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Hand contamination of anesthesia providers is an important risk factor for intraoperative bacterial transmission

Anesth Analg 2011;112:98-105

Abstract

Purpose The purpose of this study was to test the hypothesis that bacterial contamination of anesthesia providers’ hands (the origin of bacterial transmission) before patient contact places the patient at high risk for infection by transmission of bacteria. Additionally, the secondary aim was to evaluate decontamination practices in the operating room in preventing the transmission of bacteria and other organisms.

Background It is imperative that measures are taken in the operating room that prevent transmission of potentially infectious microorganisms to patients. More specific information is needed regarding how bacterial transmission occurs. In a previous clinical trial, it was found that the anesthesia environment became contaminated at the end of the anesthetic/surgical procedure more frequently than at the beginning. It was also discovered that contamination occurred in cases as short as 4 minutes. Bacterial contamination of the intraoperative and anesthetic surgical environment was associated with an increased risk of patient contamination via the intravenous stopcock set. This in turn was associated with a significant increase in patient mortality.

Methodology This research was carried out as a prospective observational study. A total of 92 pairs of operating rooms were randomly selected. The first and second cases of the day in each OR were studied sequentially. All patients received a general anesthetic according to usual and customary practice. Samples were taken in order to identify bacterial transmission and included 2 sites in the patient anesthesia environment (APL valve and inhalation agent dial on the gas machine) and of each patient’s IV stopcock set. Additionally, the hands of the anesthesia providers were cultured. Organisms that were found before the start of case 2, and not present before case 1, served as the measure of cleaning efficacy.

Transmission events were defined as bacterial organism found at the end of a case that were not present at the start. The following protocol was followed:

1. Baseline bacterial cultures were taken from the operative environment at the start of case 1, after active decontamination with a quaternary ammonium compound
2. Using the modified glove juice technique (see notes), samples were obtained from the hands of the anesthesia providers as they entered the OR but before patient contact
3. Providers used the stopcock sets for all anesthesia medication
4. At the completion of case 1, the stopcock set and environmental sites were sampled
5. Baseline cultures for case 2 were obtained after standard OR cleaning following case 1
6. The hands of the same providers were again cultured when they entered the OR at the start of case 2 but before physical contact with the patient.

7. Cultures of the environment and patient IV stopcock set were obtained again upon completion of case 2.

8. All organisms transmitted to the stopcock sets or anesthesia environment were then compared with samples taken from the hands of the providers.

Providers were identified as the origin of transmission only if the analysis confirmed that the organism found on the hand of the provider was the same organism found in the stopcock set or the anesthesia environment. All appropriate demographic data pertinent to each operating room case and the study as a whole, was obtained.

**Results**

A total of 164 cases were included in the analysis. There were no differences in patient specific demographic data in those with an intra-operative transmission event versus those without a transmission event. Regarding bacterial contamination of provider hands, 66% of hands were contaminated with 1 or more pathogens; including MRSA, VRE, methicillin sensitive Staphylococcal Aureus, Enterococcus, and Enterobacteriaceae. The overall mean number of total colony forming units (CFUs) found on provider hands was 1,045. There was no difference in total hand contamination by type of provider (physicians and CRNAs). The magnitude of CFUs found on provider hands before case 1 was greater than that before the start of case 2 (case 1 mean 1,224; case 2 mean 883, \( P < 0.001 \)). Bacterial transmission to the intra-operative environment occurred in 89% of cases. Providers were identified as the origin of this transmission in 12% of cases. Bacterial transmission to the patient IV stopcock was identified in 11.5% of cases. Anesthesia providers were identified as the origin of this transmission in 47% of cases. Contamination of the operating room environment (the measurement of efficacy of decontamination processes) occurred in 7% of the ORs analyzed. The link to stopcock contamination was 5%. One occurrence of intra-operative transmission was identified and was described as: ineffective decontamination of provider hands before case 1, leading to contamination of the environment and stopcock during case 1, followed by ineffective hand decontamination while interacting with the environment in case 2, followed by contaminated patient IV stopcock set at the end of case 2.

Univariate logistic regression analysis identified no independent risk factors for provider-origin transmission. Independent predictors of environmental contamination not linked to a provider source included: 1) surgery involving first case of the day, 2) anesthesia provider supervision of more than 1 room, 3) increasing patient age, and 4) discharge to the ICU directly from the OR.

