

Intra-operative Communication Regarding Neuromuscular Blockade: A Survey of Anaesthesiologists and Surgeons

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Abstract

Background: Surgeons and anesthesiologists have shared but often-conflicting objectives for neuromuscular relaxation. While surgeons require neuromuscular relaxation to optimize surgical conditions, anesthesiologists must balance these requests for additional muscle relaxation with timely extubation and operating room efficiency.

Methods: An internet based survey of anesthesiologists and surgeons was conducted between November 14th and December 4th, 2013. Respondents were asked a series of questions about pre-, intra- and post-operative communication regarding neuromuscular relaxation in open and laparoscopic procedures.

Results: A total of 256 anesthesiologists and 254 surgeons completed the survey. The most common reason cited by surgeons for requesting more neuromuscular relaxation in open procedures was difficulty closing the incision (86%) and in laparoscopic procedures it was patients' breathing or straining while intubated (89%). Anesthesiologists honor surgeon's requests for additional neuromuscular relaxation 60% of the time via NMB, choosing alternate approaches the remainder of the time. Reasons cited by anaesthesiologists as to why they were unlikely to administer more NMB upon request were that it was too close to the end of surgery (48%) or that they felt the patient was sufficiently relaxed (38%).

Conclusions: Surgeons' requests for additional neuromuscular relaxation at the end of surgery appear to be in conflict with anesthesiologists' desire for rapid reversal and timely extubation. Neuromuscular management approaches that provide surgeons with adequate muscle relaxation and optimal surgical conditions, while allowing anesthesiologists to provide timely extubation, should be explored.

Introduction

Medical care in the operating room is delivered by a team of healthcare professionals including nurses, surgeons, and anesthesiologists. Communication between these team members is essential to high quality care. Preliminary studies have found that communication gaps often exist between surgical team members. Failure to effectively communicate is estimated to be one of the leading causes of inadvertent patient harm [1-3]. A review conducted at three hospitals between 2000 and 2001 revealed that breakdowns in communication contributed to 43% of surgical errors [4]. The types of surgical communication errors cited include changes in personnel providing care, inadequate handoff of information from one team member to another, and difficulties identifying the responsibilities of each team member [4]. A similar study of communication errors in surgery found that approximately 30% of errors happened during the surgery itself and most often involved the attending surgeon [5]. Areas of communication weakness in operating rooms may include failure to obtain input, lack of standardization and team integration [6,7].

However, few studies have explored specific reasons why these communication gaps may form. One area in which communication gaps may exist relates to the provision of neuromuscular relaxation

during surgery. The current research explores the experiences and attitudes of surgeons and anesthesiologists, specifically characterizing their communications with each other regarding neuromuscular relaxation during surgery. These data will clarify the contributing factors to communication gaps and motivations behind decisions made during surgery.

Materials and Methods

Survey content was developed under the advisement of a practicing surgeon and anesthesiologist in order to ensure relevancy and accuracy. The contributing surgeon and anesthesiologist participated in a focus group session with the authors to discuss surgical scenarios and provide input into survey question phrasing and content. The participating surgeon and anesthesiologist reviewed the resulting survey design for accuracy and relevance to practice. In addition, the survey was pre-tested among a group of 8 physicians (4 anesthesiologists and 4 surgeons). Participating physicians participated in a 45 minute qualitative interview in which they took the online survey while providing feedback and suggestions for revisions. Insights from all contributing physicians were compiled and changes to the study were made accordingly.

Physicians participating in this online survey were recruited from the AMA (American Medical Association) master file, the Harris Interactive Physician Panel as well as other online panels in the US that consist of physicians who volunteer to complete market research and health outcomes surveys. Respondents received a survey invitation via e-mail or postal mail including information for accessing the password-protected online survey. Both surgeons and anesthesiologist respondents had similar distributions of gender, years of practice, region of practice and surgical specialty (surgeons only) to those in the AMA master file. Informed consent was collected for each respondent and was required for study participation. All respondents were rescreened within the survey to ensure that they met all qualifying criteria, which included practicing in the United States, being a licensed anesthesiologist or surgeon in practice between 2-30 years, and perform/be involved in at least 15 procedures per month, at least 5 of which were laparoscopic.

