Neuromuscular Blockade and Risk of Postoperative Pneumonia

To the Editor:

I read with interest the recent article by Bulka *et al.*,[1] which highlighted the association between perioperative use of neuromuscular blocking drugs and risk of postoperative pneumonia. It would have been useful to know which airway devices were used for the patients studied, because endotracheal intubation itself is known to be a risk factor for postoperative pneumonia and could therefore be a confounding factor. Of course, in the majority of cases, neuromuscular blockade is a prerequisite for endotracheal intubation, but not infrequently in the United Kingdom neuromuscular blockade is used in combination with a supraglottic airway device; this is generally restricted to cases where muscle relaxation is required to facilitate surgery and there is no requirement for a definitive airway. It would be telling if the strong association between the use of neuromuscular blocking drugs and postoperative pneumonia persisted irrespective of whether the trachea was intubated.

Competing Interests

The author declares no competing interests.

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Accounting for Planned Postoperative Intubation

To the Editor:

We read with interest the article by Bulka *et al.*[1] regarding the use of intraoperative nondepolarizing muscle relaxants (NDMRs) and their association with postoperative pneumonia. We commend them for increasing knowledge in an area that is exceedingly important. In this article, postoperative pneumonia occurred more frequently in patients who received an NDMR *versus* propensity-matched patients who were not administered an NDMR. Furthermore, within the NDMR subset, lack of neostigmine administration was associated with a greater than twofold higher incidence of postoperative pneumonia than their propensity-matched counterparts.

Although not explicitly stated in the article, we wonder why these patients were not routinely reversed at the end of their procedure. As described in the accompanying editorial,[2] this may have resulted from concerns of paradoxical muscle weakness and/or other side effects of acetylcholinesterase inhibitors. However, another plausible explanation may be that some of these patients were being transported to the intensive care unit for postoperative mechanical ventilation, thus not requiring NDMR reversal. In our experience, the overwhelming reason for nonreversal is predetermined postoperative intubation regardless of patient demographics, attending anesthesiologist, surgeon, or surgical procedure. Because endotracheal intubation and intensive care unit residence are both strongly associated with nosocomial pneumonia,[3] there is a high likelihood that the effect of nonreversal on this outcome is confounded by continued postoperative intubation. To determine whether this manner of confounding exists, separate analyses should be performed that only include patients who were extubated at the end of the surgical procedure before leaving the operating room. Although tedious, these additional investigations would strengthen the argument about the importance of NDMR reversal.

There are also separate issues with the propensity match, in particular with the match for the NDMR/no-NMDR analysis. It can be argued that the biggest determinant of NDMR use is the particular surgical procedure itself, and surgeries that are associated with postoperative pneumonia (thoracotomies, laparotomies, *etc.*)[4–7] are routinely not performed without NMDR. To control for surgical procedure, the authors used Clinical Classifications Software (CCS; Agency for Healthcare Research and Quality; Rockville, Maryland) groupers in the propensity match. Although there are more than 230 single-level CCS procedure categories, there is still too much variability within certain groupings to provide an adequate representation of the surgical procedure variable for the context of the study. As an example, CCS category 96 (fifth most common CCS code in study), "other OR lower gastrointestinal therapeutic procedures," includes more than 80 Current Procedural Terminology codes with both laparoscopic and open colorectal procedures. Thus, a laparoscopic case may have been paired with a laparotomy despite the dissimilar incidence of postoperative pneumonia attributable to these procedures.[4] This is also true for a number of other CCS groupers including category 40, "other diagnostic procedures of respiratory tract and mediastinum," which includes both thoracoscopic surgeries and thoracotomies with differing inherent rates of postoperative pneumonia.[5] Although the CCS classifier is inadequately broad in this respect, the authors still were unable to produce a propensity match with an unbiased (standardized difference less than 10%)[8] surgical procedure variable for the NDMR/no-NMDR analysis. To better separate the effects of the surgical procedure from NMDR use with regard to the incidence of postoperative pneumonia, a balanced match with an adequate procedural variable (*e.g.*, hard-matched Current Procedural Terminology code) must be performed.

Although the use of a more procedurally specific type of matching would most likely lead to a decrease in statistical power within a given data set, selection bias with regard to surgical procedure cannot be properly controlled for without doing so.

In addition, variables that are known to be correlated with postoperative pneumonia need to be accounted for in the analysis to better elucidate the real impact of NMDR and neostigmine reversal on this outcome. These include patient functional status, smoking history, and presence of chronic obstructive pulmonary disease.[3,6,7] Although these variables were indirectly accounted for in this study through the American Society of Anesthesiologists classification, a previous investigation revealed that each of these aforementioned factors were still associated with postoperative pneumonia even after controlling for American Society of Anesthesiologists class.[7] Also, this analysis does not account for the beneficial effects of optimum postoperative analgesia, specifically epidural analgesia,[9] on the occurrence of postoperative pneumonia. Lastly, several references in this article are erroneous. In fact, all four citations in the second paragraph of page 649 do not confirm the ideas expressed in their respective sentences.

Competing Interests

The authors declare no competing interests.

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Risk of Postoperative Pneumonia with Neuromuscular Blockade: Keep It Simple!

To the Editor:

We read with interest the article by Bulka *et al.*[1] regarding the relationship between the management of intraoperative neuromuscular blockade and postoperative pneumonia. The use of large databases to address rare outcomes has increased in recent years. The value in using these databases is the large number of patients who can be assessed. Such large numbers would be extremely challenging to achieve in a randomized controlled study. However, a major limitation and concern with database studies like this one is subsequent confusion between correlation and causation. With regard to residual paralysis, we believe that these challenges can be bypassed with one simple technique—the objective monitoring of the effects of a neuromuscular blocking agent. Although the incidence of residual neuromuscular blockade at extubation is significant,[2] currently, monitoring of neuromuscular blockade is still not an explicitly articulated American Society of Anesthesiologists basic monitoring standard.[3] Whereas many practitioners use such monitoring in their practice, others rely on clinical signs of strength or other outdated measures, such as the 5-s head lift or 50-Hz sustained tetanus to determine adequate recovery from neuromuscular blockade before extubation. Still others simply rely on time from reversal agents being given.[4]

Perhaps the reluctance to consistently monitor the effects of neuromuscular blocking agent and, most importantly, the adequacy of recovery before extubation, represents a peculiar psychologic phenomenon. The practice of anesthesiology is replete with situations in which parameters are monitored at baseline and for the effects of any intervention. In addition, many of our routine practices could be deemed unnecessary in the majority of patients, yet are performed to prevent devastating outcomes in the remaining small percentage of patients. Examples include preoxygenation before the induction of anesthesia, maintenance of blood pressure within certain parameters to prevent stroke or myocardial ischemia, and maintenance of normothermia to prevent wound infection and cardiovascular complications. These practices have become routine or standard because they protect patients from rare but serious complications. As Perrow[5] points out, Murphy's law is wrong: everything that can go wrong usually goes right, and then we draw the wrong conclusion. The ability to adequately ventilate 1,000 successive patients could