

Functional outcome at 1 vs. 2 years after severe traumatic brain injury

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Abstract

Purpose: The aim of the study was to evaluate the outcome of patients with severe traumatic brain injury (STBI) after 12 and 24 months (Glasgow Coma Scale GCS ≤ 8 points for at least 24 hours).

Methods: A total of 51 patients underwent a multidisciplinary early rehabilitation treatment until they were discharged from hospital and local ambulatory care was deemed sufficient. The follow-up examination took place 12 and 24 months after the STBI.

Results: Data revealed a high level of independence in activities of daily living (mean Barthel Index after 1 year 92.7 points, after 2 years 93.7 points). After 1 and 2 years, 74.5% and 80.4% of the patients, respectively, were completely independent of need for care. Nevertheless, more than half of the patients had sensorimotor, behavioural, speech, visual and/or auditory disturbances. Return to work rates improved between 1–2 years after trauma, as evidenced by the rate of patients being back to full time work at 1 year ($n = 14$, 28%) and 2 years ($n = 20$, 40%) post-STBI; although none of these changes reached statistical significance.

Conclusion: In summary, there are still changes in both impairment and disability related areas between 1–2 years post-STBI, but the degree of improvement is variable depending on the area being considered. Clinicians should remain aware of the fact that modulation of impairment and disability appear to continue well beyond 1 year post-STBI, which may impact on decisions regarding the provision and intensity of further rehabilitation efforts.

Keywords: Outcome, rehabilitation, traumatic brain injury, professional reintegration, activities of daily living, need of care

Introduction

The incidence of traumatic brain injury (TBI) is high in Europe. Incidence rates of up to 300 cases per 100 000 inhabitants are reported, depending on the definition and severity of TBI [1, 2]. STBI plays an important role in road traffic and leisure time accidents. The main causes of STBI are vehicular accidents including car, bicycle and motorcycle related trauma. Frequently, these types of injuries result in severe neurological impairment and functional disability with associated and sometimes catastrophic socio-economic consequences [3–5].

About 40% of deaths in road traffic accidents are due to TBIs. The majority of victims are young males. According to Mayer [6], 50% are younger than 25 years of age. Mortality after severe brain injury continues to be high (e.g. 20–30%) in spite of pre-clinical and clinical therapy [7–13]. Baehr [1] confirmed that, due to these improved measures, the mortality rate of persons with STBI decreased. Rehabilitation medicine is now challenged by patients who survive with severe complex deficits (sensorimotor, disorders of consciousness and neurocognitive as well as neurobehavioural)

Schönle [14] and Kirchberger [15] confirmed the importance of immediate rehabilitation following the trauma and the importance of a rehabilitation continuum of care.

Based on ethical and health policy principles, the goal of medical management is to support the recovery of these patients and achieve the best quality of life and highest level of functional independence possible including social reintegration. The difference in rehabilitation outcomes are quite stark when one compares both acute as well as long-term community re-entry outcomes now with those outcomes achieved in the 1960s [16–18]. Research has demonstrated that the earlier the process of rehabilitation is started and maintained, the better the final outcome [14, 15, 19].

After in-patient discharge, the rehabilitation process continues in out-patient facilities, with the main focus on therapy of neuropsychological deficits and behavioural disturbances. The best chance of restoring the brain's functional abilities is within the first 2 years following the brain trauma [4, 5]. Even if further improvement is possible, the first 2-year interval is considered critical.

The current study compares impairment level and disability status outcomes following STBI (as defined by a Glasgow Coma Scale GCS ≤ 8 points for at least 24 hours) in patients after 12 and 24 months.

Methods

Patients were selected from a cohort of cases with STBI documented for a collaborative trauma research project. STBI was defined as a Glasgow Coma Scale GCS ≤ 8 points for at least 24 hours, together with a significant brain injury as evidenced by Abbreviated Injury Scale (AIS) severity level ≥ 3 which was confirmed by diagnostic procedures (x-ray, CCT). For this study only those survivors were selected who had complete follow-up examinations at 1 and 2 years after trauma. All patients were treated through the Department of Neurosurgery at the University of Cologne in Germany.

