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FUNCTIONAL AND PSYCHOSOCIAL OUTCOME ONE YEAR AFTER SEVERE TRAUMATIC BRAIN INJURY AND EARLY-ONSET REHABILITATION THERAPY

M. Lippert-Grüner, Ch. Wedekind and N. Klug

From the Department of Neurosurgery, University of Cologne, Köln, Germany

This study evaluates the impact of early-onset continuous rehabilitation treatment on the 1-year outcome of patients after severe traumatic brain injury. Immediately after recovery from mechanical ventilation, a total of 48 patients underwent a complex early rehabilitation treatment until they were discharged from hospital and local ambulant care was deemed sufficient. The follow-up examination took place 12 months after trauma. Data reveal that at 1 year 91.6% of the patients were completely or restrictedly independent of care and capable of carrying out activities of daily living, although they frequently were still suffering from marked behavioural and also from certain sensorimotor deficits. Only 45.8% of the patients were obviously able to work without restrictions or had returned to work. In those subjects who were not or only very restrictedly able to work, behavioural and speech deficits were significantly more frequent. Behavioural and speech deficits seem to represent the major cause that hinders professional reintegration. Rehabilitation therapy therefore should be specifically directed to improve these deficits.

Key words: outcome, rehabilitation, traumatic brain injury, occupational reintegration, behavioural deficits.

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Correspondence address: Dr M. Lippert-Grüner, Department of Neurosurgery, University of Cologne, DE-50924 Köln, Germany

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INTRODUCTION

The interest concerning functional outcome of patients with traumatic brain injury (TBI) has increased during past years. Many studies have focused on long-term quality of life and productivity issues for the growing population of TBI survivors (1–4). Individual factors pertaining to the recovery from TBI have been identified, as are patients' age, coma duration, initial Glasgow Coma Scale (GCS) score, duration of post-traumatic amnesia and the pre-traumatic state of health (5–8).

Investigators agree that rehabilitation therapy has a beneficial effect on the outcome of patients with TBI, although a comparison with control groups is still lacking due to ethical and practical reasons (9–11). Accordingly, the principle objectives are improving spontaneous recovery, minimalizing early and late complications and intensive use of the regenerative capacity and the residual plasticity of the brain (12). As the level of consciousness improves, it becomes possible to gradually apply a comprehensive rehabilitation treatment, aiming at a maximum reduction of functional deficits and furthering independence in carrying out the activities of daily living.

The present prospective study was performed to evaluate the functional outcome as well as the extent of occupational and social reintegration in patients 1 year after severe brain injury and after continuous rehabilitation treatment, beginning during the acute stage of TBI.

MATERIAL AND METHODS

Subjects included consecutively in this prospective observation study were suffering from severe TBI (sTBI; Glasgow Coma Score (GCS) <8 for at least 24 hours). They were admitted between 1994 and 1997 to the intensive care unit of the Neurosurgical Department of the Cologne University. Patients with a documented history of a psychiatric disorder or prior brain injury were excluded from the study. A total of 79 patients (age 15–70 years, mean 31.81 years) were included, of whom 16 died during the acute phase of the treatment, 2 patients died during the observation period; 1 patient was excluded because of a psychiatric disorder, 4 patients were foreigners and returned after acute treatment to their home countries; 1 patient was 12 months after trauma severely disabled and still under inpatient rehabilitation, 4 patients had moved with unknown destination. Three patients refused to attend the follow-up examination. Thus, a total of 48 patients was followed for 1 year and re-examined at that time point. For ethical as well as for practical reasons, a control group was not defined. Thus, all patients underwent a rehabilitation process including three rehabilitation steps: first, the early-onset rehabilitation at the neurosurgical intensive care unit; second, subacute inpatient rehabilitation; third, outpatient (ambulatory) rehabilitation. Early-onset rehabilitative treatment began with recovery from controlled mechanical ventilation, stabilization of circulatory functions and normalization of intracranial pressure. Rehabilitation consisted of multimodal sensory stimulation (acoustic, tactile, olfactory, gustatory, visual, kinaesthetic and proprioceptive stimulation) (13). Physiotherapy was directed to prevent contracture, to compensate for paresis and for spasticity which was also treated by administration of drugs (lioresal, sirdalud). Furthermore, therapy aimed at achieving a simple level of communication. Facio-oral training was performed to re-establish swallowing. The intensity of the therapy was adapted individually to the patients' ability to cope with the strain induced with a duration of about 3 hours/day. With increasing communicative facilities, patients underwent occupational therapies and also cognitive/behavioural and speech therapy. Besides preventing complications and improving respiratory function, therapy was directed mainly to restore communication, especially by multimodal sensory stimulation with assessment of patients' reactions.

