI; improving the reliability of prognostic models by machine learning [92■,93].

Although these initiatives seem promising, and will likely improve TBI care when successful, we should not underestimate the difficulties in conducting traditional studies, such as not only the variation between patients, injuries and healthcare systems but also the variety and potential boundaries of ethics and culture. Randomization of severely injured TBI patients, as one example, is considered inappropriate by many physicians. Prospective, large, multicentered, compared-effectiveness research initiatives might provide necessary evidence in the future [50].

CONCLUSION

Decision-making in s-TBI is highly complicated because of uncertainty regarding treatment cost-effectiveness, prognostication and unacceptability of outcome, which are caused by a lack of scientific evidence and also by different societal and individual values. Physicians absolutely do not intentionally deprive patients of a chance on achieving an outcome they would have considered acceptable. Research collaborations between medical specialties and across the borders of traditional sciences of medicine, sociology and philosophy might lead to practical evidence, reduced uncertainty and improved care and outcome for s-TBI patients.

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Conflicts of interest

There are no conflicts of interest.

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- ■ of special interest
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45. Ho KM. Predicting outcomes after severe traumatic brain injury: science, humanity or both? J Neurosurg Sci 2018; 62:593–598.

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This study discusses several important moral dilemmas and conflicts in patients in an unresponsive wakefulness syndrome. These considerations could also be useful for physicians not necessarily confronted with this particular patient subgroup.

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There are many different views on the use of prediction models like the IMPACT and CRASH models. This qualitative study assesses the perception of physicians.

54. ■■ Dijkland SA, Foks KA, Polinder S, *et al.* Prognosis in moderate and severe traumatic brain injury: a systematic review of contemporary models and validation studies. J Neurotrauma 2019; doi:10.1089/neu.2019.6401.

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