Neurorehabilitation Following Craniocerebral Trauma

Klaus R.H. von Wild in cooperation with the TBI Study Council*

Abstract
Purpose: To review the quality management of functional neurorehabilitation in patients after craniocerebral trauma with an emphasis on factors that may explain variability of early and late outcomes after 1 year and how this might be influenced to improve health-related quality of life after traumatic brain injury (TBI).

Methods: First ever prospective controlled, population-based, multicenter study on epidemiology of acute craniocerebral injuries (CCI) in Germany and analysis of acute medical care and functional rehabilitation with early and 1-year outcome. Catchment areas Hanover and Muenster (sum of inhabitants 2.114 million). The definition of acute CCI was according to the ICD-10: S-02, S-04, S-06, S-07, S-09 in combination with dizziness or vomiting, retrograde or anterograde amnesia, impaired consciousness, skull fracture, and/or focal neurologic impairment.

Results: 6,783 CCI patients (58% male) were admitted for emergency hospital treatment. 28% patients were < 1 to 15 years, 18% > 65 years of age. Completed questionnaires of 63.5% of the patients were analyzed. 1-year follow-up of two thirds of acute CCI. Incidence was 321/100,000. Initial CCI severity (Glasgow Coma Scale [GCS]) of 55% of patients showed 90.9% mild, 3.9% moderate, and 5.2% severe TBI. 5,221 patients (77%) were hospitalized, 1.4% of them died. Follow-up of 63.5%. Only 258 patients (3.8%) received neurologic-neurosurgical rehabilitation (73% male), 68% within 1 month after injury, 5% were < 16 years, 25% > 65 years of age. Early rehabilitation of 100 patients (39%), one fifth referred within first week. Outcome end of early rehabilitation phase “B”: Glasgow Outcome Scale (GOS) 1 = 4%; GOS 2 = 2.7%, GOS 3 = 37.3%, GOS 4 = 26.7%, GOS 5 = 29.3%, and end of rehabilitation “B–E": GOS 1 = 1.2%, GOS 2 = 1.7%, GOS 3 = 21.8%, GOS 4 = 36.2%, and GOS 5 = 39.1%.

Conclusion: Data on the epidemiology and quality management of early functional rehabilitation met the criteria set in 1992. Management of frequent multiple organ lesions and complications (57%) without referring the patient to another hospital and early functional outcome confirm the author’s concept of neurosurgical early rehabilitation.

Key Words
Rehabilitation following craniocerebral injury · Early rehabilitation of TBI · Prospective study on quality management in head injuries · Complications following isolated TBI and polytrauma · Health-related quality of life after TBI

Eur J Trauma 2005;31:344–58
DOI 10.1007/s00068-005-2059-z

* Advisory board: W.J. Bock, Prof. em. Dr. med., former Director of the Neurosurgical University Hospital, Duesseldorf; W. Gobiet, Dr. med., former Head of the Neurologic Clinic, Hessisch Oldendorf; U. Lehmann, PD Dr. med., Senior Registrar at the Department of Accident, Hand, and Restorative Surgery of the Saarland University, Homburg/Saar; K. Mayer, Prof. em. Dr. med., Industrial Cooperative Compensation Fund Accident Clinic, Tuebingen; E. Rickels, Prof. Dr. med., Head of the Department of Neurosurgery, Clinic of the Medical University, Ulm, former Senior Registrar at the Neurosurgical Clinic of the Medical University, Hanover (MHH); Dr. B. Sens, Head of the Center for Quality Management in Healthcare, Physicians' Chamber of Lower Saxony, Hanover; H.D. Wassmann, Prof. Dr., Director of the Neurosurgical University Clinic UKM, Muenster; P. Wenzlaff, Medical Statistics, Center for Quality Management in Healthcare, Physicians' Chamber of Lower Saxony, Hanover; R. Wiechers, former Managing Director of the Curatorium CNS for Accident Victims with Injuries of the Central Nervous System and of the Hannelore Kohl Foundation, Bonn; K.R.H. von Wild, Dr. med. Professor of Neurosurgery, Medical Faculty of the Westphalian Wilhelms University Muenster, former Head of the Neurosurgical Department and the Unit for Posttraumatic Early Rehabilitation, Clemenshospital, Teaching Hospital, Muenster, Germany.

