Table of Contents

General
- Quantification of anesthesia providers’ hand hygiene in a busy metropolitan operating room: what would Semmelweis think? ....3

Orthopedics
- Sleep apnea and total joint arthroplasty under various types of anesthesia: a population-based study of perioperative outcomes ...6

Pain
- Pain intensity on the first day after surgery: a prospective cohort comparing 179 surgical procedures ..................................................10
- The importance of communication in the management of postoperative pain ..............................................................14

Patient Safety
- Flammability of surgical drapes and materials in varying concentrations of oxygen ..........................................................17

Regional Anesthesia
- The risk and outcomes of epidural hematomas after perioperative and obstetric epidural catheterization: a report from the Multicenter Perioperative Outcomes Group Research Consortium ....19
New health information becomes available constantly. While we strive to provide accurate information, factual and typographical errors may occur. The authors, editors, publisher, and Lifelong Learning, LLC is/are not responsible for any errors or omissions in the information presented. We endeavor to provide accurate information helpful in your clinical practice. Remember, though, that there is a lot of information out there and we are only presenting some of it here. Also, the comments of contributors represent their personal views, colored by their knowledge, understanding, experience, and judgment which may differ from yours. Their comments are written without knowing details of the clinical situation in which you may apply the information. In the end, your clinical decisions should be based upon your best judgment for each specific patient situation. We do not accept responsibility for clinical decisions or outcomes.
Quantification of anesthesia providers’ hand hygiene in a busy metropolitan operating room: what would Semmelweis think?

Biddle C, Shah J

Abstract

Purpose The purpose of this study was to quantify the rate at which hand hygiene was necessary during anesthesia care starting from preanesthetic assessment and ending with transfer to the PACU. World Health Organization (WHO) guidelines were used to determine when hand hygiene was necessary. A second purpose was to identify the rate at which anesthesia providers actually engaged in hand hygiene.

Background Hospital-acquired infections are an important source of morbidity and mortality. They affect up to 10% of hospitalized patients; 1.7 million a year including, perhaps, 100,000 patient deaths. The causes of hospital-acquired infections are multifactorial, including transmission of pathogens by the hands of healthcare providers. Studies have reported a very low rate of hand hygiene (hand washing or sanitizing) by healthcare providers. And, the observers in previous studies were likely known to the subjects being observed, resulting in improved hand hygiene during data collection. Pathogens are transmitted to and from patients, often from a patient’s skin to themselves, during the highly technical and fast paced care characteristic of anesthesia administration.

The OR is an area where pathogens and a large number of patients are concentrated. Immunocompromised patients are not uncommon. Anesthesia care is often performed by a single individual. The care is challenging and often many tasks must be performed in short periods of time or multiple tasks are required simultaneously. Hand hygiene is necessary to protect patients from their own bacterial flora as well as pathogens from other patients and the anesthesia provider. Staph aureus is the most common cause of wound infections and 20% of healthcare providers are continuously carry S aureus in their noses. Despite administration of preoperative antibiotics, the overall wound infection rate is 5%. IV line stopcocks are commonly used during anesthesia for drug administration despite the fact that they are well known to become easily contaminated. In the ICU, hand hygiene is required an average of 20 times an hour.

Methodology This was a prospective, observational study of hand hygiene in anesthesia providers at a major teaching medical center. Anesthesia providers included attending anesthesiologists, anesthesia residents, CRNAs, and graduate student registered nurse anesthetists. The observers were five RNs specially trained for this study and placed in the OR as supposed circulators in
orientation so as to conceal their true purpose from anesthesia providers being observed. The observer RNs were hired from outside the institution where data collection took place and assigned to random perioperative areas and ORs during a four week period. As a result, anesthesia providers were observed from the preop holding area through the entire anesthetic and into the PACU. Both the number of times when WHO guidelines called for hand hygiene and whether or not the anesthesia provider engaged in hand hygiene were recorded. Clean gloves were close at hand everywhere the anesthesia providers were working and sinks for hand washing were usually within 10 feet of the patient or immediately outside the OR. Alcohol based hand sanitizer was readily available, usually within easy reach of anesthesia providers.

**Result**  
During the four week observation period hand hygiene was called for by WHO guidelines a total of 7,976 times while anesthesia providers were engaged in clinical practice. Depending upon the phase of anesthesia care (e.g. induction, maintenance, emergence), hand hygiene was indicated between 34 and 41 times an hour. During peak patient care times, hand hygiene was called for an average of 54 times an hour. The overall rate at which anesthesia providers failed to employ hand hygiene when called for was 82%. Failure to wash or sanitize hands when called for was most common during the following tasks:

- preparing drugs and equipment for the next case with hands contaminated by current case
- leaving contaminated gloves on after intubation, suctioning, or LMA insertion
- leaving contaminated gloves on after using a central line or arterial line
- picking up items off the floor and using them

**Conclusion**  
Hand washing and/or sanitization was necessary an average of 34 to 41 times an hour during anesthesia care, and up to 54 times an hour during the busiest times. A variety of anesthesia providers failed to wash or sanitize their hands 82% of the times it was needed. Failure of hand hygiene occurred during a wide variety of direct patient anesthesia care and during ancillary anesthesia activities.

**Comment**  
This study is not an indictment of anesthesia providers. It is a wake up call and an identification of just how big the problem of infection control is in the anesthesia workplace. It is probably a much bigger problem than we know in other areas as well, but we are interested in the problem from an anesthesia perspective.

