New Perioperative Cervical Injury

Medical and Legal Implications for Patients and Anesthesia Providers

In the current issue of Anesthesiology, Hindman et al. report on 48 cases within the American Society of Anesthesiologists (ASA) Closed Claims database in which patients acquired new onset injury to the cervical spine, spinal cord, or nerve roots in association with general anesthesia, patient positioning, and surgery. This research is a logical extension of the work of these researchers at the University of Iowa (Iowa City, Iowa). They previously used cinefluoroscopy to identify potentially injurious alterations in cervical spine biomechanics during laryngoscopy and tracheal intubation. In the research published in the current issue of Anesthesiology, these researchers join forces with experts in ASA Closed Claims database research from the University of Washington (Seattle) and others to determine whether there is evidence of meaningful perioperative cervical injury associated with quantifiable care practices.

This paper based on data registered in the ASA Closed Claims database between 1970 and 2007 yielded informative results: 73% of patients were male, mean ± SD patient age was 47 ± 15 yr. Cervical injury claims were more often permanent and disabling (69%) than other general anesthesia claims (19%; \( P < 0.001 \)). Spinal cord injury occurred in 37 patients and typically resulted in quadriplegia (33 [89%]). Cord injuries usually occurred in the absence of traumatic injury (81%) or cervical spine instability (76%), though cervical stenosis was common. Nearly a quarter of cord injuries were associated with the sitting position. The authors concluded that cord injury was commonly associated with some form of preoperative anatomic abnormalities (including spinal stenosis) (81%), direct surgical complications (24%), preprocedural symptomatic cord injury (19%), intraoperative head and neck position (19%), and airway management (11%). Of all cervical injury claims, better monitoring (e.g., pulse oximetry, capnography, electrophysiologic monitoring) was deemed to have potentially improved outcomes in only 9% versus 22% of all other general anesthetic claims (\( P = 0.043 \)).

In interpreting these and other results reported by Hindman et al., it is instructive to review the research limitations, using the standards for database research I (W.L.L.) recently presented. Hindman et al. report that new onset cervical injury was the basis of a mere 0.9% of all ASA Closed Claims related to general anesthesia. In addition, they report that the annual rate of cervical injuries (as a fraction of all ASA Closed Claims data) increased during the study interval. However, it is not possible to calculate accurately an incidence of patient harm using the ASA Closed Claims database because this tool does not allow for accurate assessment of either a numerator or denominator. Regarding the numerator, for a patient to be entered into the ASA Closed Claims database, the patient must have a recognizable injury for which blame is assigned to care providers—resulting in a financial settlement or jury award in favor of the plaintiff. If a new injury is unrecognized because of its subtlety, its origin is assigned to factors other than medical care, the patient dies from other causes, or there is no financial settlement or jury award (as a result of influence by physicians, lawyers, public sentiment, or other factors) involving an insurance company, data will not be reported to the ASA Closed Claims database. Hence, the ASA Closed Claims database would have underreported the incidence of true cervical injury in the United States during the study period. Similarly, the ASA Closed Claims database is incapable of identifying the total number of at-risk patients that constitutes the denominator during the study period. As such, it is not possible to know if the increasing fraction of cervical injury patients within the ASA Closed Claims database reflects a relative increase in those having cervical injuries, or a relative decrease in those having injuries from other causes. These same uncertainties about whether ASA Closed Claims data are representative of broader, cervical injury patient populations could also affect calculations of the relative influence of one source of injury (e.g., airway management) versus another (e.g., patient positioning).

Another concern is that the investigators were able to explore the details of the individual cases only to the extent
that those cases were reported in ASA Closed Claims. Specifically, investigators were not able to return to original source data (i.e., outside the ASA Closed Claims files) and clarify omissions or inconsistencies. Hindman et al.1 clearly detail how information was entered into the ASA Closed Claims files. Readers must assume that those who originally entered the ASA Closed Claims data (i.e., not Hindman et al.) reported their observations and inferences flavored with the standards and understanding of anatomy, physiology, and caretaker responsibility peculiar to the era of ASA Closed Claims data entry. Information absent or misinterpreted in the original ASA Closed Claims documents forever remains in a less-than-desirable state, impervious to secondary efforts to validate the data quality.

In interpreting ASA Closed Claims data, we can also infer that at one extreme of pathology are those instances in which injury was sudden and relatively independent of systemic physiology. Mechanical factors such as tissue avulsion or maceration would be suspect, occurring as a result of airway manipulation, surgical intervention, or like factors. At the other end of the spectrum, one might expect that smoldering, subinjurious insults resulting from baseline patient pathology (including bony, ligamentous, and other aberrations of the spine observed in 81% of patients who eventually experienced cord injury1) could produce injury if coupled with sustained aberrations of systemic physiology. For example, in the second scenario, systemic hypotension—particularly if coupled with hyperglycemia—could very well convert an at-risk patient into an injured patient.4 Unfortunately, in the 48 ASA Closed Claims files, numeric blood pressure values and the presence of hypotension were inadequately reported. In addition, glycemic status was represented even less well. Clearly, alterations in glycemia occurred in these 48 injured patients because the authors tell us that 19% had diabetes mellitus; we simply cannot determine the timing and extent of any hyperglycemia as it relates to injury.

