Acta Neurochirurgica (2019) 161:231–232
https://doi.org/10.1007/s00701-019-03813-8

EDITORIAL (BY INVITATION) - BRAIN TRAUMA

Neuroendoscopy—a minimally invasive alternative in the surgical management of traumatic intracerebral contusions?

Niklas Marklund[1]

Received: 9 January 2019 / Accepted: 12 January 2019 / Published online: 22 January 2019

In the present issue of *Acta Neurochirurgica*, Dr. Masaki Mino and co-workers [8] describe the technical details of neuroendoscopy for the evacuation of traumatic intracerebral contusions causing delayed clinical deterioration. The indications for surgery in the 10 patients were (1) development of new neurological symptoms, (2) deterioration of consciousness level by more than two points on the GCS, or (3) increased intracranial pressure (ICP) ≥ 25 mmHg. The present manuscript is interesting since it brings an additional treatment option to a heterogeneous clinical condition for which consensus has not been reached in the neurosurgical community, particularly with regard to moderate-size lesions as well as optimal strategy for elderly patients.

Traumatic cerebral contusions represent the most common parenchymal injury following traumatic brain injury (TBI), observed in the vast majority of severe TBI and up to ca 25% of moderate TBI patients. These lesions are most commonly located inferiorly/anteriorly in the frontal and/or temporal lobes and become surrounded by an edema after the first few post-injury days. An increased mass effect is common over the first post-injury days, both from the hemorrhage itself and from the developing edema, and such "blossoming" occurs in up to ca 50% of all contusions [1, 12]. The increased mass effect may then lead to increased ICP, impair cerebral perfusion, and result in subacute clinical deterioration requiring surgical management. Furthermore, although uncommon, delayed traumatic intracerebral hemorrhages have been observed beyond the first post-injury week, even in those with no or minor findings on initial CT scan [3]. The risk factors for clinical deterioration have recently been addressed [1, 12], emphasizing the highly dynamic features of intracerebral contusions.

The surgical guidelines published in 2006 [2] recommended that in patients with a Glasgow Coma Scale (GCS) score of 6–8 with frontal or temporal contusions ≥ 20 mL and a midline shift ≥ 5 mm and/or cisternal compression on CT, or with any lesion ≥ 50 mL, neurosurgical contusionectomy and decompression via craniotomy are warranted. Using standard neurosurgical techniques, the blood clots and adjacent contused brain tissue are removed to achieve sufficient decompression. Thus, when clinical deterioration or refractory intracranial hypertension is attributed to the contusion, or when the lesions result in marked mass effect including obliteration of the basal cisterns on CT scan, surgery is indicated. In addition, the hemorrhagic component may be the primary cause of the contusional edema [6] providing an additional argument for surgical treatment.

The clinical efficacy of standard craniotomy has only rarely been compared to other surgical methods [5, 10]. Arguably, the most important and influential study on the role of surgery is instead the Surgical Trial in Traumatic Intracerebral Haemorrhage (STITCH[Trauma]) trial, the first randomized controlled trial comparing surgery for traumatic contusions to best medical management. Here, the primary endpoint was dichotomized functional outcome which was not improved by surgery ($p = 0.17$). However, mortality ($p = 0.006$) as well and the Rankin Scale and Glasgow Outcome Scale-Extended ($p = 0.047$ and $p = 0.043$ respectively) was significantly improved by early contusionectomy [4]. Unfortunately, this trial had to be prematurely discontinued for funding reasons and only 170 out of the targeted 840 patients could be included. Yet, these data clearly indicate an important role for surgery in the management of traumatic contusions. However, whether surgical removal of moderate-sized contusions adds benefit to neurocritical monitoring and medical treatment [11] and whether patients in a relatively good clinical state (GCS > 8) benefit from surgery remain controversial. Additional studies on the role of surgery for traumatic contusions are clearly warranted.

This article is part of the Topical Collection on *Brain trauma*

✉ Niklas Marklund
Niklas.marklund@med.lu.se

[1] Skåne University Hospital, Department of Clinical Sciences Lund, Neurosurgery, Lund University, Lund, Sweden

While minimally invasive tools including endoscopy are evaluated in ongoing studies in spontaneous non-traumatic and non-aneurysmal intracerebral hemorrhage [7, 9], similar studies in TBI are scarce. In the present article by Mino et al. [8], neuroendoscopy was used to treat traumatic intracerebral contusions. A single burr hole was placed at the frontal or temporal region to introduce a rigid endoscope. The target was the blood-fluid interface, as visualized on CT, and aspiration of the liquid component of the necrotic core was performed under endoscopic guidance.

