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Predictors and clinical outcomes from failed Laryngeal Mask Airway Unique: a study of 15,795 patients

Anesthesiology 2012;116:1217-26
Ramachandran SK, Mathis MR, Tremper KK, Shanks AM, Kheterpal S

Abstract

Purpose  The purpose of this study was to identify clinical predictors and outcomes of failed Laryngeal Mask Airway Unique (uLMA) placement.

Background  Laryngeal mask airways have been used in clinical practice since 1981. They have revolutionized how anesthesia providers manage the airway. These supraglottic airway devices are safe and have a low failure rate. The incidence of life-threatening complications with supraglottic airway devices has been estimated to be 1 in 46,174 cases. The incidence of adverse airway events, such as airway obstruction and laryngospasm, with the Classic LMA are reported to be 0.15% - 7%, with placement failure rates ranging from 0.19% to 4.7%. The uLMA is a single-use LMA which is used in many institutions in lieu of the Classic LMA. The failure rates for the uLMA are lower than the Classic LMA, 0 - 2.5%. Unfortunately, little is known about what risk factors might predict which patients may be at risk for failed uLMA placement.

Methodology  This was a retrospective, observational study conducted at the University of Michigan. The investigators collected data from their anesthesia information management system computer database to identify adult patients that underwent general anesthesia with the use of a uLMA between January 2006 and October 2009. Exclusion criteria included children, instances in which laryngoscopy was performed prior to uLMA placement, and when the uLMA was removed because of a change in the surgical procedure.

Multiple patient, anesthetic, and surgical characteristics were examined to identify predictors of failed uLMA placement. A failed uLMA was defined as any acute airway event occurring between induction and completion of the surgery which required removal and rescue with an endotracheal tube. Airway events included the inability to ventilate because of a leak or airway obstruction, need to administer succinylcholine to facilitate uLMA reinsertion attempts, and adverse airway events. Adverse airway events were defined as desaturation ≤85%, hypercapnia with EtCO₂ >50 mm Hg, and increased peak inspiratory pressures ≥25 cm H₂O on two consecutive readings 1 minute apart.

The primary outcome of the study was to identify predictors of uLMA failure. The secondary outcomes were the incidence of difficult mask ventilation in patients with failed placement and frequency of unplanned hospital admissions. Statistical analysis and sample size were appropriate.
Result  A total of 15,795 adult patients had a uLMA placed at this facility between 2006 and 2009. Of these cases, 170 patients (1.1%) were identified as having failed uLMA placement requiring subsequent intubation. Failures occurred prior to surgical incision (61%), during table rotation (16%), and during maintenance of anesthesia (23%).

In 48% of the cases of uLMA failure, the device placed was outside the recommended size for patient body weight. When uLMA failure occurred, there was no documented attempt to reinsert the uLMA in 61% of cases, 1 attempt at reinsertion in 25% of cases, and 2 or more attempts in 14% of cases. Of the 27 cases of uLMA failure during surgical table rotation, 9 occurred during head and neck surgery.

Inadequate ventilation secondary to a leak occurred in 42% of cases. Significant adverse respiratory events occurred in 62% of uLMA failures (n = 106). Twenty-two percent (22%) of failed uLMA cases experienced severe desaturation of ≤85%. Gastric contents in the uLMA were seen in three of the 170 uLMA failures. Eight patients required succinylcholine to break a laryngospasm, 4.7% of failures.

Logistic regression identified three independent clinical predictors of uLMA failure and the odds ratio of failure when the risk factor was present. They included:

- surgical table rotation (OR = 5.0, P < 0.0001)
- male gender (OR = 1.7, P = 0.002)
- poor dentition (OR = 1.6, P = 0.049)

In the 1,089 patients in whom mask ventilation was attempted, the incidence of difficult mask ventilation was 3 times higher in those with failed uLMA placement as compared to those without failed placement (P < 0.05).

Most uLMA cases occurred in the ambulatory setting and they included 131 of the 170 recorded uLMA failures. In 14% of these uLMA failure cases, an unplanned hospital admission was required (reason for admission not specified). Only 2 out of the 170 patients who had uLMA placement failure required an unplanned intensive care unit admission for persistent hypoxemia (1 inpatient and 1 outpatient).

Conclusion  The incidence of failed uLMA placement was 1 in 93 cases (1.1%). Difficult mask ventilation occurred in 6% of patients with failed uLMA placement. Laryngeal Mask Airway Unique failure was 5 times more likely to occur if the surgical table was rotated. Other predictors of failure included, male gender and poor dentition. Unplanned hospital admission occurred in 14% of patients with uLMA failure; however the reasons for the admissions were not identified.

Comment  This is one of the largest studies ever published that examined predictors of failed uLMA placement. To me, the results are not surprising. The investigators found that the largest portion of the airway events (40%) were due to inability to ventilate related secondary to leaks. This is not surprising since almost half the uLMAs placed were outside the size recommendations for the patients’ body weight. This
finding highlights the importance of placing the appropriate sized LMA.

The strongest predictor of failed uLMA placement was surgical table rotation, and in 9 of these cases the procedure was on the head and neck. I suspect that the uLMA either got dislodged or became obstructed when the table was turned and/or the patient’s head was rotated. The patient most likely experienced some sort of airway event (i.e., inability to ventilate, desaturation) that necessitated conversion to an endotracheal tube. This finding highlights the importance of being vigilant when deciding to place an uLMA in a patient when the bed is going to be rotated.

When the bed is turned we lose access to the airway, so our ability to rapidly respond if there is an airway event may be delayed. If you choose to place an uLMA when the table is rotated, I would make sure the uLMA is appropriately sized, and that it is secured in place so it will not get dislodged. Reevaluate placement after rotation of the bed or when the patient’s head is turned. If the patient is a man and has poor dentition or dentures that were removed, I would be extra vigilant for the possibility of a uLMA failure, or consider placing an endotracheal tube rather than an uLMA.