**Conclusion**

Provider hand contamination immediately prior to patient care is a source for some, but not all, of the intra-operative contamination observed in this study. While the spectrum of bacterial contamination found on the hands of the providers was like those described for health care workers in similar environments, the reason for hand
contamination was not immediately obvious. Hand washing was already in place with a high compliance rate. Provider hand contamination is an important and modifiable risk factor related to intraoperative bacterial transmission. Anesthesia equipment decontamination processes are another modifiable risk factor. The first case of the day is associated with a larger magnitude of overall bacterial transmission.

Comment

This study validated the importance and necessity of aggressive hand hygiene and decontamination processes for us as anesthesia providers in preventing the transmission of microorganisms to a vulnerable population. It should motivate us to follow all processes to the best of our ability, as well as encourage collaboration with support departments to assure appropriate decontamination is carried out between cases. As providers of anesthesia care, we can indeed serve as a significant source of transmission of pathogens to our patients if we don’t follow the correct procedures.

Consider the timing of glove removal or changing gloves between common procedures such as laryngoscopy and adjusting ventilator settings and gas flow. Gloves that became contaminated with secretions while securing the airway, if not changed or removed, could be the source of microorganism transmission to the dials on the ventilator and gas machine. Now consider the next case in that same operating room. If the gas machine was not thoroughly decontaminated between cases, the gas machine dials remain dirty and the potential for transmission from dials to the subsequent patient’s IV stopcock is very real. If decontamination procedures have not been carried out correctly, if hand hygiene is substandard, if gloves are not discarded and clean ones applied between critical tasks; then transmission of pathogens is likely to occur and we have placed our patient's safety at risk. And the induction sequence is only one component of the full range of care we provide for all our patients.

World Health Organization and Hand Hygiene Task Force guidelines recommend performance of hand hygiene before entering the patient room as the number one preventative measure. How well do we adhere to this in the OR and anesthesia setting? This research shows us that it is very likely that organisms are transmitted to the patient as well as our workstations, as we move from room to room. Thorough hand washing and equipment decontamination reduces the risk of such contamination. And lastly, how comfortable are we that our anesthesia workstations have been properly decontaminated between each patient on a consistent and regular basis? As providers of care, we should be intimately involved in setting policy for decontamination processes, educate each other and those who perform the decontamination processes, and perform regular checks to assure adherence to decontamination procedures.

Mary A. Golinski PhD, CRNA
Obstetric Anesthesia

Combined Spinal Epidural vs Epidural Labour Analgesia: Does Initial Intrathecal Analgesia Reduce the Subsequent Minimum Local Analgesic Concentration of Epidural Bupivacaine?

Anaesthesia 2012;67:584-93
Patel NP, Armstrong SL, Fernando R, Columb MO, Bray JK, Sodhi V, Lyons GR

Abstract

Purpose The purpose of this study was to determine if using an initial dose of intrathecal fentanyl during labor would affect follow-up dose requirements for epidural local anesthetic analgesia.

Background The combined spinal-epidural (CSE) technique is a well-established method to provide analgesia for labor and delivery. Advantages of CSE include rapid onset and better sacral analgesia. Some studies have also suggested that the intrathecal part of a CSE may improve the effectiveness of the epidural component. Previous studies have demonstrated that CSE contribute to better dermatomal spread and higher probability of epidural success, but no study could be found that addressed the question of CSE impact on epidural local anesthetic requirements during the late stages of labor. This study attempted to address that question.

Methodology This was a prospective, randomized, double-blinded study. All women were low risk singleton pregnancies in active labor, with cervical dilation between 2 and 6 cm. Women were excluded that had pre-eclampsia, were on oxytocin inductions which had an infusion rate change during the study assessment period, received opioid medications within the previous 4 hours, or entered the second stage of labor before the study ended. Women who qualified were assigned randomly to either the CSE group or an epidural-only group. Three anesthetists were involved in the study. The first anesthetist performed the randomization procedure, the second performed the regional blocks, and the third, who was blinded to the procedure performed, assessed the impact of the anesthetic on the laboring patient and assigned follow-up doses according to protocol.