Of the 10 included patients, four were operated on day 2 and four others ≥ 10 days post-injury. Although the liquid "necrotic core" was targeted, some of the presented cases appeared to show a blood clot of high density. Thus, endoscopy needs to be evaluated in larger cohorts of TBI patients to refine the surgical indications and determine in which contusions this technique should be avoided. Although the authors argued that the contusional edema was decreased in all patients on 3-day post-surgery CT imaging, the natural course of the edema resolution in these patients could not be determined. Furthermore, the clinical condition was markedly heterogeneous where 7/10 patients had a GCS score of ≥ 12 whereas the remaining three were deeply comatose (GCS 4–5) at time of surgery.

In conclusion, the heterogeneity of surgical timing, age, and the level of consciousness makes the data presented here insufficient to suggest that neuroendoscopy is preferable or effective when compared to standard surgical techniques. Instead, the manuscript demonstrates the feasibility of using neuroendoscopy in a TBI cohort and provides arguments that minimally invasive techniques can be considered in TBI patients in whom, for any reason, standard craniotomy cannot be used. Since elderly patients may tolerate the surgical trauma of conventional craniotomy worse than younger individuals, they may be particularly suited for minimally invasive procedures as exemplified by this series of rather old patients. In the near future, clinical studies should in a randomized fashion focus on evaluating this technique to determine the potential role for, and the complications associated with, neuroendoscopy in TBI.

References

1. Allison RZ, Nakagawa K, Hayashi M et al (2017) Derivation of a predictive score for hemorrhagic progression of cerebral contusions in moderate and severe traumatic brain injury. Neurocrit Care 26: 80–86
2. Bullock MR, Chesnut R, Ghajar J et al (2006) Surgical management of traumatic parenchymal lesions. Neurosurgery 58(3 Suppl): S25–S46
3. Gentleman D, Nath F, Macpherson P (1989) Diagnosis and management of delayed traumatic intracerebral haematomas. Br J Neurosurg 3:367–372
4. Gregson BA, Rowan EN, Francis R et al (2015) Surgical trial in traumatic intraCerebral Haemorrhage (STITCH): a randomised controlled trial of early surgery compared with initial conservative treatment. Health Technol Assess 19(70):1–138
5. Huang AP, Tu YK, Tsai YH et al (2008) Decompressive craniectomy as the primary surgical intervention for hemorrhagic contusion. J Neurotrauma 25(11):1347–1354
6. Katayama Y, Mori T, Maeda T, Kawamata T (1998) Pathogenesis of the mass effect of cerebral contusions: rapid increase in osmolality within the contusion necrosis. Acta Neurochir Suppl 71:289–292
7. Kellner CP, Chartrain AG, Nistal DA et al (2018) The stereotactic intracerebral hemorrhage underwater blood aspiration (SCUBA) technique for minimally invasive endoscopic intracerebral hemorrhage evacuation. J Neurointerv Surg 10(8):771–776
8. Mino M, Fujimura M, Yoshida M et al (2018) Application of neuroendoscopic target aspiration of the necrotic core for cerebral contusion with delayed progression: technical note. Acta Neurochir. https://doi.org/10.1007/s00701-018-3753-z
9. Mould WA, Carhuapoma JR, Muschelli J et al (2013) Minimally invasive surgery plus recombinant tissue-type plasminogen activator for intracerebral hemorrhage evacuation decreases perihematomal edema. Stroke 44:627–634
10. Soukiasian HJ, Hui T, Avital I et al (2002) Decompressive craniectomy in trauma patients with severe brain injury. Am Surg 68:1066–1071
11. Valadka AB, Robertson CS (2007) Surgery of cerebral trauma and associated critical care. Neurosurgery 61(1 Suppl):203–220
12. Wan X, Fan T, Wang S et al (2017) Progressive hemorrhagic injury in patients with traumatic intracerebral hemorrhage: characteristics, risk factors and impact on management. Acta Neurochir 159:227–235