Role of conservative treatment of cervical spine injuries

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Abstract Conservative treatment still has an important role to play, despite the increasing possibilities of surgical treatment. Treatment starts at the site of trauma. Transportation and immobilisation in braces are discussed. Skeletal skull traction can be used for realignment and reduction, and eventually used in halo-vest treatment. The advantages and disadvantages of these different treatment options are discussed.

Keywords Cervical · Trauma · Conservative treatment

Introduction

Surgical fixation of fractures in general, has gained popularity. Improved imaging techniques together with more reliable surgical tools have lowered the threshold for surgery, offering the patient a short-term solution for his fracture.

Conservative measures, i.e. non-surgical tools, still have a role to play, either in the initial stage, either later on as an adjunct to surgery, or as the definitive treatment.

The goal is to provide a stable and hopefully painless spine together with the best possible neurologic recovery.

Pre-hospital care at the trauma site, followed by adequate evaluation at the emergency department, is critical. Transportation must be carried out on a spinal board, with the patient's neck immobilised by means of a collar, sandbags, and tape fixation. Children should be transported on a pediatric board, with special care to avoid flexion of the neck. Thorough physical examination is necessary in order to determine whether the patient has a complete or incomplete spinal cord injury, a root injury, or a normal neurological status.

Clinical examination must be followed by a radiographic workup, consisting of appropriate radiographs, and CT scan allowing in assessing any fractures or dislocations.

The type of fracture or dislocation, together with the neurologic status of the patient, will determine which therapeutic strategy seems most appropriate.

Although more and more guidelines for treatment are available, there are still several controversies in how to treat patients with a cervical trauma with or without spinal cord injury. A working algorithm can therefore be helpful, but a strict or dogmatic protocol is not really available against the background of these controversies.

The author discusses some of the aspects of non-surgical care of cervical trauma, in particular skeletal skull traction, the use of cervical braces, and the applications and limitations of a halo vest.

Conservative treatment can be the initial treatment and it can serve as an adjunct to surgery, or even be the definitive treatment.

Skeletal skull traction

Skeletal skull traction certainly still has a role to play in the initial phase, and is mainly indicated in cases of facet

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subluxation or dislocation, and in burst-type fractures, to stabilize and realign the cervical spine. Upper cervical fractures are also the candidates for skull traction, whereas traction is contraindicated for distractive injuries or patients with certain skull fractures. Gardner–Wells tongs are advocated because of their ease of use, whereas a halo ring can be preferred in those cases where a halo vest is considered as a definitive treatment. In children, the use of multiple halo pins is recommended in order to reduce pullout force, increase stiffness, and allow for a lower torque applied to the pins [5].

The timing of cranial traction is still controversial. Early application and attempt at reduction is advocated in patients with a spinal cord injury. Controversy mainly exists in those cases of a neurologically intact or cognitively impaired patient, recent literature supporting the safety of early reduction before magnetic resonance imaging (MRI) investigation [3, 6]. Some authors advocate routine MRI before reduction for every patient with a facet fracture or dislocation, regardless of the neurologic status. Eismont reported on a patient who woke up quadriplegic after an open reduction of a facet dislocation, as a consequence of a disk herniation that caused cord compression during the reduction.

The benefit of an MRI is to provide additional information on spinal cord compression, whether or not signal changes in the cord are present, and to show eventual lesions to the disc, ligaments and soft tissues. These benefits have to be weighed against the delay in treatment occurring as a result of it. Time constraints and tolerance or not by the trauma patient will dictate if it is appropriate to obtain an MRI examination. If a patient presents with complete paraplegia, within a few hours after trauma, MRI is not necessary. With regard to neurologic recovery, reduction may be more important than obtaining an MRI. When the patient is awake, closed reduction with skull tongs is a safe procedure, and MRI is not mandatory in this situation. However, if the patient has to undergo general anesthesia for a closed or open reduction, then MRI scan is absolutely indicated.