The study was divided into two phases. The first phase involved the administration of either a CSE or epidural alone. The CSE group received an intrathecal dose of bupivacaine 2.5mg and fentanyl 5 µg. This was followed by placement of an epidural catheter for use later in labor. In the epidural-only group an epidural catheter was placed and 20 mL of a bupivacaine 0.1% with fentanyl 2 µg/mL solution was administered. The second stage of the study involved adjusting the dose of epidural bupivacaine based on a Visual Analogue Score (VAS) for pain on a scale of 0-100, with 100 being the worse pain.

Thirty minutes after the initial injection of either the intrathecal or epidural, each woman was evaluated for pain, sensory block height, motor block, adverse effects, and duration of analgesia. Follow up epidural
injections were on “patient demand” with the concentration of bupivacaine based on the VAS obtained 30 minutes after the previous injection. The baseline epidural follow-up injection dose was set at bupivacaine 0.07%. The target VAS was 10. Women with a VAS at the 30 minute interval of less than or equal to 10 received a reduction in bupivacaine concentration of 0.01%. Women who had a VAS greater than 10 received an increase in the bupivacaine concentration of 0.01%. Thirty minutes after the on-demand injection, the initial evaluation was repeated. The study was considered “ended” for each woman 30 minutes after the second on-demand injection.

Study data was evaluated using a repeated measures ANOVA with Tukey-Kramer multiple comparison tests for time based data, while a Kaplan-Meier analysis and log rank tests were used for durations of analgesia. Significance was set at a P<0.05 (two-sided). Sample size was estimated at 39 patients per group and the final results contained 40 patient per group.

**Result**

Patient characteristics and obstetric data were similar in both groups, and the median cervical dilation was 3.5 cm before the first injection with a range of 2 and 5 cm. There were no significant differences between mode of delivery and time to spontaneous delivery between the two groups. The intrathecal dose had a 22% shorter duration than the initial epidural-only dose; 81min vs 104 min (P = 0.0003). Time between injections after the first follow-up injection was similar. The VAS was similar in both groups at various time intervals. The concentration of follow up bupivacaine injections was significantly greater, maximum sensory block height was significantly lower, and hip flexion was significantly weaker in the CSE group.

**Conclusion**

Several studies have concluded CSE to be more effective for laboring patients, while others have determined that there are no significant differences between CSE and epidural-only analgesia. This study indicated that CSE has some drawbacks that other studies failed to notice, suggesting that it is possible an epidural only approach to labor analgesia may be superior to CSE. This study found no quantitative analgesia advantage of CSE over standard epidural-only analgesia beyond the initial dose. In addition, the intrathecal dose had a 22% shorter duration of action than the initial epidural-only. The required mean epidural concentration of bupivacaine increased following the intrathecal injection for CSE techniques. Even with these statistically significant findings, there may not be a noticeable clinical impact in most situations.

**Comment**

This was a very interesting study. It was well done statistically, and the use of three different anesthesia providers during different stages of the study was an effective way to assure proper blinding of the randomization, anesthetic technique, and evaluation. This study had a unique focus; the concentration of agent for on-demand follow up doses after CSE or epidural-only initial doses. They found that women who received a CSE needed an epidural follow-up dose sooner than epidural-only analgesia. But more
than that, the parturients who started with a CSE also needed a higher concentration of bupivacaine, had weaker hip flexion, and had a lower sensory block level.

In the end, these two techniques had similar clinical outcomes. However, I found two distinct differences in this study that mirror my clinical practice. The first would be the more rapid onset of intrathecal analgesia, and the second is the need for a follow-up epidural injection sooner after an intrathecal injection than would be needed following an initial epidural-only injection. Both of these observations are clinically significant in my opinion. I find the rapid onset of the intrathecal injection to be very beneficial in most situations, and I can avoid the need for a quick follow-up epidural injection by starting an epidural infusion soon after the intrathecal injection. In about 95% of cases, I find no additional adjustment is needed before delivery. I should add that the addition of a small patient controlled epidural analgesia (PCEA) dose for the epidural (5cc every 30 minutes) helps to eliminate the need for adjustments.

Most women have a change in sensation when the baby’s head presses firmly on the perineum just prior to delivery. The PCEA gives them just enough rapid response, and the perception of control, that they seem to get by this phase with less difficulty than they would without the PCEA. I know of some anesthesia providers who use an epidural-only, periodic injection technique and swear by it. As I have always said, anesthesia is more of an art than a science, and this is especially true in obstetric anesthesia. We find differences in patient populations, facility idiosyncrasies, and physician preferences that influence how we all approach each situation. It is always nice to find studies such as these that tend to verify that different techniques have similar results, and the differences can be either useful or managed for the situation at hand.