Those who met the inclusion criteria continued to answer questions until they completed the survey, while those who did not meet the inclusion criteria exited the survey. Demographic and clinical characteristics obtained from the respondents included age, gender, type of medical practice, setting of medical practice, types of surgery performed, and typical length of surgical procedures performed. No specific quotas were set around any demographic variable.

In addition to questions regarding general communication practices between surgeons and anesthesiologists during surgery and the impact of various factors in the amount and timing of administration of neuromuscular blockade, a set of four surgical scenarios were provided with follow-up questions (Table 1). Surgical scenarios were developed in close collaboration with a practicing surgeon and anesthesiologist to ensure appropriateness and relevancy. For all surgical scenarios, physicians were asked to consider a surgical case in their specialty in which neuromuscular blockade is used. The first surgical scenario presented was a laparoscopic procedure, which was not robotic-assisted. The duration of the surgery was approximately one hour. The patient was a 35-year old female with a normal BMI and no comorbidities. In each of the following scenarios, variables were changed in order to understand the impact of each variable on decisions made during surgery. The second surgical scenario presented was the same as the first, except that the length of surgery was four hours. The third scenario was the same as the first, except that the patient had a BMI of 36. The fourth and final scenario was also a 35-year old female with normal BMI and no-comorbidities but was an open procedure lasting approximately four hours. The patient was a 35-year old female with a normal BMI and no-comorbidities. IRB approval for all study materials was obtained from the Copernicus Institutional Review Board prior to fielding this study.

Scenario	Type	Expected Duration	BMI of Patient	Patient Age	Co-Morbidities
1	Laparoscopic, not robotic-assisted	1 hour	21	35	None
2	Laparoscopic, not robotic assisted	4 hours	21	35	None
3	Laparoscopic, not robotic assisted	4 hours	36	35	None
4	Open	4 hours	21	35	None

Table 1: Description of surgical scenarios of a 35 y/o patient with no co-morbidities.

Statistical Analyses:

These analyses were based on data collected during on a cross-sectional internet-based survey conducted between November 14th and December 4th, 2013 of 510 physician respondents including 256 anesthesiologists and 254 surgeons. The average survey completion time was 14 minutes. Upon data collection, the data was cleaned to ensure its quality and integrity. The results of this study were analyzed using a variety of descriptive and comparative analytic techniques including means, medians, frequencies, cross-tabulations, and correlations in order to understand attitudes, preferences, and practices across sub-groups including physician type (surgeon vs. anesthesiologists).

Results

Demographic and baseline characteristics

Anesthesiologist respondents averaged 15 years in practice and surgeons averaged 13 years in practice. Anesthesiologists had a mean of 14 years of experience with laparoscopic procedures, while surgeons had a mean of 12 years experience. Anesthesiologists in this study were involved in an average of 117 surgical procedures per month, while

surgeons reported that they perform an average of 49 surgeries per month. Surgeons reported that of the surgeries they performed in the past month, a nurse anesthetist performed 62% of anesthesia services and 38% were performed by an anesthesiologist. Participants in this study primarily treated adults over the age of 18. Forty-nine percent and 43% respectively, of anesthesiologists and surgeons included in this study practiced at community hospitals without teaching programs, 25% and 31% practiced at community hospitals with teaching programs, 18% and 24% practiced at academic medical centers, 7% and 3% practiced at free-standing ambulatory surgical centers and 1% of anesthesiologists practiced hospital-associated ambulatory surgical centers.

Physicians practicing at academic medical centers have significantly fewer years in practice (mean of 11 years) than those practicing at community hospitals or free-standing ambulatory surgical centers (mean of 15 for community hospitals and 18 for ambulatory surgical centers). Physicians practicing at academic medical centers also report less experience with laparoscopic procedures compared to those who practice in other settings. Those practicing at academic medical centers perform/are involved in significantly fewer surgical procedures per month (mean of 66) than those who practice in other settings (mean of 94 for community hospitals without a teaching program, 82

for community hospitals with teaching programs, and 101 for ambulatory surgical centers). Please see Table 2 for full demographic characteristics.

