

◆ EDITORIAL VIEWS

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Will We Ever Understand Perioperative Neuropathy?

A Fresh Approach Offers Hope and Insight

IN the current issue of ANESTHESIOLOGY, Prielipp *et al.*¹ make an exciting contribution to our understanding of perioperative ulnar nerve injury. To fully appreciate their work, it is helpful to consider a few background issues. First, perioperative nerve injury is a considerable source of patient injury and professional liability in anesthetic practice. In the database of the American Society of Anesthesiologists Closed Claims Project, perioperative nerve injury is the second most common class of injury, accounting for 16% of all claims.² (By comparison, death and brain damage occupy first and third place, accounting for 32% and 12% of claims.) The ulnar nerve is the single most common site of peripheral nerve injury, constituting 28% of all perioperative nerve claims or 5% of the overall database. Payment for ulnar nerve injury occurs in 48% of claims, with a median payout of \$20,000. Although the incidence of ulnar nerve injury cannot be determined from the Closed Claims Project data, Warner *et al.*³ recently reported an incidence of 1:200 when neurologic evaluation was performed on a prospective and daily basis in the postoperative period, and an incidence of approximately 1:3,000 when medical records were examined retrospectively for symptoms lasting at least 3 months.⁴ Approximately one half of patients with ulnar neuropathy have deficits that persist for more than 1 year.^{3,4}

Our understanding of perioperative ulnar nerve injury has been hampered by the limitations of retrospective study, risk factor analysis, and qualitative data. External compression on the ulnar nerve in the cubital tunnel is usually regarded as the most important cause of anesthesia-related injury, but detailed study of individual cases has not provided strong corroboration.^{2,5,6} In the Closed

Claims Project database, for example, the extensive medicolegal investigation associated with claim resolution has led to the recognition of an identifiable mechanism of injury in only 9% of cases.² A large-scale multivariate analysis by Warner *et al.*⁴ found independent risk factors for ulnar neuropathy (male gender, low or high body mass, and prolonged hospital stay), but how these factors relate to specific intraoperative mechanisms of injury is still unclear. Anatomic studies have revealed differences between the elbow anatomy of male and female patients (male patients have a more prominent tubercle of the coronoid process, less adipose tissue, and a thicker retinaculum in the cubital tunnel), but our understanding of the role of these differences in the genesis of nerve injury has not evolved beyond careful speculation.^{3,7}

Prielipp *et al.* make an important breakthrough in the current study of perioperative ulnar nerve injury by demonstrating that fundamental questions can be explored with straightforward, quantitative methods of physiologic measurement. One method uses a pressure-sensing mat to determine how changes in arm position affect the external pressure transmitted to the ulnar groove. This approach generates clear and elegant results: Supination of the forearm produces the least amount of pressure at the ulnar groove, pronation produces the most, and a neutral forearm position results in an intermediate value. These findings are pleasingly consistent with inferences already drawn from basic anatomic considerations.⁸ Of further note, moving the whole arm from adduction to abduction has little effect on pressure at the ulnar groove if the forearm is supinated or pronated, but abduction of the whole arm decreases pressure at the ulnar groove when the forearm is in a neutral position. The interplay between forearm rotation and abduction of the whole arm is especially interesting, because it reminds us that the search for optimum positioning strategies requires a consideration of interacting factors and trade-offs. To take this example one step further, abduction of the whole arm may be beneficial for the ulnar nerve, particularly when the forearm is in a neutral position, but any advantage must be weighed against the possibility of undesirable stretch on the brachial plexus.

◆ This Editorial View accompanies the following article: Prielipp RC, Morell RC, Walker FO, Santos CC, Bennett J, Butterworth J: Ulnar nerve pressure: Influence of arm position and relationship to somatosensory evoked potentials. ANESTHESIOLOGY 1999; 91:345-54.

