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Safety Implications of the Boyle-Davis Mouth Gag and Tracheal Tube Position in Tonsillectomy

Br J Anaesth 2010;105:863-866
Fennessy BG, O’Connor R, Cronin M, Fenton JE, Hughes JP

Abstract

Purpose The purpose of this study was to evaluate the endotracheal tube location after the opening and closing of the Boyle-Davis mouth gag in patients undergoing a tonsillectomy.

Background Tonsillectomy is one of the most common pediatric procedures performed. The surgical technique, utilizing a mouth gag to allow opening of the mouth, positioning of the tongue, and delivery of anesthetic gases via an endotracheal tube, has changed little over the last ninety years. Use of the Boyle-Davis mouth gag allows for good visualization of the surgical area, but is not devoid of complications, such as dental trauma or displacement of the tracheal tube. Dental trauma occurs more frequently when a loose tooth is present. The effect of the mouth gag on the position of the tracheal tube is unknown.

Methodology During a 3 month timeframe, 25 patients undergoing tonsillectomy, with and without adenoidectomy, were eligible for inclusion in this study. Those excluded refused consent, had an emergency procedure, were an ASA III or IV, had a craniofacial anatomic abnormality, or experienced difficult bronchoscopy. All patients were induced with remifentanil and propofol, and intubated with an appropriately sized oral RAE endotracheal tube (ETT). Adults received cuffed and pediatric patients received uncuffed tubes. Auscultation of bilateral breath sounds and capnograph waveform were used to confirm correct placement of the ETT prior to securing it in the midline position with the mouth gag. After the surgical procedure, with the patient’s neck in the neutral position, a 4 mm (adult) or 3 mm (pediatric) fiberoptic bronchoscope was inserted through the ETT to the level of the carina. With the tip at the carina, the scope was marked at the proximal end of the ETT. The Boyle-Davis mouth gag was then opened to allow visualization of the posterior pharynx. The tip of the bronchoscope was repositioned at the level of the carina and remarked at the proximal end of the ETT. The length between the two marks was recorded. The bronchoscope was removed, the patient reconnected to ventilation, and allowed to emerge from anesthesia.

Result Although 25 patients were identified as eligible, two were excluded due to malpositioning of the ETT against the mucosa and inability to pass the 3 mm scope through a small ETT. Patients ranged in age from three to 57 years old with a mean age of 16.4 years. Patients under age 13 received non-cuffed ETT (10 of 25, 40%). Opening the Boyle-Davis mouth gag resulted in displacement of the ETT in 96% of patients. ETT movement was toward the carina in 78% of patients.
Opening the Boyle-Davis mouth gag resulted in cephalad displacement in 17% of patients (4 of 23). The mean distance of movement was 9.5 mm (0.95 cm) (range -1 to +2.7 cm). The mean distance of displacement was found to be statistically very significant \( P < 0.001 \). The ETT was more likely to be displaced if it was cuffed.

**Conclusion**  Manipulation of the Boyle-Davis mouth gag in adult and pediatric patients undergoing tonsillectomy caused displacement of the ETT in 22 out of 23 patients. The direction of displacement was not consistent. To explain the correlation between cuffed ETT and displacement, the suggestion was made that lubricating gel on the cuff might have negated the stabilizing effect. Age of the patient was not a strong indicator of the extent of movement. The authors warn of potential complications that might result from the ETT repositioning caused by the Boyle-Davis mouth gag ranging from endobronchial intubation to extubation. However, none of the patients in this study experienced any complications and the rarity of the complications makes the correlation difficult to make. Finally, the recommendation was made to auscultate breath sounds throughout the tonsillectomy and after manipulation of the Boyle-Davis mouth gag to verify correct position of the ETT.

**Comment**
Fennessy and colleagues attempted to put an objective number to the suspicion that manipulation of the mouth gag used during the tonsillectomy procedure affects the position of the ETT. The interesting and unexpected outcome was the unpredictable direction of the displacement. Because they conducted their study with the patients’ neck in the neutral position, the effect of the neck extension commonly employed by the surgeon was not measured. The predicted superior displacement with extension might practically off-set the caudad movement caused by the Boyle-Davis mouth gag. Conversely, if the Boyle-Davis mouth gag caused cephalad displacement in addition to cephalad movement due to neck extension, the risk of extubation might increase. It would be beneficial to measure the effect of the Boyle-Davis mouth gag as well as the effect of neck extension on the position of the ETT.

Other concerns that I have about the study relate to the methodology. Several variables were not controlled. Intubation was performed by providers of different levels of training. The method of securing the ETT was neither controlled nor recorded. It is unclear if the same surgeon manipulated the Boyle-Davis mouth gag in all patients. It was interesting that the researchers chose to examine the effects of the Boyle-Davis mouth gag on the position of the ETT after the tonsillectomy had been performed. This might not simulate the same conditions for use of the mouth gag. These methodological concerns might not have an impact on the results, but I think the study could be improved. The authors suggest that complications that might occur during tonsillectomy, ranging from accidental extubation; anesthetic gas leakage; tracheal mucosa trauma; aspiration; and endobronchial intubation resulting in pneumothorax, could result from the effect of Boyle-Davis mouth gag on the ETT position. Because no complications
occurred, they could not make this definitive statement at the conclusion.

This study supports the practice of using a precordial stethoscope. The anesthetist should be vigilant to auscultate breath sounds and evaluate ETT position continually to safeguard the patient. Manipulation of the mouth gag during surgery may significantly alter the position of the ETT. This study reminds us that widely accepted techniques utilized in common procedures are not risk free.

Terri M. Cahoon, DNP, CRNA
Abstract

Purpose The aim of this study was to establish whether or not non-cardiac surgical patients with a starting hematocrit of < 30% who received no more than 2 units of red blood cells during surgery were less likely to survive and more likely to experience major complications, compared with those who did not receive any transfusions.

Background Anemia is associated with poor health outcomes and blood transfusion remains the gold standard for treatment of anemia. However, current evidence suggests that blood transfusion often does not improve outcomes and may actually lead to worsened clinical results. To date, however, the evidence has been mostly from retrospective studies performed on patients undergoing cardiac surgery, those in intensive care units, and those with acute coronary syndrome. The impact of red blood cell transfusion on the outcomes of anemic patients undergoing non-cardiac surgery has yet to be established.

