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A NEW TECHNIQUE TO REDUCE EPISTAXIS AND ENHANCE NAVIGABILITY DURING NASOTRACHEAL INTUBATION

Anesth Analg 2007;105:1420-1424


Abstract

Purpose  The purpose of this study was to assess whether obturation of a conventional, Murphy-tipped endotracheal tube (ETT) with an inflated esophageal stethoscope balloon tip reduced or minimized nasal bleeding and enhanced insertion through the nasal cavity. A secondary purpose was to compare the benefit of obturation, with that of softening the ETT with warmed saline.

Background  It is not uncommon to intubate the trachea via the nasal cavity and cause nasal bleeding (epistaxis) even when appropriate cautionary insertion steps are used and preparation of the nares is methodical and cautiously carried out. Epistaxis creates potential catastrophic conditions and can negatively influence outcomes based on establishment of the airway or lack thereof. There are several reasons why patients bleed when intubated through the nasal cavity including such causes as: rigid tip or a sharp-edged Murphy eye of conventional endotracheal tubes causing tissue trauma and ineffective nasal preparation. Prepping the nares with topical vasoconstrictors is not without its problems; they are effective in reducing epistaxis but can cause an acute hypertensive response which can be life threatening if the patient has an existing compromised cardiovascular state. Several other innovative ‘techniques’ have been attempted aimed at reducing nasal mucosal trauma when intubating, however, more evidence is needed as to which technique appears to be most favorable.

Methodology  After institutional review board approval was obtained, 200 adult patients were consented and enrolled in the study. All patients were scheduled for elective dental surgery requiring nasotracheal intubation. Patients with a history of bleeding diathesis or nasal deformity were not enrolled. A standardized induction protocol and general anesthetic maintenance regime was carried out. Randomization procedure placed the patients into one of four groups. They were as follows: Group one – ETTs were put into a bottle of sterilized saline at room temperature (for softening), Group two – ETTs were obturated with an inflated esophageal stethoscope and were also placed into a bottle of sterilized saline at room temperature, Group three – ETTs were put into a bottle of sterilized saline that was warmed to 40°C, and Group 4 – ETTs were obturated with an inflated esophageal stethoscope and were put into a bottle of sterilized saline that was warmed to 40°C. After the patients were induced, the ETT, with or without obturation by the esophageal stethoscope and with or without thermo-softening, was inserted. If resistance was met, the tube was withdrawn and specific maneuvers were applied in sequence: counterclockwise rotation with gentle cephalad tilting of the tube, reinsertion into the other nostril, and reinsertion into the other nostril with counterclockwise rotation and gentle cephalad tilting of the tube. Two anesthesiologists performed all intubations and all intubations were completed using a fiberoptic bronchoscope. Recorded data included the number of attempts to insert the ETT into the nasal cavity and the estimated degree of navigability through the nasal passage. A ‘blinded’ anesthesiologist estimated the severity of epistaxis 5 minutes after the intubation. Nasal bleeding was measured by aspirating the nasopharynx using a suction catheter connected to suction tubing. The severity of bleeding was graded according to the distance that blood traveled up the suction tubing. The grading was recorded on the data collection tool. Additionally, before the patients were discharged from the recovery room, they were assessed for difficulty with nasal breathing, persistent nasal bleeding, and postoperative nasal pain. Statistical analysis was calculated to detect differences in the
severity of epistaxis between the non-thermosoftened groups with or without obturation, intubation characteristics and post-procedure complications.

Result There were no statistical differences among groups in terms of demographic data and number of attempts to intubate. There were no intubation failures either. Navigability of the ETT through the nasal cavity was the worse in group one (ETTs were put into a bottle of sterilized saline at room temperature-no obturation); group one also had the most severe epistaxis. This was statistically significant. Group four (ETTs were obturated with an inflated esophageal stethoscope and were put into a bottle of sterilized saline that was warmed to 40°C) had the least severe epistaxis as well as the least amount of post operative nasal pain; this was also statistically significant. There were no significant differences amongst the group regarding the incidences of difficult nasal breathing or persistent bleeding.

Conclusion This study revealed that obturation of the nasal ETT with an inflated esophageal stethoscope combined with thermosoftening of the ETT was effective in minimizing trauma to the naso-pharynx as evidenced by low incidences of bleeding as well as small amounts of measurable blood when suctioned.