The application of skeletal skull traction implies the availability of experienced personnel and X-ray and fluoroscopic facilities. The patients are preferably awake and positioned in reverse Trendelenburg position with shoulder straps attached to the footend of the table. The patient must be monitored with adequate analgesia and sedation. Gardner–Wells tongs are applied 1 cm superior to the pinna of the ears. Traction is being started with a weight of 10 pounds, gradually increasing with 5–10-pound increments every 5–10 min. At every step, a neurological control and check fluoro must be performed. If reduction is obtained, traction can be reduced to 10 or 20 pounds, with the neck in extension. After reduction, a CT or MRI scan should be done.

If reduction cannot be obtained, or in cases of increasing neurologic deficit, urgent surgical intervention is necessary. Other indications for conversion to an open procedure are residual spinal cord compression on postreduction MRI, excessive distraction, or a traction weight of 150 pounds.

Although long-term skull traction has a poor tolerance for the patient and is associated with morbidity, it can be part of a treatment plan to avoid fusion in complex fractures, considering conversion to a halo vest after a 6-week to 3-month period.

Cervical braces

Four categories of cervical braces have been described by Johnson et al. [4].

Cervical collars, e.g. the Necloc, the Philadelphia brace and the stiffneck collar. These orthoses offer the patient comfort, but have only limited effect on restricting motion. Rigid collars restrict motion more than soft collars, but all collars still allow significant motion of the cervical spine. Cervical collars restrict flexion and extension better than lateral bending.

A study performed by Podolsky et al. in normal subjects evaluated collars for trauma extrication and transport. They compared the soft collar, hard collar, Philadelphia collar, extrication collar, bilateral sandbags with tape, and Philadelphia collar with sandbags and tape. Sandbags and tape provided excellent restriction of motion except in extension. Extension was further limited by adding the Philadelphia collar to the sandbags and tape. The use of collars without sandbags and tape did not provide rigid restriction of cervical motion.

Soft collars are inexpensive and comfortable, but provide minimal motion restriction. These collars provide muscle relaxation, and are often used in the treatment of cervical strains.

The Philadelphia collar is a two-piece semirigid orthosis made of Plazazote, reinforced with anterior and posterior plastic struts. The Plazazote material is resistant to water, and, therefore, the Philadelphia collar is a good collar for use during bathing. This collar restricts motion better than a soft collar.

Other semirigid collars are available, such as the Aspen collar, the Miami collar, or the Malibu brace.

Each of these semirigid braces can be used to treat stable cervical fractures, or in the postoperative period. A collar with a removable liner provides superior comfort, and exchange of the liner optimizes hygiene.

Rigid collars are also routinely used in the prehospital stage for extrication and transportation of trauma victims. The stiffneck collar is often used, as it is inexpensive and offers rigid motion control, and it is easy to apply.

Poster braces (connection to the torso by two or four metal struts) and *cervicothoracic orthoses* (the anterior and posterior parts of the brace around the torso have metal connections). By incorporating the upper torso into the construct, these braces limit the amount of pivoting compared with a conventional collar.

When compared with cervical collars, a cervicothoracic orthosis provides better restriction of motion of the mid- and low-cervical spine.

The SOMI orthosis (Sterno-Occipito-Mandibular Immobilizer—SOMI) has a rigid anterior chest piece connected to rigid shoulder supports. The chest piece is connected to the shoulder supports by straps across the patient's back. This brace is easy to apply, and the mandibular support can be removed during eating. The SOMI brace provides good restriction to flexion (93% restriction of motion), but is less good for control of neck extension (42% restriction of motion), lateral bending (66% restriction of motion) and axial rotation (66% restriction of motion).

Cervicothoracic orthoses can be indicated in relatively stable injuries to the lower cervical spine or in the treatment of cervicothoracic injuries, or postoperatively in patients with a questionable fixation.

The *halo vest* remains the orthosis of choice when rigid immobilization is required of an unstable cervical spine injury. A halo vest is the most rigid external immobilizer, especially in the upper cervical spine. It restricts up to 75% of flexion–extension at C1–C2, and offers superior control of lateral bending and rotation when compared with all other cervical braces.

The original Minerva brace was a cervicothoracic orthosis that provided fairly rigid control of mid- and low-cervical spine motion at the expense of comfort. Modern adaptations of the Minerva exist, incorporating a plastic vest with liner to a mandibular support and an extension to the posterior aspect of the head.