	Anesthesiologists (n=256)	Surgeons (n=254)
Mean Years in Practice	15.4	13.4
Mean Years Experience with Lap Procedures	14.4	12.2
Mean # Surgical Procedures/Month	116.9	48.6
Mean # Lap Procedures/Month	26.7	24.3
Mean Age	47	46
Gender (% Male)	83%	85%
% Surgeries in Patients <18 Years of Age	13%	8%
% of Time Administering Anesthesia Majority of Surgery		
CRNA	35%	62%
Anesthesiologist	65%	38%
Practice Type		
Academic Medical Center	18%	24%
Community Hospital with Teaching Program	25%	31%
Community Hospital Without Teaching Program	49%	43%
Hospital-associated Ambulatory Surgical Center	1%	0%
Free-Standing Ambulatory Surgical Center	7%	3%
Practice Setting		
Urban	43%	41%
Suburban	48%	42%
Rural	8%	18%

Table 2: Characteristics of Anesthesiologists and Surgeons participating in the survey.

Importance of communication and current communication practices

The majority of surgeons and anesthesiologists surveyed rated communication as extremely important or absolutely essential to ensure optimal surgical outcomes (65% of anesthesiologists and 69% of surgeons.) Surgeons and anesthesiologists reported that they communicate better with physicians with whom they regularly work. For those surgeons they work with regularly, 62% of anesthesiologists rated their communication as very good or excellent, similar to how surgeons rated their communication with anesthesiologists (69% rate it very good to excellent). For those physicians they work with infrequently, only 27% of anesthesiologists rated their communication as very good or excellent similar to 24% of surgeons who rated their communication as very good or excellent. Those practicing in a community hospital without a teaching program rated the quality of communication between surgeons and anesthesiologists during surgery as significantly better than those practicing in academic medical centers or community hospitals with a teaching program

(58%, 31%, and 41% rate communication as excellent/very good, respectively).

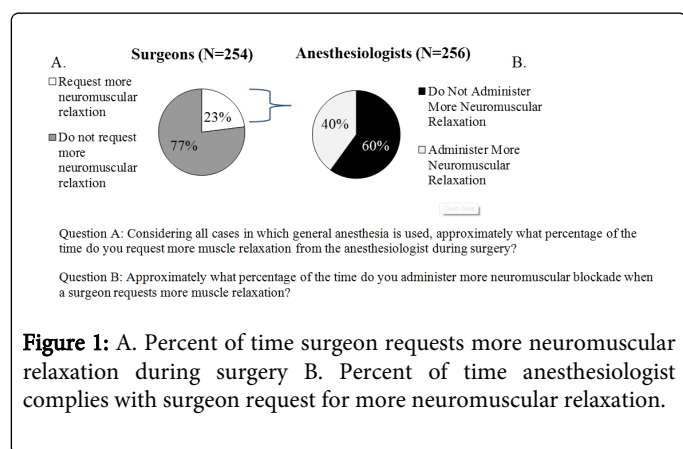
Respondents reported that post-operation management plans are only discussed 31% of the time. The routine nature of the procedure/plan of care is the main reason these plans are not often discussed (28% of anesthesiologists and 30% of surgeons cited this reason). In addition, 16% of the anesthesiologists and 17% of surgeons noted that the post-operative plan is only discussed when the case is unique/difficult/complicated. The post-operation plan is significantly more likely to be discussed among physicians practicing at an academic medical center compared to those at a community hospital without a teaching program (37% of the time, and 29%, respectively.)

Intra-operative communication

Surgeons reported that they rarely request a specific method of neuromuscular relaxation (an average of 10% of the time). Surgeons who practiced at an academic medical center were significantly more likely than those who practiced elsewhere to request a specific method

of neuromuscular relaxation during surgery. Surgeons who perform pediatric surgeries more often (10% or more of surgeries are in those 18 years old and younger) were more likely to ask the anesthesiologist for specific methods of neuromuscular relaxation.