A trick I have learned in placing LMAs in patients with no teeth is to use two soft bite blocks or rolled 4x4s placed on either side of the LMA between the molars. I then wrap the tape around the LMA and the two 4x4s and secure the tape to the maxilla.

Dennis Spence PhD, CRNA
Abstract

Purpose The purpose of this study was to determine the extent to which the hands of anesthesia providers, the patient, and environment contributed to contamination of IV stopcocks in surgical patients. The secondary aim was to identify risk factors for IV stopcock contamination and determine if these risk factors were associated with postoperative infections.

Background Healthcare associated infections are a major public health concern. One of the major contributors to these infections is bacterial cross-contamination between health care providers, the environment, and patients. The relative contribution of each of these reservoirs to infections is unknown. Previous investigations have shown that anesthesia provider hands are a frequent source of IV stopcock contamination. However, further research is needed to determine if other bacterial reservoirs, e.g. patient and environment, contribute to stopcock contamination and healthcare-associated infections.

Methodology This was a prospective, randomized, observational study at three academic institutions to examine the sources of within-case and between-case IV stopcock contamination. Subjects enrolled included adult patients undergoing general anesthesia. The first two consecutive patients in 274 randomly selected operating rooms were enrolled in the study (N = 548). Bacterial reservoirs cultured included the hands of all anesthesia providers involved in patient care (provider), the patients themselves, the anesthesia machine adjustable pressure-limiting valve (APL), and vaporizer dial (Table 1). (The anesthesia machine APL and

Table 1. Culture Sampling Sequence

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1.</td>
<td>Active decontamination of anesthesia machine by study personnel prior to first case.</td>
</tr>
<tr>
<td>2.</td>
<td>Baseline cultures of sterile stopcock, APL valve, vaporizer dial, provider hands, and patient (axilla and nasopharynx).</td>
</tr>
<tr>
<td>3.</td>
<td>At end of case 1, cultures obtained from the IV stopcock, APL valve, vaporizer dial, provider hands, and patient.</td>
</tr>
<tr>
<td>4.</td>
<td>Routine decontamination of anesthesia machine by hospital personnel between cases.</td>
</tr>
<tr>
<td>5.</td>
<td>Repeated step 2 and 3 prior to start and again at end of case 2.</td>
</tr>
<tr>
<td>6.</td>
<td>Provider hands were also cultured intermittently throughout patient care, at case end, and upon provider return to the operating room after an absence during the case.</td>
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vaporizer dials were, together, classified as the “environment.”)

Any bacterium isolated from the IV stopcock was compared with bacterial isolates from the provider, patient, and environment. If the bacteria isolated from the IV stopcock was identical to bacteria isolated from one of the three reservoirs (same organism class and biotype), and there was a temporal association, then bacterial transmission was assumed to have occurred. Between-case transmission was defined as the presence of bacteria in the stopcock of case 2 that was identical to that obtained from the stopcock in case 1. Within-case contamination occurred if the bacteria isolated in the stopcock set was identical to one isolated from one of the reservoirs (provider, patient, or environment). Providers were observed for the number of times they decontaminated their hands with hand sanitizer per hour. Providers were also assessed to determine how many times per hour they changed their gloves and the rate of hand decontamination with hand sanitizer after glove removal.

Patients were followed for 30 days postoperatively to determine the incidence of healthcare-associated infections. Bacterial pathogens identified on the reservoirs were compared with the causative organism of any postoperative infection. Statistical analysis was appropriate and significance was considered to be a P value < 0.05.

**Result**    Contamination of IV stopcocks was found in 23% of cases (126 of 548). There were 14 between-case and 30 within-case stopcock transmission events from at least one of the reservoirs; provider, environment, or patient. The most common reservoir was the anesthesia machine environment (APL valve and/or vaporizer dial), which contributed 64% of the between-case and 47% of the within-case

![Figure 1. Stopcock Contamination Transmission Events](image-url)

**Figure 1. Stopcock Contamination Transmission Events**

- **Between-case**
- **Within-case**

<table>
<thead>
<tr>
<th>Environment</th>
<th>Provider</th>
<th>Patient</th>
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<tbody>
<tr>
<td>80%</td>
<td>60%</td>
<td>40%</td>
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<tr>
<td>60%</td>
<td>40%</td>
<td>20%</td>
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<tr>
<td>40%</td>
<td>20%</td>
<td>0%</td>
</tr>
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transmission events, respectively (Figure 1). Compared to baseline sampling after active decontamination prior to start of the case, the APL valve became more contaminated by the end of the first case \( (P = 0.015) \). In contrast, the vaporizer dial did not have increased bacterial contamination. Provider hands were confirmed as vectors of transmission between the environment and contaminated stopcocks in 27% of all between and within-case transmission events.

Hospital 0 was five times more likely to be associated with IV stopcock contamination than the other two hospitals \( (P = 0.001) \). Stopcocks were 7 times more likely to get contaminated during case 2 \( (P < 0.001) \). The risk of IV stopcock contamination was reduced if providers increased their use of hand sanitizer \( (OR = 0.66, P = 0.005) \). Providers at all three facilities used hand sanitizer on average 0.4 times per hour. Providers changed their gloves 2.39 times per hour; however, 40% of the time providers did not wash their hands when gloves were removed.

A total of 44 patients developed postoperative infections (8%). Patients who had surgery at Site 0 were 14 times more likely to develop a healthcare-associated infection \( (P = 0.002) \). A higher ASA status \( (OR = 2.61, P = 0.003) \) and SENIC score (an index predicting the probability of a postoperative healthcare-associated infection) were both predictors of a healthcare-associated infection \( (P = 0.017) \). Bacterial cultures identified the causative organism in 45% of patients with healthcare-associated infections (20 of 44). In 30% of these patients, the causative organism had been found in at least one of the reservoirs (environment, provider, or patient). In 14% of patients, the bacterial organisms present at the time of surgery caused the healthcare-associated infection (6 of 44). Only one case was directly linked to the hands of an anesthesia provider before patient care.