Early onset rehabilitation was performed in every case. The duration of rehabilitation treatment in hospital was 3–4 hours a day (total time for all therapies included physiotherapy, occupational therapy, speech therapy and neuropsychology). Later, after discharge, the out-patient therapy was coordinated with neurosurgical rehabilitation based on individual needs for up to 2 years or until social and/or professional reintegration.

Follow-up examinations were carried out in the hospital 12 and 24 months after the accident. Assessment included a physical examination including neurological exam, a functional evaluation

focusing on activities of daily living (Functional independence measure FIM, Barthel Index BI), Glasgow Outcome Scale (GOS) and an interview for determination of the level of independence and the degree of professional integration (see Figure 3).

Changes from 12–24 months were compared using non-parametric paired rank tests (Wilcoxon test) or McNemar's test in the case of prevalence rates. These test procedures for paired data evaluate the hypothesis of intra individual changes over time.

Results

Early continuous rehabilitation was started in the Intensive Care Unit (ICU) on 51 patients (38 men and 13 women) with a mean age of 32.2 years (range 16–63 years). For type and frequency of intracranial and other injuries see Table I. Twenty-two patients (43%) were polytrauma cases with relevant extracranial injuries (AIS severity level ≥ 3). The average Injury Severity Score (ISS) was 25.8 points with a range of 16–48 points (Table I).

Table I.

	<i>n</i>	%
Intracranial lesions		
acute epidural haematoma	11	21.6
acute subdural haematoma	23	45.1
subarachnoidal haemorrhage	15	29.4
cortical contusion	40	78.4
skull-base-fracture	18	35.3
brainstem-contusion	9	17.6
Other injuries		
thoracic injuries	19	37.2
fracture of extremities	23	45.1
abdominal injuries	4	7.9
orofacial injuries	20	39.2

The average duration of early rehabilitation within the acute phase was 18 days (range 5–76 days). The in-patient rehabilitation phase lasted 3 months, on average (2 weeks–15 months).

The results of the follow-up assessment of activities of daily living are presented in Table II. In eight patients FIM score increased by 1–34 points ($p = 0.01$; Wilcoxon) (between 12–24 months) while only three patients improved in the Barthel score (not significant $p \geq 0.05$, at what p -value). However, in four of eight patients with an improved FIM, the difference was only 1 point (Table II).

Table II.

	BI 12 months	BI 24 months	FIM 12 months	FIM 24 months
Mean	92.7	93.7	118.5	119.9
Range	10–100	10–100	28–126	32–126

Improvement in GOS (Glasgow Outcome Scale) was observed in only four patients ($p = 0.14$, Figure 1). The overview about the functional deficits of 51 patients is presented in Table III. The marginal improvement in patients without any deficits is not significant ($p = 0.13$; McNemar Test).

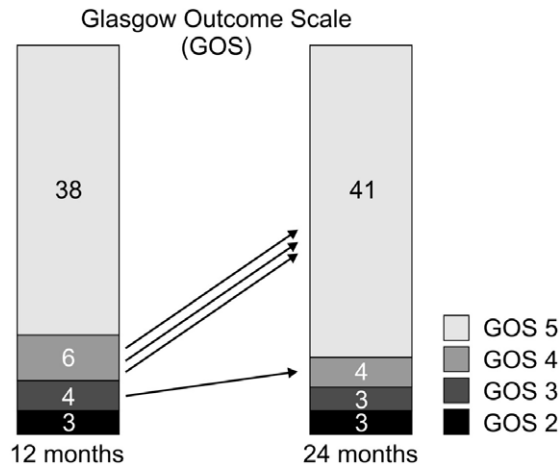


Figure 1.

Table III.

	12 months <i>n</i>	24 months <i>n</i>
Psychosyndroma	13	10
Consciousness	3	1
Ataxy	3	4
Auditory	10	9
Visual	9	7
Speech	9	9
Coordination	19	18
Sensory	6	2
Spasticity	9	7
Epilepsy	6	8
Hemiparesis	8	7
Tetraparesis	2	2
None of the above	17	21

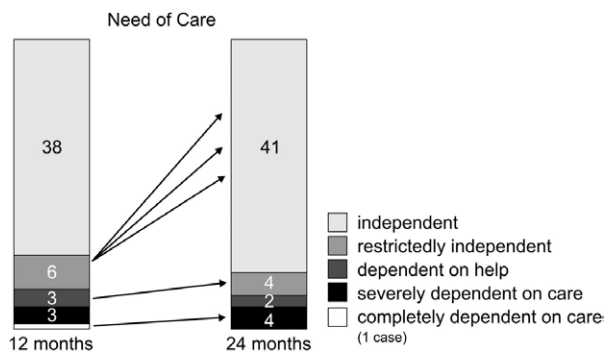


Figure 2.