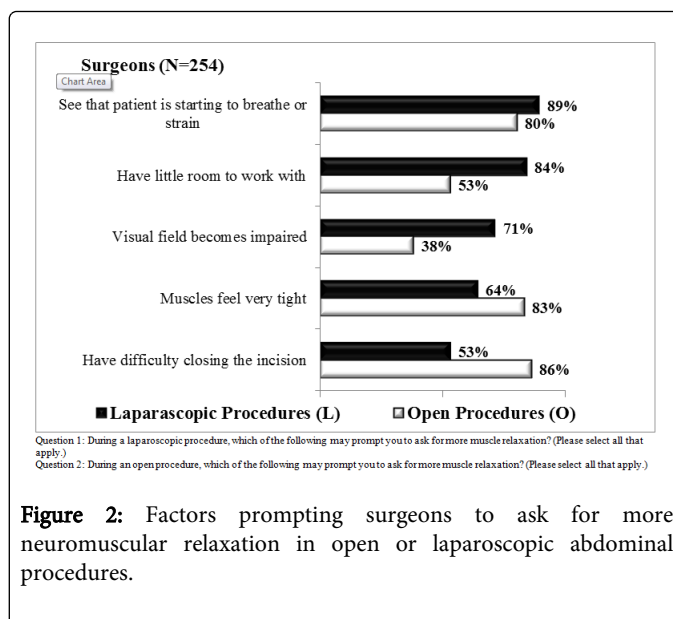
Surgeons reported requesting more neuromuscular relaxation during surgery 23% of the time (Figure 1). When surgeons do request more neuromuscular relaxation during surgery, anesthesiologists disagree with them 19% of the time. When these disagreements occur, most surgeons reported that more relaxation is eventually given (44%). Some surgeons reported that when disagreements occur scenarios are discussed and a mutual decision is made (33%). Only 6% of surgeons leave this decision to the judgment of the anesthesiologist when they disagree.



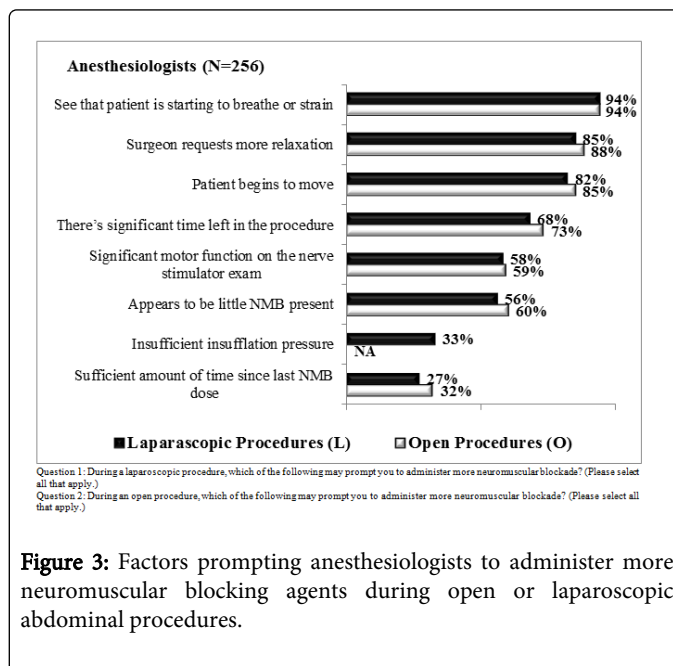
In response to a surgeon's request for more neuromuscular relaxation, anesthesiologists reported that they administer neuromuscular blockade 60% of the time (Figure 1). When surgeons and anesthesiologists disagree about whether more relaxation is needed, anesthesiologists often deepen/increase anesthesia agents (37%) or administer hypnotic agents (33%), or opiates (28%).

Factors affecting the request and administration of more neuromuscular relaxation

During open procedures, difficulty closing the incision was the most common reason surgeons request more neuromuscular relaxation (86% select this reason- Figure 2). Other important reasons cited by surgeons for requesting more neuromuscular relaxation during open procedures included the patient's muscles feeling tight (83%) and that they see the patient is breathing and/or straining (80%). During laparoscopic procedures, patient breathing or straining is the most common reason surgeons request more neuromuscular relaxation (89%). Having little room to work in (84%) and impaired visual field (71%) are also important reasons surgeons cited for requesting more neuromuscular relaxation for laparoscopic procedures. Time left in surgery is an important factor impacting the amount of neuromuscular relaxation requested by surgeons regardless of procedure type - 37% rated this as having a strong or very strong impact in laparoscopic procedures, and 40% rated it as having a strong or very strong impact in open procedures. The use of insufflation pressure was rated as having a strong or very strong impact on amount of neuromuscular relaxation requested during laparoscopic surgery by 40% of surgeons.



