Clinical Evaluation and Airway Management for Adults with Cervical Spine Instability

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KEYWORDS

- Manual in-line stabilization • Airway management • Spinal cord injury
- Cervical spine instability

KEY POINTS

- The cervical spine includes an anterior column, which provides extension stability, and a posterior column, which prevents overflexion. Lateral rotation involves the atlantoaxis, approaching 40° from midline.
- The C2 vertebra is the most common level of injury in cervical spine trauma and, even in the absence of a fracture, the spine may be unstable as a result of a ligamentous injury, which may be best visualized by MRI.
- Acquired instability of the cervical spine by disease states or genetic anomalies may necessitate careful airway management to avoid resultant cervical spine injury.
- Airway management of the unstable cervical spine requires immobilization, which is best performed with manual in-line stabilization.
- All airway maneuvers and intubation methods cause cervical motion with the least being flexible fiberoptic intubation, which may be limited by patient factors and operator experience.

INTRODUCTION

Airway management of patients with known or potential cervical spine instability can be a complicated scenario for the clinician. Airway management may be difficult as a result of immobilization, and is associated with risk for secondary neurologic injury related to pathologic cervical spine motion. This article provides an understanding of normal and abnormal cervical spine anatomy, a strategy to identify patients at risk, and provide guidelines for safely managing the airway in both emergent and elective settings.

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ANATOMY

Vertebral and Ligamentous Anatomy

The normal cervical spine is composed of 7 vertebrae, the intervertebral discs, and numerous ligaments. The C1 (atlas) and C2 (axis) vertebrae support the weight of the skull. The atlanto-occipital and atlantoaxial joints, as well as the C5-C7 vertebrae are the articular surfaces most involved in head flexion/extension. Lateral rotation involves primarily the atlantoaxis, and can approach 40° from midline in either direction.

The extent of flexion/extension and rotation are regulated and supported by the various ligaments. The posterior column ligaments include the supraspinous, interspinous, and ligamentum flavum, which prevent overflexion of the neck. The anterior column provides stability during extension and includes the anterior and posterior longitudinal ligaments, as well as the transverse, alar, and apical ligaments, which secure the odontoid process of C2 to the anterior arch of C1. This ligamentous attachment is particularly important in limiting translation of the atlantoaxial joint. The facet joints, intervertebral discs, and the intertransverse, interspinous, and supraspinous ligaments contribute to stability of the lower cervical spine.

Pathogenesis of Secondary Injury

Blunt force trauma to the head can cause numerous perturbations of normal bony or ligamentous anatomy of the atlantoaxis, atlanto-occipital complex, and the subaxial vertebrae, depending on the vector of force applied.[1] Even in the absence of a fracture, the spine may still be unstable as a result of a ligamentous injury. An unstable spinal column results in a spinal canal that can change in size with cervical motion.[2] In the intact cervical spine, the extra space of the spinal canal provides a buffer, which prevents excessive contact between the bony elements and the spinal cord. Without this buffer, secondary injury may occur with motion and compression of the spinal cord, leading to negative neurologic outcomes.

EPIDEMIOLOGY

Cervical Spine Trauma

Cervical spine instability may be broadly categorized as congenital or acquired. Of the acquired instabilities, traumatic cervical spine injury (CSI) is the most common. The United States has the highest prevalence of traumatic spinal cord injury in the world, at 908 per million.[3] Blunt trauma is associated with a 1% to 3% incidence of CSI. In a recent analysis of more than 250,000 trauma admissions over a 21-year period, significant predictors of CSI included mechanism of injury (fall, sports injury, motor vehicle related), age less than 30 years, and male sex.[4] A Glasgow Coma Scale score of less than 8 or unconsciousness, obvious facial or head trauma, hypotension, and a focal neurologic deficit have all been associated with up to a 58-fold increase in the odds of a concomitant CSI.[5–7]

The second cervical vertebra is the most common level of injury, followed by fractures of the 2 lowest cervical vertebrae (C6 and C7). A recent analysis found that nearly one-third of all injuries were considered clinically insignificant in that they did not produce instability.[8] Injuries to the upper cervical spine are responsible for up to 80% of mortality related to cervical spine trauma.[9,10]

Nontraumatic Cervical Spine Instability

Acquired instability of the cervical spine is commonly the result of arthritic degeneration.[11] A high proportion of patients with rheumatoid arthritis have cervical neck pain or radicular symptoms with radiographic evidence of atlantoaxial instability. The