Methodology This study was conducted as a retrospective observational analysis using the database of the American College of Surgery National Surgical Quality Program. Records of patients who had non-cardiac surgery between 2005-2007 were systematically selected for analysis. The database from the Quality Program was designed to provide information to member hospitals on 30-day risk-adjusted surgical mortality and complications. The sample identified 19,200 patients who had general, vascular, or orthopedic surgery. Exclusion criteria for this analysis included:

- transfusion of more than 2 units of red blood cells intra-operatively
- transfusion of more than 4 units of red cells post-operatively
- emergency procedures
- baseline hematocrit drawn >14 days prior to surgery
- procedures that did not require anesthesia (local or monitored anesthesia care only)
- patients requiring mechanical ventilation pre-operatively

Recalculating after considering the exclusion variables determined a sample of 10,100 records that could be analyzed. The primary outcome variables, considered to be ‘major complications’ were grouped as follows:

1) 30 day mortality
2) Cardiac (acute MI or cardiac arrest)
3) Pulmonary (pneumonia, ventilatory support >48 h, unplanned intubation)
4) Renal (insufficiency or acute failure)
5) Central nervous system (CVA / coma > 24 h)
6) Sepsis
7) Wound complications (deep incisional site infection, organ or space infection, dehiscence)
8) Thromboembolic (deep vein thrombosis or PE)

Statistical analysis involved the associations between intra-operative blood exposure (1 or 2 packed red cell transfusions), 30-day mortality and the other 7 “major
complications” in those undergoing non-cardiac procedures. The control group included those who did not receive any transfusions intra-operatively. A multivariate logistic regression model was used and backward stepwise selection identified risk factors from the list of potential confounding variables such as: age, gender, surgical complexity, admission source, functional status, wound classification, and co-morbidities. Co-morbidities included CHF, MI, previous cardiac surgery, peripheral vascular disease, COPD, pneumonia, dyspnea, renal disease, coma, hemiplegia, paraplegia, quadriplegias, stroke, hepatobiliary disease, nutritional status and systemic infection.

Results Overall, 21.4% of the sample received a transfusion; this appeared to be a function of the baseline hematocrit. Analyses of the demographic data showed significant differences between those who did and did not receive a transfusion. Characteristics of those transfused included:

- Older
- More likely to be female
- Transferred from another hospital
- Had a dependent functional status
- More likely to have a history of percutaneous coronary intervention
- Had a history of previous heart surgery, kidney failure, or COPD

The 30-day mortality rate for those transfused was 6.44% versus 4.26% for those who were not transfused. The multivariate analysis demonstrated that blood transfusion was associated with an increase risk of death (odds ratio 1.29; 95% CI 1.03-1.62). Those who received a transfusion were more likely to have 4 of the major complications including:

- Pulmonary, sepsis, thrombo-embolic events, and wound. Interesting to note, the interaction between transfusion of red blood cells and cardiac disease was not statistically significant for either mortality or cardiac morbidity; thus, transfusion of red blood cells was not protective in those with cardiovascular disease. The propensity-based analytic technique showed that blood transfusion was marginally associated with higher mortality rates.

Conclusion Blood transfusion of 1-2 units in non-cardiac surgical procedures was associated with an increased risk of 30-day mortality and pulmonary, septic, wound, and thromboembolic complications. The increased risk of mortality and the morbidities associated with transfusion was present after adjusting for patient characteristics, functional status, co-morbidities, and surgical complexity. Those patients who received 1 or 2 units of red blood cells had a 20% increased odds of death and a 40-90% increased odds of pulmonary, sepsis, wound, or thromboembolic complications.

Comment Current guidelines recommend that blood transfusion take place when the hemoglobin concentration is < 6 g/dl and that transfusion be avoided when hemoglobin concentrations are > 10 g/dl. We desperately need more evidence about the risks and benefits of transfusing when hemoglobins fall between 6 and 10 gm/dl. And, as the authors stated, we need additional randomized controlled trials comparing a restrictive intra-operative transfusion strategy to a
liberal one in those undergoing non-cardiac procedures. I strongly concur.

This study had several limitations, which included a lack of a documented transfusion trigger value, the fact that only non-emergent cases were included, lack of information regarding postoperative transfusion (did the non transfusion group receive less than 4 units postoperatively?; did the transfusion group receive less than 4 units post operatively?), and a lack of control of variability in hospital quality and hospital transfusion strategies. Nevertheless, it had an acceptable degree of rigor and provides us with much needed evidence.

Mary Golinski, PhD, CRNA

The odds ratio (OR) is best described as ‘treatment effectiveness’. The ratio is the odds of an event happening in the experimental group expressed as a proportion of the odds of an event happening in the control group. The closer the OR is to ‘1’, the smaller the difference in effect between the experimental group, and the control group. If the OR is greater (or less) than ‘1’, the effects of the treatment are more (or less) than those of the control group. The effects being measured may be adverse, as in this study, or desirable (for example, survival).

The propensity score is becoming a popular technique used by statisticians to address the issues of selection bias (with other confounding variables) commonly seen in observational studies used to estimate treatment effects. The appeal of propensity scoring techniques lies in an intuitive acceptable approach to balance potential confounding variables across treatment and control groups.
Hemodynamic perturbations during robot-assisted laparoscopic radical prostatectomy in 45 degree Trendelenburg position

Lestar M, Gunnarsson L, Lagerstrand L, Wiklund P, Odeberg-Wernerman S

Abstract

Purpose The purpose of this study was to assess the body’s physiologic responses to robotic assisted laparoscopic radical prostatectomy (RALRP) while in steep Trendelenburg position in healthy ASA I and II individuals. “Physiologic response” was defined as changes in central circulation (vital signs and hemodynamic values), gas exchange, ventilation-perfusion distribution, echocardiographic heart dimensions, and mitral flow velocity.

Background It is not uncommon to see cardiovascular and respiratory system alterations during RALRP; these alterations often necessitate pharmacologic interventions to stabilize. The steep Trendelenburg position required (45 degree head down) coupled with the establishment of pneumoperitoneum contributes to undesirable hemodynamic changes. Both healthy patients and those of higher acuity demonstrate significant increases in mean arterial blood pressure, right and left ventricular filling pressures, and pulmonary capillary wedge pressures during pneumoperitoneum and only 20 degrees head down position. Left ventricular filling pressures during steep Trendelenburg position has not been measured during RALRP. Previous trials have focused on right heart filling pressures during moderate Trendelenburg position.

