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George Edward Peck, David James Heming Shipway, Kevin Tsang & Michael Fertleman

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Cervical spine immobilisation in the elderly: a literature review

George Edward Peck* a, David James Heming Shipwayb, Kevin Tsangc and Michael Fertlemana

ABSTRACT
Developed populations are ageing rapidly and by 2040, approximately 1 in 4 adults will be over 65 years of age. This is resulting in higher incidence of traumatic injury in older patients. Cognitive and physical comorbidities in this group can pose significant challenges. Due to mechanisms of injury and pre-existing degenerative spinal disease, cervical spine fractures are particularly prevalent in elderly patients. These are associated with significant morbidity and mortality. In this literature review we examine current evidence surrounding the use of cervical spine immobilisation in elderly patients in the pre-hospital and emergency department setting and also as a treatment option for cervical spine fractures. We explore evidence surrounding the complications that can arise from cervical spine immobilisation, including the development of pressure sores, raised intracranial pressure, dysphagia, breathing difficulties, delirium, compliance issues, mobility and functional outcome.

Introduction

By 2040 one in four people in the UK will be aged 65 or over. Those over 85 years are the fastest growing age group, rising by more than 30% in the last decade. The rising age of the population has resulted in higher incidence of traumatic injury in the elderly, both in absolute numbers and as a percentage of national trauma admissions annually. Low level falls (<2 metres) are now the leading cause of major trauma in the UK.

Due to mechanisms of injury and presence of pre-existing degenerative spinal disease, upper cervical spine fractures are particularly prevalent in the elderly population, with atlanto-axial complex and odontoid process injuries being the most common. Cervical spine fractures in the elderly are potentially life threatening injuries with in-hospital and 1-year mortality rates in patients aged >65 years eightfold higher than in younger age groups.

Cervical spine immobilisation is routinely used in the management of cervical injuries for pre-hospital stabilisation and transfer. It is also employed during assessment and diagnostic imaging on admission. It may also be employed as a conservative treatment strategy and as a post-operative precaution. However, cognitive and physical comorbidities in elderly populations can pose significant challenges.

In this review we examine the evidence base for cervical spine immobilisation in the elderly and explore issues derived from our own practice and the literature relating to its use in the frail elderly patient.

Methods

Electronic PubMed searches were conducted to identify studies published until and including October 2017 using the following Medical Subject Headings and text words: cervical immobility/immobilisation, neck immobility/immobilisation and hard/rigid collar in combination with elderly, frail older adult, older adult, complications, pneumonia, breathing, ventilation, pressure sores, intracranial pressure, swallowing, dysphagia, delirium, balance, mobility and functional outcome. Letters and abstracts were included in the searches. 1879 articles were identified. Titles and abstracts were screened for relevance to the article title and sub-sections by two researchers. References of relevant publications were searched for additional studies. 101 articles were examined further. Only articles in English were reviewed. Those most relevant to the title subject and subheadings have been included in this narrative literature review (see Figure 1).

Pre-hospital or emergency department cervical spine immobilisation

Cervical spine immobilisation remains an important component in the assessment, stabilisation and transfer of trauma patients. Age ≥65 years and the presence of confusion confers higher risk for cervical spine injury as part of both the Canadian C Spine rules and NICE guidelines for spinal injury assessment and initial management. There is, however, a lack of high-level evidence on the effect of pre-hospital cervical spine immobilisation on patient outcomes.

Pre-existing cervical spondylosis, degenerative osteoarthritis and rheumatoid arthritis are commonly seen in elderly patients, with increased thoracic kyphosis and loss of cervical lordosis. Immobilisation of elderly patients with significant degenerative deformity in rigid hard collars may result in inappropriately over-extended positions which are poorly tolerated and have the potential to worsen fracture displacement or neurological injury. In addition, the efficacy with which collars are fitted is uncertain. Kreinest et al. found in a cohort of medical emergency conference attendees, despite training and subjective confidence,
only 11% of professional rescue personnel and emergency practitioners could effectively fit a cervical collar without error.12

Recent guidance from the London Major Trauma System advises that elderly patients be assessed on an individual basis and that soft padding and tape should be considered in some circumstances as a pragmatic alternative to rigid hard collars in the pre-hospital or emergency department management of elderly patients with severe deformities. Prompt imaging, with timely decisions regarding continued immobilisation are required to minimise morbidity associated with hard collars, and patients requiring continued immobilisation should be switched to soft padded collars early.13

Cervical spine immobilisation as a treatment option

The commonest cervical spine injuries in elderly patients involve C1 and C2 vertebrae with atlantoaxial complex and odontoid process fractures being particularly prevalent. Uncertainty persists in the literature regarding optimal management of these fractures. A recent literature review found 14 studies reporting outcomes for older patients with fractures of the upper cervical spine.14 No significant differences in outcome were observed between patients managed conservatively (with rigid collar), with halo vest and fracture reduction, and those managed with surgical fixation. Overall mortality was found to be as high as 31.4%, with morbidity ranging between 10-91%.