**Conclusion** The surrounding environment was the most likely source of bacteria with which IV stopcocks were contaminated, although bacteria on patients and provider hands also contributed pathogens. Stopcock contamination was associated with infections and increased 30 day mortality. To reduce the risk of health care-associated infections, a multimodal approach will be needed to target the most common bacterial reservoirs; environment, provider, and patient.

**Comment**

I found the results of this study very sobering; although, I do not think the results are terribly surprising. Every day in the operating room we inject medications and we touch patients, anesthesia equipment, the anesthesia machine, and other materials hundreds of times a day. Despite our best efforts to wash our hands, use hand sanitizer, and wear gloves, we probably still contribute to the problem of IV stopcock contamination and thus to postoperative infections. It is probably impossible to completely eliminate all contamination. However, I think we all can certainly do a better job.

So what can we do to reduce the risk of IV stopcock contamination? Below I have compiled a list of some recommendations that may help.
1. Before beginning work, wash your hands and arms in the surgical scrub sink with an alcohol-based solution that contains 0.5%-1% chlorhexidine or similar solution prior to the start of patient care. Consider performing a “surgical scrub.”

2. Consider removing jewelry such as rings and watches during patient care.

3. Make sure your cleaning personnel are cleaning the anesthesia machine with an appropriate decontamination solution prior to the start of every case (i.e., quaternary ammonium compound such as Dimension III). Make sure they are targeting all parts and equipment on the anesthesia machine and monitors, especially the APL valve and vaporizer dials.

4. Always use gloves during patient care. When removing the gloves, immediately wash your hands with warm soap and water or use hand sanitizer with 62%-70% alcohol.

5. Wash your hands or use hand sanitizer after every patient interaction or when you suspect they were contaminated. In this study IV stopcock contamination was reduced when providers used hand sanitizer more often.

6. Consider wiping off the stopcocks with an alcohol wipe prior to injection of medications. Keep the caps on the stopcocks when not in use.

7. Have a bottle of cleaning wipes (i.e., quaternary ammonium compound such as Dimension III) readily available to wipe down equipment if you contaminate it. For example, after intubation I wipe down the laryngoscope handle, APL valve, and vaporizer dial with one of these wipes and any time during the case if I feel I contaminated them.

8. At the end of each case make sure your cleaning personnel are cleaning the anesthesia machine, cart, and monitors with the appropriate cleaning solution or wipes. Consider gently reminding them, especially if you think the equipment is contaminated.

9. Do not reuse syringes. Throw them out once you have administered the medication. While this increases costs, it is in keeping with AANA safe injection practices. The syringes may serve as vectors for bacterial cross-contamination.

10. If you teach students or residents, review these practices with them. By role modeling good behaviors we can help ensure our future generations of anesthesia providers develop good infection control practices.

This list is not all inclusive; certainly there are other measures that CRNAs, surgeons, nurses, and patients can take to minimize the risk. However, I think some of these recommendations may help reduce the risk of IV stopcock contamination and postoperative infections.

Dennis Spence, PhD, CRNA

The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.
Aromatherapy as Treatment for Postoperative Nausea: A Randomized Trial


Abstract

Purpose The purpose of this study was to compare the effectiveness of aromatherapy with essential oils or isopropyl alcohol to saline placebo on postoperative nausea severity in patients who underwent ambulatory surgery.

Background Nonpharmacologic interventions such as aromatherapy have been found to reduce, at least in the short-term, the severity of postoperative nausea (PON). Aromatherapy is cheap and noninvasive which makes it appealing to patients and nursing staff. This study sought to compare the effects of three different aromatherapy agents on the change in PON severity at 5 minutes after aromatherapy administration.

Methodology This was a prospective, randomized, placebo-controlled study comparing:

1. essential oil of ginger (Ginger group)
2. blend of essential oil of ginger, spearmint, peppermint, and cardamom (Blend group)
3. isopropyl alcohol (Alcohol group)
4. saline placebo

All patients enrolled in the study were from one ambulatory surgical suite. This study was designed to evaluate the effect of these aroma agents on the patient’s first complaint of nausea in the post anesthesia care unit. There were no limitations or control on the type of anesthetic, anesthetic agents, or opioids used, use of prophylactic antiemetics, type of antiemetics administered in the post anesthesia care unit, or number of postoperative nausea and vomiting (PONV) risk factors.

On admission to the post anesthesia care unit, research nurses asked patients to rate their level of PON using a 0 to 3 Likert scale (0 = no nausea, 1 = some, 2 = a lot, 3 = severe). Those who reported no nausea were not assigned to a treatment group. Patients who reported nausea were randomly assigned to 1 of the 4 treatment groups. Patients were asked to inhale the scent through their nose and exhale through the mouth 3 times. Five minutes later, each subject was asked to rate their nausea again. After 5 minutes, if the patient still reported nausea then an antiemetic was administered. Statistical and power analysis were appropriate.

Result A total of 1,151 patients were screened for inclusion; 301 patients experiencing PON and received the randomized aromatherapy. No significant differences were found in risk factors for PON, use of prophylactic antiemetics (type not reported), or postoperative opioids (Table 1). Patients in the ginger and blend groups reported significant reductions in nausea severity when compared to the saline or alcohol groups (P < 0.05; Figure 1). Patients in the...
blend group had a higher proportion of patients who reported improvement than those in the ginger group (P = 0.03). The percentage of patients who reported some nausea relief was 33% in saline group, 44% in the alcohol group, 50% in the ginger group, and 62% in the blend group. The percentage of patients who requested antiemetics in the post-anesthesia care unit was significantly lower in the ginger and blend groups when compared to the alcohol or saline groups (P<0.05; Figure 2).