Methodology The study was performed as a prospective analysis, using each patient as their own control. Hemodynamic and physiologic responses were assessed before, during, and after RALRP in 16 ASA I and II males. All surgeries were performed using an intra-peritoneal technique with the intra-abdominal pressure maintained between 11-12 mm Hg. Anesthesia was standardized using a propofol infusion for maintenance (no inhalation agent) Fluid administration was also standardized; all patients received 350-400 mL/hr of crystalloid. Ventilator settings were adjusted to keep EtCO₂ at 32 mm Hg.

Prior to induction of general anesthesia, a radial arterial line was placed and after induction of anesthesia, a pulmonary artery catheter was introduced via the right internal jugular vein. Additionally, a multi-plane transesophageal echocardiograph probe (TEE) was inserted and used to measure right atrial transverse diameter, left ventricular end diastolic volume and end systolic area. At each of the time periods listed, the following measurements were taken: MAP, CVP, MPAP, PCWP, CO, MVO₂, airway pressures, ventilatory volumes, ventilatory compliance, and ventilation/perfusion distribution (see notes)-

• Time 1: following induction and supine position, steady state conditions during
abdominal insufflation (for measurements of ventilation-perfusion), no surgical stimulation

- **Time 2**: five minutes after insufflation of CO₂, supine (pneumoperitoneum established)
- **Time 3**: Trendelenburg position (45 degrees head down) for five minutes
- **Time 4**: Trendelenburg position (45 degrees head down)-measurements repeated after 40 minutes (the only measurement performed during surgery)
- **Time 5**: supine position, conclusion of surgery; deflation of the abdomen -- for the last 8 patients only due to the findings of a 2-3 fold increase in both right and left sided filling pressures

**Results**
There were no peri-operative complications noted and the mean surgical time was 3 hours 4 minutes. All patients had less than a two day hospital length of stay.

**The following findings regarding hemodynamic responses were statistically significant:**

1. Pneumoperitoneum increased MAP by 25% (P < 0.05)
2. Trendelenburg position increased the CVP, MPAP, and PCWP from initial values of 9, 15, and 10 to 21, 30, and 22 mm Hg respectively (P < 0.001)
3. Changes in CVP and PCWP were strongly correlated (r = 0.92, P < 0.001)
4. Pneumoperitoneum increased SVR by 20% (P < 0.05)
5. Left ventricular stroke work index increased by 35% and right ventricular stroke work index increased by 65% in the first Trendelenburg measurement (P < 0.05)

**The following findings regarding ventilation, gas exchange, and ventilation-perfusion distribution were statistically significant:**

1. Peak and mean inspiratory pressures were increased 46% and 28% respectively by pneumoperitoneum (P < 0.001)
2. Pneumoperitoneum and Trendelenburg position resulted in a stepwise decrease in total lung compliance from 60 to 28 mL/cm H₂O (P < 0.001 and P < 0.05)
3. With pneumoperitoneum established, PₐO₂ increased 24% to 146 mm Hg (P < 0.05)
4. E₉CO₂ increased during Trendelenburg position and after surgery end (P < 0.01)

**Conclusion**
Based on the findings of this study, it is not possible to identify specific preoperative patient related risk factors that may lead to poor outcomes. The hypothesis that cardiac output would be significantly decreased during pneumoperitoneum and 45 degree Trendelenburg position was not supported. While heart filling pressures were increased significantly, cardiac performance appeared unaffected in the healthy individuals. This most likely reflected that lower acuity patients had sufficient cardiac reserve and even an ability to increase cardiac contractile force, in order to compensate for the increased pressure work.

**Comment**
We continue to try and understand the effects on the cardiac and respiratory system when subjected to dramatic positioning required for the robotic procedures combined with pneumoperitoneum. This study was conducted on a very small sample of a healthy population, or relatively healthy population,
however, it does add to the body of evidence we are starting to acquire and we absolutely need more of.

We must have a concise and rational method to use when determining who is most appropriate and who can tolerate steep Trendelenburg position combined with moderate insufflation pressures. As aforementioned in other abstracts, if the sophisticated surgical technology is not in harmony with what the body can tolerate and outcomes are poor, we are no farther ahead!

Mary A. Golinski, PhD, CRNA

Notes - The ventilation perfusion ratio is the ratio of the alveolar ventilation to the amount of blood that perfuses the alveoli. For the estimation of the ‘ventilation-perfusion distribution’ in this study, a mixture of 6 inert gases were dissolved in isotonic saline and infused IV at a constant rate of 3 mL/min. After 45 minutes (to establish steady state conditions), both arterial and mixed venous blood gases were obtained and analyzed chromatographically. Retention and excretion ratios were computed and via a 2 step procedure the solubility of each inert gas was determined. Following this, the ventilation perfusion ratio was estimated and the overall ventilation perfusion mismatch, as well as any existing shunt regions and dead space areas were calculated.

The transient increase in PaO2 during pneumoperitoneum probably reflected an improvement of the ventilation/perfusion mismatch caused by the general anesthesia.

Editor’s Note: Previous research has shown that end tidal CO2 does not accurately represent arterial CO2 during prolonged laparoscopic surgery in Trendelenburg position. The disconnect between arterial CO2 and end tidal CO2 becomes greater the longer the duration of the case. For more details see, “LAPAROSCOPIC COLON SURGERY: UNRELIABILITY OF END-TIDAL CO2 MONITORING,” in the August 2008 issue of Anesthesia Abstracts.
Obstetric Anesthesia

**Anesthesia complications during scheduled cesarean delivery for morbidly obese women**

Am J Obstet Gynecol 2010;203:276.e1-e5
Vricella LK, Louis JM, Mercer BM, Bolden N

**Abstract**

**Purpose** The purpose of this study was to determine the incidence of anesthesia complications in morbidly obese women undergoing elective cesarean delivery.

