



Proposal of modification in management strategy for intracranial hemorrhage in low- and middle-income countries

Omotayo A Ojo^a, Chiazor U. Onyia^{b,*}

^a Neurosurgery Unit, Department of Surgery, Lagos University Teaching Hospital, Lagos, Nigeria

^b Neurosurgery Unit, Department of Surgery, Lagoon Hospitals, Lagos, Nigeria



ARTICLE INFO

Keywords:

Intracranial hemorrhage
Hemorrhagic stroke
Early intervention
Low- or middle-income countries

ABSTRACT

This brief communication describes the challenges faced by neurosurgeons in Low- or middle-income countries to treat neurosurgical emergencies from intracranial bleeds (whether traumatic or spontaneous). The authors point out that in low- or middle-income countries and Africa in particular, resources, facilities, and personnel are lacking to follow the guidelines proposed for treating these conditions in high-income countries. The proposal offered here is to move to early surgical intervention because algorithms to monitor patients under conservative management guidelines are often not possible.

1. Background

Intracranial hemorrhage requiring surgical evacuation (whether traumatic or not) is generally a significant cause of mortality and often challenging to manage in most low- or middle-income countries. This is as a result of inadequate intensive care facilities, insufficient medical personnel for proper neuromonitoring required to accurately know when to abandon conservative management for surgical intervention and various logistic difficulties in getting surgery done as soon as indicated for such emergencies. In addition, there are still very few neurosurgeons for the populace in such settings as well.

Over the decades, findings from various studies on spontaneous intracranial bleeds have formed the basis for most guidelines on when to intervene with surgical treatment for these patients [1–4]. Surgical Trial in Lobar Intracerebral Hemorrhage (STICH II) trial and other such trials have been well documented to influence timing of surgery. Amongst other criteria for intracerebral hemorrhage, current recommendation for surgical intervention over medical management include persistently elevated ICP (intracranial pressure) in spite of optimal medical therapy and rapid neurologic deterioration [3,4]. By all standards, these would ideally require serial ICP measurements by experienced personnel and close neurological observation in a neurointensive care unit [4–7]. This is because raised ICP is the most important factor for mortality in both traumatic and spontaneous

intracranial hemorrhage.

In neurotrauma on the other hand, the current guidelines for abandoning conservative care for surgical intervention in patients with traumatic acute extradural hematoma include total volume of clot more than 30cm³, maximum thickness of more than 15 mm, midline shift on CT scan more than 5 mm, a Glasgow coma score of less than 8 as well as presence of neurologic deficits [1]. However, the conservative care must ideally be done with ICP monitors and close neurological observation in a neurological centre. Current guidelines for surgical intervention without any consideration for initial conservative care in patients with acute subdural hematoma include clot thickness more than 10 mm or midline shift more than 5 mm irrespective of the Glasgow coma score, or clot thickness less than 10 mm and midline shift less than 5 mm but with an intracranial pressure of 20 mmHg or more, drop in Glasgow coma score by 2 points or more below initial score from time of injury to admission, or either asymmetric or fixed and dilated pupils [2]. Dynamic intracranial pressure monitoring signals the time when additional imaging examinations are needed in order to single out patients who should have timely surgical intervention [7]. The capacity and facility for these are still grossly lacking in most low- and middle-income countries, and this is largely due to prevailing poor economic situation in most cases. In addition to these problems, there are only a few with access to medical insurance capable of offering adequate financial back-up to meet up with the costs of serial CT scans

Abbreviations: ICH, intracerebral hemorrhage; EVD, external ventricular drainage; GCS, Glasgow coma score; IVH, intraventricular hemorrhage; ICP, intracranial pressure; ICU, intensive care unit; HDU, high dependency unit; CT, computerized tomography; BP, blood pressure; STICH, Surgical Trial in Lobar Intracerebral Hemorrhage

* Corresponding author at: Department of Surgery, Lagoon Hospital, 17B Bourdillon Road, Ikoyi, Lagos, Lagos state, Nigeria.

