Early Rehabilitative Concepts in Therapy of the Comatose Brain Injured Patients

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Summary

Objectives. To evaluate the changes of vegetative parameters and behavioural assessment in comatous patients after severe brain injury during the Multimodal-Early-Onset-Stimulation (MEOS) in early rehabilitation.

Material and Methods. We studied 16 predominantly male (3:1) patients, age mean 43.6 (16–77) years. Mean coma duration was 22.2 (8–41) days, therapy duration (MEOS) 9.8 (1–30) days. The initial GCS was 6.6 (3–9), KRS 5.3 (0–15). Including criteria for therapy: Severe head trauma, coma for at least 48 hours (GCS < 8), vegetative stability, normal intracranial pressure, abandon of mechanical ventilation, sedation and severe infections. MEOS was finished in achieving GCS > 9, follow-up investigations were made after 2 years.

Results. We identified significant changes in two vegetative parameters (heart/respiratory frequencies), even in deep coma (GCS 3–4). Most significant changes were caused by tactile and acoustic stimulation. Standardized behavioural assessment turned out to be particularly advisable in cases of medium coma (GCS 5–7). Stimulation of tactile and acoustic senses resulted mainly in mimical, head and eye movements. Follow-up was possible in 14 patients: One remained in a vegetative state (GOS 2), two exhibited severe neurologic/neuropsychologic deficits, depending on care (GOS 3), six sustained major functional deficits (GOS 4), at though they were able to perform the tasks of daily life on their own, three patients reached GOS 5. Two returned to their former jobs.

Discussion and Conclusion. The present results indicate that stimulation therapy should be based on a close observation of patterns of behaviour, and, at least in deep coma stages, involve the registration of vegetative parameters. It may be sensitive to identify parameters predicting a favourable or unfavourable outcome. Preliminary data seem to support the hypothesis that the absence of any response to external stimuli is indicative of an unfavourable outcome.

Keywords: Early neurorehabilitation; sensory stimulation; traumatic coma.

Introduction

Early rehabilitation is an integrated interdisciplinary therapy, which starts early and proceeds continuously with changing points of interest. Its aim is to support spontaneous recovery, to reduce the risk of early and late complications, and to make intensive use of the brain’s own rehabilitative ability and plasticity.

At present, it has not been possible to make a reliable prognosis about the recovery from the “vegetative postraumatic state”, not even on the basis of clinical data or electrophysiologic data such as evoked potentials. Consequently, other electrophysiologic examinations like event-related potentials or the analysis of changes in the EEG-spectre are increasingly used to detect covert reactions to external stimuli. Until now, this diagnosis of sensory or cognitive capacities in comatose patients or patients with reduced consciousness has proven to be very difficult. Since patients appear to react to stimuli from their surroundings, an observation which is often reported by close relatives, it is believed that to a certain extent comatose patients are able to process external stimuli. Reuter et al. (1989) showed that slow cortical potentials can be used to characterize mental functions as well as to assess comatose patients’ chances of recovery.

In the literature, there is no satisfactory answer to the question whether further specific measures can enhance to the healing process and accelerate recovery from coma [1, 6]. Experiments carried out on animals have disclosed the possibility of changing patterns of neuronal activation by means of external influences like auditory, tactile, or visual stimulation [5]. Over the last few years sensory stimulation has played an increasingly important role in early rehabilitation therapy.

Patients and Methods

We report on a regime of multimodal stimulation performed in comatose patients during early rehabilitation at a neurosurgical intensive care unit. Patients who have been comatous for more than 48 hours after trauma were selected for this therapy.
The present study, which was carried out over a period of two years, focuses on 89 patients aged 16–65 years suffering from severe brain injury. Sixteen of them (mean Age: 43.6 years) qualified for multimodal-early-onset-stimulation-therapy (MEOS), which lasted for an average of 9.8 (range 1–30) days. The patients received early rehabilitation treatment at the neurosurgical intensive care unit for an average time period of 27.9 days. The mean Glasgow Coma Score (GCS) at the beginning of the stimulation therapy was 6.56 (range 3–9).

The stimulation therapy consists of auditory, tactile, olfactory, gustatory and kinesthetic procedures, administered daily in two units of one hour each.

Special restrictions have to be made concerning frequency and intensity of sensory stimulation in order to avoid overly straining the injured brain. Controlled stimulation therapy should include low noise levels and adequate intervals between stimulation and medical and nursing activities. Furthermore, the patient’s notion of time should be supported by alternating phases of activity and intervals without therapy. Rather than following a static pattern, stimulation units are based on dialogue answers and the actual level of function achieved in the several sections.

The so-called dialogue answers to stimulation only appear at changes of vegetative parameters in the coma patient. Such reactions are monitored during the whole stimulation phase by means of a feedback for system recording and continuous registration of heart rate and respiration rate and galvanic skin response, including the possibility of direct graphical reproduction. These electrophysiological data were recorded and analyzed with the Paron-biofeedback device (PAR Elektronik GmbH) and the VITAPORT system developed at Cologne University. The VITAPORT system allows the co-registration of EEG and EMG.

The observation of the patient’s behaviour becomes increasingly important as coma depth decreases. A standardized behavioural assessment protocol was developed during the first stages of the examinations on the basis of the KRS (Koma-Remissions-Scale), which also focuses on vegetative changes. The patient’s most frequent reactions were clarified into mimic reactions, vocal utterings, arousability/attentiveness, motor reactions and vegetative changes.

Results and Conclusions

Clinical observations of the patients under stimulation revealed that changes in vegetative parameters (e.g. in changes of the heart rate and respiration rate) precede any visible behavioral change. To prove whether these changes differ from baseline without stimulation, a 10 minute baseline before stimulation and every 10 minutes between the stimulation sessions (A-B-A design) was recorded.

We were able to identify changes in the vegetative parameters (heart rate and respiration rate) of our patients, even those in deep coma (GCS 3–4). Figure 1 displays the monitoring of a multimodal stimulation therapy administered to a 38-year old patient, a therapy which was begun on the 4th posttraumatic day. At that time, the GCS reached 4 points. During stimulation, the heart rate showed significant changes, especially during tactile stimulation.

The most important changes were found during tactile and acoustic stimulation. Standardized behavioural assessment turned out to be particularly advisable in cases with GCS 5–6. Again, a stimulation of the tactile and acoustic senses resulted mainly in head and eye movements.

Two years later, 14 patients were reexamined, whilst two patients were prevented from attending the examination by structural problems. One of the patients examined had remained in a vegetative state (GOS 2), two suffered from severe neurological and neuropsychological deficits and were dependent on care (GOS 3), six exhibited from functional deficiencies, though they did perform the tasks of daily life on their own (GOS 4), and three had a GOS of 5. Two of these had been able to return to their old jobs.

It seems important to identify parameters predicting a favorable outcome in non-responding comatose patients during diagnostic stimulation. At present, the number of observations available is still too small to provide a final answer to this question, and the follow-up is too short to determine the usefulness of this diagnostic approach. Preliminary data seem to support the hypothesis that the absence of any response to external stimuli is indicative of an unfavorable outcome. However, we cannot infer a good prognosis from patients’ capacity to give vegetative responses.

References