**Background** The incidence of morbid obesity in parturients is reported to be 8%. Morbid obesity is associated with complications during pregnancy and cesarean delivery. Obesity has been reported to increase the difficulty of regional anesthesia placement in parturients undergoing cesarean delivery. Regional anesthesia is reported to be more difficult in obese parturients and there is an increased rate of conversion to general anesthesia during cesarean delivery. Furthermore, there is an increased risk of death when morbidly obese women undergo general anesthesia for cesarean delivery. However, the incidence of complications after regional anesthesia in morbidly obese parturients is not known.

**Methodology** This was a retrospective cohort study comparing the incidence of complications in 141 morbidly obese (BMI ≥40 kg/m²), 251 overweight and obese (BMI 25-39 kg/m²), and 185 normal-weight (BMI <25 kg/m²) parturients undergoing elective cesarean delivery. Parturients were excluded if they were less than 37 weeks gestation, presenting with multiple gestations, active contractions, ruptured membranes, or contraindication to regional anesthesia. Medical records were reviewed by the principal investigator and data were recorded from patients who underwent an initial attempt at regional anesthesia (spinal, epidural or combined spinal-epidural). Recorded data included current and pre-pregnancy BMI, ethnicity, insurance status, age, number of prior cesarean deliveries, ASA status, and comorbidities. Anesthesia data included type of regional anesthetic, number of placement attempts, procedure times for anesthesia and surgery, and anesthesia complications.

The primary outcome was a composite of anesthesia complications defined as the presence of ≥1 of the following:

- failed regional anesthesia requiring general anesthesia
- insufficient duration of regional anesthesia
- requiring supplemental analgesics or general anesthesia
- complicated regional anesthesia
- profound intraoperative hypotension
- cephalad spread of spinal block resulting in intubation
- postdural puncture headache
- neurological or serious complications related to neuraxial anesthesia

Profound hypotension was defined as ≥3 BPs recorded <80 mm Hg systolic or 50 mm Hg diastolic requiring intensive volume resuscitation, pressure support, and prolonged monitoring. Complicated
regional anesthesia was defined as cases requiring > 3 attempts at placement. The secondary outcomes were number of attempts at placement of the neuraxial technique and frequency of requiring supplemental intravenous analgesics. All spinal anesthetics were placed in the sitting position and 12-15 mg of 0.75% bupivacaine with 0.2-0.25 mg intrathecal preservative free morphine was injected at the L2-3 or L3-4 interspace.

Descriptive and inferential statistics were used to analyze the results. Multivariable logistic regression was used to predict the presence or absence of regional anesthesia complications. Power analysis determined that 136 parturients would be needed in either group. A P value < 0.05 was considered significant.

**Result** No significant differences were noted in age and number of prior cesarean deliveries. Morbidly obese parturients were more likely to be African American (51.7%), have government insurance (75.5%), have a higher pre-pregnancy BMI, and significantly more comorbidities when compared to the other two groups (P < 0.05) (Table 1). A larger percentage of morbidly obese parturients required >3 regional anesthesia attempts when compared to normal weight parturients (Figure 1). General anesthesia was more common in the morbidly obese group compared to the two other groups (P < 0.05). Similarly, anesthesia and surgical times were also significantly longer in the morbidly obese group (P < 0.0001).

The only anesthesia complications occurred in the morbidly obese group (Figure 2). No serious complications such as epidural abscess, aspiration, failed intubation, neurologic sequelae, or cardiac arrest occurred in any parturient. The overall rate of anesthesia complications was 8.5% in the morbidly obese group. Use of supplemental ketamine was similar between the three groups (morbid obese group: 12% vs. obese/overweight: 10.4% vs. normal weight: 5.4%; P = 0.08).

Logistic regression determined that pre-pregnancy BMI >40 kg/m² (positive likelihood ratio: 4.0) and current BMI >45 kg/m² (positive likelihood ratio: 4.1) were the most predictive of composite anesthesia complications related to regional anesthesia attempts (P < 0.05).

**Conclusion** Regional anesthesia was more difficult and complications more common in morbidly obese parturients presenting for elective cesarean delivery. Morbidly obese parturients should be counseled about these potential complications when presenting for cesarean delivery.

**Comment** Morbidly obese parturients are some of the most challenging patients to administer anesthesia to. Additionally, they are at an increased risk for obstetric and anesthesia complications. Furthermore, these patients present with significantly more comorbidities such as chronic hypertension, preeclampsia, and diabetes which can impact the anesthetic plan. The results of this study are not surprising to me and I suspect many of our readers have taken care of
morbidly obese patients who have experienced these complications. It is more difficult to place neuraxial anesthetics in this population, and they are more prone to aortocaval compression and cephalad spread of neuraxial anesthesia due to an interaction between excess weight and physiologic changes of pregnancy.

So how can readers apply these results to practice? They help in tailoring the anesthetic plan and anticipating potential complications. If you think it will require multiple attempts to place the spinal or epidural I would recommend performing a preprocedural ultrasound exam and identify the ideal insertion point and depth to the epidural space. Recent research suggests this technique may improve success in obese and normal weight parturients.\textsuperscript{1-4}

Additionally, I would ensure to administer an adequate fluid bolus to minimize hypotension after placement of the spinal anesthetic and ensure left uterine displacement. Anesthesia providers may want to consider the following:

**Table 1. Baseline Demographics and Outcomes**

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Morbid Obese n = 142</th>
<th>Overweight &amp; Obese n = 251</th>
<th>Normal Weight n = 285</th>
<th>MO vs. O P value</th>
<th>MO vs. NI P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>African American</td>
<td>51.7%</td>
<td>40.1%</td>
<td>18.6%</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Caucasian</td>
<td>38.5%</td>
<td>43.2%</td>
<td>54.1%</td>
<td>0.02</td>
<td>0.005</td>
</tr>
<tr>
<td>Hispanic</td>
<td>9.1%</td>
<td>13.9%</td>
<td>20.8%</td>
<td>0.008</td>
<td>0.004</td>
</tr>
<tr>
<td>Other</td>
<td>0.7%</td>
<td>0.8%</td>
<td>5.5%</td>
<td>0.002</td>
<td>0.03</td>
</tr>
</tbody>
</table>