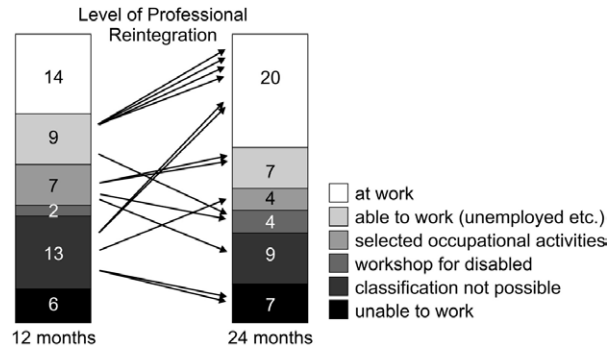


Figure 3.

Special emphasis has been placed on the identification of independence/need for care and measures of professional re-integration. These results are presented in Figures 2 and 3.

The level of professional re-integration shows positive trend (classification not possible—patients are still on sick leave). The number of patients returning to work increased from 14 to 20 between 12–24 months post-injury; however, the majority of these individuals were already able to work after 12 months (Figure 3). In general, the observed changes were not significant ($p = 0.17$, Wilcoxon).

Drop out

A total of 65 patients surveying the acute phase of treatment (age 16–75 years, mean 36.1) were included, two patients was excluded because of a psychiatric disorder, four patients were foreigners and returned after acute treatment to their home countries; one patient was 12 months after trauma severely disabled and still under inpatient rehabilitation, seven patients refused to attend the follow-up examination. Thus, a total of 51 patients was followed for 12 and 24 months and re-examined at theset time points.

Discussion

The main problems in comparing the results of TBI outcome studies are the different assessment methodologies used, as well as the heterogeneity of patients groups and their therapy. These phenomena, in part, explain the problems comparing the results of this study with others [20, 21].

Compared with Anderson et al. [22], 90% of this group is independent in activities of daily living (ADL) and did not need another person's assistance after 1 year, while the rate was only 30% in Anderson et al.'s [22] study. Both investigations were comparable with respect to entry conditions and the type of intracranial lesion(s). In the study by Mazaux and Richer [23], rehabilitation was started later than

in this study, on average 6 weeks from injury, with a range of 1 week to 7 years. Mazaux and Richer concluded that only 50% of patients with STBI reached 'good recovery' (GOS = 4 and 5). Less than 50% were fully independent in ADLs. Chua and Kong [24] studied a group of TBI patients (76% with STBI) and found that 90% of patients could participate in household activities, but only 25% of this group were successfully reintegrated in their job. Hawkins et al. [25] examined outcome of patients after STBI with early onset rehabilitation and found findings fully comparable to these results. The rate of professional reintegration in this study has been replicated similarly in numerous other investigations [26–31].

Hawkins et al.'s [25] and these results on rehabilitation outcomes, as compared to other authors mentioned in this paper, confirm the usefulness of early onset and continuous rehabilitation, mainly as it positively impacts levels of ADL independence. In spite of these aforementioned positive results, one is still confronted, even 2 years after the brain trauma, with a group of patients with different impairments, not only sensorimotor ones but also ones involving behavioural and communication disturbances, the latter problems often-times being crucial impediments to achieving higher levels of professional reintegration.

Importantly, there was a very small difference in all outcome parameters between 12–24 months post-injury as measured by the chosen parameters in this study. At 12 months post-STBI the outcomes achieved by a continuous rehabilitative treatment were not significantly improved upon over the ensuing 12 months. There are still some patients who improve, but the degree of improvement was low in most of the cases. A positive trend was only observed in the level of professional reintegration, although without statistical significance, which may be accounted for by the limited sample size.

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