A systematic review in 2015 of the treatment of type II odontoid fractures in patients aged >60 years identified 21 articles with 1233 patients meeting inclusion criteria.15 Short-term and long-term mortality were lower in patients who underwent surgical treatment than in those who had non-surgical treatment. There was no significant difference in the rate of complications. However, the authors did acknowledge that significant selection bias is likely to have affected their results as patients with multiple comorbidities who were not fit for surgery were automatically included in non-operative cohorts, thus increasing mortality overall for patients managed conservatively. Surgical approach (posterior vs anterior) showed no significant difference in mortality or complication rate. Similarly, no difference in mortality or complication rate was identified with hard collar or halo orthosis immobilisation.

Halo vests remain a potential treatment option but several authors have suggested that complication rates are higher in elderly patients, with respiratory compromise, dysphagia and pin-related issues.16,17 A systematic review in 2017 including 714 patients >60 years managed conservatively for odontoid fractures found significantly higher complications in patients managed with halo orthoses vs hard collar (p < .001).18 Higher mortality rates have also been reported.19,20

Some authors have suggested that in elderly populations fibrous union of the odontoid is an adequate goal, and that a rigid collar can provide sufficient immobilisation to achieve this in many cases.21-23 Myelopathy has been found to be a rare consequence of non-union.24 Therefore a good outcome in elderly patients may not depend on radiographic criteria for bone union, but depend on functional outcomes and a return to pain-free, independent living.25

The quality of research to this date has been limited. A Cochrane systematic review in 2008 could find no randomised controlled trials in trauma patients of all ages upon which to inform a decision about best practice.26 As seen in other fields of medicine, this is compounded in frail, elderly populations by challenges with ethical approval and consent.

Length of stay

There is some evidence that patients managed conservatively have a shorter inpatient stay than those managed surgically. Fagin et al.27 published a retrospective review of 108 patients with odontoid fractures and found the length of stay was less for non-operative patients compared with operated patients (8.5 compared to 13.9 days; p < .001). Similarly, Smith et al.28 found in a retrospective cohort analysis of older patients with type II odontoid fractures (>80 years of age) the length of acute hospital stay was shorter for those managed conservatively vs surgically (mean; 11.2 vs 22.8 days; p < .05).

Rigid versus soft collars

Both rigid and soft collars limit movement of flexion/extension more than lateral flexion and rotation.29 However, it is generally accepted that immobilisation in a rigid collar results in greater overall limitation in cervical spine mobility compared to a soft collar. Whitcroft et al.30 found that, in healthy non-elderly adults, use of a soft collar resulted in a reduction in cervical range of movement of up to 17.4%, whilst rigid cervical collars are able to achieve up to 62.9% reduction in range of motion, and a recent systematic review found that soft collars have a poor ability to reduce mobility of the cervical spine.31 Despite this, in a prospective cohort study comparing range of motion, although subjects exhibited less full, active range of motion of the cervical spine when immobilised in a rigid collar than when they were placed in a soft collar, the motion recorded during various functional tasks was not significantly different for 13 of 15 functional activities of daily living, regardless of which cervical device was applied.32 This raises the possibility that soft collars can act as a proprioceptive guide for patients intolerant of rigid collars to help to prevent cervical motion during functional activities. Pain as a result of acute fracture may also act as a nociceptive deterrent against mobility in the early stages after injury.
Complications of cervical spine immobilisation

Whilst making decisions about treatment, an awareness of the consequences of prolonged periods of cervical spine immobilisation is important.

Pressure sores

Pressure sores are a well recognised complication of rigid cervical spine immobilisation. A systematic review found incidence of collar-related pressure ulcers ranging from 6.8% to 38% typically at the occiput, chin, shoulders, and back. General immobility as a consequence of cervical spine immobilisation can also lead to pressure sores in other locations such as the sacrum, elbows and heels. Intensive care admission, mechanical ventilation, necessity for cervical MRI and length of time for cervical spine clearance have all been found to significantly increase risk of pressure ulcer development, and for every one day in a cervical collar, risk of a collar-related ulcer increases by 66%. If prolonged immobilisation is required, collars with softer padding and greater adjustability, such as the Miami J and Aspen collars, have been found to exert less pressure upon contact areas than the Stiff Neck extrication collar or Philadelphia collar. The former types of collar are therefore generally regarded as being more comfortable and better tolerated.