We’ve been getting information on the problem of infection control in anesthesia for a number of years. (See a list of some other studies included in previous issues of Anesthesia Abstracts following this comment.) This is the first I’ve read to quantify just how challenging a problem we are facing. We know with certainty that pathogens are moved around by the hands of the anesthesia provider. Hand washing has always been rightly emphasized as an important...
This study tells us that we may need to wash or sanitize our hands up to 54 times an hour; almost once a minute!!! A quick hand wash takes me about 25 seconds once I’m at the sink; 23 minutes of the hour or about a third of my hourly anesthesia time. Hand sanitization takes slightly less time. You might rightly ask, “If I do that, when will I get any work done?”

And therein lies the problem. It is probably not possible to wash or sanitize our hands almost once a minute and still conduct an anesthetic. Therefore, we need to start looking for other solutions that don’t require one third of our time for hand washing. Some suggestions might include:

- Screening anesthesia providers for nasal S aureus colonization
- Limiting handling of non-essential items during the case
- More thorough disinfection of the anesthesia work area (including computer keyboards) between cases by anesthesia techs
- Replacing stopcocks for drug administration with a less easily contaminated receptacle

Please don’t let this study discourage you from hand hygiene. Even with other solutions, we must pay close attention to hand hygiene; using gloves, changing them often, and keeping hand sanitizer so close we don’t have to look for it to use it. The photo here is a container of hand sanitizer I clip to my scrub pants. I can reach down and get hand sanitizer almost automatically while I’m paying attention to another aspect of the case. Our patients can’t afford us to avoid dealing with the infection control problem because it looks too big to overcome.

Michael A. Fiedler, PhD, CRNA
Sleep Apnea and Total Joint Arthroplasty Under Various Types of Anesthesia: A Population-Based Study of Perioperative Outcomes


Abstract

Purpose The purpose of this study was to compare perioperative outcomes in patients with obstructive sleep apnea (OSA) who underwent total joint arthroplasty with either neuraxial, neuraxial + general, or general anesthesia.

Background It has been estimated that over 25% of surgical patients have OSA. OSA is associated with an increased risk of perioperative complications. Patients undergoing total joint arthroplasty have some of the highest rates of OSA. Often they receive a neuraxial anesthetic either alone or in combination with general anesthesia. The American Society of Anesthesiologists practice advisory encourages regional anesthesia in patients with OSA when possible; however, this recommendation is largely based on expert opinion. This study examined a large database to compare outcomes after total joint arthroplasty in patients with OSA who received various combinations of regional and general anesthesia. The investigators hypothesized that the use of neuraxial anesthesia, either alone or in combination with general anesthesia, would be associated with improved outcomes after primary total knee or hip arthroplasty (TKA and THA).

Methodology The investigators examined the Premier administrative database on patients with a diagnosis of OSA who underwent TKA and THA. The database contained discharge information from 400 acute care hospitals in the United States. Investigators recorded data on:
- type of anesthesia (neuraxial, neuraxial & general, and general)
- comorbidities
- demographics
- costs
- length of stay
- blood transfusion rates
- 30-day mortality
- need for postoperative ventilation
- critical care admission
- complications

Major complications examined included:
- deep venous thrombosis
- pulmonary embolism
- cerebrovascular event
- pulmonary
- cardiac (excluding myocardial infarction)
- acute myocardial infarction
- pneumonia
- all infections
- acute renal failure
- gastrointestinal
- 30-day mortality

Investigators also examined cardiac complications (consisting of acute myocardial infarction and other cardiac complications) and pulmonary complications (pulmonary complications, pneumonia, and pulmonary embolism) as separate categories.
Investigators compared complication rates and outcomes for neuraxial, combined neuraxial & general, and general anesthesia.

**Result** A total of 30,024 records of patients with a diagnosis of OSA who underwent TKA and THA were included in the analysis. Seventy-five percent (75%) of the cases were TKA. Overall, 74% of all total joint surgeries were performed with general anesthesia only, 15% with combined neuraxial & general, and 11% with neuraxial anesthesia alone. Peripheral nerve blocks were used in 8% of general anesthesia patients, 1.5% of combined neuraxial & general patients, and 1% of neuraxial anesthesia only patients. The comorbidity index was similar across the three groups (P = NS). Approximately 70% of all patients had hypertension, 40% were obese, 30% had uncomplicated diabetes, 25% had COPD, 7% had complicated hypertension or a history of acute myocardial infarction, and 3% had peripheral vascular disease.

The rate of major complications was significantly lower in patients who underwent neuraxial anesthesia (16%) compared to the combined neuraxial & general (17.2%) or general anesthesia (18.1%; P = 0.0177; Table 1). Rates of blood transfusion were significantly lower in the neuraxial (12.7%) and neuraxial & general (12.4%) patients compared to the general anesthesia group (13.8%; P = 0.027). Significantly more patients in the general (6.9%) and neuraxial & general (4.8%) groups required critical care services admission compared to the neuraxial group (3.1%; P < 0.0001). Need for mechanical ventilation was also significantly lower in the neuraxial (2.8%) and neuraxial & general (2.8%) groups compared to the general anesthesia group (4.4%; P < 0.0001). Length of hospitalization was slightly longer in the general group (2.8 days) compared to the neuraxial & general (2.6 days) and neuraxial groups (2.6 days; P < 0.001).