Comment While this study was not without its limitations, for example no use of vasoconstrictor substances, it was creative and innovative in technique. In the most stable of patients and in the most controlled situations, nasal bleeding can occur simply from the technique itself of placing a nasal ETT. In any individual, aspiration of blood and/or obstruction of view due to bleeding when trying to establish an airway can be disastrous and lead to horrible outcomes. The technique of obturating the ETT with an esophageal stethoscope and inflating the tip seems like a lot of work and rather cumbersome. However the authors are to be congratulated in their creativity using routine and rather inexpensive items during a sophisticated technique –nasal intubation- to prevent what could be disastrous outcomes.

Mary A. Golinski, PhD, CRNA
USE OF THE MCGRATH VIDEOLARYNGOSCOPE IN THE MANAGEMENT OF DIFFICULT AND FAILED TRACHEAL INTUBATION

Br J Anaesth 2008;100:116-119

Shippey B, Ray D, McKeown D

Abstract

Purpose The purpose of this article was to report three cases of failed or difficult intubation in which the McGrath videolaryngoscope was used to successfully place an endotracheal tube.

Background An ASA closed claims study identified respiratory complications as the largest class of anesthesia complications. Problems with endotracheal intubation constitute a third of these respiratory events. Difficult laryngoscopy is reported to occur in up to 8% of general anesthetics. Failed intubation is rare. Flexible fiberoptic laryngoscopy has long been the approach of last resort to difficult intubation but bronchoscopes are expensive, easily damaged, and not always immediately available. Videolaryngoscopy is a tool that may aid in reducing the number of complications with intubation. Videolaryngoscopy may become the next step when conventional direct laryngoscopy has failed or is judged likely to fail. Videolaryngoscopy is fairly easily learned, highly portable devices are available, and few complications of their use have been reported.

Methodology The following three cases occurred over a three month period.

Case I A 62 year old, 80 kg female with a body mass index (BMI) of 31 kg/m² was discovered unconscious. Her thyromental distance was <6.5 cm (normal ≥ 7 cm), mouth opening > 3 cm, teeth intact, and she had a short neck. She was preoxygenated, anesthesia was induced and she was paralyzed. With cricoid pressure, an inexperienced junior resident failed to intubate, seeing only the epiglottis. Next, a moderately experienced anesthesia resident performed a laryngoscopy and was unable to see the epiglottis despite backward, upward, right pressure on the larynx (BURP maneuver). Next a senior anesthesia resident performed a laryngoscopy with the McGrath videolaryngoscope, visualized the entire glottis, and placed the endotracheal tube (ETT).

Case II A 71 year old, 70 kg female trauma victim arrived with her cervical spine immobilized in a semi-rigid cervical collar. She had an overbite but no other findings associated with a difficult intubation. Anesthesia was induced, she was paralyzed, the cervical collar was removed, and the spine was immobilized with in-line traction. At this point, somewhat limited mouth opening was discovered. With cricoid pressure, an experienced anesthesia resident performed a laryngoscopy and was able to see the epiglottis only with external laryngeal manipulation. He was, however, unable to pass a bougie into the trachea. The patient was ultimately intubated with a flexible fiberoptic bronchoscope and underwent surgery. She was extubated postoperatively. Eight hours postoperatively reintubation was required. Her cervical spine had since been cleared. After administration of propofol and alfentanil (no muscle relaxant) an attending anesthesiologist performed a laryngoscopy with a 4 Macintosh blade seeing only the epiglottis with external laryngeal manipulation. The attending next performed laryngoscopy with the McGrath videolaryngoscope, visualized the entire glottic opening, and placed an ETT on the first try.
Case III A 46 year old, 100 kg female with a BMI of 33 kg/m² was scheduled for an emergency cholecystectomy. A difficult intubation was not predicted despite her airway being assessed as a Mallampati class III. She was preoxygenated, anesthesia was induced and she was paralyzed. With cricoid pressure, laryngoscopy was performed with a Macintosh 4 blade. Only the epiglottis was visualized. On the second attempt, the McGrath videolaryngoscope was used, the entire glottis was visualized, and the ETT was placed in one try.