**Conclusion**  Aromatherapy with ginger or blended aromas (a blend of essential oil of ginger, spearmint, peppermint, and cardamom) was effective in the immediate treatment of postoperative nausea. Isopropyl alcohol was no more efficacious than saline. Aromatherapy is an inexpensive therapy that can easily be used by patients as needed.

**Comment**  Aromatherapy for PONV prophylaxis has been around for a long time. Early studies found isopropyl alcohol provided more rapid PON resolution when compared to ondansetron in women undergoing gynecological surgery\(^1\) and in patients at high-risk for PON treated with prophylactic ondansetron when compared to promethazine.\(^2\) In recent years, other agents such as ginger and blended aroma agents have been investigated as rapid treatments for PON. In this study the investigators compared 3 different agents and found ginger and a blended aromatherapy agent were effective in reducing PON severity.

<table>
<thead>
<tr>
<th>Table 1. Risk Factors for PON</th>
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<tr>
<td>Female gender</td>
</tr>
<tr>
<td>History of motion sickness</td>
</tr>
<tr>
<td>History of PON*</td>
</tr>
<tr>
<td>Volatile/N20 use</td>
</tr>
<tr>
<td>Surgery &gt; 60 min</td>
</tr>
<tr>
<td>GI surgery</td>
</tr>
<tr>
<td>GYN surgery</td>
</tr>
<tr>
<td>Postoperative opioids</td>
</tr>
<tr>
<td>Prophylactic antiemetics</td>
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</table>

**Note.** P = NS for all risk factors. *P = 0.08.
I was surprised no difference was found with isopropyl alcohol, given that previous studies\textsuperscript{1,2} found it was efficacious. I think this current study may have been biased towards the other agents. One of the major problems in this study was that the investigators wanted to replicate a “natural setting” of what occurs commonly in the postanesthesia care unit. The patient complains of nausea and the nurse has them sniff an aroma agent; then they go get the antiemetic to administer. Unfortunately, the investigators did not control for the type of anesthetic, number of PONV risk factors, type or amount of opioids, or antiemetics administered. This makes it difficult to interpret the results. For example, the saline and alcohol groups both had a larger proportion of patients with a history of PONV (55\% and 50\%, respectively) when compared to the ginger (36\%) and blend groups (41\%). Given the lack of control in study design, I suspect there was significant variability in patient management and this could partially explain the results.

So how can we incorporate these results into our practice? I would use any one of these three agents as a quick treatment while an antiemetic was being prepared to be administered. My experience is that aromatherapy agents have a short duration of action, so I think antiemetic agents must be available to the patient.

\textbf{Dennis Spence PhD, CRNA}


The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.
PATIENT SELECTION FOR DAY CASE-ELIGIBLE SURGERY: IDENTIFYING THOSE AT HIGH RISK FOR MAJOR COMPLICATIONS

Anesthesiology 2013;119:1310-21

Abstract

Purpose The purpose of this study was to identify risk factors for morbidity and mortality after outpatient surgery.

Background Over the last 3 decades there has been a dramatic increase in the number of outpatient surgical procedures performed at hospitals and ambulatory surgery centers across the United States. The reason for this increase is due to the use of short-acting anesthetics, better monitoring, innovations in minimally invasive surgical techniques, and economic pressures to reduce costs.

Appropriate patient selection for outpatient surgery, especially when performed in an Ambulatory Surgery Center, is a critical factor which helps ensure low morbidity and mortality. Unfortunately, there are no national, prospective studies examining risk factors and outcomes after outpatient surgery. The authors of this study sought to identify risk factors for morbidity and mortality within 72 hours of outpatient surgery.

Methodology The authors examined data from the Patient Use Data File of the American College of Surgeons’ National Surgical Quality Improvement Program (ACS-NSQIP). All patients aged 18 and older who underwent outpatient surgery from 2005-2010 were included. A surgery was defined as “outpatient” if the patient arrived at the facility on the same day as the procedure and was discharged the same day (including 23-hour observations). Patients were followed through their operative course until postoperative day 30. Trained nurses then performed a chart review at the institution where the surgical procedure was performed and made direct patient contact to further identify complications diagnosed and treated at other institutions. Data from freestanding Ambulatory Surgery Centers and acute care hospitals were included in the analysis. Patients who required a blood transfusion prior to surgery or had a central nervous system tumor were excluded.

Investigators examined the incidence and risk factors for perioperative morbidity and mortality within 72 hours of surgery. The outcome included a composite of:

• intraoperative morbidity (cardiac arrest or myocardial infarction)
• postoperative surgical complications (surgical infections, wound disruption)
• postoperative anesthetic (unplanned intubation, on ventilator >48 hours)
• postoperative medical (pneumonia, pulmonary embolism, progressive renal insufficiency, acute renal insufficiency, stroke/TIA with neurological deficit, cardiac arrest requiring CPR, myocardial infarction, bleeding requiring transfusion, graft/prosthesis/flap failure, deep vein thrombosis, sepsis or septic shock, and postoperative death within 72 hours)
Multivariable logistic regression while controlling for surgical complexity was used to analyze the data. A P < 0.05 was considered significant.