When the investigators controlled for significant covariates (age group, gender, ethnicity, comorbidity index, and type of surgery) the odds of combined major complications was significantly lower in those who received neuraxial anesthesia (with or without general anesthesia) compared to general anesthesia alone (P <0.05). Likewise, pulmonary complications were significantly lower in patients who underwent combined neuraxial & general compared to general anesthesia alone (P = 0.013). Use of neuraxial anesthesia had no effect on the odds of cardiac complications. The use of neuraxial anesthesia reduced the odds of critical care admission, mechanical ventilation, prolonged length of stay and

<table>
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<tr>
<th>Table 1. Incidence of Major Complications</th>
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<tr>
<td>Major Complication</td>
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</tr>
<tr>
<td>Major Complication</td>
</tr>
<tr>
<td>Blood transfusions</td>
</tr>
<tr>
<td>Mechanical Ventilation</td>
</tr>
<tr>
<td>Critical Care Admission</td>
</tr>
<tr>
<td>30-day Mortality</td>
</tr>
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</table>
increased costs compared to general anesthesia alone (P < 0.05). The use of neuraxial anesthesia had the greatest impact on reducing the odds of critical care admission when compared to general anesthesia (OR = 0.43).

The use of a peripheral nerve block did not reduce the rate of combined, pulmonary, or cardiac complications. However, the use of a peripheral nerve block did reduce the odds of patients needing critical care admission (OR = 0.46), mechanical ventilation (OR = 0.66), and prolonged length of stay (OR = 0.84). However, use of a peripheral nerve block was associated with increased costs (OR = 1.4).

**Conclusion**  Neuraxial anesthesia, either alone or in combination with general anesthesia, was associated with improved outcomes after total joint arthroplasty in patients with OSA. Its use reduced the odds of major complications, requirement for critical care admission (especially for neuraxial anesthesia alone), or mechanical ventilation, and was associated with reduced hospital length of stay and costs.

**Comment**  The results of this large population-based study are not surprising. Patients with OSA overall did better if they received neuraxial anesthesia; either alone or in combination with general anesthesia. Patients who got straight neuraxial anesthesia required less critical care unit admission even when compared to those who received neuraxial & general anesthesia. In fact, patients who received combined neuraxial & general anesthesia were 1.5 times more likely to require critical care unit admission compared to neuraxial anesthesia alone. This is not surprising given patients with OSA are more sensitive to the respiratory depressant effects of anesthetic agents. These patients probably required closer observation because providers were concerned.

I would have liked to have seen the authors break down the results between TKA and THA. TKA is more amenable to being conducted under neuraxial anesthesia alone and these patients are more likely to get a peripheral nerve block. I was surprised at the low rate of peripheral nerve block use. My guess is as more providers become proficient with ultrasound guided peripheral nerve block continuous catheter placement we will see this technique used more often after total knee arthroplasty. In my experience, the use of a multimodal analgesia plan that includes a combined spinal/epidural anesthetic with either preoperative or postoperative placement of a continuous femoral nerve block catheter provides excellent analgesia after TKA. At our facility, we remove the epidural on the morning after surgery then start the femoral catheter infusion. Surgeons can then start their anticoagulation protocol later that day based on our guidelines.

My recommendation to anesthesia providers is to consider using neuraxial anesthesia alone or in combination with a continuous peripheral nerve block for TKA and neuraxial for THA whenever possible. I encourage anesthesia providers to become competent with ultrasound guided regional anesthesia; consider attending a course, and working with an experienced
regionalist. These techniques have a steep learning curve and really take a lot of practice under the tutelage of an experience regional anesthesia provider. In addition, check with your billing company or hospital coders to make sure you document the ultrasound guided block appropriately to ensure reimbursement.

Finally, it is critical that you maintain close communication with the surgical and nursing teams. This is especially important if the surgeon plans to use the new anticoagulant direct thrombin inhibitor (dabigatran) and direct factor XA inhibitor (rivaroxaban). Currently, only rivaroxaban is approved for venous thromboembolism prevention after THA or TKA in the United States. In Europe both are approved for this use. Also, some surgeons are starting to request tranexamic acid (TXA) administration during TKA and THA to decrease bleeding. Anesthesia providers are encourage to review these drugs.

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

**Pain intensity on the first day after surgery: a prospective cohort comparing 179 surgical procedures**

Anesthesiology 2013;118:934-944
Gerbershagen HJ, Aduckathil S, van Wijck AJM, Peelen LM, Kalkman CJ, Meissner W

**Abstract**

**Purpose** The purpose of this study was to describe patient pain scores the first day after surgery following 179 different surgical procedures performed at 105 hospitals in Germany.

**Background** Despite advances in analgesic techniques, many patients still experience moderate to severe, untreated postoperative pain. Untreated postoperative pain is associated with cardiopulmonary complications and increased morbidity and mortality. Understanding the level of pain for specific surgical procedures may help anesthesia providers and surgeons improve their perioperative pain management strategies. Multimodal analgesia, at some level, is beneficial for almost all patients.