Result In each of these cases, conventional direct laryngoscopy resulted in a grade 3 or 4 view of the glottis but laryngoscopy with the McGrath videolaryngoscope resulted in a grade 1 view and successful intubation. The authors reported that these experiences were consistent with their wider experience during which almost all patients were intubated with one or two attempts using the McGrath videolaryngoscope. They noted, however, that insertion of the ETT into the glottis, once visualized, was sometimes difficult and required the routine use of a stylet.

Conclusion Using the McGrath videolaryngoscope resulted in expeditious endotracheal intubation in all three patients reported in which the glottis could not be seen during conventional direct laryngoscopy.

Comment

The last two decades have greatly increased our options for placing an endotracheal tube in patients who are difficult to intubate. There are now at least three different models of video laryngoscopes available. I have used two of them in the OR and am encouraged by their potential for facilitating what would otherwise be a difficult intubation.

Flexible bronchoscopes have been available for intubation for a long time. But bronchoscopes are expensive (so we don’t have many of them), hard to clean (so they have down time when they are unavailable), easily damaged, cumbersome, and require a fair amount of training and experience to use skillfully. Videolaryngoscopes, on the other hand, are less expensive (though certainly not cheap), use disposables so cleaning is usually minimal, are less easily damaged because the fiberoptic channel is in a rigid part of the device, are almost as self contained as a standard laryngoscope, and anesthetists require little training and experience to use them skillfully. I hope that all CRNAs will become familiar with these devices and I hope that all departments of any size will acquire at least one for evaluation. More study and experience is needed before I’ll be convinced that videolaryngoscopes should be the place to start when a difficult intubation is encountered. Additionally, the devices now available have different features and advantages. It may be that, with further experience and testing, we learn that one of these devices is clearly better than the others. In the end, though, I wouldn’t be surprised if a videolaryngoscope turns out to be the next big thing in anesthesia.

Michael Fiedler, PhD, CRNA

Anesthesia Abstracts will closely watch the information becoming available about videolaryngoscopes and keep you informed. If you have clinical experience with videolaryngoscopes please share your assessment with your colleagues in the “blog with the editors” section of the web site. If you have suggestions about coverage of this topic please share it with the editors through the “contact us” link on the web site.
THE PENTAX-AWS VIDEO-LARYNGOSCOPE: THE FIRST EXPERIENCE IN ONE HUNDRED PATIENTS

Anesth Analg 2008;106:257-259

Asai T, Enomoto Y, Shimizu K, Shingu K, Okuda Y

Abstract

**Purpose** The purpose of this evaluation was to assess the performance of the Pentax-AWS videolaryngoscope in a series of 100 anesthetized patients.

**Background** The Pentax-AWS is one of several newly available videolaryngoscopes designed to aid in intubation when conventional direct laryngoscopy is difficult or impossible. The waterproof laryngoscope handle contains the light source, a video camera, and a color video display screen. The display screen is unique in that it has a “target” cross hair positioned in the middle of the screen to indicate the direction of travel of the endotracheal tube (ETT) when it is advanced. A disposable component acts both as the laryngoscope blade and as a guide for the ETT and, optionally, a suction catheter. Prior to use, the ETT is positioned in the guide without a stylet. The tip of the ETT is visible on the monitor while the videolaryngoscope blade is being advanced into the mouth. Once the glottis is visible and the target on the video screen is positioned over the glottis the ETT can be advanced into the trachea.

**Methodology** This evaluation included ASA class I – III patients with normal airways. Patients thought to have a difficult airway, those at risk for aspiration of gastric contents, and those with airway or neck pathology were excluded. An 8 mm ETT was used in men and a 7 mm ETT was used in women. The study was observational with only one group. All patients where anesthetized and paralyzed by an experienced anesthesiologist who had trained with the Pentax-AWS on a manikin prior to the study. Total intubation time was measured from picking up the videolaryngoscope to removal of the videolaryngoscope from the mouth.

**Result** The study included 100 patients. The complete glottic opening was visible on the first attempt in 99 of 100 patients. In one patient the Pentax-AWS was not used when it was discovered that the patient had a number of loose teeth. Intubation was successful in 98 of 99 patients, 96 with one attempt and 2 with two attempts. The single failure was due to the ETT hanging up on the arytenoid cartilages. The median time for intubation was 35 seconds (range 5 to 120 seconds).