After discharge from our department, the stage of subacute rehabilitation in centres for neurological rehabilitation began. At this time point patients were mostly cooperative and able to participate in an individual complex rehabilitative treatment. The mean duration of the daily rehabilitative program was about 4 hours. It comprised different

kinds of physical therapy, occupational therapy, speech therapy and behavioural therapy.

After finishing stationary rehabilitation (mean duration 12 weeks), the third stage of ambulatory rehabilitation started, aiming at social and occupational reintegration. The coordination of this phase was initiated during the ambulatory rehabilitation sessions at our department which also included the 1-year follow-up examination.

Neuropsychologic diagnosis was made and neuropsychologic therapy was conducted according to the standards described in the books of Cramon et al. (14–15). Routine psychotherapy was not applied, antidepressant drugs were used only at rare instances. Three of the cases presented suffered from heterotopic ossification.

At one year after trauma, all patients were interviewed, mostly in the presence of a close relative, and a standardized neurological examination was performed. To quantify the functional outcome, the following test battery was used: Glasgow Coma Scale (GCS) and Coma Remission Scale (CRS). The functional independence was analysed using Barthel-Index (BI), Functional Independence Measure (FIM) and Disability Rating Scale (DRS). Additionally, the patients' ability to work (unrestricted—selected tasks—disabled workshop—unable to work) and the need of care (independent/restrictedly independent—dependent on help—dependent on care—severely dependent on care—completely dependent on care) were rated.

The χ^2-test was used for statistical analysis.

RESULTS

A total of 48 patients was re-examined 12 months after TBI (36 (75%) men and 12 (25%) women; mean age 31.8 years, range 15–68 years). Twenty patients (42%) had additional multiple organ injury. Mean Injury Severity Score (ISS) was 32.5 (range 25–66). Closed head injury was diagnosed in 38 (79%) patients, 10 (21%) suffered from open head injury. Skull base fractures were present in 17 (35%) subjects. An acute epidural haematoma was seen in 10 (21%), an acute subdural hematoma in 20 (42%), traumatic subarachnoid hemorrhage (SAH) in 14 (29%), cortical contusions in 39 (81%) and brain stem contusions in 8 (17%) subjects. Bone fractures were the most commonly occurring associated injuries in patients (fractures of legs in 8 (17%), of arms in 9 (19%), followed by orofacial injuries in 15 (31%), pulmonary trauma in 5 (10%), and spinal injury in 8 (17%).

Table I summarizes the outcome scores obtained 12 months after trauma. Neurological examination revealed that many patients still had marked neurological deficits (Table II). The care needed was assessed as follows: One of the patients (2.2%) was still completely dependent on care. Two other patients (4.3%) were classified as severly dependent on care, one patient (2.2%) was dependent on help, 4 patients (8.3%) were restrictedly independent whereas 40 patients (83.3%) were completely independent of care.

Seventeen patients (35.4%) were at work after 1 year. Five patients (10.4%) were able to work (but were actually unemployed or had retired already). Seven patients (14.6%) were able to perform selected occupational activities, 2 patients (4.2%) were integrated in a workshop for disabled persons, 5 patients (10.4%) were classified as unable to carry out or to learn a job. For 12 patients (25%) a definitive classification at that time was not possible since they were still under rehabilitative treatment, therefore the exact level of recovery could not be determined at this point.