**Methodology** This was a quality improvement program conducted in Germany, which utilized a postoperative pain registry that included results from a 15-item questionnaire completed by each surgical patient 24 hours after surgery. Example questions included:

- worst pain in first 24 h since surgery using 0-10 numeric rating scale (NRS)
- worst pain in first 24 h since surgery with movement (NRS)
- type of anesthesia (regional and/or general)
- mean 24-hour morphine equivalents

A total of 578 surgical wards in 105 German hospitals were part of the registry. All patients admitted between May 2004 and May 2008 were included in the analysis. Surgical groups included:

- obstetrics
- orthopedics (traumatology)
- general surgery (abdominal)
- neurosurgery
- cardiothoracic
- ear-nose-throat
- general surgery (non-abdominal)
- oral and maxillofacial
- urology
- eye surgery

Descriptive statistics were used to analyze the results. The surgical group and procedures were ranked by their median worst pain since surgery; results were also analyzed based on whether or not regional anesthesia was administered.

**Result** A total of 70,518 patients were included in the analysis. General anesthesia was used alone in 75% of the cases, and in 8.5% of cases regional anesthesia was used alone or with general anesthesia. Fifty-five percent (55%) of patients were female. The proportion of patients between the ages of 18-40 years was 20%, 41-60 was 37%, 61-80 40%, and >80 was 4%.

In general, the higher the postoperative pain, the higher the likelihood patients received one or two
nonopioid analgesics. However, more than 20% of patients did not receive a nonopioid analgesic. These patients underwent less painful surgeries (pain scores <3 out 10). Orthopedic and trauma patients typically received nonopioid analgesics. Overall, there was a very low rate of local anesthetic infiltration into surgical wounds across all surgical procedures.

The median worst pain across all patients was 5 (interquartile range [IQR] 3-7), and pain during movement was 4 (IQR 2-5). Spinal fusion surgery was associated with some of the highest pain scores. For ENT surgery the most painful surgery was tonsillectomy (n = 402) which had a median worst pain score of 6 (IQR 5-7). All other ENT procedures had a median worst pain score of 3 (IQR 2-4). Not surprisingly, orthopedic surgeries were associated with some of the highest pain scores (median worst pain = 5, IQR 3-7).

Most “major” open thoracic and abdominal surgeries were associated with lower pain scores (≤4). In 50% of these cases, patients received epidural analgesia. For example, an open prostatectomy done under general anesthesia had a median pain score of 5 (IQR 3-6), but if epidural analgesia was used the median worst pain score was 2 (IQR 0-4).

Laparoscopic surgical procedures were found to have high postoperative pain scores associated with low opioid administration. The most painful laparoscopic procedure was incisional hernia repair (worst pain score = 5), followed by appendectomy (worst pain score = 5), extraterine pregnancy (worst pain score = 5), salpingo-oophorectomy (worst pain score = 5), myomectomy (worst pain score = 5), and cholecystectomy (worst pain score = 5). On average, only 28% of patients who had these procedures received any opioids.

Some of the most painful procedures were major spine surgeries (median worst pain score = 7). Of the
40 most painful surgeries, 22 were orthopedic procedures with a median worst pain score of 6 or 7. In only 16% of these cases was regional anesthesia used. Of the 179 different surgical procedures, open reduction and internal fixation of a calcaneal fracture was the most painful with a median worst pain score of 7 (IQR, 5-8). Ironically, peripheral nerve blocks were not administered to patients undergoing calcaneal fracture surgery. The least painful procedures included eye surgery, transurethral procedures, and superficial procedures (i.e., excision lymph nodes; varicose vein stripping).

**Conclusion** Patients undergoing many common “minor-to-moderate” surgical procedures (i.e., laparoscopic procedures; hemorrhoidectomy, tonsillectomy) experienced high levels of postoperative pain. Patients undergoing minor-to-moderate surgeries were less likely to receive adequate analgesia. Patients would benefit if providers would better adhere to evidence-based postoperative pain management recommendations.

**Comment** I choose this article because it provides good data on the postoperative pain experienced by patients across a variety of surgeries in a country that does not appear to commonly use multimodal analgesia with opioids, regional anesthesia, infiltration of local anesthetics, and nonopioid analgesics. Therefore, I think the results reflect the true “worst” pain scores patients may experience in the first 24 hours after surgery. I believe these results may help better inform our perioperative pain management strategies. As the