Steven Wooden, DNP, CRNA
COMPARISON OF 2 CUFF INFLATION METHODS BEFORE INSERTION OF LARYNGEAL MASK AIRWAY FOR SAFE USE WITHOUT CUFF MANOMETER IN CHILDREN

J Emerg Med 2013 Feb;31:346-52
Kim M, Bai S, Oh J, Youm S, Lee J

Abstract

Purpose  The purpose of this study was to determine whether laryngeal mask airway (LMA) intra cuff pressures would be within a clinically acceptable range during insertion in pediatric patients using two different inflation techniques: half the maximal recommended air volume or resting air volume.

Background  The LMA has gained widespread use for both anesthetists and pre-hospital providers. Learning to insert the LMA and establish and maintain an airway is relatively easy. Additionally, there are fewer complications as a result of LMA use compared to endotracheal intubation. Practitioners have acknowledged, and the literature supports, that the smaller LMAs used in the pediatric aged group are easier to insert when the cuff is partially inflated prior to insertion. What remains unknown is the safest volume of air used to inflate the cuff prior to insertion. There are more complications observed when cuff pressures are excessive, such as mucosal damage and airway edema, in children compared to adults. Additionally, the LMA is difficult to seat and air leakage occurs to a greater extent with abnormally high cuff pressures.

Methodology  After IRB approval was obtained from guardians, 80 children scheduled for elective inguinal hernia repair under general anesthesia were randomized into one of two groups:

1. Half Volume Group: each LMA was fully deflated then filled with half the maximum inflation volume according to manufacturer’s guidelines.

2. Resting Volume Group: each LMA was fully deflated then the pilot balloon valve was connected to a piston free syringe allowing the intra cuff pressure to equalize with atmospheric pressure. The syringe was then disconnected prior to insertion.

Normal saline was used to lubricate all LMAs and each size used was chosen according to the manufacturers guidelines.

Inclusion criteria for the sample were:
- ASA physical status I or II
- Age 0-9 years
- Weight between 5-30 kg
A standardized sevoflurane general anesthetic was administered for all cases without nitrous oxide or neuromuscular blocking agents. An experienced provider inserted all LMAs using a rotational technique. Successful insertion was confirmed using standard practice such as normal capnography waveforms and symmetrical chest wall excursion. Insertion time, ease of insertion, necessary manipulations of the LMA, and repositioning of head or neck were documented. Upon securing the LMA, the intra cuff pressures were measured using a manometer. Oropharyngeal sealing efficacy was determined by measuring airway leak pressures and leak volume (see notes). Intracuff pressures were then adjusted to below 60 cm H₂O, or if less than 40 cm H₂O and with a notable leak, air was inserted to maintain adequate ventilation. Fentanyl was administered or a caudal block performed for perioperative analgesia. The LMAs were removed when each child was awake. Any complications were documented.

Result

A total of 78 patients were able to complete the study; 39 in each group. There were no statistically significant differences between groups in terms of demographic data which included: gender, age, height and weight, ASA status, LMA size, total anesthesia and surgery time. Statistically significant differences were noted between groups in the following variables:

- Half Volume Group required more manipulations to seat the LMA properly (p = .007)
- Half Volume Group had a lower mean intracuff pressure (P = .005)

Half Volume Group had fewer patients with intracuff pressures >60 cm H₂O (P = .04)

Leak volume and leak fraction were lower in the Resting Volume Group only during the mechanical ventilation (P = 0.01)

There were no serious complications in either group and evidence of pharyngeal morbidity was absent during the recovery phase for both groups.

Conclusion

This study demonstrated that inflating the LMA cuff prior to insertion using the Half Volume technique in pediatric patients resulted in a safe intracuff pressure. These pressures may minimize the risk of airway complications. It also demonstrated that using the Resting Volume technique was beneficial as it required less manipulation of the LMA during insertion and an appropriate seal was maintained during mechanical ventilation. Neither technique resulted in evidence of trauma to the airway.