Overall, the investigators judged the Pentax-AWS to be easy to insert, obtain a full view of the glottic opening, and advance the ETT into the glottis. Advancing the ETT into the glottis was easier than their previous experiences with other videolaryngoscopes. The Pentax-AWS was somewhat difficult to use in patients with limited mouth opening due to the maximum width of the laryngoscope blade, 2.5 cm. While the blade / ETT guide was disposable and the handle easy to clean, the blade cost approximately $20 during the study period.

**Conclusion** The Pentax-AWS was easy to use in patients with normal airways. It offered the advantage of easy ETT advancement without a stylet as long as sufficient mouth opening was possible.
Comment

I’ve long wished we had some sort of “Consumer Reports” style journal that rigorously evaluated and compared the equipment and supplies we use in anesthesia and critical care. It doesn’t seem efficient to base our purchase decisions on informal, and often very limited, evaluations. And the rigorous evaluations sometimes performed are costly for an individual department both in terms of professional time invested and money spent. As a result, I’m excited to see structured evaluations such as this one and hope to see more of them in the future.

The Pentax Airway Scope has arrived a bit later than other videolaryngoscopes and, I think, is less well known. It is different than the Glidescope and McGrath videolaryngoscopes in some important ways. With other devices, the ETT must be directed towards the glottis at quite an angle. Even with a correctly angled stylet and the ability to see the ETT and the glottis on a video screen, it can sometimes be difficult to direct the ETT into the glottis. The AirWay Scope has a disposable plastic guide that clips onto the video laryngoscope. An ETT is pre-positioned in the guide which aims the tip of the ETT at a target that appears in the middle of the video screen. No stylet is used. I have used the Pentax AirWay Scope once to intubate a patient with a normal airway. I found it much easier to advance the ETT into the glottis than with other video laryngoscopes I’ve used. Of course, that was one intubation in a patient with a normal airway. Any evaluation of the benefits of the AirWay Scope should be based upon a number of intubations in patients with difficult airways. Nevertheless, I was encouraged by the well thought out design and ease of use.

Michael Fiedler, PhD, CRNA

More information about, and photographs of, the Pentax AirWay Scope is available at the manufacturer’s web site at:

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Abstract

Purpose  The purpose of this study was to compare cervical spine movement during oral endotracheal intubation with the AirWay Scope (Pentax, Tokyo, Japan), McCoy laryngoscope, and Macintosh laryngoscope.

Background  Traditional laryngoscopy with a Miller or Macintosh laryngoscope blade requires extension of the cervical spine. Patients with limited cervical spine mobility may be difficult to intubate. In patients with cervical spine injury, or presumed injury, movement of the cervical spine is undesirable.

The AirWay Scope is a video laryngoscope handle with a color video camera and screen built in and a guide through which the endotracheal tube (ETT) is advanced. The bulk of the device requires somewhat greater mouth opening prior to insertion than do the Macintosh or McCoy laryngoscopes.

Methodology  This prospective, randomized, blinded study included ASA I and II patients with normal cervical spines who were scheduled for elective surgery that required general anesthesia and endotracheal intubation. Exclusion criteria included age less than 18 years, predicted difficult intubation, and the absence of incisors. Subjects were intubated with one of three devices: the AirWay Scope, the Macintosh laryngoscope, or the McCoy laryngoscope (Penlon Ltd, Abingdon, UK). Anesthesia was induced with propofol 1 mg/kg, ketamine 1 mg/kg, fentanyl 100 µg/kg, and vecuronium 0.1 mg/kg. Cervical spine (C-spine) motion was assessed separately during mouth opening and during insertion and use of the laryngoscopes. C-spine motion was recorded via fluoroscopy and evaluated by a single radiologist who was unfamiliar with the laryngoscopes being used and unaware of the purpose of the evaluation. C-spine motion was expressed in degrees of change with negative numbers indicating flexion and positive numbers indicating extension.

Result  Though 45 patients were enrolled, data from only 37 were analyzed. Seven were excluded because of technical issues with the fluoroscopic recording. One was excluded because the vocal cords were not visualized with the McCoy laryngoscope. This patient was visualized and successfully intubated with the AirWay Scope.