Anesthesiologists reported that the most common factor prompting them to administer more neuromuscular blockade is patient breathing or straining (94% cite this reason- Figure 3). However, surgeon request for more relaxation is also a very important factor in prompting anesthesiologists to administer more neuromuscular blockade (85% selected this reason for laparoscopic procedures and 88% for open procedures.) The most impactful factor in determining the amount of neuromuscular relaxation an anesthesiologist administers is the time left in surgery, cited by 91% and 87% as having a strong/very strong impact in laparoscopic and open procedures respectively.



The primary reason anesthesiologists hesitate to administer more neuromuscular blockade is that it is too close to the end of the surgery - 48% cited this reason (Figure 4). However, when surgeons were presented with surgical scenarios four hours in duration and asked

their likelihood to request more neuromuscular relaxation during the first, second, third, and fourth hour, they consistently indicated that they are most likely to request more neuromuscular relaxation in the fourth and final hour. When anesthesiologists were presented with the same four-hour surgical scenarios, they indicated that they oblige a surgeon's request for more neuromuscular relaxation 64% to 68% of the time in the first hour of surgery, while only 8 to 14% of the time in the fourth hour (Figure 5). Concern about the patient's ventilatory function post-operatively was cited as a reason that anesthesiologists often do not administer neuromuscular blockade during the last hour of surgery, especially if the patient is obese. Anesthesiologists selected concern about post-operative ventilation as a reason why they may be unlikely to administer more neuromuscular blockade 79% of the time in a surgical scenario with an obese patient.

improvement. While most surgeons and anesthesiologists believe that communication is extremely important or absolutely essential in ensuring optimal surgical outcomes; respondents report that communication is less than ideal, particularly among physicians who don't work together on a regular basis. Most of the physicians surveyed do not discuss the plan for immediate post-operative management because they think it is unnecessary for standard cases. This is an area for miscommunication about post-operative plans which may result in less than optimal outcomes for patients. Those practicing in academic medical centers are most likely to discuss the post-operative plans, likely due to the presence of residents/trainees.

Surgeons only request more relaxation from the anesthesiologist for about 1 in 5 procedures. When they do, it is because they see that the patient is starting to breathe or strain or because they do not have enough room to work in during laparoscopic surgery. During laparoscopic surgery, the surgeon controlled insufflation pressure impacts the amount of neuromuscular relaxation requested. During open surgeries, surgeons report that they generally request more neuromuscular relaxation when the muscles feel tight or if they are having difficulty closing the incision. Requests for more muscle relaxation from the surgeon typically occur toward the end of the procedure although this is when anesthesiologists are least likely to administer more.

Anesthesiologists report that they selectively honor surgeons' requests for more neuromuscular relaxation slightly more than half the time. Approximately one-third of the time this is because the anesthesiologist believes that the patient is already adequately relaxed. While this may be the case, it has been established that anesthesiologists infrequently used objective monitoring to determine if a patient has achieved adequate relaxation and may rely to heavily on clinical heuristics to decide whether to antagonize neuromuscular blockade [8-10]. The most important factor in determining the amount and timing of neuromuscular blockade administered was the time remaining in the procedure. It appears that the major factor preventing anesthesiologists from administering more neuromuscular blockade at the end of the procedure is a remaining duration is not sufficient to allow for the reversal of additional neuromuscular blockade. This is illustrated by the anesthesiologists concerns about respiratory function keeping them from administration of more neuromuscular blockade during the last hour of a long procedure.

Anesthesiologists say that they do not administer more NMB when the surgeon requests more neuromuscular relaxation about 40% of the time. However, surgeons estimate that anesthesiologists disagree with them on the need for more neuromuscular relaxation about 20% of the time. This discrepancy likely indicates that anesthesiologists administer different agents to achieve the surgeon's desired level of relaxation without discussing details with the surgeon. Only 17% of anesthesiologists respond by communicating with the surgeon when disagreements about the need for more relaxation occur. Instead, anesthesiologists report that they often deepen/increase inhaled anesthesia agents, administer more hypnotic agents, or opiates to achieve the desired result.