**Result** A total of 244,397 cases were included in the analysis. The most common outpatient surgical procedures were:

- hernia repair
  - (36%: inguinal hernia [17.2%], umbilical [8.2%], abdominal wall [3.3%], femoral/inguinal hernia [5.3%])
- laparoscopic cholecystectomy (23%)
- excision/removal of breast lesion (15.5%)
- partial mastectomy with or without lymph node dissection (9%)
- knee arthroscopy with or without ligament/ meniscus repair (3.7%)
- laparoscopic gastric band placement (3.1%)
- repair of bladder defect (1.3%)
- tonsillectomy (1.1%)

The incidence of perioperative morbidity and mortality within 72 hours was 0.095% or 1 in 1,053 cases (n = 232). The incidence of postoperative death within 72 hours was 1 in 11,662 (n = 21). Nine deaths occurred on the day of surgery, seven on postoperative day 1, and five on postoperative day 2. No patients died in the operating room. Out of 232 morbidities, the most common morbidities included:

- pneumonia (n = 46)
- unplanned postoperative intubation (n = 37)
- wound disruption (n = 25)
- bleeding (n = 21)
- sepsis (n = 19)
- stroke/TIA with neurological deficits (n = 15)
- postoperative myocardial infarction (n = 15)

Eighty-four percent (84%) of cases experiencing an event were discharged within 23 hours of surgery. This indicates most complications occurred after patients were discharged.

<table>
<thead>
<tr>
<th>Table 1. Morbidity &amp; Mortality within 72 hours of Outpatient Surgery</th>
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<tbody>
<tr>
<td>Perioperative Morbidity &amp; Mortality</td>
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<tr>
<td>Postoperative Mortality</td>
</tr>
<tr>
<td>Pneumonia</td>
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<tr>
<td>Unplanned postoperative intubation</td>
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<tr>
<td>Wound disruption</td>
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<tr>
<td>Bleeding requiring transfusion</td>
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<tr>
<td>Sepsis</td>
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<tr>
<td>Stroke/TIA with neurological deficit</td>
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<tr>
<td>Postoperative myocardial infarction</td>
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<tr>
<td>Septic shock</td>
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<td>DVT</td>
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</table>

**Note.** Total cases = N = 244,397. Total complications n = 232. Other complications included postoperative cardiac arrest requiring CPR n = 8, pulmonary embolism n = 7, progressive renal insufficiency n = 6, acute renal failure n = 4, graft/prosthesis/flap failure n = 6, surgical site infection n= 3, on ventilator> 48 hours n = 2, intraoperative cardiac arrest requiring CPR n = 0, intraoperative myocardial infarction n = 0.

There were 7 independent predictors of morbidity and mortality within 72 hours after outpatient surgery. They included:

- COPD
- history of CVA or TIA
- overweight BMI (BMI 25-29.9)
- obesity (BMI > 30)
- prior percutaneous coronary intervention or cardiac surgery
- prolonged operative time
- hypertension

Results are presented in Table 2.

**Conclusion** The overall incidence of perioperative morbidity and mortality after outpatient surgery was low. These results confirm the safety of outpatient surgery. Several risk factors were identified.
which may aid in the selection of patients suitable for outpatient surgery.

**Comment**

Results from this study confirm that outpatient surgery is very safe for the vast majority of patients. However, these results indicate there are several comorbidities which may increase patients’ risk for perioperative complications. This information is useful because it can help us anticipate and possibly mitigate potential complications.

So how can we use this information to prevent complications? We probably have very little or no control over complications such as wound disruption and bleeding requiring transfusion; these are surgical complications. To minimize deep vein thrombosis we need to ensure the sequential compression devices are on prior to induction, but other factors may play a larger role in this complication (i.e., surgical duration, patient obesity). We should ensure we wash our hands regularly and use good aseptic technique if we want to help reduce the incidence of sepsis, septic shock, and pneumonia. Also, we should ensure patients are optimized, especially those with COPD, hypertension, and cerebral vascular or cardiac disease. It is critical that we stay familiar with current guidelines on the use of beta blockers and keep handy a copy of the ACC/AHA 2007 guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery.

One also needs to ask the question, is this patient suitable for outpatient surgery? For example, a 300 lb. patient with suspected obstructive sleep apnea, hypertension, and coronary artery disease may not be the most suitable candidate for outpatient surgery. This type of patient might benefit from an overnight stay rather than having surgery in an ambulatory surgery center.

I would have liked to have known which factors were associated with each specific complication. I suspect that patients with COPD may have had high rates of pneumonia postoperatively given they are at risk for pneumonia. Certainly, obesity can make surgery time longer and does increase the likelihood that patients have obstructive sleep apnea. One could speculate that obesity, and possibly suspected obstructive sleep apnea, could have contributed to the higher rates of unplanned postoperative intubation. Mokhlesi et al. found a higher proportion of patients with obstructive sleep apnea required emergent intubation and mechanical ventilation on the day of surgery or the first postoperative day compared with non-sleep disordered breathing patients after bariatric surgery (i.e., gastric banding; 90% vs. 63%, P < 0.001).

<table>
<thead>
<tr>
<th>Table 2. Predictors of Morbidity &amp; Mortality after Outpatient Surgery</th>
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<tr>
<td>COPD</td>
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<tr>
<td>History of CVA or TIA</td>
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<tr>
<td>Overweight BMI (25-29.9)</td>
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<tr>
<td>Obesity (BMI &gt;30)</td>
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<tr>
<td>Prior PCI/cardiac surgery</td>
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<td>Prolonged operative time</td>
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<td>Hypertension</td>
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Note. Results presented as adjusted odds ratio (adjusted for surgical complexity).
The take-home message from this study is to ensure you have protocols and procedures in place which help ensure patients are optimized and appropriately monitored postoperatively. Finally, administer an anesthetic which hastens recovery and minimizes complications.

**Dennis Spence PhD, CRNA**


The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.
Pain

POSTOPERATIVE ANALGESIA AFTER MODIFIED RADICAL MASTECTOMY: THE EFFICACY OF INTERSCALENE BRACHIAL PLEXUS BLOCK

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Kaya M, Oguz G, Senel G, Kadiogullari N

Abstract
Purpose  The purpose of this study was to determine if an interscalene brachial plexus block provided effective analgesia following modified radical mastectomy surgery. Secondarily, the study tested the hypothesis that an interscalene brachial plexus block following modified radical mastectomy would reduce the dose of opioids needed for post-operative analgesia.