Comment

After analyzing the results of this study very cautiously, I concluded the following. We should be inserting LMAs for all patients, irrespective of age, using a technique which the evidence supports as creating minimal risk of trauma or complications. We should maintain the LMA using techniques that do the same. The most logical manner to approach the process of inserting and maintaining an LMA is with:

1. selection of size based on weight and age
2. always approach insertion with a gentle hand
3. consistently use a manometer!

A manometer is a very important tool in this clinical scenario, yet I rarely see it used. The manometer provides us with an additional piece of data; a
measurement that we can use to prompt an intervention on our part in terms of inflating or deflating the LMA cuff. Using a manometer appears to be one of the best ways to decrease the risk of trauma to the airway when an LMA is properly inserted. Why is it not used on a consistent basis? This study demonstrated that using a Half Volume insertion method minimized excessive intracuff pressures; which are known to cause pharyngeal complications. However, I believe this is most true when the excessive pressures exist for any time beyond insertion time.

This study also demonstrated that a Resting Volume insertion technique resulted in the need for fewer manipulations to establish and maintain the airway quickly. This is perplexing: should we insert the LMA using the Half Volume technique that created adequate intra cuff pressures or the Resting Volume technique that allows for quick establishment of the airway with minimal manipulations required? My own conclusion is this: be extremely gentle, insert the LMA with a half volume technique, immediately assess the cuff pressure with a manometer, and adjust both position and pressure as necessary. If we are secure with the information that excessive intra cuff pressure in the LMA is known to create complications, we should be consistently measuring cuff pressures in order to minimize complications.

Mary Golinski, PhD, CRNA

Notes: Oropharyngeal sealing efficacy was determined by the airway leak pressures and the leak / volume fraction.
Pharmacology

INTRAOPERATIVE INTRAVENOUS LIDOCAINE REDUCES HOSPITAL LENGTH OF STAY FOLLOWING OPEN GASTRECTOMY FOR STOMACH CANCER IN MEN

Kang JG, Kim MH, Kim EH, Lee SH

Abstract

Purpose The purpose of this study was to examine the effects of a systemic bolus and infusion of lidocaine during general anesthesia on pain, postoperative opioid analgesia consumption, ileus, and time until readiness for discharge in men having subtotal gastrectomy.

Background Pain intensity, analgesic medication use, and recovery of bowel function are key aspects of recovery after intraabdominal surgery. Opioid side effects include PONV, respiratory depression, pruritus, and ileus. Interventions that reduce the need for opioid analgesia speed the return of bowel function and readiness for discharge. Lidocaine has analgesic, antihyperalgesic and anti-inflammatory effects. Intraoperative systemic lidocaine has been shown to improve postoperative recovery; specifically to reduce pain, reduce need for opioid analgesia, reduce inflammation, speed the return of bowel function, and speed readiness for discharge. In other studies, patients who received a lidocaine infusion had better pain relief following open prostatectomy and laparoscopic colectomy.

Methodology This was a prospective, randomized, double-blind study of ASA class I and II men, 45 years to 60 years old, having subtotal gastrectomy. Exclusion criteria included severe systemic disease and preoperative analgesic maintenance therapy.

Patients were randomized into a lidocaine or placebo group. The lidocaine group received an IV bolus of 1.5 mg/kg before skin incision followed by an infusion of 1.5 mg/kg/h until skin closure. Placebo patients received an equal volume of saline. All patients were induced with sodium pentothal and maintained with sevoflurane in 50% oxygen and air. Vecuronium was used for muscle relaxation. No opioids were administered until just prior to emergence. Fifteen minutes before the end of surgery all patients received 0.5 mg/kg Demerol. In the PACU, IVPCA with fentanyl and ketorolac was begun. The basal rate included 15 µg/h fentanyl and 1.8 mg/h ketorolac. A demand dose and lockout was also provided. In addition to the IVPCA, patients could receive supplemental Demerol and a fentanyl patch upon request. Patients were assessed for lidocaine side effects throughout the perioperative period. Pain at rest was assessed with a visual analogue scale from 0 to 10 at 24, 48, and 72 hours postoperatively. The time to first flatus and defecation were recorded. Hospital discharge occurred when patients met specific discharge criteria, as judged by surgeons.
blinded to their group assignment. Statistical analysis was appropriate.

**Result** A total of 47 patients were included in the analysis; 24 lidocaine patients and 23 placebo patients. Patient demographics were similar. Hemodynamic changes that might be attributed to lidocaine, such as severe hypotension; low heart rate; or arrhythmias, did not occur intraoperatively. Likewise, no patients reported circumoral numbness, a metallic taste, or visual disturbances while in the PACU.