**Insurance**

<table>
<thead>
<tr>
<th></th>
<th>Morbid Obese n = 142</th>
<th>Overweight &amp; Obese n = 251</th>
<th>Normal Weight n = 285</th>
<th>MO vs. O P value</th>
<th>MO vs. NI P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government</td>
<td>75.5%</td>
<td>71.8%</td>
<td>56.3%</td>
<td>0.002</td>
<td>0.003</td>
</tr>
<tr>
<td>Commercial</td>
<td>14%</td>
<td>24.6%</td>
<td>31.7%</td>
<td>0.001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>None</td>
<td>11.2%</td>
<td>3.2%</td>
<td>10.9%</td>
<td>0.002</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Pre-Pregnancy, BMI**

<table>
<thead>
<tr>
<th></th>
<th>Morbid Obese n = 142</th>
<th>Overweight &amp; Obese n = 251</th>
<th>Normal Weight n = 285</th>
<th>MO vs. O P value</th>
<th>MO vs. NI P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Pregnancy, BMI</td>
<td>46.8 ± 6.87</td>
<td>31.8 ± 4.53</td>
<td>22 ± 1.92</td>
<td>0.03</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

**Comorbidities**

<table>
<thead>
<tr>
<th></th>
<th>Morbid Obese n = 142</th>
<th>Overweight &amp; Obese n = 251</th>
<th>Normal Weight n = 285</th>
<th>MO vs. O P value</th>
<th>MO vs. NI P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic HTN</td>
<td>28.7%</td>
<td>9.5%</td>
<td>1.6%</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Preeclampsia</td>
<td>7.7%</td>
<td>4.4%</td>
<td>0</td>
<td>0.001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Diabetes</td>
<td>21%</td>
<td>14%</td>
<td>6.6%</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Asthma</td>
<td>24.5%</td>
<td>16.7%</td>
<td>8.7%</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>OSA</td>
<td>6.3%</td>
<td>1.2%</td>
<td>0</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

**Anesthesia Type**

<table>
<thead>
<tr>
<th></th>
<th>Morbid Obese n = 142</th>
<th>Overweight &amp; Obese n = 251</th>
<th>Normal Weight n = 285</th>
<th>MO vs. O P value</th>
<th>MO vs. NI P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinal</td>
<td>85.2%</td>
<td>92.4%</td>
<td>91.9%</td>
<td>0.02</td>
<td>0.07</td>
</tr>
<tr>
<td>Epidural</td>
<td>3.5%</td>
<td>0.8%</td>
<td>3.2%</td>
<td>0.03</td>
<td>1.0</td>
</tr>
<tr>
<td>CSE</td>
<td>11.3%</td>
<td>6.8%</td>
<td>4.9%</td>
<td>0.13</td>
<td>0.04</td>
</tr>
<tr>
<td>General</td>
<td>6.4%</td>
<td>0</td>
<td>0</td>
<td>0.006</td>
<td>0.02</td>
</tr>
</tbody>
</table>

**Procedure Time, min**

<table>
<thead>
<tr>
<th></th>
<th>Morbid Obese n = 142</th>
<th>Overweight &amp; Obese n = 251</th>
<th>Normal Weight n = 285</th>
<th>MO vs. O P value</th>
<th>MO vs. NI P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anesthesia</td>
<td>132 ± 45</td>
<td>106 ± 27</td>
<td>94 ± 23</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Surgery</td>
<td>79 ± 39</td>
<td>62 ± 23</td>
<td>53 ± 20</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

**Anesthesia Complications**

<table>
<thead>
<tr>
<th></th>
<th>Morbid Obese n = 142</th>
<th>Overweight &amp; Obese n = 251</th>
<th>Normal Weight n = 285</th>
<th>MO vs. O P value</th>
<th>MO vs. NI P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anesthesia</td>
<td>8.5%</td>
<td>0</td>
<td>0</td>
<td>0.0001</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Note: MO = morbid obesity; O = overweight and obese; NI = normal weight.
Figure 1. Regional Anesthesia Placement Attempts

Note. MO = morbidly obese; O = obese or overweight; NI = normal weight

Figure 2. Type of Regional Anesthesia Complications in Morbidly Obese Patients

Note. MO = morbidly obese; O = obese or overweight; NI = normal weight
to reduce the spinal dosage and consider placing a combined-spinal epidural. A CSE has the advantage of allowing additional bolusing of local anesthetics if the level is too low or the surgery outlasts the spinal anesthetic. As was demonstrated in this study the surgical duration was significantly longer in the morbidly obese group when compared to the other two groups. Not surprisingly, the morbidly obese group had a higher rate of CSE placement compared to the other two groups. I suspect the anesthesia providers suspected the surgery might take longer and decided to place a CSE because of this possibility.

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.
Survey study of anesthesiologists’ and surgeons’ ordering of unnecessary preoperative laboratory tests


Abstract

Purpose The purpose of this study was to describe the factors influencing surgeons’ and anesthesiologists’ ordering of unnecessary preoperative laboratory tests and consultations.

Background Physicians have reported that much of the testing they order as part of routine preoperative assessment is not necessary. In order to address the issue of appropriate preoperative testing, the authors’ institution gave sole responsibility for preparing patients for surgery to the Department of Anesthesiology. Decisions were guided by institutional guidelines developed by a committee of anesthesiologists and surgeons. The number of preoperative tests ordered decreased after this implementation, but an internal analysis revealed that many ordered tests were considered “unnecessary” according to the guidelines. This article reported the results of a nationwide survey that was done as a follow up to the institutional internal analysis.

Methodology The mailed survey consisted of four clinical scenarios from general surgery, gynecology, orthopedics, and otolaryngology. Scenarios involved increasingly complex medical histories. Respondents were given a list of a wide range of possible preoperative tests or consultations, and asked to choose which they would order for the patient in the scenario. They were also asked questions regarding factors that influenced them to order a particular test. Factors addressed were:

- another physician might want the test
- patient’s ability to pay
- patient’s described condition
- patient’s insurance status
- nature of the procedure
- institutional policy
- result likely to affect management
- medical-legal considerations
- patient’s age

The physicians chosen to receive this survey were selected randomly from membership lists of the American Society of Anesthesiologists and the American College of Surgeons. All four scenarios were sent to a random sample of 400 anesthesiologists and an additional 20 anesthesiologist directors in academic medical centers. Each of the scenarios was sent to a random sample of 400 physicians whose specialization shared that of the scenario. A test was categorized as unnecessary if the responses from the anesthesiologist directors unanimously considered it unnecessary for the given scenario. The responses from the other specialty groups were compared to the responses from the anesthesiologist test group.