<table>
<thead>
<tr>
<th>Rank</th>
<th>Procedure</th>
<th>Max Pain Score</th>
<th>Mean 24-hr Morphine Equivalent (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Open reduction calcaneal fx</td>
<td>7</td>
<td>40 ± 32</td>
</tr>
<tr>
<td>2</td>
<td>Spinal fusion, dorsal 1-2 segments</td>
<td>7</td>
<td>37 ± 89</td>
</tr>
<tr>
<td>3</td>
<td>Spinal fusion, dorsal ≥3 segments</td>
<td>7</td>
<td>27 ± 39</td>
</tr>
<tr>
<td>4</td>
<td>Myomectomy (open)</td>
<td>7</td>
<td>24 ± 29</td>
</tr>
<tr>
<td>5</td>
<td>Proctocolectomy (open)</td>
<td>7</td>
<td>28 ± 32</td>
</tr>
<tr>
<td>6</td>
<td>Complex spinal reconstruction</td>
<td>7</td>
<td>29 ± 36</td>
</tr>
<tr>
<td>7</td>
<td>Arthrodesis (foot joint)</td>
<td>6</td>
<td>12 ± 20</td>
</tr>
<tr>
<td>8</td>
<td>Arthrodesis (hand,wrist)</td>
<td>6</td>
<td>10 ± 20</td>
</tr>
<tr>
<td>9</td>
<td>Casearean delivery</td>
<td>6</td>
<td>27 ± 33</td>
</tr>
<tr>
<td>10</td>
<td>Open reduction femoral head</td>
<td>6</td>
<td>31 ± 27</td>
</tr>
<tr>
<td>11</td>
<td>Hand resection arthroplasty</td>
<td>6</td>
<td>11 ± 27</td>
</tr>
<tr>
<td>12</td>
<td>Shoulder joint replacement</td>
<td>6</td>
<td>25 ± 23</td>
</tr>
<tr>
<td>13</td>
<td>Arthrodesis (ankle)</td>
<td>6</td>
<td>19 ± 22</td>
</tr>
<tr>
<td>14</td>
<td>Pancreatectomy (whipple)</td>
<td>6</td>
<td>18 ± 8</td>
</tr>
<tr>
<td>15</td>
<td>Open knee surgery</td>
<td>6</td>
<td>26 ± 32</td>
</tr>
<tr>
<td>16</td>
<td>Open reduction tibial shaft</td>
<td>6</td>
<td>12 ± 25</td>
</tr>
<tr>
<td>17</td>
<td>Open reduction patella</td>
<td>6</td>
<td>18 ± 26</td>
</tr>
<tr>
<td>18</td>
<td>Open reduction proximal radius</td>
<td>6</td>
<td>10 ± 15</td>
</tr>
<tr>
<td>19</td>
<td>Appendectomy (open)</td>
<td>6</td>
<td>14 ± 22</td>
</tr>
<tr>
<td>20</td>
<td>Open reduction (proximal tibia)</td>
<td>6</td>
<td>23 ± 28</td>
</tr>
<tr>
<td>21</td>
<td>Open shoulder reconstruction</td>
<td>6</td>
<td>26 ± 32</td>
</tr>
<tr>
<td>22</td>
<td>Partial shoulder joint replacement</td>
<td>6</td>
<td>24 ± 26</td>
</tr>
<tr>
<td>23</td>
<td>Hemorrhoidectomy</td>
<td>6</td>
<td>13 ± 22</td>
</tr>
<tr>
<td>24</td>
<td>Tonsillectomy</td>
<td>6</td>
<td>7 ± 15</td>
</tr>
<tr>
<td>25</td>
<td>Open cholecystectomy</td>
<td>6</td>
<td>28 ± 33</td>
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</table>
results demonstrated, even some of the most common “minor” surgeries (i.e., laparoscopic surgery) were associated with significant postoperative pain.

These results speak to the importance of using a multimodal analgesic plan that takes into consideration the patients comorbidities and maximizes pain relief while at the same time minimizing side effects and complications. I believe it is important that anesthesia providers keep up with the latest analgesic drugs (i.e., liposomal bupivacaine) and techniques such as ultrasound guided peripheral nerve blocks and continuous techniques.

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

The importance of communication in the management of postoperative pain

Sugai D, Deptula P, Parsa A, Parsa F

Abstract

Purpose  The purpose of this study was to assess whether or not preoperative patient education, as a component of effective communication, had an impact on the perception, plan, and management of postoperative pain.

Background  The importance of effective communication between care providers and recipients of care cannot be overestimated. Past research has demonstrated that optimal provider-patient communication can improve health outcomes in various ways, including recovery from surgery and management of pain. It is universally understood that endogenous opioids (e.g. endorphins) are responsible for counteracting, at least to some degree, certain physical stressors such as post surgical pain. However, post surgical pain management usually involves the use of opioids and the adverse effects of opioids can be detrimental; they include causing a reduction in the effectiveness of endorphins. As a result, alternative pain management regimens are consistently proposed aimed at minimizing reliance on opioids for the control of post surgical pain. These regimens include appropriate provider-patient communication techniques with an emphasis on patient education describing the role of endogenous endorphins as well as alternatives to traditional opioid analgesia.

Methodology  This study was conducted as a prospective randomized clinical trial between 1/2008 and 10/2011. Patients having outpatient surgical procedures volunteered to participate.

The Experimental Group (n=69) participated in two education sessions led by the same surgeon. The first session was approximately 2 weeks prior to surgery and the second session was on the day of surgery. Sessions were 15-30 minutes in length and involved both oral and written communication. Visual schematics were used as an adjunct to the spoken and written word. Patients were:

1. educated about the 'action of and importance of endorphins' as natural opioids
2. educated about the side effects of opioids
3. educated about the negative effects opioids have on endorphins
4. informed about non-opioid analgesics; gabapentin, celecoxib, and intravenous acetaminophen & their opioid sparing properties
5. given a choice to receive preoperative treatment (30-60 minutes prior to surgery) of:
   5.1. po 600mg gabapentin
   5.2. po 400mg celecoxib
6. given a choice to have a prescription for hydrocodone

The experimental group was further subdivided into three groups:

Group A: Those who preferred not to receive hydrocodone, gabapentin, or celecoxib
Group B: Those who refused hydrocodone but accepted preoperative gabapentin and celecoxib
Group C: Those who accepted a prescription for hydrocodone as a rescue analgesic
The Control Group (n = 66):
1. received 600 mg gabapentin and 400 mg celecoxib 30-60 minutes before surgery
2. did NOT receive oral or written patient education of any formal type
3. were handed a prescription for preoperative gabapentin, celecoxib, and hydrocodone

The control group was further subdivided into two groups:
- **Group A**: those who did not request refills on hydrocodone
- **Group B**: those who requested refills on hydrocodone

All patients were allowed to take acetaminophen 1,000 mg every 6 hours when needed for control of post surgical pain. Control group patients were given simple explanations regarding the fact that celecoxib and gabapentin would be used for preventing post operative pain but were not given any specific information regarding how these drugs may preserve endorphin function.

