Airway Management of the Cervical Spine Injured Patient

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10/3/07
Incidence: Clinically significant cervical spine injury occurs in 3-6% of all trauma patients.

Anesthesiologists often first line in airway management.

Early stabilization of unstable spine plays critical role in prevention of further neurologic compromise.

Nexus Study: high probability of c spine injury with: posterior midline tenderness, focal neuro deficit, altered mental status, intoxication, painful distracting injury (sensitivity 99%).
Anatomy

- Conventionally divided into upper (C1-C2) and lower (C3-C7) segments
- Differ based on space available for spinal cord (luminal diameter of spinal canal in AP plane); upper segments have cord occupying more of spinal space than at lower segments
Cervical Stability

- White et al: defined limits of displacement of cervical spine at which damage to spinal cord would occur
- Maximal horizontal motion (subluxation): 3.5 mm (or 20% vertebral body width on lateral x-ray)
- Maximal angular motion: 11 degrees
- SAC measurement: > 6 mm narrowing suggests cord compromise
- Study set the parameters by which other studies could determine safety of airway techniques
Conventional Laryngoscopy

Advantages: familiar, quick, offers aspiration protection if RSI with cricoid pressure

Disadvantages: ? Strain on cervical spine
Cervical motion with conventional laryngoscopy in stable C spine

2 studies sought to evaluate stable cervical spine motion in live patients

1. Sawin et al: looked at cervical motion with MAC 3 after induction of GA
   - utilized lateral fluoroscopy to evaluate motion of each spinal segment from occiput to C5
   - most significant motion demonstrated at C1 level (approximately 6.8 degrees)
   - minimal movement noted below C3

2. Horton et al: direct laryngoscopy with lateral fluoroscopy under only topical anesthesia
   - similarly concluded most motion occurred at C1-C2 with minimal movement below C4
Conventional Laryngoscopy and the destabilized C spine

- Multiple studies have evaluated cervical motion in the unstable C spine in fresh cadaveric model
  1. Lennarson et al: evaluated orotracheal intubation with different immobilization techniques (MILS vs traction)
     - used White model to create unstable C4-5 segment
     - MILS reduced movement/angulation, caused no clinically significant subluxation
     - traction created clinically significant movement at injury site
  2. Donaldson et al: evaluated motion in cadaver model with unstable C1-2 segment
     - compared multiple airway techniques on C spine motion (chin lift, jaw thrust, blind nasal, conventional oral intubation)
     - used the SAC measurement to assess cervical spine movement
     - chin lift and jaw thrust created greatest narrowing of SAC (>3mm) and most angular displacement (4-5 degrees)
     - measurements of distraction from oral and nasal intubation similar (<1mm SAC narrowing); thus preintubation maneuvers caused more distraction than any individual intubation technique
Gerling et al: compared C spine motion with multiple immobilization techniques (C collar vs MILS) and different blades (Miller, MAC, McCoy)
- created destabilized C5-6 segment in fresh cadaver models
- lateral fluoroscopy used to measure axial distraction, AP displacement, and angular rotation
- found that MILS caused less movement compared to C-collar immobilization (statistically significant difference)
- Miller blade caused less axial distraction compared to MAC and McCoy, but no difference in AP displacement or angular rotation (\(? \) Clinical significance)
Fiberoptic Bronchoscopy

Advantages: maintenance of neck in neutral position, good alternative if presumed difficult mask ventilation, documentation of post-intubation neurologic exam

Disadvantages: increased time requirement, requires cooperative pt, ? Availability of equipment, blood in airway may compromise visibility, topicalization of cords may present aspiration risk
Fiberoptic Bronchoscopy and Cervical Motion

- Brimacombe et al: utilized lateral fluoroscopy in destabilized C3 fragment in fresh cadaver model
- compared FOB with multiple airway techniques (face mask ventilation, conventional orotracheal intubation, intubating LMA, and traditional LMA)
- FOB produced statistically significant improvement over all other techniques in terms of cervical motion (FOB produced NO detectable motion at destabilized segment)
- as in Donaldson study, face mask ventilation produced more cervical motion than any intubation technique
LMA and c-spine injuries

- Advantages: ease of insertion, fast
- Disadvantages: no aspiration prophylaxis (NOT a first line airway in trauma pt), effect on cervical motion
- Few studies to evaluate safety of LMA in cervical spine injury

1. Keller et al: measured pressure exerted by standard and intubating LMA on C spine of fresh cadaver model
   - used microchip sensor in pharyngeal surface C2-3 to estimate pressure on normal c spine
   - lateral fluoroscopy used to assess displacement
   - #5 LMA inflated to 40 ml and posterior displacement visualized
   - found that LMA and ILMA generated similar pressures against C spine and both created clinically significant posterior displacement (>2.5mm) of upper cervical spine

2. Kihara et al: used ILMA and MILS with lateral fluoroscopy to assess cervical motion during placement of LMA and intubation itself
   - noted predominantly flexion on placement (opposite of intubation); however, no clinically significant motion noted
   - majority of motion noted at C1-3; minimal below C3
Limitations of Current Literature

- Rely on cadaveric models...how well do tissues translate to live human model? (Lennarson study)
- Inherent problem with ethical nature of conducting prospective studies on live pts with C spine injuries
Conclusions

- Cervical spine injuries in trauma pts have a wide spectrum of clinical presentations; airway should be addressed accordingly (urgency of situation, mental status of pt, etc.)
- No one airway management strategy has definitively demonstrated better outcomes
- Preintubation maneuvers consistently demonstrate as much, if not more, cervical spine motion than intubation itself
- Oral ETT with MILS generates more cervical motion than FOB, but NO study in destabilized C spine has demonstrated a clinically significant amount of spinal cord compromise
- The majority of cervical motion produced by conventional oral ETT consistently seen in upper cervical segments; FOB may be preferable in lesions above C3 if clinical situation allows
- Controlled FOB generates minimal to no cervical motion, but is limited by operator experience, equipment availability, patient cooperation, and increased time to intubation
- LMA not a first line airway management strategy in pt with c spine injury secondary to aspiration risk and causes some degree of cervical motion; further studies needed to assess clinical significance
References

- Keller, C, Pressure Exerted Against the Cervical Vertebrae by the Standard Intubating Laryngeal Mask Airways: a Randomized Controlled, Cross-Cover Study in Fresh cadavers, Anesthesia and Analgesia; 89: 196-1300
References (cont)