E-mail address: shalomazor@yahoo.com (C.U. Onyia).

<https://doi.org/10.1016/j.clineuro.2019.03.026>

Received 13 February 2019; Received in revised form 26 March 2019; Accepted 30 March 2019

Available online 01 April 2019

0303-8467/ © 2019 Elsevier B.V. All rights reserved.

as well as ICP monitoring with prolonged ICU care which may be required for such cases. Additionally, the heavy burden of head injuries in low-income countries is an extra reason suggesting the need for a more simplified treatment strategy. An attempt to assess and summarise the quality of previous clinical standard practice guidelines for neurotrauma into one single standard guideline identified only 1 out of 24 such guidelines formulated in a middle-income country, while all the remaining 23 guidelines which were developed in high-income countries were of more quality [24]. None was identified from a low-income country. Most of these other guidelines had limited applicability for resource-challenged settings [24,26].

Raised ICP is the most important factor for mortality in both traumatic and spontaneous intracranial hemorrhage. The pressure could be as a result of mass effect from the bleed or secondary hydrocephalus from blocked CSF pathway. Either way, the earlier the pressure is normalised, the better for prognosis. In standard centres, the protocol involves continuous monitoring of ICP with ICP measuring devices along with medical management of raised ICP. Some involve the use of ventricular drainage as a means of reducing ICP. The facilities for such are too expensive in most low- and middle-income countries.

Bleed in the ventricle is never to be ignored particularly when the CSF pathway is completely compromised at the time of CT scan review or if there is a possibility that it could be because of ongoing bleeding which is usually obvious with serial scan. In low- and middle-income countries however, it is often unlikely that the patient would be able to do further serial CT scans because of cost and the logistics involved. Therefore, an earlier surgical intervention would be expedient to manage such patients appropriately based on clinical presentation and findings of brain CT scans. Of course, where the facilities are available, the standard protocol of medical management of ICP control, serial CT scan, ICP monitoring with or without ventricular drain would be recommended.

Surgical approaches will depend on the aetiology and findings from the initial CT scan. Generally, it is widely believed that surgical evacuation of a clot after an intraparenchymal bleed in the brain not only eliminates the mass effect and prevents intracranial herniations, but also eliminates the chances of the hematoma expanding, improves brain perfusion, reduces tendency for development of brain edema and removes blood products which may be a potential source of secondary injury to the brain [4,10–17]. All these effects progressively worsen over the first 24 h after the bleed and may lead to irreversible injury within few hours [12,15,18]. This has been attributed to the concept of a penumbra of functionally impaired but yet potentially reversible neuronal injury surrounding the clot [11,12,14,19]. Previous studies in animals have suggested that early removal of the clot reduces the ischaemic damage in this zone [12,19]. In addition, a third of these patients are still actively bleeding by the time they present at the emergency department, and the increase in the size of the blood clot during the first few hours after its onset is thought to be a key determinant of neurological deterioration [16].

According to final findings from the second Surgical Trial for Intracerebral Hemorrhage (STICH II), early surgery was postulated to have a small but clinically relevant survival advantage for patients with spontaneous superficial intracerebral haemorrhage [4,20,21]. Additionally, mortality rate at 6 months was 18% in the early surgery group compared to 24% in the initial conservative treatment group [16,20,21]. However, though this benefit was not demonstrated to be a significant one, many agree that timely and aggressive management in the acute phase may mitigate secondary brain injury [15–17].

Furthermore, in the initial stages of the STICH II study, 62 (21%) of 291 patients assigned to initial conservative treatment went on to have delayed surgery but at the time of the delayed surgery, these patients were in deeper coma with worse neurological deficits than were those in the early surgery group [10,20]. This trial was in a high-income country where the need for urgent surgical intervention could be quickly met with as a result of adequate facilities for specialized

neuromonitoring and readily emergency neurosurgical service [22]. The scenario is not easy to duplicate in most low- and middle-income countries. Patients are better off with an early surgery based on presentation, clinical and radiological findings [23].