Result Seventeen of the 20 anesthesiologist directors responded to the survey. The anesthesiologist directors unanimously agreed that 36 of the 72 possible tests or consultations were unnecessary. They did not
unanimously agree that any of the tests were necessary in any of the scenarios. Response rates for all other groups were less than 50%.

Among the anesthesiologist test group, 54% did not order an unnecessary test. The anesthesiologists of the test group were less likely than other specialties to order unnecessary tests:

- 53% less than gynecologists
- 64% less than general surgeons
- 66% less than otolaryngologists
- 67% less than orthopedists.

None of the factors that might influence the decision to order a particular test was found to be statistically significant in the sample. Anesthesiologists trained after 1979 were 48% less likely to order an unnecessary test than those trained earlier.

**Conclusion**  Anesthesiologists in this sample consistently ordered fewer unnecessary tests, as defined in this study. These results support the value of anesthesiologists in making decisions regarding preoperative testing of patients. Encouraging anesthesiologists to become engaged in their institutional policies can help reduce the costs of unnecessary care. However, departments should be aware of the potential for differences as to what constitutes an unnecessary test, based on generational differences.

**Comment**

The issue of appropriate preoperative testing is a significant one. Over-testing is a waste of resources, while under-testing is a threat to patient safety. This descriptive survey provides some preliminary information about the tests that physicians order preoperatively. The use of a randomized national sample is a strength of this study. Their finding that none of the popularly proposed reasons for over-testing emerged as a clear motivator is interesting.

These authors made an underlying assumption that was not identified in their article. They assumed that anesthesia directors of academic medical centers were a source authority as to what preoperative tests are indicated, and which are not. While it is reasonable that such a group would be well versed in this decision making, the agreement among the group was less than robust. They unanimously agreed only half of the time that a test was unnecessary, and there were no episodes of unanimous agreement on the necessity of any of the tests. One would think that if there is good empirical evidence upon which these decisions are based that the agreement among practitioners with current academic standing would have been more impressive. The results that the anesthesiologist test group were less likely to order unnecessary tests than other specialties may be a reflection that anesthesiologists agree with each other, rather than a demonstration that anesthesiologists make better decisions about preoperative testing. It is not clear if they agree with one another because of traditional beliefs held in common, or based upon research evidence.

Reducing or eliminating unnecessary preoperative testing is an important issue that requires more thought. Determining what tests are “necessary” is not an easy task, especially when specific patient circumstances are taken into consideration. In fact, it may be that we can only reasonably achieve the most
general guidelines about what tests are needed. It may be that the only way to totally eliminate all unnecessary preoperative testing is to also eliminate a significant number of necessary tests in the process; a situation that would almost certainly result in patient harm. Perhaps, at least for now, our best course is to have a reason for each test ordered. (Guidelines can result in ordering unnecessary tests just as easily as individual decisions. Witness the fact that there was so little agreement in this survey about what tests were appropriate.) The psychological literature teaches us that there is a legitimate place for both empiric evidence and intuition / experience in our decision making processes. As our body of knowledge grows we should carefully apply the principles of evidence based practice as well as our clinical experience to preoperative testing decisions. In this way we can develop informed best practice guidelines for preoperative testing and consultation.

Cassandra Taylor, DNP, DMP, CRNA, CNE
Low-dose, low-concentration levobupivacaine plus fentanyl selective spinal anesthesia for knee arthroscopy: A dose finding study

Anesth Analg 2011;112:477-80
De Santiago J, Santos-Yglesias J, Giron J, Jimenez A, Errando CL

Abstract

Purpose The purpose of this study was to determine which of three low-dose, low-concentration doses of levobupivacaine-fentanyl solutions had the shortest time to ambulation and highest PACU bypass rate.

Background Prolonged motor blockade after spinal anesthesia for ambulatory surgery is a common cause of delayed discharge. Recent research suggests that low-dose, low concentration selective spinal anesthesia minimizes motor blockade and preserves proprioception (joint position sense). However, this technique has not been evaluated in patients undergoing knee arthroscopy.

Methodology This was a prospective, randomized, double-blind study of 90 ASA I and II patients undergoing outpatient knee arthroscopy. Patients were excluded if they had a preexisting neurologic deficit, diabetes, BMI > 38 kg/m², height < 150 cm or > 185 cm, and any contraindication to spinal anesthesia. Patients were randomized into one of three groups: (1) 5 mg (1 mL) levobupivacaine 0.5% with 10 mcg fentanyl; (2) 4 mg (0.8 mL) levobupivacaine 0.5% with 10 mcg fentanyl; (3) 3 mg (0.6 mL) levobupivacaine 0.5% with 10 mcg fentanyl. All solutions were hypobaric and prepared to a total volume of 3 mL. All spinal anesthetics were performed in the sitting position. After placement patients remained sitting for 2 minutes then were positioned supine with the table elevated to 20-30 degrees. Time to surgical block was recorded as the time from completion of the spinal until a T-12 sensory level. Adequate analgesia was defined as no complaints of pain when testing the knee and thigh with a toothed forceps. Sensory block (tested with sensation to cold) was evaluated at 2, 4, 6, 10 and 15 minutes, then every 15 minutes until discharge home. A propofol infusion (2 mg/kg/hr) was used to provide sedation. Fentanyl was titrated for complaints of pain. General anesthesia was administered for inadequate analgesia or failed spinal anesthesia. Failed spinal anesthesia was defined as a sensory block < T-12 or need for general anesthesia.

The primary outcome was time to ambulation, defined as the time from spinal injection to unassisted ambulation. Secondary outcomes included degree of motor block, incidence of abnormal proprioception, number of patients bypassing the PACU, and time to discharge. Motor block was evaluated with a modified Bromage scale. A Romberg test was used to evaluate proprioception. Time to discharge, was defined as time from spinal injection to discharge home with PACU score ≥ 9.
Sample size calculations determined 30 subjects would be needed in each group. Descriptive and inferential statistics were used to analyze the results. A P <0.05 was considered significant.

**Result** A total of 60 subjects completed the study. Shortly after starting the study two of four patients in the 3 mg had failed spinal anesthetics because of inadequate anesthesia. Therefore, the 3 mg group was eliminated and a new randomization sequence was completed for the remaining patients.