The amount of Demerol administered in the PACU and IVPCA use at 24 hours, 48 hours, and 72 hours was no different between groups. The number of patients who requested additional pain medicine above the IVPCA and visual analogue scale pain intensities were no different between groups. However, the median total dose of Demerol per patient who asked for additional pain medication was significantly less in the lidocaine group, 50 mg, than in the placebo group, 150 mg (P=0.04). Fentanyl patches were used in 1 lidocaine patient vs. 3 placebo patients and the IVPCA was refilled in 1 lidocaine patient vs. 2 placebo patients, though these differences were not statistically significant. The time to return of bowel function was not statistically significantly different between groups. The time to first defecation was 10 hours earlier in the lidocaine group. Nevertheless, the lidocaine group had a significantly shorter length of hospital stay. Lidocaine patients were discharged in an average of 8.7±1 days vs. 9.5±3 days for placebo patients (P=0.006).

**Conclusion** A low dose bolus and infusion of lidocaine significantly decreased postoperative opioids needed for pain relief following subtotal gastrectomy. Length of stay postoperatively was also reduced by 0.8 days.

**Comment** Don’t give in to the temptation to think that lidocaine didn’t make much difference in these inpatients having a substantial surgery because pain scores, Demerol given in the PACU, and IVPCA use weren’t any different between groups. Remember, open gastrectomies are fairly big cases and quite painful. What lidocaine did in this case was substantially reduce the amount of pain medication needed postoperatively. Lidocaine patients used a full two thirds less Demerol above and beyond their IVPCA, on average, than placebo patients. They were also less likely to need a fentanyl patch or an IVPCA refill. But the final proof that lidocaine was beneficial to gastrectomy patients was the fact that they met hospital discharge criteria almost a day sooner than placebo patients. Not only does this show that the patients were doing better, but it also significantly reduces the cost of care for this surgical population. For inpatient surgery, postoperative care has been shown to make up 50% or more of variable costs. So every day a patient does not spend in the hospital represents a big savings.

These results are impressive. We should give this technique serious consideration.

**Michael A. Fiedler, PhD, CRNA**
**Pharmacology**

**KETAMINE AS AN ADJUNCT TO FENTANYL IMPROVES POSTOPERATIVE ANALGESIA AND HASTENS DISCHARGE IN CHILDREN FOLLOWING TONSILLECTOMY—A PROSPECTIVE, DOUBLE-BLINDED, RANDOMIZED STUDY**

Paediatr Anaesth 2011;21:1009-14

Elshammaa N, Chidambaran V, Housny W, Thomas J, Zhang X, Michael R

**Abstract**

**Purpose** The purpose of this study was two-fold: first, to determine if the combination of ketamine and fentanyl was efficacious in alleviating pain postoperatively in children who had outpatient tonsillectomy surgeries and second, to determine if ketamine was conducive to a safe and speedy recovery in the same population.

**Background** Opioids are typically administered in the post-anesthesia care unit (PACU) to control pain following tonsillectomy. Their use, however, is limited by an extensive adverse effect profile which includes drowsiness and respiratory depression. The adverse effect profile is especially problematic in this high risk group. Children who require tonsillectomy are also often diagnosed with sleep apnea or they have exhibited sleep apnea-like symptoms. Lethargy, drowsiness, and respiratory depression can be detrimental during the immediate recovery period. Many different classes of medications, such as non-steroidal anti inflammatory agents, have been studied as potential alternatives for opioids in order to avoid the adverse effects. Most have met with unimpressive levels of success and acceptance.

Ketamine, which non-competitively binds to the N-methyl-D-aspartate receptor, produces both preemptive analgesia and analgesia. Given in varying doses, it appears to prevent pain before one has exposure to a painful stimulus, such as surgical interventions. Most notably, ketamine does not suppress respirations. Fentanyl is often chosen for analgesia in the PACU for outpatients due to its short duration of action. While numerous studies have been conducted in the adult population assessing the effects of ketamine when used with fentanyl and other opioids, this study focused specifically on post-tonsillectomy pediatric patient. Would the addition of ketamine facilitate a reduction in fentanyl dose, produce effective analgesia, and allow safe and rapid recovery?