During mouth opening, median upper C-spine movement was –5° (range –16° to –1°) in the AirWay Scope group, –1.3° (range –9.5° to +4°) in the Macintosh group, and –4° (range –12° to +6.5°) in the McCoy group (P not significant).

During insertion and use of each laryngoscope, median cumulative upper C-spine movement was +22.3° (range +3.5° to +30°) in the AirWay Scope group, +32.3° (range +19° to +39.5°) in the Macintosh group, and +36.5° (range +23° to +56°) in the McCoy group (P<0.001, AirWay Scope compared to Macintosh and McCoy groups). Median movement at the C-1 / C-2 interface was
statistically significantly less (P<0.012) than the other laryngoscopes. Median movement at the C-3 / C-4 interface was statistically significantly less (P<0.019) than the McCoy laryngoscope.

The average (standard deviation) time required for intubation was 29.8 (15.4) seconds in the AirWay Scope group, 16.8 (10.7) seconds in the Macintosh group, and 23 (5) seconds in the McCoy group (P=0.030).

**Conclusion**

The least amount of C-spine motion was observed during intubation with the Pentax AirWay Scope video laryngoscope, though it took longer than with either the Macintosh or McCoy laryngoscopes. Mouth opening to insert the AirWay Scope resulted in slightly greater (statistically insignificant) C-spine motion than did mouth opening for either of the other laryngoscopes.

**Comment**

I’m encouraged to see the number of new video laryngoscopes that have become available recently. Manufacturer’s research and development efforts in this area stand not only to make our work easier but may also contribute to lessened morbidity and mortality. Intuitively, it seems as though using a videolaryngoscope would require less extension than direct laryngoscopy and, thus, result in less cervical spine motion.

I found it interesting that C-spine motion occurred during mouth opening. We are probably all used to C-spine stabilization beginning before mouth opening, but in preparation for intubation, not to prevent C-spine movement during mouth opening. From here on, I’ll be thinking about C-spine motion during mouth opening as well as during intubation.

There are a number of studies of cervical spine motion during various intubation techniques. This one gets points for using appropriate and conservative statistics. I have confidence in the results that were presented. It is easy to expect that the cervical spine doesn’t move at all during intubation with a video laryngoscope because we don’t actively extend the neck. This study in normal airways shows that this is not the case, though the AirWay Scope was associated with less C-spine motion than direct laryngoscopy. Until we have C-spine motion studies using the Pentax AirWay Scope in patients with difficult airways, this information suggests that intubation with the AirWay Scope produces noticeably less C-spine motion than direct laryngoscopy.

Michael Fiedler, PhD, CRNA

More information about, and photographs of, the Pentax AirWay Scope is available at the manufacturer’s web site at:


More information about, and photographs of, the Penlon McCoy laryngoscope is available at the manufacturer’s web site at:

http://www.penlon.com/products/laryngoscopes/mc_coy.html
Abstract

Purpose     The purpose of the study was to ascertain if combining a superficial cervical plexus block with a general anesthetic minimized postoperative pain in those who had undergone carotid artery surgery. A secondary purpose was to assess the level of patient satisfaction with this combined technique for post operative pain control.

Background     Reducing stress during the peri-operative period for individuals who have carotid artery disease is of paramount importance. High degrees of stress, especially when amplified due to pain and discomfort, can lead to hypertension which can, in turn, lead to complications such as stroke and myocardial ischemia. Many individuals who have carotid artery disease requiring an endarterectomy already suffer from hypertension as well as coronary artery disease. Administration of a general anesthetic with the newest and most modern agents is typically not a problem; titration of these rapid acting, rapidly metabolized, and rapidly eliminated drugs allows for appropriate control of one’s hemodynamics. However, post operative pain management remains challenging. In the immediate post operative period, patients must be awake and oriented, and be able to cooperate during a neurologic assessment. Intravenous opioids can alleviate any discomfort; they clearly cause somnolence and make it difficult to ascertain a required neurologic assessment. Superficial cervical plexus blocks offer a safe and efficacious alternative to control pain and discomfort, therefore potentially eliminating the vicious cycle of stress due to pain leading to hemodynamic instability which can worsen the stress and continue the cycle.

