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NECK STABILIZATION IN TRAUMA PATIENT: AN EMERGENCY MEDICINE PERSPECTIVE

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ABSTRACT

Spinal trauma is among the most common causes of death among young and healthy individuals. Additionally, due to disability, spinal injury places an enormous burden on both the economical system and the society itself. The main principle of managing early spinal injury in an emergency setting is to stabilize the patient to prevent movement and further deterioration of the patient's status. This procedure is especially important in the suspicion of cervical spine trauma due to the vital nerves that run through this part of the spine. The cornerstone of diagnosis of spinal damage is CT although it is not perfectly suited for the assessment of the spinal cord injury. The golden standard for the assessment of the extent of damage is MRI, which allows for the best visualization of the soft tissues. To date, there have been developed several devices which allow for the immobilization of the spine. The most commonly used is the cervical collar which restricts the movement of the neck, therefore preventing further damage to the spine. The second device is called longboard, on which the patient is laid and then attached by the straps. While easy to use and fast to apply, the guidelines recommend against the use of the said device and place its role more toward quick extraction devices. The same guidelines recommend the vacuum mattress as a method of choice for transporting patients. Although stabilization is important there are some groups of patients who do not benefit from immobilization. The scales that facilitate the decision-making process are easy to use and achieve high sensitivity.

KEY WORDS: cervical spine; trauma; neck; cervical collar

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INTRODUCTION

Trauma is one of the leading causes of death among young and healthy individuals and at the same time is the leading cause of years of life lost [2]. Among these causes a special wage is given to the acute spinal injuries due to the fact that they not only account for the major part of death following trauma but also are a leading cause of severe disability in this population of patients, resulting not only in rapid deterioration of life quality for the said patients but also placing an enormous economic burden on the healthcare systems worldwide [3]. It has been long established that spinal stabilization is crucial to survival and further recovery from these kinds of injuries [4]. This procedure is especially important in the cervical region due to the vital innervation pathways that cross this part of the spine [5]. In this review, we would like to present the data and statistics regarding the methods of cervical spine stabilization in the traumatic patients

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MATERIAL AND METHODS

The anatomy of the cervical spine

The cervical spine consists of 7 vertebrae named C1 to C8. It is connected to the scull cranially and to the thoracic spine distally. The main role of the cervical vertebrae is to protect the spinal cord, support the head and facilitate the blood flow to the brain through the holes in the transverse processes where the blood vessels lie [8]. The first two cervical vertebrae C1 and C2 are called the atlas and the axis respectively. They are referred to as the atypical vertebrae due to their unique structure and their role in the connecting of the spine to the skull. These 2 vertebrae alone are responsible for more than 50% of rotation and 50% of flexion in the neck. The structure of these vertebrae differs from those found beneath them. The atlas is ring-shaped vertebra that connects and forms a joint with the skull and C2 by the corresponding condylates. C2 has a characteristic den or odontoid process which allows for rotational movements. This joint is further stabilized by the transverse ligament which runs posteriorly [6]. The remaining vertebrae C3–C7 are more concurrent and are built in a similar fashion to the remaining vertebrae of the spine [7]. The cervical spine receives circulation through the cervical radicular artery which arises from the subclavian artery. The artery then proceeds through the transverse process and enters the skull forming the basilar artery [9].

Nerves of the cervical spine

The cervical spine is the first structure to accommodate the spinal cord as it leaves the skull and enters the spinal canal and reaches the first lumbar vertebrae [10]. The understanding of the anatomy of the spinal cord is crucial in understanding the clinical manifestation of the injury to the spinal cord. Ranging from chronic conditions such as neck pain caused by the rheumatoid arthritis [11] to those caused by acute injury such as during sport or accidents [12].

Spinal cord injuries

Spinal cord injuries may be divided into 2 major groups: complete and incomplete spinal cord injuries. In complete spinal cord injuries, the spinal cord is permanently damaged and the area innervated by the spinal cord loses its function. This type of damage in the cervical spine in the C1 to C4 nerves results in tetraplegia/quadriplegia meaning the loss of movement below the neck, resulting in the need for constant personal care with complete assistance in everyday activities e.g. bathing, eating, or dressing. Other complications of this type of injury are the loss of ability to control the bladder, impaired speaking, and severe impairment of breathing. The complete injury to the C5 level reduces the strength of the arms but one may move them, however, due to preserved movements of the upper trunk one may move around on the wheelchair. The C6–C8 injury results in the limitation of the quality of life however, the patient may drive an adapted vehicle which allows for some dose of independence and patients may more or less use the muscles of the upper trunk [13]. Diagnosis of spinal cord injury is predominantly done on-site of the injury. The main goals of first help and diagnosis is similar to the other types of trauma and require the following ABC scheme (airway, breathing, circulation) [14]. Additionally, the anamnesis with the precise determination of the injury history, mechanism, and the context of trauma is required. Following the clinical diagnostic process, the use of imaging is crucial to assess the level and distribution of trauma. While the most common first-line imaging includes computerized tomography, which reveals the bone fractures, is performed [15], it does not allow for the proper diagnosis of nerve damage. Therefore the golden standard for the radiological diagnostic method is magnetic resonance imaging (MRI) as it allows not only for the determination of the level of injury but also allows for the assessment of prognosis following injury [16]. The MRI also allows for deeper investigation as it reveals other trauma to the cord and surrounding tissues such as contusion, compression, edema, or damage to the ligaments [17, 18]. These findings are then incorporated into the scales which allow for the prediction of the outcome of the damaged patients e.g. Brain and Spinal Injury Center score [19]. However, even a single factor such a length of the damaged section may be used to predict the outcome [20]. These factors make MRI a go-to method for the imaging of spinal injury.