**Methodology** This was a prospective, randomized, double-blinded study. A total of 60 children, aged 2-7 years, ASA I and II, and scheduled for elective tonsillectomy with or without adenoidectomy were enrolled. Randomization assigned the participants to one of four groups as follows:

- Group F1: Fentanyl 1 µg/kg
- Group F2: Fentanyl 2 µg/kg
- Group Ketamine: Ketamine 0.5 mg/kg
- Group Fentanyl-Ketamine: Fentanyl 1 µg/kg plus Ketamine 0.5 mg/kg

No child received premedication. Study medications were administered intravenously prior to incision. Induction and maintenance consisted of an inhalation...
technique with sevoflurane in nitrous oxide and oxygen. Neuromuscular blocking agents were used at the discretion of the provider. All children received dexamethasone and ondansetron and were extubated awake upon case conclusion. Pain was measured by a blinded observer at 4 time points: arrival to the PACU and at 30, 60, and 90 minutes following PACU arrival. Supplemental analgesia was administered as needed. The need for supplemental analgesia in the PACU was determined by a FLACC score > 5. Those who required supplements were excluded from subsequent measurements.

**Result** There were no significant demographic differences noted between the groups considering age, weight, and gender. There were no differences between groups in time to awaken / emergence, anesthesia time, incidence of PONV, or emergence agitation/delirium. Only total surgical time and study group a patient was assigned to were predictors of pain upon arrival in the PACU ($P = 0.02$). Pain scores increased with surgical time.

After adjusting for surgical time, pain scores for study groups Ketamine and Fentanyl-Ketamine were significantly lower at PACU arrival time compared to the F1 group. Supplemental analgesia was required in 5 of 15 children in each of the fentanyl only groups; 2 children in the Ketamine group, and 1 child in the Fentanyl - Ketamine group. Groups Fentanyl-Ketamine and F2 had the shortest stays in the PACU and therefore quicker discharge times.

**Conclusion** Children receiving ketamine with or without fentanyl prior to surgical incision for tonsillectomy procedures had statistically significant lower pain scores upon arrival to the PACU compared with those who received only fentanyl at doses of 1-2 µg/kg. In addition, those who received ketamine required less supplemental analgesia in the PACU although this was not statistically significant. In this study, ketamine was found to be a valuable adjunct to fentanyl analgesia with limited adverse effects and a resultant shorter PACU length of stay.

**Comment**

While this study did not demonstrate that pain scores in the PACU remained lower for those who received ketamine, I found this data to be clinically significant and absolutely helpful for enhancing quality care in the immediate post-operative period. Typically, tonsillectomy procedures are not lengthy even when technically challenging to the surgeon, yet those who do require the surgery often have the associated diagnosis of sleep apnea and the immediate post-operative period is a critical time. (It is noted in the literature that if a child does have sleep apnea preceding tonsillectomy, it takes approximately 3 weeks post surgery for all symptoms to disappear). These short procedures are:

- extremely painful during recovery
- involve the airway
- have a potential for post-operative bleeding which may compromise the airway further
- are performed on pediatric patients who often have associated high risk clinical diagnoses

They indeed place these individuals at greater risk and present challenges for the anesthesia provider. Identifying the most appropriate technique to
minimize pain and respiratory depression is always imperative. This is especially true with this surgical population. The multimodal approach described in this study may indeed be safer and more effective than common practice.

Mary Golinski, PhD, CRNA

NOTE: The FLACC Pain Scoring system (Face, Legs, Activity, Cry, Consolability) was designed for children ages 2 months to 7 years. Similar to the APGAR scoring system, the FLACC assigns a score of 0, 1, or 2 to observable characteristics in each of the 5 areas assessed. Higher scores correlate with greater pain. The maximum score is 10.
THE APPLICATION OF DEXMEDETOMIDINE IN CHILDREN UNDERGOING VITREORETINAL SURGERY

J Anesth 2012;26:556-61
Lili X, Jianjun S, Haiyan Z

Abstract
Purpose  The purpose of this study was to determine how dexmedetomidine affected intraocular pressure, hemodynamic patterns, extubation responses and emergence characteristics (i.e. delirium) in the pediatric patient undergoing vitreoretinal surgery.