1 Professor of Neurosurgery, Medical Faculty, University of Muenster, Professor of Neurorehabilitation and Re-engineering of brain and spinal cord lesions, International Neuroscience Institute (INI), Hanover, Germany.

Received: May 25, 2005; accepted: June 22, 2005.
Introduction
Acute craniocerebral injury (CCI) is a major ethical and social burden in the industrialized countries with regard to life-long disability, unnatural death, and the enormous social-economic costs [2, 5, 10, 16, 17, 25, 31–33, 48, 48]. Modern medical therapy and emergency computed tomography (CT) have enabled increasingly more patients to survive, in many cases, however, suffering from severe impairments of higher cerebral function [14, 18, 21, 25, 36–38, 44, 45, 57, 60]. Mental neurobehavioral disability calls for a different degree of adjustment than does the need to cope with most physical disabilities [8, 9, 21, 41]. “Brain damage has become synonymous with loss of skills, while the rehabilitation of brain-damaged individuals has become known as a method to restructure lives within a social context”, quoted after Anne-Lise Christensen who established neuropsychological rehabilitation for CCI patients in Europe. Neurologist surgeons, neurologists, and neuropsychologists with special expertise in traumatic brain injury (TBI) have become more and more responsible for holistic posttraumatic rehabilitation [3, 8, 9, 18, 21, 29, 30, 38, 39, 53, 55, 62]. The German Task Force Guidelines for Early Neurological Neurosurgical Rehabilitation (ENNR) are accepted by the politicians, care providers, and insurance companies [7, 16, 17, 39, 42, 43, 53]. Following this concept the author was able to establish a special unit for neurosurgical early rehabilitation as part of the neurosurgical department [39, 59, 61]. This concept is addressed: (1) to refer the patient as early as possible from the intensive care unit (ICU) for ENNR in the same building and (2) to start the individually designed rehabilitative intervention very early on, (3) to promote functional recovery, brain plasticity, and compensation strategies, and (4) to prevent and treat frequent secondary and tertiary complications that keep the patient on the ward. The German social and health care systems are well known for a high standard of structural and process quality that is provided for the medical management of acute CCI, aimed at the victim’s full social reintegration [3, 8, 9, 41]. The network of regional structures for public health care and neurorehabilitation are state of the art throughout Germany, and they are reported to be at a high-standard level in Austria and Switzerland (personal communication, Meeting of the Board and Managing Committee of the World Federation of Neurorehabilitation, June 9/10, 2005, London). Bearing this in mind it is surprising that for Germany like for other European countries reliable figures of acute CCI care and posttraumatic rehabilitation are lacking to evaluate and qualify the efficiency of the regional structures and the quality management of patients after CCI.

The prime intention of this study was to collect and to analyze reliable data on the resource deployment and the quality management concerning effectiveness and the efficiency of acute CCI care and neurorehabilitation, with a special focus on the ENNR. A further objective was to record the epidemiology and the quality of acute medical treatment after CCI in respect to establishing a CCI database for Germany by E. Rickels.

Methods
The Study Council decided to select the two major regions of Hanover and Muenster on the basis of their sound infrastructure as well as their involvement with respect to the observance of the guidelines for acute CCI management and of the German Recommendations for ENNR, published in 1993 [1, 5, 7, 28, 34, 36, 45, 53]. The population-based study was designed as a multicenter, prospective, clinical, controlled study to analyze the epidemiology of CCI and quality management of acute medical care and posttraumatic functional neurorehabilitation of patients after CCI admitted to the regional hospital for emergency examination within a 1-year period. The catchment area with a geographic diameter of 100 km each totaled 2,114,385 inhabitants, in the Hanover region, the capital of Lower Saxony and an industrialized urban region, with 1,255,618 million inhabitants, and the Muenster region, the governmental capital of North Rhine-Westphalia, rural, with 858,767 population (State statistics agencies of Lower Saxony and Nord Rhine-Westphalia and the German Federal Statistics Office, status December 31, 2000). Both cities have major trauma centers and neurological departments at the medical faculty of the respective universities and at the class A city hospitals, besides another 13 local hospitals each. For posttraumatic rehabilitation 28 institutions are available for both areas. Four special forms have been designed for documentation and computerized analysis by the TBI Study

---

4 Coma Remission Scale: [12, 14].
6 Early Rehabilitation Barthel Index: [42].