Kaohsiung Journal of Medical Sciences (2017) xx, 1–7

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: http://www.kjms-online.com

Original Article

The effect of cranioplasty in cognitive and functional improvement: Experience of post traumatic brain injury inpatient rehabilitation

Jyong-Huei Su [a], Yu-Hsin Wu [a], Nai-Wen Guo [b], Ching-Fen Huang [a], Cyuan-Fong Li [a], Chia-Hsin Chen [a,c], Mao-Hsiung Huang [a,c,*]

[a] *Department of Physical Medicine and Rehabilitation, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan*
[b] *Institute of Behavioral Medicine, College of Medicine, National Cheng Kung University, Taiwan*
[c] *Faculty of Medicine, College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan*

Received 18 November 2016; accepted 26 April 2017

KEYWORDS
Traumatic brain injury;
Cranioplasty;
Rehabilitation;
Cognitive function

Abstract To investigate the effect of cranioplasty on rehabilitation of post-traumatic brain injury (TBI) patients, 37 patients with TBI were arranged by retrospectively assessment study. Those TBI patients receiving in-hospital rehabilitation in the Department of Rehabilitation in a medical center of South Taiwan from 2010 to 2015 were assigned into two groups: A and B. All patients entered the multidisciplinary holistic in-patient rehabilitation training for about 1 month. Patients in Group A received decompressive craniectomy (DC), patients in Group B received DC and cranioplasty. All assessments were arranged right on admission and before discharge. The functional activity evaluation included muscle power and Barthel index (BI), and cognitive function evaluation, including the Rancho Los Amigo Scale, Mini Mental State Examination (MMSE), Community Mental State Examination (CMSE), and the Luria-Nebraska Neuropsychological Battery-Screening Test Short Form (LNNBS). The results showed that there were synergetic effects of cranioplasty on post-TBI patients with rehabilitation training, especially in the BI score, and cognitive improvement in CMSE and LNNBS.

Conflicts of interest: All authors declare no conflicts of interests.

* Corresponding author. No. 100 Tzyou 1st Road, Kaohsiung Medical University Hospital, Taiwan.
E-mail address: maohuang@ms24.hinet.net (M.-H. Huang).

http://dx.doi.org/10.1016/j.kjms.2017.05.002

Introduction

Functional, behavioral, and cognitive disabilities often contribute to the difficulties in rehabilitation programs of victims with post-traumatic brain injury (TBI) [1,2]. Decompressive craniectomy (DC) has been a solution to relieve increased intracranial pressure in an emergent situation from one hundred years ago [3]. The skull breach is linked to a rare complication related to neurological symptoms, as known as trephined syndrome (TS) or sinking skin flap syndrome, which is characterized by some non-specific symptoms, such as headache, seizure, dizzy sensation, fatigue, imprecise annoyance at skull defect, anxiety and uncertainty, depressive disorder and vibration intolerance [4–6]. Usually, neurological hindrance greatly interferes with the progress in post-TBI rehabilitation and causes inconvenience in daily activities.

Cranioplasty generally is regarded as the primary treatment for repairing skull defects, mostly for the reason of cosmetic appearance, protection of brain tissue, or managing the adverse influence of TS [7]. Furthermore, recent studies have shown the unanticipated improvement of motor and cognitive impairment after cranioplasty [1,6–12]. These promising positive effects might be helpful in further rehabilitation arrangements in collaboration with cranioplasty effects. However, the evidence is mostly limited to case studies and is not focused on TBI populations, and although supportive, is not sufficient. Therefore, the purpose of this study is to confirm the effect on cognitive and functional gain of cranioplasty application on a post-TBI population during the in-hospital rehabilitation period.

Material and methods

Patients

A retrospective case review study was performed in a local medical university-affiliated medical center in Kaohsiung Medical University Hospital (KMUH). Ethical committee approval was confirmed by Institutional Research Board review. All patients who suffered from traumatic brain injury and underwent DC from January 2010 to December 2015, completed the multidisciplinary holistic in-patient rehabilitation training. The training program included physical and occupational therapy for 20 h per week, speech/swallowing training 5–8 h per week, and related neurological assessment arranged before and after the rehabilitation program. The average admission duration was 31.24 $\pm$ 7.53 days, with total rehabilitation duration around 580 h.

One hundred and ninety-four subjects with TBI were recruited initially, after excluding those who were not severe TBI (pre-operation GCS $<$ 8 at initial status), had not undergone DC for relieving intracranial pressure, had illicit drug use, or were physically/cognitively unstable. Eight people who were lost to data were excluded as well. Eighty-one eligible patients were finally enrolled in this study as shown in Fig. 1.

The patients were divided into two groups including a decompressive craniectomy group (Group A, 65 patients), and a cranioplasty group (Group B, 16 patients). For the recommended time interval between 3 and 6 months after DC for reconstructive cranioplasty being suggested, we excluded those TBI patients in Group A who had received in-hospital rehabilitation within 3 months after TBI for normalizing the time interval effect on cognitive or functional change [13]. Finally, Group A with 21 subjects and Group B with 16 subjects entered the analysis. We acquired the data from Group A before and after rehabilitation training for investigating the effect of DC, whereas the data acquired in Group B was including the effect after DC and cranioplasty.

All the data was retrospectively collected by using the digitalized patient data base in KMUH. The demographic data is presented in Table 1. There was no significant difference between the two groups.

In order to compare the effects of cranioplasty on a severe TBI population, we compared the age, admission duration, Rancho Los Amigo Scale (RLS), Barthel index, muscle power, Mini Mental State Examination (MMSE), Community Mental State Examination (CMSE), and Luria-Nebraska Neuropsychological Battery-Screening Test Short Form (LNNBS) at initial admission before undertaking rehabilitation programs. All patients' initial GCS was completed at initial admission to the rehabilitation ward with RLS score around 4–5; the cognitive status might have fluctuated, but all patients completed the evaluation. If the patient was unable to complete some test items, the score would be zero.

In order to compare the effects of DC + rehabilitation with DC + rehabilitation + cranioplasty, we compared the data of Group A (the effect after DC and rehabilitation training) and Group B (the effect after cranioplasty and rehabilitation training). Furthermore, for analysis of the effect of cranioplasty on rehabilitation programs in Group B, we compared the data before and after cranioplasty, with both completing rehabilitation training.

Functional assessment

The functional domain including muscle power and Barthel index is recorded at admission and discharge. Muscle power of the affected side is measured by manual muscle test by an experienced physical therapist. For upper limb strength, elbow flexor/extensor is tested; for lower limb strength, knee flexor/extensor is tested. The grading score ranges from 0 to 5. Zero represents no muscle contraction, and five represents a normally sound side.

The Barthel index [14], which has demonstrated high inter-rater reliability and test–retest reliability, is widely used in the evaluation of performance in activity in daily living (ADL). The attending physician evaluates 10 categories of the Barthel index, and sums up the total score.

Cognitive assessment

The cognitive function consists of Rancho Los Amigo Scale (RLS), Mini Mental State Examination (MMSE), Community Mental State Examination (CMSE), and Luria-Nebraska Neuropsychological Battery-Screening Test Short Form (LNNBS), which are proven to be extensively accessed in TBI

Please cite this article in press as: Su J-H, et al., The effect of cranioplasty in cognitive and functional improvement: Experience of post traumatic brain injury inpatient rehabilitation, Kaohsiung Journal of Medical Sciences (2017), http://dx.doi.org/10.1016/j.kjms.2017.05.002