Background  Administering an anesthetic for small children having ophthalmic surgical procedures can be challenging. Rendering the patient immobile and preventing anesthetic related increases in intraocular pressure are often necessary. Typically, the volatile agent sevoflurane is used because it is well tolerated when used for an inhalation induction, has a low toxicity profile, and provides stable vital signs as well as rapid emergence. However, emergence delirium may occur in up to 80% of pediatric patients. Some intravenous anesthetic agents have been used in an effort to reduce or eliminate emergence delirium but responses have been inconsistent. Dexmedetomidine, a selective alpha-2 adrenergic receptor agonist, has sedative, analgesic, anxiolytic, and sympatholytic properties. In addition, it does not cause respiratory depression. This research was conducted to determine if dexmedetomidine could be added to a standard sevoflurane anesthetic to minimize or eliminate behavior that typically caused an increases in intraocular pressure (IOP) during emergence.

Methodology  This was a prospective, randomized, double blind clinical trial. A total of 60 children, aged 3-7 years, were enrolled. The children were placed in 1 of 2 groups as follows: Group D received dexmedetomidine 0.5 µg/kg diluted in normal saline to a volume of 10 mL over 10 minutes subsequent to a sevoflurane inhalation induction and placement of an IV. Group P received a placebo of normal saline 10 mL during the same time frame. All children received a standardized anesthetic which included 1-2% end-tidal sevoflurane and a remifentanil infusion. Baseline intraocular pressures were measured after inhalation of sevoflurane and again 10 minutes after the dexmedetomidine or placebo infusion. All children were extubated awake and the cough reflex was observed for the first 15 minutes following extubation with the incidence and severity assessed via a 4 point scale. Also documented was the incidence of airway irritability after extubation, the severity of emergence delirium, and pain scores via a modified CHIPPS scale.

Results  There were no statistically significant differences in the demographic profiles between the two groups.
1) IOP was no different between groups at the two time points it was measured.

2) MAP and HR were lower during extubation in the D group (P<0.05)

2) Coughing episodes (10 vs. 21) were fewer in the D group (P<0.05)

2) Coughing was less severe (3 moderate & 7 minimal in group D; vs. 2 severe, 7 moderate & 12 minimal in group P) in the D group (P<0.05)

4) The incidence of emergence delirium / agitation (10% vs. 43%) was lower in the D group (P<0.05)

5) Time to emergence & time to extubation were no different between groups.

The remaining variables measured between the 2 groups, such as time to extubation; airway irritability (laryngospasm, bronchospasm); and pain scores, were not significantly different between groups.

**Conclusion**  
This study demonstrated that pediatric patients having vitreoretinal surgery who received dexmedetomidine 0.5 µg/kg over 10 minutes in a one time dose exhibited less coughing compared to placebo during extubation, had a lower MAP and HR during extubation, and lower incidences of emergence delirium. Dexmedetomidine did not influence IOP or intra operative vital signs compared to placebo.

**Comment**  
It is widely accepted that IOP is largely dependent upon the balance between the formation and drainage of aqueous humor and somewhat affected by changes in choroidal blood volume, vitreous volume, and extra ocular muscle tone. Choroidal blood flow and hence IOP decrease when the mean arterial pressure falls below 90 mmHg. While previous studies found that the administration of dexmedetomidine resulted in lower IOP, it may have been the result of a lower MAP induced by the drug versus the direct effects of dexmedetomidine on alpha-2 receptors. Nonetheless, there are certain situations that warrant a reduction in IOP, such as certain eye procedures. Dexmedetomidine appears to have a role in preventing increases in IOP from occurring. Additionally, the drug itself appears to be quite favorable in terms of its sedative properties, especially in regards to the prevention of emergence delirium often seen in the pediatric patient. While emergence delirium itself may not create a physiologic crisis (unless it progresses to or precipitates an airway emergency), it is quite unsettling to the patient, the caregivers, and certainly the parents of the child. And one could reasonably ask, might preventing agitation during emergence also prevent increases in IOP?

Many of the properties of sevoflurane provide favorable outcomes in the pediatric patient; it would be a shame to reduce its use due to the moderately high incidence of emergence delirium. Administering other medications to minimize emergence delirium has proven problematic, for example narcotics or benzodiazepines, which can cause respiratory depression and prolonged emergence. The sedative, analgesic, anxiolytic, and sympatholytic properties of dexmedetomidine appear helpful for promoting a smooth emergence when combined with sevoflurane in the pediatric patient.

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