No significant differences were noted in baseline demographics or surgical duration between the groups. The majority of subjects in both groups were men, with an approximate age of 43 years and a BMI of 26.5 kg/m². Average surgical duration was 34 ± 11.5 minutes. Median sensory dermatome level was T-4 in both groups (5 mg Group: T6-T3 vs. 4 mg Group: T6-T4; P = 0.53). The time to surgical block was 4 ± 1 minutes in both groups (P = 0.92). Surgical conditions were good in both groups (P = ns). Sensory dermatome levels took significantly longer to recede in the 5 mg group when compared to the 4 mg group (Table 1). Two patients (6.7%) in the 4 mg group required fentanyl intraoperatively compared to no patients in the 5 mg group (P = 0.49). Time to ambulation and time to discharge home were significantly less in 4 mg group (Figure 1). After completion of the surgery, significantly more patients in the 4 mg group bypassed the PACU, had no motor block or abnormal proprioception, and could ambulate unassisted (Figure 2).

| Table 1. Comparison of Sensory Dermatome Levels after Levobupivacaine Spinal Anesthesia |
|---------------------------------|-----------------|-----------------|-----------------|
|                                | 5 mg (n = 30)   | 4 mg (n = 30)   | P Value         |
| 30 min                         | T-4             | T-4             | not significant |
| 45 min                         | T-5             | T-6             | < 0.001         |
| 60 min                         | T-6             | T-8             | < 0.001         |
| 75 min                         | T-8             | T-11            | < 0.003         |
| 90 min                         | T-11            | L-2             | < 0.001         |
| 120 min                        | L-2             | S-2             | 0.004           |

**Conclusion** Four milligrams of levobupivacaine with 10 mcg fentanyl provided adequate surgical anesthesia and had the shortest time to ambulation and highest PACU bypass rate.

**Comment** The administration of spinal anesthesia for outpatient procedures such as knee arthroscopy is becoming less common. There are multiple reasons for this; patients misperception or fears of spinal anesthesia, perceived anesthesia delays to place the spinal anesthetic, surgeon or anesthesia provider preference for general anesthesia, prolonged motor blockade, urinary retention, and transient neurologic symptoms. Hyperbaric 5% lidocaine has a fast onset of spinal anesthesia with a favorable recovery profile; however, concerns over transient neurologic symptoms (TNS) caused it to fall out of favor with anesthesia providers. 1,2 In recent years prilocaine3,4 and preservative free chloroprocaine5 have been purported to be alternatives to 5% lidocaine and bupivacaine because of their short duration of action and lower incidence of TNS when compared to 5% lidocaine.2 In this
Figure 1. Time to Ambulation & Discharge by Group

![Graph showing time to ambulation and discharge by group.](image)

* Time to ambulation
** Time to discharge

* P = 0.006
** P < 0.001

Note: Values are median (min, max)

Figure 2. Postoperative Outcomes after Surgery

![Graph showing postoperative outcomes after surgery.](image)

- Bypassed PACU
- No motor block
- Abnormal proprioception
- Unassisted ambulation

P < 0.001 for all outcomes
study the investigators evaluated a low-dose, low concentration mixture of hypobaric levobupivacaine with fentanyl for knee arthroscopy. They demonstrated that a dose of 4 mg with 10 mcg fentanyl provided rapid surgical anesthesia (4 minutes) with a favorable recovery profile (90 minutes to discharge ready) for knee arthroscopy that averaged less than 45 minutes from time of spinal injection. Eighty percent of the patients who received the 4 mg dose bypassed the PACU. These are encouraging results. I would be interested in trying this dosing strategy for patients who request spinal anesthesia for a diagnostic knee arthroscopy scheduled for less than 45 minutes.

What I found interesting was that recovery times were significantly longer on all outcomes with only a 1 mg increase in levobupivacaine. Furthermore, a majority of patients still had a significant spinal block at the end of the surgery. Looking at their data it appears that it took over 90 minutes for patients in the 5 mg levobupivacaine dose to drop below a T-11 level compared to 75 minutes in the 4 mg group. Anesthesia providers should consider these times and adjust the dose according to the proposed duration of anesthesia if they choose to use a low-dose, low-concentration technique. However, given levobupivacaine is an S-enantiomer of bupivacaine with similar onset and duration of action as bupivacaine, providers may be able to use a similar low-dose, low concentration technique with bupivacaine.

It is important to point out that the knee arthroscopies were on average 33 minutes in duration. Therefore, if I suspected the surgeon was going to take longer than 45 minutes to do a knee scope I would probably increase the dose to 5 mg. With this dose most patients could be discharged home within 2.5 to 3 hours.

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.
PERIOPERATIVE NERVE INJURY AFTER TOTAL KNEE ARTHROPLASTY: REGIONAL ANESTHESIA RISK DURING A 20-YEAR COHORT STUDY

Anesthesiology 2010;114:311-7
Jacob AK, Mantilla CB, Sviggum HP, Schroeder DR, Pagnano MW, Hebl JR

Abstract

Purpose This single institution, large cohort study sought to determine if the risk of peripheral nerve injury after total knee arthroplasty (TKA) differed by regional anesthetic technique.

Background The incidence of peripheral nerve injury after TKA is approximately 10%. Regional anesthesia techniques are frequently used to provide intraoperative and postoperative analgesia after TKA. However, their use may increase the risk of peripheral nerve injury. The incidence of peripheral nerve injury after regional anesthesia ranges from 0.03-1.5%, with peripheral nerve block techniques having a higher incidence than central neuraxial blockade.

Methodology This was a retrospective study of all patients over the age of 18 who underwent TKA at a single institution from January 1988 to July 2007. Patients were excluded if they underwent a staged bilateral procedure during the same admission, or if they had a preexisting sensory or motor deficit. Demographic data, side of surgery (left, right, bilateral), surgeon, total tourniquet time, and type of surgery (primary or revision) were recorded. Anesthetic technique was classified as (1) general anesthesia, (2) neuraxial anesthesia (spinal or epidural), or (3) combined spinal/epidural. If a supplemental peripheral nerve block was utilized, the type of block was recorded. The primary outcome was the presence of new peripheral nerve injury within 3 months of surgery. Multivariable logistic regression was used to evaluate risk factors for peripheral nerve injury.