Patients were followed until the 5th postoperative day and were asked to self-rate their perceived level of pain intensity daily on a predefined pain scale (see notes). Additionally, control patients were asked to record the date, time, and type of pain medication taken. The incidence of PONV was also recorded.

Primary outcome measures included 1) the use of opioid analgesics and 2) self-rated pain. The education group was compared to the non-education group.

**Results**

Patients’ use of opioid analgesics and self-rated pain in the experimental group were as follows:

**Experimental A** (education only, n = 43/69)
- Mean pain score first 5 days postoperatively = 2.6
- ‘0’ requests for opioids postoperatively
- ‘0’ incidence PONV
- Duration of pain in days = 2.8

**Experimental B** (education + gabapentin + celecoxib, n = 20/69)
- Mean pain score for first 5 days postop = 2.0
- ‘0’ requests for opioids postoperatively
- “0” incidence PONV
- Duration of pain in days = 1.9

**Experimental C** (education & hydrocodone, n=6/69)
- Mean pain score first 5 days postop = 3.0 (p < 0.05)
- 2 filled hydrocodone prescription and utilized
- Same 2 had PONV
- Duration of pain in days = 3.1

Patients’ use of opioid analgesics and self-rated pain in the control group:

**Control A** (no education, no hydrocodone refill request, n = 53/66)
- Mean pain score first 5 days postop = 3.2
- 53 requested opioids postoperatively (p < 0.05)
- 14 had PONV
- Duration of pain in days = 4.2 (p < 0.05)

**Control B** (no education and requested refill of hydrocodone, n = 13/66)
- Mean pain score first 5 days postop = 3.1
- 13 requested opioids postoperatively
- 9 had PONV
- Duration of pain in days = 4.9 (p < 0.05)

**Conclusion**

In this study, the use of a formal patient education process was a major influencing factor leading to minimal use of opioid opioids for the management of post operative pain. The control group who had no formal education regarding endorphins used hydrocodone significantly more as a method to control postoperative pain (experimental
group C and both control subgroups), experienced side effects, had more intense pain scores, and a longer duration of pain. This suggests support of the theory that opioid narcotics blunt the natural response to endorphin production and leads to down regulation of mu receptor expression.

**Comment**

I agree with the authors that the results of this study may be multifaceted. Educating patients regarding the role of endorphins in postoperative pain may have allowed the patients to feel empowered and in control, versus not understanding the physiologic response mechanisms and simply relying on traditional directives, such as “when you feel pain, take opioids.” The mind is a very powerful thing and often times truly understanding why you feel what you feel, and what is probably the best way to minimize discomfort without experiencing the adverse effects of opioids, is key. Also, there is a strong possibility that this education is the same as the placebo effect! I do however, believe in the evidence suggestive of the endorphin theory and how endorphins can become ineffective, when opioids are used. It should be noted that pain scores were generally lower in the groups that received education about postoperative pain … except in the group that received education and hydrocodone. Additionally, an explanation for a portion of the study results may be related to the benefits of multi-modal pain management therapy. The group with the lowest pain scores received education + gabapentin + an NSAID.

One significant limitation of the study is the lack of information regarding the types of surgical procedures that were performed and whether that an impact on the results.

**Mary Golinski PhD, CRNA**

Pain scale description: Pain intensity was quantified using 0-5 point scale:

0 = no pain
1 = mild pain, annoying, nagging
2 = discomforting, troublesome, nauseating, grueling, numbing
3 = distressing, miserable, agonizing, gnawing
4 = intense, dreadful, horrible, vicious, cramping
5 = excruciating, unbearable, torturing, crushing, tearing


Patient Safety

Flammability of Surgical Drapes and Materials in Varying Concentrations of Oxygen

Anesthesiology 2013;119:770-6
Culp WC, Kimbrough BA, Luna S

Abstract

Purpose The purpose of this study was to test the flammability of a number of items commonly used in the OR in the presence of 21%, 50%, and 100% oxygen.

Background There are estimated to be over 600 OR fires in the USA each year; an unknown number are unreported. Fire requires a source of oxygen, fuel, and a source of ignition. When oxygen is present in concentrations greater than room air (21%), the risk of fire starting is increased as is the rate at which fire spreads. Electrocautery unites are estimated to be used in 85% of operative procedures and are a common source of ignition for fires. Fuel for a fire may include gowns, drapes, towels, laparotomy sponges, alcohol (chiefly in prep solutions) and patient biologicals (e.g. hair, skin). Closed claims analysis through 2006 reported that surgical drapes were the most common fuel source.

The Consumer Product Safety Commission (CPSC – a US government agency) has set standards for the flammability of surgical gowns but there are no standards for the flammability of other items commonly used in the OR. Nevertheless, a number of manufacturers adhere to CPSC standards for gowns when manufacturing their OR drapes. OR fires commonly involve drapes. However, there are no CPSC requirements or flammability tests that take into account enriched oxygen environments.