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This study also uses somatosensory evoked potentials to explore the relation between sensory changes and electrophysiologic changes when external pressure is applied to the ulnar nerve. Here the fundamental question is whether the patient's perception of sensory change can be regarded as a reliable indicator of evolving nerve injury. Under the optimal reporting conditions of this study (unmedicated participants and repetitive queries about sensory changes), one half of the volunteers failed to perceive any sensory changes despite markedly abnormal changes in somatosensory evoked potential signal strength. This is an important finding, because it suggests that reports from the patient may be of limited value in the early detection of compressive nerve injury. Akin to the lesson that we already know for myocardial ischemia, the patient may be unable to warn us that compressive nerve injury is occurring, simply because the early symptoms are subclinical or "silent." The somatosensory evoked potential findings in this study also help us understand why Warner *et al.*⁴ found no significant difference in the incidence of ulnar neuropathy among patients receiving general anesthesia, regional anesthesia, and sedation.

Prielipp *et al.* deserve special commendation for the careful way they have handled the clinical implications of their findings. Frankly, the relations between arm position and pressure at the ulnar groove are so striking and distinct that the temptation to translate them into clinical "rules" is nearly irresistible. The problem, of course, is that this study is not designed to establish a direct cause-and-effect relation between arm position and actual nerve injury. Although the study shows that arm position can affect the amount of external pressure on the ulnar nerve, it is possible that arm position may be inconsequential if the external pressure falls below a certain threshold, or if the duration of pressure does not exceed some critical value.

Does this mean that the findings have no practical application? Absolutely not. Until we have a better ability to predict and monitor ulnar nerve injury, these findings can serve as guides for clinical decision-making. These data are useful not only because they give us a physiologic rationale for making an educated guess about preferred forearm position but also because they provide a basis for considering the relative merits of alternative positions. For example, if body habitus or musculoskeletal deformity makes it difficult to place a patient's forearm in supination, then the neutral position might be

regarded as the next most logical choice. Such considerations may be helpful in positioning elderly patients, who often have such limited mobility that it is difficult to secure the forearm in supination without worrying about the application of excessive force.

The work of Prielipp *et al.* is a wonderful advance, but it also serves as a humbling reminder that we have a limited understanding of the relations between conventional perioperative care and the genesis of peripheral nerve injury. It may be difficult to believe or admit that medical science is not sufficiently advanced to explain how certain injuries occur, but this is probably the most truthful statement we can make about many instances of perioperative nerve injury. By following the lead offered by Prielipp *et al.*, perhaps we can develop a more rigorous understanding of perioperative nerve injury and a more effective basis for identifying preventive strategies.

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References

1. Prielipp RC, Morell RC, Walker FO, Santos CC, Bennett J, Butterworth J: Ulnar nerve pressure: Influence of arm position and relationship to somatosensory evoked potentials. *ANESTHESIOLOGY* 1999; 91: 345-54
2. Cheney FW, Domino KB, Caplan RA, Posner KL: Nerve injury associated with anesthesia: A closed claims analysis. *ANESTHESIOLOGY* 1999; 90:1062-9
3. Warner MA, Warner DO, Matsumoto JY, Harper CM, Schroeder DR, Maxson PM: Ulnar neuropathy in surgical patients. *ANESTHESIOLOGY* 1999; 90:54-9
4. Warner MA, Warner ME, Martin JT: Ulnar neuropathy: Incidence, outcome, and risk factors in sedated or anesthetized patients. *ANESTHESIOLOGY* 1994; 81:1332-40
5. Kroll DA, Caplan RA, Posner K, Ward RJ, Cheney FW: Nerve injury associated with anesthesia. *ANESTHESIOLOGY* 1990; 73:202-7
6. Dawson DM, Krarup C: Perioperative nerve lesions. *Arch Neurol* 1989; 46:1355-60
7. Contreras MG, Warner MA, Charboneau WJ, Cahill DR: The anatomy of the ulnar nerve at the elbow: Potential relationship of acute ulnar neuropathy to gender differences. *Clin Anat* 1998; 11:372-8
8. Wadsworth TG: The cubital tunnel and the external compression syndrome. *Anesth Analg* 1974; 53:303-8