The comfort provided by an orthosis is an essential factor, not only with regard to patient's compliance, but also in the prevention of complications. Contact area between the brace and the patient should be maximized to lower contact pressures. The use of soft or semirigid materials should be used at the sites of skin contact. Skin breakdown is a potential complication, and even a significant risk in comatose patients, or patients with the loss of sensation. In these patients, it is essential to check the skin on a regular basis. Off the shelf orthoses are often used, and will fit a majority of patients. However, the use of thermoplastic materials and custom-made braces further enhances comfort, compliance and will thus better meet the ultimate goal of brace treatment. Optimizing brace fitting will lower the complication rate. Apart from skin problems, such as rash or ulcers, other complications may be inadequate immobilization, muscle atrophy, psychological dependence or pain. It

is better to advise the patient to wean from a collar than to stop its use abruptly. By weaning from a collar, the patient can gradually rebuild proprioception and build up muscle strength.

Halo-vest treatment

A halo ring can be applied for urgent reduction. A halo vest or jacket can be used as definitive treatment, as an adjunct to surgery, or as treatment for non-contiguous fractures. A halo vest is the most effective way to immobilise the cervical spine externally and is superior to braces. It is the stiffest immobilization, restricting up to 75% of flexion–extension in the upper cervical spine. A halo vest also provides the best control of rotation and lateral bending.

The use of halo vest may allow in shortening the hospital stay, and is also a relatively cheap method of treatment.

When a vest has been applied both the supine and upright X-rays must be performed to detect eventual loss of reduction in standing or sitting position.

Applying a halo ring and vest requires the availability of a trained team, consisting not only of a physician, but also an assistant and orthotist. Before starting, the physician should check the availability of the correct ring and vest size, halo pins, wrenches and screwdrivers [1].

The ring is temporarily held in place by means of three positioning pins with plastic caps. Following local anesthesia, four halo pins are applied in adult patients. Appropriate pin site placement is crucial. The anterior pins are placed anterolaterally about 1 cm above the orbital rim, below the equator of the skull, and above the lateral two-thirds of the orbit, in the so-called “safe zone”. The posterior pins should be placed directly opposite to the anterior pins. During anterior pin placement, the frontal sinus is located centrally above the nose, extending to the medial part cranial to the orbit. Also at a risk is the supraorbital nerve running over the medial one-third of the orbit. Lateral to the orbit, the temporal fossa should also be avoided because of its thin bone, and because of the presence of the mastication muscles.

The pins should be tightened sequentially in an opposite way, with increments of two in./lb, to a final torque of eight in./lb. The pins should be retightened once to eight in./lb 24–48 h later. After ring application, a vest can be applied.

The use of halo vest is relatively contraindicated in the presence of severe cachexia, in patients with severe deformity (ankylosing spondylitis or scoliosis), in morbid obese patients, in the elderly, or in non-compliant or tetraplegic patients. Ligamentous injuries are prone to poor healing and, therefore, halo-vest application may not be the best course of action.

Halo rings can safely be used in the pediatric population, although a high complication rate has been reported in the literature (68%) [2]. The number of pins must be increased to 8 or even 10, and the torque reduced to 2–4 pounds in children. Because of the immaturity of the skull, a CT scan of the head is recommended to determine the best pin sites, especially in children younger than 6 years of age. Braces have a poor compliance in children. Fractures, even ligamentous injuries, have a better healing capacity in children than in adults. Therefore, the application of a halo vest has wider applications in the pediatric than in the adult patient group.

The use of a halo vest is mainly indicated in cancellous bony injuries with limited displacement. The duration of treatment varies between 6 weeks and 4 months. Overall, its use is limited to the treatment of a minority of cervical fractures.

Conclusion

The decision-making in choosing the most appropriate treatment modality for a cervical trauma involves many considerations, including injury type, neurologic status,

risk of displacement, patient's body habitus and eventual deformity, and compliance. The choice of one modality over the other should be made on an individual basis, taking the above-mentioned factors into consideration.

Conflict of interest statement None of the authors has any potential conflict of interest.

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