Background  Previous clinical trials reported approximately 60% of breast surgery patients experience severe postoperative pain. Modified radical mastectomy procedures involve removal of not only skin, but the entire breast as well as axillary contents. Theory suggests that postoperative pain results primarily from the axillary component of the surgery.

The benefits of managing severe pain are well known. It allows for early ambulation and mobility. Well managed pain prevents the development of chronic pain. General endotracheal anesthesia is typically used for breast surgery and opioids are used to control (or attempt to control) postoperative pain. The side effects of opioids following mastectomy procedures are no different than when used following other surgical procedures. Regional and local anesthesia techniques have been studied including brachial plexus interscalene blocks combined with thoracic epidural anesthesia; however, brachial plexus blocks have not been studied solely for postoperative analgesia following radical mastectomy.

Methodology  This study was a randomized, controlled but un-blinded experiment. The study was planned for 60 ASA status I-III women scheduled for elective unilateral modified radical mastectomy with axillary node dissection under general anesthesia. Women were randomized into one of two groups:

- **Group 1**: interscalene brachial plexus block
- **Group 2**: control group - no interscalene block

All patients received a standardized anesthetic which included an NSAID and antiemetic. Upon conclusion of the surgical procedure, Group 1 received an interscalene brachial plexus block using a nerve stimulator and 30 mL of 0.25% bupivacaine. Both groups were provided post-operative analgesia with IV PCA morphine. Pain was assessed using a visual analog scale at times 0 (PACU admittance), 1, 2, 4, 6, 12, and 24 hours following surgery. When the pain score reached 40 mm or greater (0 - 100 mm scale), morphine was administered. Total morphine consumption and associated side effects were recorded as well as any complications of the brachial plexus block. The primary outcome variable was total morphine consumption in the first 24 hours post-surgery.
Result There were no demographic differences between groups in age, weight, ASA status, or duration of surgery time. VAS pain scores were lower in Group 1 (brachial plexus block group) at all measured times (P < 0.007) except at 24 hours. Morphine requirements were higher in the first hour following surgery in the control group. Over the first 24 hours post-operatively the control group used 22 mg morphine on average compared to 5 mg morphine in the brachial plexus group. Nausea and the need for additional antiemetic therapy were significantly higher in the control group. Two patients in the regional group exhibited signs of Horner’s syndrome; however, there were no serious side effects as a result of the block.

Conclusion Postoperative analgesia provided by ipsilateral interscalene brachial plexus block was effective in managing postoperative pain for the first 24 hours following modified radical mastectomy. Those who received the plexus block had minimal morphine requirements compared to a control group and therefore experienced fewer morphine side effects.

Comment Inadequately controlled post-surgical pain results in longer post-surgical recovery times, delayed ambulation and daily functioning, higher incidence of surgery related complications, prolonged hospital length of stay, higher readmission rates, and a potential for progression from acute to chronic pain. I have found in the scientific literature that 10% to 15% of patients undergoing leg amputation, CABG, breast surgery, and femoral hernia develop chronic pain! I am astounded at these statistics. The reason those who undergo these procedures are at risk for chronic pain is not totally understood. Following breast cancer surgery, the incidence of reported persistent pain is very high and may be related to a plethora of not only physical but psychological mechanisms. We are rapidly changing postoperative pain management and the investigations conducted are assessing the utility of non-opioid alternatives, and appropriately so.

This study had some limitations, such as performing the block while the women were anesthetized (the researchers did not feel it was appropriate to subject the women to an invasive technique with such high anxiety levels), and not using ultrasound guidance. It does provide evidence that the technique minimized the need for opioids. I would like to see future studies combining interscalene brachial plexus block for modified radical mastectomy and intravenous acetaminophen with the total elimination of opioids.

Mary Golinski, PhD, CRNA

Note: The innervation of the breast is supplied by the brachial plexus (C5-T1), branches of the intercostal nerves (T3-T6), and the intercostobrachial nerve (T2). The chest wall is innervated by the intercostobrachial, thoracicus longus, thoracodorsal, lateral pectoral, and medial pectoral nerves. The skin of the axilla and upper arm is supplied by the intercostobrachial nerve. During axillary node dissection, the intercostobrachial nerve is often sacrificed. Most patients experience pain in the axilla and upper limb after surgery. An interscalene block covers the brachial plexus and T1-T2, depending on the volume of local used. Typically an interscalene block misses the intercostal nerves, so some type of analgesia will be necessary.
Effect of Intravenous Fluid Therapy on Postoperative Vomiting in Children Undergoing Tonsillectomy

Elgueta MF, Echevarría GC, De la Fuenta N, Cabrera F, Valderrama A, Cabezón R, Muñoz HR, Cortinez LI

Abstract

Purpose The purpose of this study was to evaluate the impact of intraoperative super-hydration with lactated ringers (LR) on postoperative vomiting (POV) in children undergoing elective tonsillectomy or adenotonsillectomy.

Background Tonsillectomies and adenotonsillectomies are among the most commonly performed surgeries in the pediatric population. POV is the most frequently endured post-surgical complication. Furthermore, POV is the primary anesthesia complication necessitating prolonged hospital stays and readmission. Nearly 70% of this patient population experience POV when prophylactic antiemetic administration is withheld. Pharmacologic antiemetic prophylaxis has effectively decreased the incidence of POV following tonsillectomies and adenotonsillectomies; however, it has by no means eliminated its occurrence. In addition, pharmacologic prophylaxis is associated with increased anesthetic costs and the risk of additional side effects.