Methodology     The research was carried out as a randomized, controlled, blinded prospective study. After IRB approval, patients were enrolled and informed consent was obtained from those who were scheduled for elective and unilateral carotid endarterectomy surgery. Forty six patients were randomized in to 1 of 2 groups (n=23 for each group). The treatment group received a superficial cervical plexus block with ropivacaine 10 mL of a 10 mg/mL (1%) solution after a standardized general anesthesia induction regime was completed. The control group also received a superficial cervical plexus block but the block was administered using 10 mL of NaCl 0.9% solution. The same standardized general anesthetic induction regime was completed with the placebo group. The provider was blinded to the solution used for the blocks; the syringes were prepared by a nurse not involved in the study itself. During the procedure, somatosensory evoked potential monitoring was done of the median nerve to detect carotid clamp associated cerebral ischemia and the need for shunt insertion. When the patients were taken to the recovery room post procedure, patient controlled analgesia (PCA) was provided utilizing morphine sulfate. No other analgesic drugs were administered. Pain levels were assessed via a visual analogue pain scale (VAS) per protocol. Upon discharge from the recovery room, arterial pCO₂ was obtained and documented, and each patient was asked to score the quality of their pain therapy using a simple scale technique, for example, 1 as ‘very good’ and 6 as ‘insufficient’. Statistical analysis scored the differences between the two groups in terms of morphine sulfate consumption via the PCA, maximum pain level via the VAS, arterial pCO₂ level and quality of pain therapy.

Result     The analysis did not show any differences in demographic variables between the two groups. After exclusions due to non-steroidal anti-inflammatory drug usage in the recovery room, 23 patients were in the ropivacaine group and 19 patients were in the placebo group. Surgical technique was endarterectomy with patch closure in 36 patients (ropivacaine group n = 19 and placebo group n = 17), eversion endarterectomy in 5 cases, and graft interposition in 1 case. No shunts were used intra operatively. None of the patients demonstrated neurologic deficits within 24 hours after surgery and there were no complications as a result of the cervical plexus block. The ropivacaine superficial cervical plexus block group demonstrated lower (maximum) VAS scores, lower morphine
sulfate consumption via PCA, and higher patient satisfaction scores. All three of these variables were statistically significant. Statistical significance was not seen between the two groups of arterial pCO₂ measurements.

**Conclusion** This prospective, randomized, controlled clinical study demonstrated that those patients who received a ropivacaine superficial cervical plexus block for post operative pain control after carotid artery surgery required significantly less morphine in the recovery room and had higher satisfaction scores regarding their pain control experience. The superficial cervical plexus block for carotid surgery is a relatively easy-to-perform technique for blocking the cutaneous branches of the cervical plexus. It offers an appropriate degree of analgesia and bears no additional risks to these patients. The patients in this study were highly satisfied with their pain management technique.

**Comment**

Combining a regional anesthetic technique with a general anesthetic, when either technique alone does not achieve the desired outcome, offers great potential. This is especially true in the high risk patient undergoing high risk surgical procedures. Often times, alternative methods of pain control, such as intravenous opioids, simply cannot be tolerated, cause post operative complications, and can alter a neurologic status when immediate assessment is needed. Regional anesthetic techniques have become more and more commonplace and appear to be well tolerated in the patient as well as demonstrating high levels or degrees of satisfaction. In skilled hands, with all necessary pre procedure protocols maintained, regional anesthesia for post operative pain control can lead to superior outcomes. It should be considered when applicable, when the benefits far outweigh the risks, with the intent to maximize patient safety, comfort and satisfaction. The combined anesthetics may indeed take more time to perform, but all things considered, may minimize post operative complications and this itself may be a significant benefit outweighing the care and time needed to treat complications.

Mary A. Golinski, PhD, CRNA
FATAL ERRORS IN NITROUS OXIDE DELIVERY

Anaesthesia 2007;62:1202-1206


Abstract

Purpose The purpose of this report was to describe the number of deaths that occurred due to inspiration of excessive concentrations of nitrous oxide during general anesthesia.