Methodology This prospective, laboratory study used the Standard for Flammability of Clothing Textiles (SFCT) protocol developed by the CPSC. A match was used as the ignition source. The SFCT was modified to include enriched oxygen environments. The following materials were tested (each manufactured by Medline Industries, Mundelein, Ill.):

- surgical gown (polypropylene)
- utility drape (polypropylene)
- surgical drape (polypropylene)
- blue OR towel (cotton)
- laparotomy sponge (cotton)

Each sample was tested five times in each of three oxygen concentrations. “Ignition Time” was the time between lighting of the match and a sustained fire on the material being tested. “Burn Time” was the time it took to burn the sample completely. Each sample was cut to a standard size. Shorter ignition and burn times indicated greater flammability of the material being tested.

Result Ignition Time decreased as the oxygen concentration increased (P<0.001). The surgical gown and the utility drape (made to the same standards) failed to ignite in room air and were omitted from Ignition Time measures. The median Ignition Time for all materials in different oxygen concentrations were as follows:

- 21% oxygen ignition in 0.9 seconds
- 50% oxygen ignition in 0.4 seconds
- 100% oxygen ignition in 0.2 seconds
Likewise, Burn Times decreased as oxygen concentration increased (P<0.001). Again, excluding materials that did not burn, median Burn Times for all materials in different oxygen concentrations were as follows:

- 21% oxygen burn time 20.4 seconds
- 50% oxygen burn time 3.1 seconds
- 100% oxygen burn time 1.7 seconds

All materials tested, including the gown and drape that did not burn in room air, ignited in less than 1 second at 50% oxygen or greater. Laparotomy sponges were consumed by fire most quickly in enriched oxygen; burning completely in less than 2 seconds. All other materials burned completely in only a few seconds in enriched oxygen. According to CPSC criteria for fabrics, in 50% oxygen the OR gown, utility drape, and laparotomy sponge burn so fast they would be classified as unsafe to use. In 100% oxygen all tested materials would be classified as unsafe. An unanticipated finding in this study was that OR towels and laparotomy sponges were observed to burn as a “Flash Fire” in oxygen rich environments. Flash fires involve a rapidly moving flame, often almost instantaneous, and may move over the surface of the burning material without consuming it in its entirety. Such fires occur too quickly to put out in an OR environment and may result in patient burns or burning flesh almost immediately.

In the OR, patient burns often involve superficial procedures of the neck or head, sedation, and supplemental oxygen delivered under drapes covering the head that can collect oxygen. About 1/3rd of fires during sedation cases were fueled by alcohol-based prep solutions that were not allowed to dry completely before an ignition source was applied; generally a cautery unit.

**Conclusion**

Because OR fires in an oxygen enriched environment spread so quickly and result in patient injury before they can be extinguished, preventing these fires is essential. Supplemental oxygen should be minimized to the lowest effective FrO2 and alcohol based prep solutions should be allowed to dry completely. If a fuel and ignition source must be present, supplemental oxygen is best avoided.

**Comment**

It is easy to want to think that OR fires are a thing of the past; that they are an historic footnote that disappeared with cyclopropane anesthesia. Patients who have suffered burns, often severe facial burns, bear witness to the contrary. When extra oxygen is available, from nasal cannula O2 or a face mask, just about anything will burn, and burn fast. And, as this study shows, when drapes, towels, and laps burn completely in 3 or 4 seconds, the only solution is preventing the fire from starting in the first place. Cautery (ignition source) and drapes (fuel) are almost always going to be present. The only thing we control is the oxygen. While we may have previously thought of oxygen as always providing an extra margin of safety, it can also increase risk. Using open sources of oxygen, like a nasal cannula, are a risk benefit decision just like every other drug we give. We would be wise to give oxygen a way out from under the drapes and to use just enough of it to keep that patient’s sat in at an acceptable level. Better yet, placing a nasal cannula and not turning the oxygen on unless it is needed when the presence of supplemental oxygen may complete the “fire triangle” and increase the risk of an OR fire more than the extra oxygen benefits the patient.

Michael A. Fiedler, PhD, CRNA
The risk and outcomes of epidural hematomas after perioperative and obstetric epidural catheterization: a report from the Multicenter Perioperative Outcomes Group Research Consortium


Abstract

Purpose The purpose of this study was to describe the incidence and outcomes of epidural hematoma after perioperative and obstetric epidural catheter placement.

Background Epidural hematoma is a rare, but potentially devastating, complication of epidural catheterization. Previous epidemiologic studies in obstetric patients estimate the rate of hematoma to be 1:200,000, with all cases occurring in patients with preexisting coagulopathy (hemorrhage, HELLP syndrome, or preeclampsia). In surgical patients, one series reported a rate of 1:18,000, with higher rates in patients undergoing total knee arthroplasty; most likely due to low molecular weight heparin use. Most studies have only examined epidural hematoma rates at single centers or in European centers making it difficult to determine exact rates and compare outcomes because of practice differences between Europe and the United States. Therefore, the Multicenter Perioperative Outcomes Group (MPOG), a consortium of 11 academic centers with electronic anesthesia information management systems (AIMS), was formed to pool perioperative outcome data for research purposes.

Methodology This was a retrospective observational study by the MPOG consortium that examined data on the incidence and outcomes of epidural hematoma after catheterization placement in surgical and obstetric patients. Eleven of the institutions reported data on surgical patients and six institutions provided data on obstetric cases.Investigators queried AIMS and quality assurance databases to identify all epidural catheter insertions. Next the investigators examined these databases and billing records to determine if any of the patients underwent operations for evacuation of an epidural hematoma within six weeks. Data were collected on demographics, comorbidities, details of epidural placement, perioperative coagulation laboratory results, anticoagulant or antiplatelet administration, and neurologic outcomes. Investigators reported the rate and outcomes of epidural hematoma separately for surgical and obstetric patients.