Previous studies have assessed the impact intraoperative super-hydration and supplemental fluid therapy had on the incidence of POV. Research has focused on the adult surgical population while only a small number of studies have focused on the pediatric surgical population. Outcomes have varied.

Super-hydration is defined as 30/mL/kg/hour of lactated ringers solution.

Methodology The investigators performed a prospective investigation from July 2010 through March 2012. Study participants consisted of 100 ASA I-II patients ranging from 1 year to 12 years of age.

Exclusion criteria were as follows:
- diabetes mellitus
- mental retardation
- obesity (BMI > 95th percentile)
- antiemetic or psychoactive medication within previous 24 hours
- gastroesophageal reflux

Subjects received no preoperative medications and were NPO for a minimum of 4 hours. A routine inhalation induction was performed using sevoflurane and oxygen only. Intravenous access followed induction, and subjects were then randomly assigned to one of two intraoperative fluid therapy groups:
- Group 1: 10 mL/kg/hour of LR
- Group 2: 30 mL/kg/hour of LR

Both study subjects and anesthesia providers were blinded to the fluid therapy groups.

To aide intubation, 4 mcg/kg fentanyl and 0.16 mcg/kg mivacurium were administered IV. Anesthesia was maintained with an oxygen/nitrous ratio of 1:1 and 2% sevoflurane. To maintain the mean arterial pressure within 20% of baseline, additional 1 mcg/kg fentanyl boluses were administered as needed. All subjects received rectal 40 mg/kg acetaminophen. Upon surgical completion, patients received atropine...
and neostigmine to assist in neuromuscular block "reversal," and gastric contents were suctioned through an orogastric tube. LR infusions were ceased at extubation. All patients were monitored in the PACU for 120 minutes and then admitted to the floor overnight. The incidence of retching and vomiting was recorded starting at tracheal extubation. Ondansetron 0.15 mg/kg IV was administered after the first episode of retching or vomiting. If POV continued for 20 minutes, patients received 0.015 mg/kg droperidol IV.

A visual analog scale (VAS) or Childrens and Infants Postoperative Pain Scale (ChIPPS) evaluated pain in the PACU at 15, 30, 45, 60, 90, and 120 minutes. With VAS or ChIPPS scores > 4, oral codeine was administered. If pain control remained inadequate, 0.1 mg/kg morphine IV was administered until pain scores were < 4.

No additional IV fluids were infused during patients’ PACU stay. Patients were allowed to consume liquids as soon as fluids were requested. Pain was controlled on the floor with PO acetaminophen. Patients were discharged home on postoperative day one. Twenty-four hours following their surgical procedure, parents were interviewed via telephone and asked whether the child had any of the following episodes: (a) retching or vomiting, (b) fevers > 100.4 °F, or (c) thirst.

Logistic regression was performed to analyze episodes of retching or vomiting during the first 24 hours.

**Results** Episodes of retching or vomiting within the first 24 hours were as follows:

- **Group 1** 10 mL/kg/hour of LR: 41 of 50 patients (82%)
- **Group 2** 30 mL/kg/hour of LR: 31 of 50 patients (62%, P=0.026)

The adjusted logistical regression's odd ratio suggested Group 1 subjects were 2.9 times more likely to experience at least one episode of retching or vomiting compared to subjects in Group 2. Postoperative pain scores were similar between the two groups.

**Comment**

POV is a multifactorial complication that burdens a significant proportion of our surgical patients. Of note, pediatric adenotonsillectomy patients are most likely to experience POV. Many theories exist to explain why children are so vulnerable. One of the most popular theories focuses on the lengthy NPO periods which lead to severe preoperative hypovolemia. The large fluid deficits then precede gut ischemia. The gut ischemia is perceived to be the causative factor behind POV.

This issue is then magnified when the POV is intractable, requiring overnight hospital admission. This is not an uncommon occurrence as POV is the leading cause of unanticipated hospital admission following out-patient surgical adenotonsillectomies. When POV requires admission, both patient and parent satisfaction decrease and hospital costs increase.

The authors of this study did a service to the future pediatric surgical population. This study designated a single factor linked with POV (intraoperative fluid volume administration) and unveiled how, at different rates, it impacted the incidence of POV. Before further discussing the study’s results, I would like to
reiterate what is known about POV in the pediatric surgical population:

- Incidence of emesis markedly increases after age 3 and continues to rise with age (infants 5%, children 20%, pubertal teens > 30%)
- Intraoperative super-hydration effectively decreases POV in children undergoing strabismus surgery
- Surgical procedures lasting longer than 30 minutes are an independent risk factor for POV
- Adenotonsillectomy is strongly associated with POV
- Volatile anesthetics are strongly associated with POV
- A previous history of POV or a sibling history of POV is an independent risk factor
- Long-acting opioids are an independent risk factor
- Without antiemetic prophylaxis, POV following adenotonsillectomies has been found to be as high as 89%

Some patients are more susceptible to POV than others. The episodes of retching and vomiting can be quite profound. Furthermore, severe POV has been associated with the following:

- Tonsillar bed wound dehiscence
- Electrolyte imbalances
- Pulmonary aspiration
- Delayed postoperative discharge
- Increased probability of hospital admission

While the study was well performed, it was not without its flaws; some of which were acknowledged by the authors. Nevertheless, the study failed to do the following:

- Determine the average NPO deficit
- State whether the patients’ fluid deficits were entirely corrected
- Record oral fluid consumption in the PACU
- Determine a rate of postoperative hospital admission (all study patients were admitted for overnight monitoring)
- Avoid ethical concerns secondary to the withholding of prophylactic antiemetics in a surgical population prone to POV

The study produced data that was clinically and statistically significant. Perhaps the most impressive feature was that the intraoperative super-hydration technique did not increase anesthetic costs. A desirable study now would determine the impact the addition of the super-hydration technique to other known antiemetic techniques (antiemetic prophylaxis, decadron administration, etc.) on POV rates in the pediatric surgical population. However, I strongly feel that one could assume the combined techniques would further reduce the rate of POV in the pediatric adenotonsillectomy population.