Result A total of 12,329 patients were included in the analysis. The average age was 69 ± 10 yr, with 56% of the patients being women. Most procedures were unilateral TKA (69.7%), followed by 15.5% unilateral revisions and 14.8% bilateral revisions. Neuraxial anesthesia was the most common technique (45%), followed by general anesthesia (44%) and combined neuraxial/general anesthesia in 8% of patients. Approximately one-third (31%) received a peripheral nerve block for postoperative analgesia.

The overall incidence of peripheral nerve injury was 0.79% (95% CI, 0.64-0.96%). A total of 97 cases of peripheral nerve injury were identified. The use of peripheral nerve blocks significantly increased from a low of 0.2% in the years 1993-1997 to a high of 82.5% in the years 2003-2007 (P <0.0001). However, the incidence of peripheral nerve injury did not change over time (P = 0.36). The incidence of peripheral nerve injury was significantly higher after bilateral procedures (1.7%; 95% CI, 1.15-2.41%) when compared to unilateral primary (0.65%; 95%
CI, 0.49-0.85%) and unilateral revision (0.52%; 95% CI, 0.25-0.96%), respectively (Table 1).

Table 1. Incidence and Characteristics of Peripheral Nerve Injury

<table>
<thead>
<tr>
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<th>Unilateral Primary n = 8590</th>
<th>Unilateral Revision n = 1911</th>
<th>Bilateral Procedure n = 1829</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNI</td>
<td>0.65%</td>
<td>0.52%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Age</td>
<td>18-49</td>
<td>1.9%</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>50-59</td>
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<tr>
<td></td>
<td>60-69</td>
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</tr>
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<td></td>
<td>70-79</td>
<td>0.38%</td>
<td>0.53%</td>
</tr>
<tr>
<td></td>
<td>≥80</td>
<td>0.28%</td>
<td>0.41%</td>
</tr>
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<td>Anesthesia</td>
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<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td>Yes</td>
<td>0.66%</td>
<td>0.18%</td>
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</tbody>
</table>

Notes: PNI = Peripheral Nerve Injury, PNB = Peripheral Nerve Block

Significant risk factors for peripheral nerve injury after TKA included age, type of surgery, and total tourniquet time. For every 10 year decrease in age the odds of a peripheral nerve injury was 0.70 times less (95% CI, 0.59-0.83%, P <0.001). For every 30 minute increase in tourniquet time the odds of a peripheral nerve injury was 1.28 times greater (95% CI, 1.09-1.50, P = 0.003). Patients who had a bilateral TKA were 2.14 times more likely to develop a peripheral nerve injury (95% CI, 1.33-3.44, P = 0.002). Gender, type of anesthesia, and use of a peripheral nerve block were not associated with development of a peripheral nerve injury.

A majority of the cases of peripheral nerve injury were sensorimotor deficits (75%). A majority of patients had complete recovery (62%), 36% had partial recovery, and 2% had no improvement in their neurological deficits 2.5 years after surgery. In 21% of patients (n=20) more than 1 year was needed to achieve maximal neurologic recovery. Patients with an isolated sensory deficit recovered faster than those with a sensorimotor deficit (73% vs. 57%, P < 0.0001).

Twenty-five patients who had a peripheral nerve block developed a peripheral nerve injury (Table 1). In a little more than a quarter (28%) the peripheral nerve injury was in the same nerve distribution as the peripheral nerve block. Forty percent (40%) had peripheral nerve injury in a distribution that may have been related to the nerve block, and 32% of patients had a neurological deficit in a distribution unrelated to the nerve block. Nineteen (76%) patients developed sensorimotor deficits and 6 (24%) developed sensory deficits only. The odds of complete neurological recovery was significantly less in those that had a peripheral nerve block (OR, 0.37; 95% CI, 0.15-0.94, P = 0.03). Six months after surgery, 25% had complete recovery and at 12 months eight more had maximal neurologic recovery (total 72%). Two patients required more than a year to achieve maximal neurologic recovery, however neither had complete recovery.

Conclusion  The use of regional anesthesia does not increase the risk of peripheral nerve injury after TKA. However, in rare cases when a peripheral nerve injury occurs in the presence of a peripheral nerve block recovery is less likely.
Comment

Peripheral nerve blocks, specifically ultrasound-guided continuous femoral nerve blocks are rapidly becoming the gold standard for analgesia after total knee arthroplasty. While this study did not specifically address the use of ultrasonography or continuous femoral nerve blocks, these results do provide strong evidence that peripheral nerve blocks after total knee arthroplasty do not increase the risk of peripheral nerve injury. In this large, single institution study the risk of peripheral nerve injury was greatest after bilateral total knee arthroplasty and was more common in younger patients. Not surprisingly, longer tourniquet times were associated with a significant risk for developing a peripheral nerve injury. In this study the authors did not find an association between bilateral procedure and tourniquet times, however younger patients are more likely to undergo bilateral procedures, so this could explain the higher incidence of peripheral nerve injuries in this population.

The authors did report that patients who received a peripheral nerve block and experienced a peripheral nerve injury were less likely to recover completely. It is important to point out that only 68% of patients (17 out of 25) who developed a nerve injury after a total knee arthroplasty had a peripheral nerve block in the same or related nerve distribution as the neurological deficit. These results do not establish causation, only that there is a relationship. The exact mechanism is unclear, however it may be due to a “double crush syndrome.” Double crush syndrome refers to the coexistence of dual compressive lesions along a nerve course. These dual insults (e.g., tourniquet ischemia and needle or catheter associated nerve trauma secondary to PNB) may work synergistically to worsen the nerve injury. Given that majorities of the peripheral nerve injury associated with PNB were sensorimotor in nature I believe this may explain this finding. However, further research would be needed to confirm this.

I think the important take home message from these results is that patients undergoing a bilateral procedure are at increased risk for developing a peripheral nerve injury. It is important that we counsel and document that we explained these risks to all patients, especially if we are going to perform a peripheral nerve block. During the procedure, the surgeon should be frequently reminded of the tourniquet times and this should be documented on the anesthetic record. If a patient does develop a persistent neurological deficit it is important to ensure the patient receives the appropriate care (i.e., neurological consultation) and that the patient is followed until complete recovery.

Dennis Spence, PhD, CRNA


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