Background Human error is responsible for 82% of complications during anesthesia. Airway-related complications account for at least 50% of anesthesia-related deaths. Nitrous oxide is frequently used during general anesthesia. Excessive nitrous oxide may be delivered as a result of a gas supply misconnection or failure of anesthesia machine safety systems (e.g. the oxygen – nitrous oxide flowmeter interlock). Catastrophic nitrous oxide-related morbidity and mortality seems to be a rare event. A Medline search produced only a few case reports over the last 30 years, none since 1990.

Methodology The authors hypothesized that deaths due to excessive nitrous oxide administration had occurred in the preceding years despite the absence of reports in the scientific literature. Believing that such a complication would result in legal action and media coverage they searched 30 national newspapers, 3 weekly magazines, and 3 internet-based news archives as well as 110 local periodicals for the term “nitrous oxide.” When the search term was found they read the body of the article to determine if it was related to an anesthesia death. (Nitrous oxide is also used, for example, in high performance cars.) The search encompassed a two and a half year period beginning in April of 2004. News sources from Germany, Switzerland, and Austria were searched.

Result Six anesthetic deaths associated with excessive nitrous oxide administration were identified. No non-fatal cases were identified.

Case 1: The first patient anesthetized at a newly opened outpatient surgery center became hypoxic during induction of anesthesia, arrested, and died following resuscitation efforts. The oxygen pipeline had been connected to the nitrous oxide source during construction of the surgery center.

Case 2: A 19 year old slightly injured accident victim arrested during induction of general anesthesia and died following resuscitation efforts. The oxygen pipeline was connected to the nitrous oxide tank in the basement of the hospital.

Case 3: The oxygen pipeline of a cardiopulmonary bypass machine was connected to the nitrous oxide supply. A patient died of hypoxia during bypass.

Cases 4-6: In a single week, three women died in the same hospital during induction of general anesthesia for cesarean section. The oxygen and nitrous oxide supplies were misconnected within the anesthesia machine.
In each case, attention to a properly functioning and calibrated inspiratory oxygen monitor would have revealed the problem early on. Furthermore, the process of preoxygenation can be used as a biologic test of the oxygen supply. An increase in the patient’s oxygen saturation while breathing 100% oxygen is consistent with a normally functioning oxygen supply. A falling oxygen saturation while breathing what should be 100% oxygen may indicate the inhalation of an hypoxic gas mixture.

**Conclusion**

Hypoxia due to the delivery of inappropriately high concentrations of nitrous oxide have occurred since 1990 despite the lack of reports in the scientific literature.

**Comment**

This article is a case study in how using your head can get you far. For me, it makes three great points and any one reading this comment right now could have done just exactly what these authors did. (No research training required.) I love this report, in part, because it shows thinking without even an awareness that their might be a box to think in (it is that far, “outside the box”).

We are used to things working correctly and we are used to trusting the wall oxygen supply. Complacency could come quite easily. Nevertheless, oxygen pipelines are sometimes connected to the wrong gas supply and equipment sometimes fails. The first point is a rather obvious one. Never trust the label on the gas supply – always use a properly functioning, calibrated, inspiratory oxygen monitor. The anesthesia machine check can be drudgery and it might be tempting to scrimp on the machine check. But making sure the oxygen monitor works and is calibrated is the best way I can know that I am really administering oxygen.

The second point is that just because we don’t hear about a complication in anesthesia journals doesn’t mean it isn’t occurring. These authors’ approach to finding evidence of nitrous oxide complications was novel and ingenious and so simple we’re all wondering why we would never of thought of it.

The last point was, for me, a new way to think about “preoxygenation.” I’ve always been a believer in preoxygenation because it increased the margin of safety so that even in that healthy patient, if something went totally wrong only once in my career I’d have the longest possible time to fix it before the patient started becoming hypoxic. But here, the authors give me a new reason to preoxygenate patients. Not only is it to increase the concentration of oxygen in their lungs, it is also as a final verification that the gas marked oxygen really is oxygen.

Don’t get me wrong. If one of us had been preoxygenating a patient and the patient had become hypoxic we would certainly have noticed the fall in oxygen saturation and investigated the problem. I’m not suggesting that if the circumstance had arisen we would have missed it. But that is reacting to the problem. These authors taught me to proactively think about preoxygenation as a test of the oxygen supply system as well as a way to increase the concentration of oxygen in the patient’s lungs prior to induction. That, for me, was an important new way of thinking about preoxygenation.