Table I. *Means and ranges of the scores obtained 1 year after traumatic brain injury*

	GCS	CRS	Barthel	FIM (motor)	FIM (cognitive)	DRS
Mean	14.9	23.8	94.1	86.2	33.2	34.4
Range	11–15	16–24	0–100	13–91	9–35	17–37

GCS = Glasgow Coma scale, CRS = coma remission scale, FIM = functional independence measure, DRS = disability rating scale.

Table III shows the cross correlation between occupational status and neurological/behavioural deficits one year after TBI. Statistical analysis revealed that behavioural deficits ($p < 0.01$) as well as speech disturbances ($p < 0.05$) were significantly more frequent in those patients who were occupationally handicapped (able to perform selected tasks or worse) whereas all other neurological deficits were more or less equally distributed among the different groups.

DISCUSSION

Our results show that 1 year after trauma the vast majority of the patients have already reached a high level of independence in performing their activities of daily living. In contrast to this finding many patients still had marked behavioural and speech deficits. Their persistence causes difficulty concerning the reintegration into school/professional life. This is reflected by the degree of occupational reintegration at 1 year. Despite the independence in performing activities of daily living, less than 50% of the patients had returned or were at least able to work after 12 months. Rather than to the severity of neurological functional impairment, this low proportion is due to the

Table II. *Neurological/behavioural deficits 12 months after trauma*

	n	%
Consciousness	2	4.2
Behaviour	14	29.2
Auditory	8	16.7
Visual	10	20.8
Swallowing	2	4.2
Speech	6	12.5
Coordination	17	35.4
Sensory	8	16.7
Muscle tone	8	16.7
Ataxy	2	4.2
Epilepsy	5	10.4
Hemiparesis	8	16.7
Tetraparesis	1	2.1

Table III. *Occupational status and neurological/behavioural deficits*

	Unrestricted	Presumably unrestricted	Selected tasks	Disabled workshop	Unable to work	Undetermined
Consciousness					2	
Behaviour	1		3	1	3	6
Auditory	4	2			1	1
Visual	4			1	1	4
Swallowing					1	1
Speech			1		2	3
Coordination	5		1	1	4	6
Sensory	2		1		2	3
Spasticity					3	5
Ataxy					1	1
Epilepsy	1	1	1			2
Hemiparesis	1				3	4
Tetraparesis						1

continuing disturbances in the patients' behaviour and their emotional and cognitive facilities.

The comparison of different outcome studies is quite difficult, because severity of the injury, strategies of therapy and measurement instruments often differ (16–19). In contrast to the findings of Anderson et al. (17) and Mazaux & Richter (20), about 90% of our patients were independent in activities of daily living and had no need for care. Anderson et al. (17) found that one year after injury only about 30% of patients with TBI were independent of care. Only 27/50 patients had achieved a moderate or good recovery. Although inclusion criteria and the severity of injury in this study are comparable with our sample, rehabilitation treatment started at a different time point. Median time from injury to admission at the rehabilitation unit was 6 weeks (range 1 week to 7 years). Mazaux & Richter (20) found that one year after the injury only 50% of the severe brain injured patients had a good recovery. Less than 50% were fully independent for all domestic activities and social life. Chua & Kong (18) examined the outcome of patients with TBI at 1-year post trauma (76% of these had severe TBI). The authors found a favourable outcome in about 90% of the patients who were living at home 1 year after trauma, but only 25% of them were occupationally re-integrated.

The results of Hawkins et al. (21) obtained from a sample of patients who underwent early-onset rehabilitative treatment are widely comparable with ours as to the outcome one year after trauma: The proportion of occupational reintegration is similar, as is the case in other reports dealing with this matter (2, 19, 22–25).

In contrast to our data and the findings of Hawkins et al., all other studies detected only a low proportion of patients who were fully independent in performing activities of daily living.

Our results and other reports underline the high efficacy of current rehabilitation strategies to regain independence of care and the unrestricted competence to perform activities of daily living. One year after TBI, however, occupational reintegration and—as a prerequisite—the reduction of behavioural and speech deficits remain to be achieved in the majority of these patients.

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