The types of fractures in the cervical region

The C1 fracture named Jefferson fracture occurs most often during diving in the shallow water or road accident and amounts to 2–13% of acute cervical spine trauma [21]. It is caused by the axial loading of the vertebrae and results in fracture of the anterior and posterior arch of C1. Interestingly there is a male predominance in this fracture in a younger population [22], which reverses in the older patients. While the classic injury mechanism

involves diving in the shallow water, the diagnosis of this injury is not always plain and simple [23]. And may require the use of CT or MRI to assess the ligamental damage [24] as well as measuring the atlanto-dens interval which when reduced indicates the fracture in question [25]. Following the diagnosis, the fracture is then classified by the injury pattern into 3 types [26]. The C2 fracture is named a hangman fracture and is the most commonly affected vertebrae in the cervical spine fracture [27]. Similar to the C1 fractures, there is a bimodal distribution in the age of patients with the younger patients who suffer a high energetic trauma and the elder population from low energy [28]. What needs to be said and addressed when discussing these kinds of fractures is that they result in high mortality and morbidity [29].

The spinal immobilization

Whenever there is a suspicion on the cervical spine trauma it shall be stabilized in the neutral position based on the head resting on the flat surface to reduce further damage and protect the patient [30]. What is important is that regardless of the clinical presentation, the mechanism of injury alone is the paradigm to stabilize the patient's spine [31], as there were studies reporting the rapid deterioration of the patient during the transport to the hospital [32]. Especially since the numbers of secondary spinal injuries range up to 25% [34]. Therefore a range of equipment has been developed to facilitate this procedure and provide the patient with a higher chance of recovery. However, we must remember that regardless of spinal immobilization almost 5% of patients still suffer from neurological worsening [35].

Cervical collar

The cervical collar has been the cornerstone of cervical spine stabilization in the prehospital setting for more than 40 years [33]. The idea behind stiff stabilization is that it allows for the restriction of movement and hence it should prevent secondary injury [36]. While the collars serve their function the crucial part of the application is the correct size, which allows for the proper stabilization [37]. The studies also provided data that in healthy volunteers the cervical collar performs well in regards to the stabilization mechanism [38, 39], it might be counterproductive and give a false sense of security in the patients with unstable fractures in the cadaveric model [40]. The collars fulfill their duty as stabilizing equipment very well as they can be applied and removed without the significant displacement of the head [41] and prevent further neurological damage [42]. On the flip side however they are known to cause respiratory problems [43] and overall are uncomfortable to wear for a long time.

The longboard

Since 1971 the long spine board has been advised by the American Academy of orthopedic Surgeros for the management of spinal injury when transporting the patient to the hospital regardless of clinical condition and based only on the mechanism of injury [44]. This recommendation started to change as since the 80s there were more and more studies recommending against the use of the spinal board. The main concerns were the tissue breakdown, from the hypoxia [45], high pressure against tissues [46], and the decrease in pulmonary function resulting in respiratory insufficiency [47, 48]. The current recommendations by the EMS Physicians place the role of longboard as the extraction device only and strongly recommend against using it as the transporting one [49].

Vacuum mattress

While in use for quite some time only recently the vacuum mattress has been recommended to be a stabilization of choice over the longboard [50]. The equipment itself consists of the mattress-shaped device filled with polystyrene beads which retract over the pressure of the patient's body. When the patient is placed, the vacuum is applied and the bed itself stiffens giving solid support to the patient. This allows for more support of the natural curvatures of the spine [51, 52] and provides the patient with more comfort during the transport [53]. Additionally, the study by Hamilton showed that the stabilization forces are higher than those in longboard without compromising the comfort of the patient [54]. Some studies however contradict these findings and provide data that the stabilization forces in longboard and vacuum mattresses are similar [55]. The disadvantage which makes the vacuum mattress less appropriate in the emergency medicine setting is the fact that it takes a longer time to set up, which might hinder the prognosis of the patient [56]. Another point that has to be taken into consideration is that in the rocky terrain the vacuum mattress might be punctured [57].

Who shall we stabilize?

The studies showed that the clinical findings are superior to the mechanism of injury when the question

of stabilizing the patient arises [58]. Several national emergency service associations worldwide have adopted some kind of triaging scales when deciding on spine stabilization [59]. The decision is important as the immobilization may result in pain [60], increasing difficulty in clinical examination [61] and intubation [62]. Therefore, the newest guidelines of the Danish working group issued a strong recommendation against the efforts of spinal stabilization in case of patients with isolated penetrating injuries, a weak recommendation against the use of the rigid cervical collar as well as the hard backboard, and a weak recommendation for the use of a vacuum mattress in case of ABCDE-stable patients [63]. The recommendation against the use of stabilization in penetration trauma is further reinforced by the guidelines by the American College of Emergency Physicians [64]. Additionally, the American Association of neurological surgeons recommends that the hard collar shall be used as a method of choice for managing prehospital stabilization [65].

Who shall we not stabilize

The National Emergency X-Radiography Utilization Study (NEXUS) criteria is a valuable tool when determining the patients who do not require the C spine immobilization [66]. While overall sensitive [67] the criteria are not reliable in patients over 65 years old [66]. The second scoring system that may be used to determine the need for spine stabilization is called the Canadian C spine rules, which has better sensitivity, better sensibility, and a lower rate of imaging use [68].

CONCLUSIONS

Spine injuries possess a great threat to the life of the patient and shall not be underestimated. The stabilization is a priority to reduce secondary damage. Longboard shall be avoided, and a vacuum mattress is preferred. The use of scoring scales reduces the number of unnecessary immobilizations.

Conflict of interest

None declared.

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