Intracranial pressure (ICP)

Rigid collars have a snug fit around the neck which distorts jugular venous architecture. Stone et al. found that the cross-sectional area of the internal jugular vein increases by 35% after rigid cervical collar placement in young healthy volunteers. More recently optic nerve sheath diameter, a non-invasive method of detecting raised intracranial pressure, has been found to be elevated in young healthy individuals placed in cervical collars. Several authors have found significantly raised ICP in patients with rigid collar immobilisation. This may not only contribute towards discomfort, but worsen delirium and non-compliance with orthoses. There may also be implications upon intracranial hypertension in patients with coexistent severe head injury.

Breathing

Respiration has been found to be affected by rigid cervical spine immobilisation, with significant reductions in FEV1 (forced expiratory volume over 1 second) and FVC (forced vital capacity). This effect is more pronounced at the extremes of age and increases with duration of immobilisation. Evidence is lacking for a direct causal relationship between rigid cervical spine immobilisation and pneumonia. However, the general decline in mobility as a consequence of cervical spine immobilisation is a well-recognised risk factor for atelectasis, hypoxia, acute respiratory failure and hospital-acquired pneumonia. Pneumonia remains the most frequent complication of cervical spine immobilisation in several case series of elderly patients.

Swallowing

Cervical bracing has also been found to significantly impair swallowing. Even in healthy young individuals, changes in initiation of swallowing response, increased pharyngeal residue, alterations in bolus flow, laryngeal penetration and even overt aspiration have been observed with rigid cervical spine immobilisation.

Delirium and non-compliance

Many elderly patients with cervical spine injuries have coexistent acute delirium, dementia and confusion associated with traumatic head injury. In a retrospective case series delirium was the second commonest complication after pneumonia in older patients with an incidence of 37.5%. Delirium is a well-recognised risk factor for poor outcome and in-hospital mortality in elderly patients. The management of delirium is challenging and requires optimisation of the patient environment including elimination of pain or discomfort, consideration of 1:1 nursing and if necessary pharmacological restraint. The benefit of maintaining compliance with cervical orthoses must be carefully weighed against the potential harm that comes with sedation. Close liaison between care of the elderly specialists and senior surgical decision makers is essential and the application for deprivation of liberty safeguards (DOLS) must also be considered.

Balance, mobility and functional outcome

There is very little published evidence to suggest rigid collars affect balance. One study in healthy volunteers found no significant difference in standing balance measures in either young or old age groups with or without rigid collar use. Some authors comment upon functional outcomes using the neck disability index, pain scores and the Cervical Spine Outcomes Questionnaire but we could find no articles specifically addressing mobility with cervical spine immobilisation. One study, in young healthy volunteers, found that range of movement when performing 15 functional activities of daily living was reduced by approximately 50% when wearing a rigid collar. Many frail elderly patients on the brink of functional dependence prior to admission are unable to look after themselves independently with rigid cervical collars in place. Often this can result in temporary placement in step-down wards or residential care settings for the duration of collar treatment, which is both expensive and unpopular with patients. In many hospitals rigid collars can only be managed on specialist neurosurgical or trauma wards. This can lead to delays in admission to downstream rehabilitation facilities and has potential to block acute trauma beds.

Conclusion

The evidence base for the use of cervical spine immobilisation in elderly patients is poor. Its use in the initial transfer and management of patients following trauma is widely accepted but consideration should be given for pragmatic alternative stabilisation methods in elderly patients with significant degenerative deformities. Whilst literature and systematic reviews report similar mortality in patients managed conservatively or surgically, selection bias is likely to significantly affect results, as patients with multiple comorbidities are more likely to be treated non-surgically. Halo orthoses may be associated with higher rates of complications and mortality in elderly patients. Prolonged cervical spine immobilisation as a treatment option is associated with morbidity which must be taken into account when deciding on treatment. Risks and benefits of maintaining cervical spine immobilisation in patients with delirium or dementia must be carefully considered when taking into account the consequences of...
pharmacological restraint. The socio-economic consequences of prolonged cervical spine immobilisation in frail elderly patients need to be explored further. High quality studies adjusted for age and comorbidities, and with greater focus upon functional outcomes and quality of life measures, are required to be able to make informed decisions about treatment strategies in the future.

**Disclosures statement**

The authors report no declarations of interest, no previous presentation, funding, industrial affiliation or competing interests in materials described in our submission.

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