Surgeons and anesthesiologists work to balance the need for sufficient neuromuscular relaxation with patient safety. Although conflicts between surgeons and anesthesiologists about the need for more neuromuscular relaxation are fairly uncommon, they do occur. Anesthesiologists are hesitant to use neuromuscular blockade to achieve the surgeon's desired level of neuromuscular relaxation toward the end of the procedure and are therefore forced to use alternative

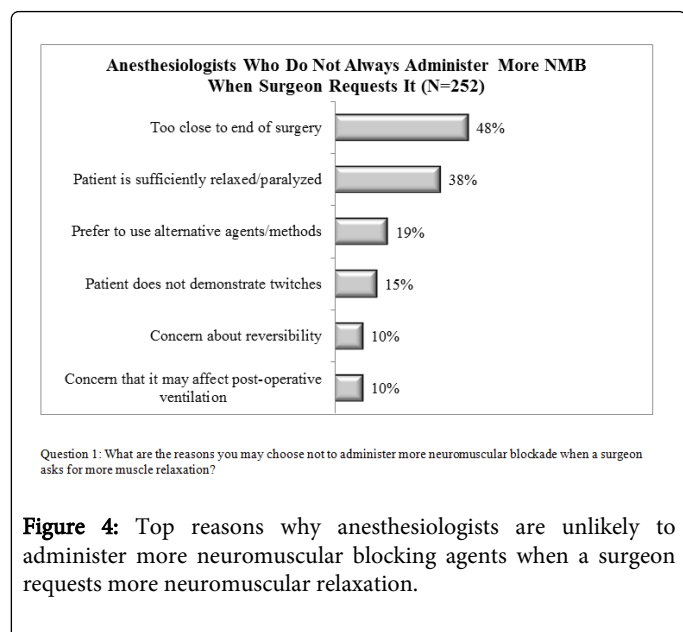


Figure 4: Top reasons why anesthesiologists are unlikely to administer more neuromuscular blocking agents when a surgeon requests more neuromuscular relaxation.

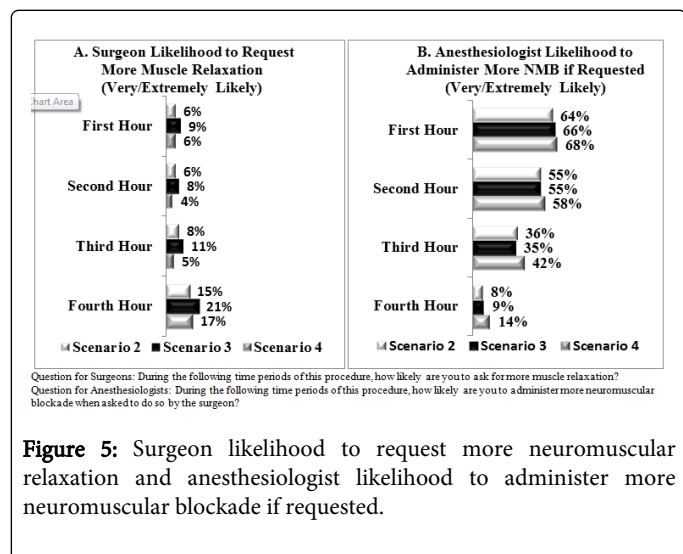


Figure 5: Surgeon likelihood to request more neuromuscular relaxation and anesthesiologist likelihood to administer more neuromuscular blockade if requested.

Discussion

Communication between surgeons and anesthesiologists is generally good but this study has identified potential opportunities for

agents. Techniques to optimize and ensure adequate neuromuscular relaxation and optimal surgical conditions at the end of the procedure, while allowing anesthesiologists to address limited duration of the procedure, should be explored. These techniques may include the increased use of alternatives to neuromuscular blockade to provide neuromuscular relaxation, the development of new, shorter acting neuromuscular blocking agents, or the increased use of current neuromuscular blocking agents in coordination with reversal agents that result in rapid and complete reversal of neuromuscular blockade.

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