2. Recommendation

This brief communication describes the challenges faced by neurosurgeons in Low- and middle-income countries to treat neurosurgical emergencies. Intracranial hemorrhage (whether traumatic or spontaneous) requires adequate optimization to maximize clinical recovery and functional outcome [13]. In view of the various difficulties in low- and middle-income countries and other resource-constrained settings as highlighted, rather than currently accepted algorithms of initial medical treatment of raised ICP from intracranial bleed (whether traumatic or spontaneous) under close monitoring with serial brain scans and surgery being the last resort following failure of medical treatment, we recommend early surgical intervention on presentation in the following circumstances for any patient who qualifies for initial conservative care under close monitoring with neuroimaging and ICP monitoring :

- Unavailability of ICP monitoring device
- Unavailability of standard ICU (or at least HDU) facility, equipment and staff
- A minimum of *three* Serial CT / neuroimaging scans not readily available after initial CT imaging

Secondly, data can be utilized from early surgical intervention arms of the STICH

studies cited to get at an estimate of outcomes using this approach in low- and middle-income countries and then extrapolated to propose specific criteria for select patients who meet the criteria for initial conservative care under neuroimaging in low- and middle-income countries. It is important to note at this point, that some studies have revealed that traumatic brain injury management in low-income countries is grossly underrepresented in the literature [25,26]. Consequently, there is a lack of exact information from such countries regarding surgery for intracranial (traumatic) conditions. Hence, the need for this suggested modification in strategy of care may be more pressing than it already appears [24].

Instead of currently accepted guidelines, this approach has potential for better long-term outcomes in Africa and other low- and middle-income countries, although there is still need for a prospective study to confirm if it is truly so. Though the outcomes in terms of full neurologic recovery and return of normal function may not be satisfactory in all cases, it would be more beneficial in reducing morbidity and mortality along with less economic burden and cost of neurosurgical care in such settings with limited capacity [1–3].

Funding

None.

References

- [1] M.S. Greenberg, Epidural hematoma, *Head Trauma: Handbook of Neurosurgery*, 7th edition, Thieme, New York, 2010, pp. 894–896.
- [2] M.S. Greenberg, Subdural hematoma, *Head Trauma: Handbook of Neurosurgery*, 7th edition, Thieme, New York, 2010, pp. 896–899.
- [3] M.S. Greenberg, Guidelines for considering surgery vs. medical management, *Intracerebral Hematoma: Handbook of Neurosurgery*, 7th edition, Thieme, New York, 2010, pp. 1118–1129.
- [4] I.I.I.J.C. Hemphill, M.S. Greenberg, C.S. Anderson, et al., Guidelines for the management of spontaneous intracerebral hemorrhage. A guideline for health care professionals from the American Heart Association/American Stroke Association, *Stroke* 46 (2015), <https://doi.org/10.1161/STR.0000000000000069> 000-000.
- [5] C.K. Dastur, W. Yu, Current management of spontaneous intracerebral haemorrhage, *Stroke Vasc. Neurol.* 00 (2017), <https://doi.org/10.1136/svn-2016-000047> e000047.

