Magnitude of intracranial pressure changes following rigid external cervical collar immobilization in cases sustaining Traumatic Brain Injury: Impact analysis current status

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Abstract: Rigid collars are routinely used to immobilise the cervical spine during early phase of management of trauma cases until cervical clearance is obtained or else diagnosed as case of cervical spine injury following detailed clinical as well as neurological evaluation. Spinal injuries commonly coexist in patients sustaining severe head injury. Till date, there is no clear cut consensus about effect of application of a rigid collar in cases suffering with traumatic brain injury. However, concern are regularly raised over collar application, such practice may have adverse effect on cerebrovascular regulation and ultimately affecting intracranial pressure and outcome. Authors made detailed Pubmed, EMBASE, AMED, and Thomson Reuters, Medline line search and could find out six articles. According to existing literature, the cervical collar has the potential to influence intracranial pressure in patients suffering with head injury. There are several reports in the literature showing that cervical immobilization may alter intracranial pressure and the changes in ICP closely depend on the types of cervical collars used. Authors discuss the current status based on review of updated literature on possible effect on the intracranial pressure produced by application of rigid cervical collar and briefly literature is reviewed.

Key words: Utility of cervical collar, head injury, intracranial pressure, concern

Introduction
Poly-trauma cases carry high risk of cervical spine injury along with other associated injuries. These patients should be safely evacuated from the site of incident and common protocol includes immobilization of the cervical spine with application of a rigid external cervical collar to further prevent
potential exaggeration of unstable cervical spine and associated spinal cord injuries in the prehospital settings (1). Placement of a protective cervical collar is common in cases of acute head trauma. Hard cervical collar or alternatives like rigid external cervical brace SOMI is applied and continued till the clearance cervical spine is obtained (1-4).

Effect on intracranial pressure

Mobbs et al. observed cases suffering with head trauma carry high risk of having a concomitant cervical spine injury and a rigid cervical collar is usually applied to each patient until spinal stability is confirmed. Hard collars application may cause potentially venous outflow obstruction and additionally represents as nocioceptive stimulus, may lead to intracranial pressure rise (5).

Mobbs et al. in their prospective study involving ten cases suffering with head-injury with a post-resuscitation Glasgow coma scale score of nine or less underwent measurement of intracranial pressure both the before and following the application of cervical hard collar. Authors observed 90% cases had a rise in intracranial pressure following application of the collar and difference in pre- and post-application intracranial pressure was significant statistically. Mobbs et al. Concluded early cervical spine assessment and clearance in head-injured patients is recommended to minimize the risk of intracranial hypertension related to prolonged cervical spine immobilization with a hard collar (5).

Hunt et al. observed significant rise from the baseline intracranial pressure when the collars were applied with the mean rise of 4.6 mmHg, which was statistically significant. Further. Mean rise was greater in patients with a baseline intracranial pressure greater than 15 mmHg compared to counterpart having less than 15 mmHg. Authors observed no significant change in cardio-respiratory parameters during collar application, venous compression in the neck seems to be plausible explanation for intracranial pressure rise. Hunt et al. cautioned rigid collars should be removed as soon as cervical spine injury has been excluded in head-injured victims or else an alternative method of spinal stabilisation must be considered (6).

Placing a cervical collar is a routine procedure and helps to reduce the risk of secondary spinal injury, however by altering the ICP it can lead to intracranial injury. According to these reports, the cervical collar has the potential to influence intracranial pressure in patients with traumatic brain injury. There are several reports in the literature showing that cervical immobilization may alter intracranial pressure and the changes in ICP closely depend on the types of cervical collars used. Effect of cervical collars on intracranial pressure in patients with head neurotrauma (7).

It has been shown that patients with severe head injury particularly those who are unstable, unconscious and intubated may have up to 14% of cervical lesions and up to 7% of these lesions (5, 8). The application of cervical collars has the potential risk to increase intracranial pressure causing obstruction to the venous drainage (8, 9). Other adverse effects of cervical immobilization are increased
respiratory effort, skin ischemia, pain and discomfort.

Kolb et al. prospectively evaluated the change in measured cerebrospinal fluid pressure after the application of a rigid Philadelphia collar in 20 adult patients without cervical spine injury undergoing lumbar puncture. The average pressure was 176.8 mm H2O initially and increased to an average of 201.5 mm H2O after collar placement (range 0 to 120) which statistically significant. Authors noted even small increment in pressure could be significant in patients who already have an elevated intracranial pressure (11).

Maissan et al. noted rigid cervical collar immobilization to the cervical spine are known to increase intracranial pressure in severe traumatic brain injury and the cerebral blood flow might decrease according to the Kellie Monroe doctrine. For this reason, the use of the collar in patients with severe traumatic brain injury has been abandoned from several trauma protocols in the Netherlands. Maissan et al. in a prospective blinded cross-over study evaluated the effect of application of a rigid cervical collar in 45 healthy volunteers by measuring their optical nerve sheath diameter by transocular sonography an indirect non-invasive method to estimate ICP and pressure changes. They observed application of a collar resulted in a significant increase optic nerve sheath diameter in both side and concluded application of a rigid cervical collar significantly increases the optic nerve sheath diameter in healthy volunteers with intact cerebral autoregulation (12).

However, early of diagnosis of cervical spine injury will segregate those cases where cervical immobilization is not required anymore and cervical collar can be safely taken out and can be managed for associated traumatic brain injury (13-16).

However, current evidences have several limitations to generalize the findings, as analysis was primarily directed only to determine the effect of intracranial pressure rise on cervical collars and it does not pertain to neurological outcome of patients (7).

**Conclusion**

The currently available data fail to clearly establishing the impact of cervical collar application always produces rise in the intracranial pressure in those cases, who sustained traumatic head injury; although the rise in intracranially pressure may be of lesser impact than non-application might produced devastating consequences in form of worsening of unstable cervical spine injury as well as deterioration of neurological status and associated spinal cord injury. According to recent authors consensus an early evaluation of the cervical spine in patients with head trauma is necessary to reduce the impact of prolonged use of cervical collars and their possible influence on intracranial pressure, multicentric randomized case controlled studies are required to determine and actually quantify the exact and precise magnitude of rise in the intracranial pressure following immobilization of cervical spine with a rigid cervical collar.
References

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