

Laryngoscopy Force, Visualization, and Intubation Failure in Acute Trauma

Should We Modify the Practice of Manual In-line Stabilization?

CERVICAL spine stabilization during transport and general care reduced secondary neurologic injury from 10–25% to 1–3%.¹ This experience led airway managers to adopt manual in-line stabilization (MILS) during direct laryngoscopy (DL).² Although MILS is intuitively appealing, there is, as Santoni *et al.* state in this issue of ANESTHESIOLOGY, “no objective evidence of benefit.”³ Substantial ethical and logistical hurdles stand in the way of a randomized controlled trial.² The data presented by Santoni *et al.*³ combined with previously performed research suggest that no benefit would be found, even if a randomized controlled trial were performed. In contrast to transport and general care, DL mechanically displaces structures adjoining the cervical spine, which transfers force to the vertebrae.^{4,5} By fitting a size 3 Macintosh blade with miniature pressure transducers and employing a randomized crossover design, Santoni *et al.* demonstrate that MILS doubles the force that must be applied during intubation.³

That doubling of laryngoscopy force may be harmful is, like MILS, intuitively appealing. In fact, the cadaver study conducted by Lennarson *et al.*⁵ showed that application of MILS significantly increased subluxation at the site of complete ligamentous disruption, even though the intubators in that study obtained only “limited visualization . . . intended to produce the least cervical movement possible.” Santoni *et al.* provide a plausible explanation for the Lennarson group’s findings – the laryngoscopists in both studies needed to apply more pressure to overcome the effects of MILS, and the increased pressure caused greater subluxation in the cadaveric injury model. In practice, MILS probably has greater effects on the injury site than Lennarson’s group reported. Clinicians working under the trying circumstances of an acute trauma intubation³ are more likely than study participants to focus on successfully passing the tube and are less likely to focus on limiting the force they apply to the laryngoscope.

Even with the important new data from Santoni *et al.*, we doubt that clinicians will be eager to abandon or even modify MILS. During the past few decades, there

have been few, if any, reliable reports of intubation causing secondary spinal cord injury,² and MILS has been the standard of care. This record will not be easily dismissed because many clinicians share our concern that patients will be injured by any change in practice. The dilemma is ironic because the work of Santoni *et al.* and Lennarson *et al.* suggest that this fortunate history may be despite, and not because of, MILS.

The paper by Santoni *et al.* raises another concern. As Nolan and Wilson⁶ and others have demonstrated, MILS degrades DL view. Santoni *et al.* observed this in six of nine patients who were successfully randomized. Although not designed to do so, the study illustrates how harmful view degradation can be. With MILS, anesthesiologists having an average of 19 yr experience could not intubate 3 of 10 fasted, stable patients screened to exclude predictors of difficult intubation. The first of these patients was not included in the study because the laryngoscopist obtained a grade four view with the modified Macintosh 3 blade and felt it necessary to use a size 4. One patient was esophageally intubated, and the third sustained a dental injury. These three incidents in this small study are remarkable because much trauma airway management is performed by clinicians with far less experience than the participating anesthesiologists. In addition, these intubation attempts were made under well-controlled circumstances, in contrast to many acute trauma intubations.³

Although trauma airway studies in academic centers demonstrate high success rates by anesthesia and emergency physicians,^{7,8} this work does not directly support MILS. These studies included penetrating trauma; although clinicians almost certainly used MILS in the blunt trauma cases, it is impossible to know how rigorously they applied the technique. One of these studies⁸ reported that 35% of the patients experienced complications, including hypoxia in 17%. The MILS-associated intubation failures observed by Santoni *et al.*³ probably explain a significant percentage of the hypoxic events. This is troubling because patients intubated with MILS are far more likely to have traumatic brain injury than unstable C-spine fractures,² and $\text{SaO}_2 < 90\%$ predicts poor neurologic outcome.⁹

Technically, there are some important limitations to the work by Santoni *et al.* Because the group measured pressure directed against the anterior surface of a Macintosh blade, the intubators could not use external posteriorly directed pressure. Posterior pressure may improve view and increase intubation success in some patients,¹⁰ so this restriction could have resulted in the application

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of more laryngoscope force and intubation failure. It is important to note that the restriction applied to both MILS and non-MILS DL attempts and that posterior pressure can cause significant C-spine movement.¹¹ In fact, the findings of Santoni *et al.*³ and Donaldson *et al.*¹¹ raise the concern that opposing force vectors of posterior pressure and DL have the potential to create dangerous torque across an injury site, so the restriction may be justified for reasons the authors did not specifically mention. The study also prohibited stylet use, which is common, if not ubiquitous, in acute trauma airway management. Although this limitation is important, stylet use would not have changed the view degradation observed with MILS. It is possible that stylet use would have made the study anesthesiologists comfortable intubating with suboptimal views, and they may not have applied as much pressure during DL. As with posterior pressure, the stylet prohibition applied to both groups, and one can only speculate about how this affected the study's outcome.

The most significant limitation is addressed in detail by the authors. The sample size is small; as they note, this increases the risk that the doubling in pressure with MILS was due to chance. Weighing against that concern is the *P* value of <0.025 for this prospectively determined primary outcome. In addition, the study findings are consistent with expectations derived from previously published work on head and spine movement during laryngoscopy, MILS, and view degradation.⁴⁻⁶ Finally, the small sample size is very meaningful – MILS caused harmful complications, leading the authors to conclude that it would be unethical to expose additional subjects to the procedure.

We commend Santoni *et al.* for adding useful data to assess the risks and benefits of MILS. The available information argues for various changes in technique,² but no return to the practices of the prestabilization era.¹ Fiber-optic stylets and periscope-like devices allow trained clinicians to apply MILS and obtain better visualization, possibly with less force.^{12,13} Unfortunately, soiling is common in acute trauma, and little published work addresses these devices' performance in soiled airways.¹⁴ C-spine related studies of the Intubating Laryngeal Mask Airway™ (LMA North America; La Jolla, CA) have yielded conflicting data,¹⁵⁻¹⁷ and more research is

needed to define its role in acute trauma. Because intubation guided by direct laryngoscopy is familiar, effective, and fast, it will persist. Santoni *et al.*³ strengthen the case against rigorously applying MILS during this procedure.^{2,5}

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