All the aforementioned limitations are attributable to the core ASA Closed Claims data—not to the authors highly discipline approach to retrieving, analyzing, and reporting their findings. To the contrary, readers of the article by Hindman et al.1 have shown great discipline in discussing and surprising. Spinal cord injury associated with airway instrumentation was uncommon, accounting for a mere 11% of patients. In contrast, 24% of patients had surgery in the sitting position. It is remarkable that the sitting position, which is used in a small fraction of anesthetized patients within the United States, was associated with such a large proportion of ASA Closed Claims patients having cervical injury. Both surgical and nonsurgical factors should be considered as causative. Throughout the world, the sitting position is applied unevenly. At Mayo Clinic (Rochester, MN), there is a long history of frequent use of the sitting position in neurosurgical patients, and that use persists today, with the expectation that appropriate application results in improved patient outcomes.5 However, at other medical centers, and in other populations of patients, there is now mounting evidence of central nervous system insults1 and worsened outcomes in patients anesthetized in head-up positions.7,8 Further, there is suspicion that much of this injury may be attributable to a casual approach to positioning, blood pressure measurement technique, and management of blood pressure and other physiologic variables.7,8 According to this reasoning, excessive contortion of the patient’s anatomy, blood pressure measurement that does not account for potential hydrostatic pressure gradients at the level of vulnerable tissues, and—on top of this—utilization of blood pressure reductions (in an attempt to lessen bleeding at the operative site) may all contribute to injury. Unfortunately, the ASA Closed Claims data do not allow firm conclusions as to whether these factors contributed to injury in the current report, nor do the ASA Closed Claims data reveal whether inexperienced practitioners of the sitting position selectively placed the highest risk patients in this position to improve surgical access. As such, it is not clear whether the ASA Closed Claims data point to an adverse effect of the sitting position per se, or whether it is patient selection, physiologic management, or anatomic variations once in the sitting position that are of more concern.

It is tempting to use the ASA Closed Claims data to develop excessive inferences about the causes of injury, but here Hindman et al.1 have shown great discipline in discussing associations and developing hypotheses worthy of future research challenges. It also is tempting for readers—indepen- dent of comments made by the authors—to cast blame as to who is at fault for adverse outcomes, placing often innocent parties at risk for litigation. However, here we issue a word of caution, based on lessons learned from another form of perioperative injury. Before 2000, ulnar neuropathies after anesthesia and surgery were very common causes of successful lawsuits against anesthesiologists. Anesthesia providers and the legal community assumed that this effect was the result of
some fault in anesthesia care. It was only because of research conducted in the mid-to-late 1990s that the natural history of these deficits was revealed. In studies involving hundreds of patients, ulnar neuropathies were never present at the completion of surgery, and most did not first appear until 1 or 2 days after surgery. Indeed, some did not appear until as late as a week after surgery. Similar deficits occurred in hospitalized patients who never had surgery. Many postoperative ulnar nerve deficits were traceable—through musculoskeletal imaging and nerve conduction studies—to chronic patient conditions. As a result of this research, there were far fewer successful lawsuits against anesthesiologists whose patients experienced postoperative ulnar neuropathies. We wonder whether future research will also lessen the culpability and legal risk of anesthesia providers regarding new onset cervical injuries.

Certainly the observation of Hindman et al. of an 81% incidence of preoperative anatomic abnormalities (e.g., bony and ligamentous aberrations), but a 76% incidence of “stable spines,” in patients subsequently cord injured hints that heretofore under-recognized inherent patient vulnerability may be a common contributor to injury in this small number (n = 37) of patients.

Great research often leaves us with more questions than answers. By this standard, Hindman et al. have given the readers of Anesthesiology a wonderful gift. They have used a novel research method and rigorous research standards to glean from the ASA Closed Claims database heretofore unappreciated knowledge about new onset cervical injury in anesthetized surgical patients. We can take some comfort (though how much comfort is unclear) that contemporary anesthesiologists’ efforts to avoid injury during laryngoscopy and endotracheal tube placement are paying off. However, we should be disturbed that there are other groups of heretofore unrecognized patients who are becoming injured, and for reasons that are not readily apparent. Whether there are identifiable and remediable causes remain to be determined.

Thankfully, Hindman et al. have presented a rich collection of data, free of interpretive encumbrances, that allow the interested reader to study and restudy the data—perhaps reaching new conclusions and developing additional testable hypotheses. The thoughtful review of the literature provided by Hindman et al. will help readers place their assessments into context as they begin their search for more information on this important and relevant topic.

William L. Lanier, M.D., Mark A. Warner, M.D. Department of Anesthesiology, Mayo Clinic, Rochester, Minnesota. lanier.william@mayo.edu

References

3. Lanier WL: Using database research to affect the science and art of medicine. Anesthesiology 2010; 113:268–70
5. Black S, Ockert DB, Oliver WC Jr, Cucchiara RF: Outcome following posterior fossa craniectomy in patients in the sitting or horizontal positions. Anesthesiology 1988; 69:49–56
7. Lanier WL: Cerebral perfusion: Err on the side of caution. APSF Newsletter 2008; 22:1,3,4