Result There were a total of 79,837 obstetric epidural placements. There were no reported cases of hematoma requiring decompressive laminectomy. Seven of 62,450 surgical patients who had epidural placement developed hematoma requiring decompressive laminectomy. The incidence of decompressive laminectomy after epidural hematoma...
was approximately 1:9,000 non-obstetric epidural placements (95% CI, 1:4,330 to 1:22,189). Five of seven patients had persistent neurologic deficits on discharge, so the rate of neurologic injury was approximately 1:12,000.

The time from epidural placement to first symptoms of neurologic deficit was a median of 32 hours (range: 11 to 71 hours). Five of seven cases presented with symptoms after the first 24 hours (n = 4 thoracic epidurals). The other two had symptoms recognized at 11 and 14 hours after epidural placement (n = 2 thoracic epidurals). The time from first symptoms to decompressive laminectomy was a median of 12 hours (range: 9 to 54 hours). Of the two patients with complete recovery, the time to laminectomy was 9 and 54 hours respectively. All patients presented with both motor and sensory deficits.

Five patients had thoracic and two had lumbar epidural placement, respectively. Three patients underwent vascular procedures, two underwent abdominal surgery (sigmoid colectomy and hepatectomy), and one each underwent single lung transplant and total hip replacement. Four of seven patients received perioperative anticoagulant regimens that clearly deviated from the American Society of Regional Anesthesia guidelines (ASRA). Two patients had an INR of 1.6 at the time of epidural placement (ASRA recommends INR ≤ 1.4), and three patients received concurrent heparin and aspirin. The patient who underwent sigmoid colectomy had a history of end stage kidney disease and was dialysis dependent, and thus may have had some preexisting platelet dysfunction. The patient who underwent hepatectomy for malignancy was on preoperative SQ heparin (last dose 14 hours before epidural placement) and had a preoperative INR of 1.6 and PTT of 50, and received heparin 5000 u SQ three times a day postoperatively (outside ASRA recommendations). He was severely coagulopathic with an INR of 5.3 when the hematoma was identified on MRI. The time to his first symptoms was 71 hours after epidural placement and it was 12 hours from first symptoms to laminectomy. He developed T-9 paraplegia.

**Conclusion**  Epidural hematoma is a rare, but serious complication. There were no cases of epidural hematoma in almost 80,000 labor epidurals. The rate of epidural hematoma resulting in neurologic deficits upon discharge was 1 in 12,000. These results highlight the importance of following ASRA guidelines and being vigilant and monitoring for signs and symptoms of hematoma, especially while epidural catheters are still in place.

**Comment**  In this study the investigators found no epidural hematomas in almost 80,000 labor epidurals; however, all the cases reported in the literature were in patients with preexisting coagulopathy. This made me think an obstetrical patient I took care of when I was stationed in Guam who developed Acute Fatty Liver of Pregnancy (AFLP) after a vaginal delivery.\(^1\) This patient became severely coagulopathic post-delivery with an INR that peaked at 4.1. She had an epidural for delivery and had the catheter removed
only a few hours before she showed overt signs of AFLP and coagulopathy. We conducted hourly neurologic checks and fortunately, she did not develop an epidural hematoma.

The results of this study are important because they highlight several important issues. First, anesthesia providers need to keep current on the latest recommendations from ASRA with regards to neuraxial anesthesia and anticoagulation or antiplatelet medications. This is especially important as the direct Factor Xa inhibitors rivaroxaban and apixaban, and the direct thrombin inhibitor dabigatran are administered or planned to be administered in patients undergoing neuraxial anesthesia. Rivaroxaban is approved in the United States, Canada, and Europe for venous thromboembolism prophylaxis after hip or knee replacement surgery and for stroke prevention in patients with non-valvular atrial fibrillation. Apixaban is currently under Food and Drug Administration review in the United States for venous thromboembolism prophylaxis. The problem with these medications is there is no laboratory test to measure their anticoagulant activity or ability to easily reverse their effects. Readers are encouraged to read the excellent review article by Levy et al.

In this study, most of the epidural hematomas reported occurred in patients who received thoracic epidurals. In four of the seven cases, providers did not follow ASRA recommendations for neuraxial anesthesia in patients on anticoagulants or antiplatelet medications or with elevated INR values. Most of the patients developed symptoms within 24 hours of epidural placement, and most of these patients had thoracic epidurals. However, the time to decompressive laminectomy averaged 12 hours, which may explain the high rate of neurologic deficits upon discharge. Previous research studies report better neurological outcomes if decompressive laminectomy was performed within 8 hours of symptom onset. These results highlight the importance of following published ASRA guidelines for prompt recognition and treatment of patients with signs and symptoms of an epidural hematoma. This can be difficult in a patient with an epidural because many of these patients may have some degree of lower extremity weakness even with thoracic epidurals. Other signs include worsening blockade, back pain, and bowel or bladder dysfunction.

I think the take home message is that anesthesia providers need to be vigilant and maintain close communication with patients, staff, and surgeons to prevent the potentially devastating complication of epidural hematoma. Be cognizant of the interactions of the patients’ history, potential complications of the surgery (i.e., coagulopathy) and current and planned medications that may be administered.

**Dennis Spence PhD, CRNA**


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