- [6] R. Reichart, S. Frank, Intracerebral hemorrhage, indication for surgical treatment and surgical techniques, *Open Crit. Care Med. J.* 4 (2011) 68–71.
- [7] R. Sahni, J. Weinberger, Management of intracerebral hemorrhage, *Vasc. Health Risk Manage.* 3 (5) (2007) 701–709.
- [10] M.L. Flaherty, J. Berk, Surgery for intracerebral hemorrhage: moving forward or making circles? *Stroke* 44 (2013) 2953–2954.
- [11] A.A. Kumar, J.S. Valson, Surgery in spontaneous intracerebral hemorrhage— a series analysis, *J. Neurol Stroke* 2 (4) (2015) 00060, <https://doi.org/10.15406/jnsk.2015.02.00060>.
- [12] H. Zheng, C. Chen, J. Zhang, Z. Hu, Mechanism and therapy of brain edema after intracerebral hemorrhage, *Cerebrovasc. Dis.* 42 (2016) 155–169, <https://doi.org/10.1159/000445170>.
- [13] P.F. Mack, Intracranial hemorrhage: therapeutic interventions and anaesthetic management, *Br. J. Anaesth.* 113 (S2) (2014) ii17–ii25.
- [14] R. Thiex, S.E. Tsirka, Brain edema after intracerebral hemorrhage: mechanisms, treatment options, management strategies and operative indications, *Neurosurg. Focus* 22 (5) (2007) E6.
- [15] E.C. Jauch, J.A. Pineda, J.C. Hemphill, Emergency neurological life support: intracerebral hemorrhage, *Neurocrit. Care* (2019), <https://doi.org/10.1007/s12028-015-0167-0>.
- [16] K.M. Thompson, S.Y. Gerlach, H.K.S. Jorn, J.M. Larson, T.G. Brott, J.A. Files, Advances in the care of patients with intracerebral hemorrhage, *Mayo Clin. Proc.* 82 (8) (2007) 987–990.
- [17] A.R. de Oliveira Manoel, A. Goffi, F.G. Zampieri, D. Turkel-Parrella, A. Duggal, T.R. Marotta, R. Loch Macdonald, S. Abrahamson, The critical care management of spontaneous intracranial hemorrhage: a contemporary review, *Crit. Care* 20 (2016) 272.
- [18] K.E. Wartenberg, S.A. Mayer, The STICH trial: the end of surgical intervention for supratentorial hemorrhage? *Curr. Neurol. Neurosci. Rep.* 5 (6) (2005) 473–475.
- [19] M.S. Siddique, D.A. Mendelow, Surgical treatment of intracerebral hemorrhage, *Br. Med. Bull.* 56 (2) (2000) 444–456.
- [20] A.D. Mendelow, B.A. Gregson, E.N. Rowan, G.D. Murray, A. Gholkar, P.M. Mitchell, Early surgery versus initial conservative treatment in patients with spontaneous supratentorial lobar intracerebral haematomas (STICH II): a randomised trial, *Lancet* 382 (2013) 397–408.
- [21] A.D. Mendelow, B.A. Gregson, P.M. Mitchell, G.D. Murray, E.N. Rowan, A. Gholkar, Surgical trial in lobar intracerebral haemorrhage (STICH II) Protocol, *Trials* 12 (2011) 124.
- [22] J.Y. Kim, H.J. Bae, Spontaneous intracerebral hemorrhage, *J. Stroke* 19 (1) (2017) 28–39.
- [23] A.O. Adeleye, U.A. Osazuwa, G.I. Ogbole, The clinical epidemiology of spontaneous ICH in a sub-saharan African country in the CT scan era: a neurosurgical in-hospital cross-sectional survey, *Front. Neurol.* 6 (169) (2015).
- [24] A. Patel, M.M.C. Vieira, J. Abraham, N. Reid, T. Tran, K. Tomecsek, et al., Quality of the development of traumatic brain injury clinical practice guidelines: a systematic review, *PLoS One* 11 (9) (2016) e0161554.
- [25] H.A. Sitsapasan, T.P. Lawrence, K. Wester, Neurotrauma outside the high-income setting: a review of audit and data-collection strategies, *World Neurosurg.* 79 (3–4) (2013) 568–575.
- [26] A. Razmkon, Priorities and concerns for research on neurotrauma in the developing world, *Bull. Emerg. Trauma* 1 (1) (2013) 5–6.

Additional reference

- [8] S.X. Yu, Q.S. Zhang, Y. Yin, Z. Liu, J.M. Wu, M.X. Yang, Continuous monitoring of intracranial pressure for prediction of post-operative complications of hypertensive intracerebral hemorrhage, *Eur. Rev. Med. Pharmacol. Sci.* 20 (2016) 4750–4755.
- [9] M.S. Greenberg, The modified Rankin scale, *Outcome assessment: Handbook of Neurosurgery*, 7th edition, Thieme, New York, 2010, p. 1183.