As anesthesia professionals, we should, of course, always weigh the risks and benefits of our anesthetic options. There are pediatric patients with pathophysiologic disorders that would respond poorly to intraoperative super-hydration. Therefore, we should continue to prepare our anesthetic plans on a case-by-case basis and by no means apply this fluid management technique to all our pediatric adenotonsillectomy patients without thought.

Kenneth J Taylor, DNP, CRNA

Visual Analog Scale (VAS) - Numeric scale with the range of 0 through 10, with 0 = no pain and 10 = worst possible pain

Children and Infant Postoperative Pain Scale (ChIPPS) - A 10-point numeric instrument measuring 5 categories appointing a score of 0, 1, or 2 to each. The five categories are: (a) crying, (b) facial expression, (c) trunk posture, (d) leg posture, and (e) motor restlessness.
Abstract

Purpose  The purpose of this study was to describe the strategies used to communicate decisions during surgery and the ways in which this dialog creates or compromises the situational awareness of all involved.

Background  Providers in the operating room (OR) develop situational awareness by knowing “where have we come from, where are we now, and where are we going?” Teams who function in dynamic environments such as the OR require a shared situational awareness, which helps all members focus on the “big picture.” Shared situational awareness requires communication through dialog, contributes to effective teamwork, and clinical decision-making.

Methodology  During this study, 143 Australian metropolitan surgeons, physician anesthetists, nurses, and ancillary staff were observed or interviewed regarding their dialog and decision making in the OR. Data were examined for patterns and themes using established qualitative research methods.

Result  Providers used distributed (explicit) dialog in order to build shared situational awareness and coordinate clinical decision-making. Three features of decision-making dialog emerged as recurring themes. These were synchronizing/strategizing, sharing local knowledge, and prioritizing contingencies.

Synchronizing/strategizing allowed providers to time tasks appropriately based on cues provided by other team members. An example of synchronizing/strategizing occurred when a surgeon announced publicly that he was going to talk himself through the next step of the procedure. Synchronizing/strategizing can also occur in response to more subtle cues, such as when scrub nurses anticipated the need for an instrument before it was requested because they overheard dialog not necessarily addressed to them.

Sharing local knowledge included providers’ understanding of the patient condition, the procedure, each other’s capabilities, and equipment. The degree to which knowledge is shared among the providers influenced their dialog with each other. An example of shared knowledge occurred during a cardiac procedure, during which the anesthetist described the care as regimented, consisting of one way of doing things. Since all participants knew the cardiac regime, only subtle differences in decision-making needed to be discussed, in contrast to more involved dialog required during general cases. Provider experience plays an obvious role with shared local knowledge. Providers with great levels of
experience can help maintain a smooth work flow for the entire team.

Prioritizing contingencies takes place during times of urgency or emergency when the team must respond to unpredicted situations. Dialog among providers is needed to communicate changes in the plan of care. An example of prioritizing contingencies occurred when the anesthetist communicated information of the patient’s deteriorating condition. The surgeon confirmed understanding of this dialog and decided to abandon his original surgical plan and instead focus on patient stabilization and incision closure.

**Conclusion** Decision making in the OR can benefit from communication strategies to improve situational awareness. Dialog among providers that is distributed, that is to say explicitly and openly spoken, helps establish a shared perspective of the big picture that promotes cohesive patient care.

**Comment** It is tempting to view OR events in separate silos based on provider roles. Anesthesia decisions seem separate from surgical decisions which are separate from decisions made by surgical nurses. Providers who operate in silos may block out important information that should influence their decision making. Maintaining a sense of situational awareness promotes cohesive patient centered care delivered by coordinated teams of providers. Building a cohesive shared awareness requires effective communication through explicit dialog among providers.

Communication may seem like something that is just “common sense,” making it an unusual subject for a research study. The ability to communicate well may seem to just come naturally. But the reality is that some of us do struggle to be understood and any of us can be less understood than we realize. Communication is a skill that can benefit from focused practice similar to efforts to improve IV starts or peripheral block placement. Studies such as this provide us with increased understanding about the individual components of OR dialog. We can use this increased understanding to improve our own communication skills as well as mentor the skills of nurse anesthesia students and new graduates.

This study gives us information about how we talk in the OR and what we talk about. While Australian ORs do not have providers equivalent to CRNAs, the fundamental elements of OR communications are similar. Our scientific understanding of OR teamwork is still in the early stages, and efforts have focused mostly on crisis management and error prevention. A nice feature of this study is that data were collected during routine procedures; adding to our understanding of ordinary dialog and decision-making.

The clinical examples included in this article illustrate different ways we talk in the OR. Providers sometimes talk out loud, in a sort of free association way, to share their thinking with others. Sometimes providers overhear dialog not necessarily addressed to them, but which nonetheless helps them in their own decision making. Other dialog is specifically aimed to deliver a
particular message, and is completed by the other provider explicitly acknowledging their receipt and understanding. Each one of these types of dialog is a specific strategy we can make use of in our communication and decision-making.

This article identified three types of things we talk about in the OR. We use dialog as a guide to synchronizing/strategizing our decisions. We use dialog to share knowledge among providers. Our dialog also helps us prioritize contingencies, especially when events occur differently than we planned. CRNAs are skilled at multitasking and are used to doing all of these things simultaneously. As CRNAs, our dialog to build a shared situational awareness will not only increase the quality of our own decision-making, it will also help other providers improve theirs.

**Cassandra Taylor, DNP, DMP, CRNA, CNE**