Michael Fiedler, PhD, CRNA
TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION AT THE PC-5 AND PC-6 ACUPUNCTURES REDUCED THE SEVERITY OF HYPOTENSION AFTER SPINAL ANAESTHESIA IN PATIENTS UNDERGOING CAESAREAN SECTION

Br J Anaesth 2008;100:78-81


Abstract

Purpose The purpose of this study was to compare the hemodynamic effects of Transcutaneous Electrical Nerve Stimulation (TENS) at the PC-5 and PC-6 acupuncture sites, sham acupuncture sites, and in control women not receiving TENS during cesarean section with spinal anesthesia.

Background Hypotension occurs commonly in women undergoing a cesarean section with spinal anesthesia. Traditionally, IV fluid preloading, left uterine displacement, and vasopressors have been used in an effort to prevent hypotension in these patients. Acupuncture-based treatments have been used for anxiety, nausea and vomiting, and analgesia. In animal studies, electrical stimulation at the PC-5 and PC-6 acupuncture points has increased sympathetic stimulation resulting in an increase in stroke volume and cardiac output. The PC-5 and PC-6 sites are located on the palmar side of the distal forearm between the long palmar and radial flexor tendons. Previous studies using TENS for electroacupuncture have shown different effects with different frequencies of TENS stimulation. TENS at 2-4 Hz inhibited sympathetic responses, at 5 Hz no changes were seen, and 30-70 Hz was associated with a vasoconstrictor response.

Methodology This prospective, randomized, single blind study included ASA I, term pregnant women scheduled for cesarean section. Women with preeclampsia, preexisting hypertension, diabetes, or a body mass index > 30 kg/m² were excluded. Control women received no TENS treatment. The non-acupoint group received TENS at sham (non-acupuncture) locations on both shoulders. The acupoint group received TENS bilaterally at both the PC-5 and PC-6 acupuncture points on the distal forearm via 1.5 cm electrodes.

In TENS groups, a 50 Hz TENS current was turned up to the greatest intensity that women would tolerate without muscle contraction or discomfort. All women received 10 mL/kg lactated ringers. Next an epidural catheter was inserted at the L1-L2 interspace and a subarachnoid block with 12 mg of isobaric bupivacaine and 20 µg fentanyl was performed at the L3-L4 interspace. The epidural was dosed with 1% lidocaine as needed to achieve or maintain a surgical level of anesthesia. The cesarean section began when a block of at least T-6 was achieved. Ephedrine 4 mg was given every two minutes if the systolic blood pressure (BP) was 30% below baseline or less than 90 torr.

Result Each group included 12 subjects. Baseline BP and heart rate were similar between groups. The incidence and total dose of epidural lidocaine injections were also similar between groups.
The lowest BPs were higher in the acupoint than in either of the other groups. The lowest median systolic BP was 70 torr (range 68-82) in the control group, 81 torr (range 71-92) in the non-acupoint group, and 94 torr (range 84-109) in the acupoint group (P<0.001). The incidence of hypotension was 83% in the control group, 83% in the non-acupoint group, and 33% in the acupoint group (P=0.013). HR was no different between groups. The control group received a median of 8 mg of ephedrine (range 8-16), the non-acupoint group received 14 mg (range 8-18), and the acupoint group received a median ephedrine dose of 0 mg (range 0-12) (P=0.025).

Conclusion TENS stimulation of 50 Hz at the PC-5 and PC-6 acupuncture sites was associated with a lower incidence and severity of hypotension than TENS stimulation at a non-acupuncture site or control patients receiving no TENS stimulation during cesarean section with regional anesthesia.

Comment

Studies like this intrigue me even though I understand so little about how the treatments really worked. For that matter, while I’ve not read widely about it, I’ve never read anything that purports to describe a definite mechanism by which acupuncture works. While we tend to be accepting of familiar things with unknown mechanisms of action (how do inhalation agents produce general anesthesia?) we are less accepting of “foreign” things with unknown mechanisms of action (acupuncture).

Hypotension occurs in most women who have a cesarean section with spinal or epidural anesthesia. I don’t think we really understand the mechanism(s) responsible for this hypotension. The most commonly used preventative treatment, IV fluid preloading, has been studied extensively for a couple decades without much of a reduction in the incidence or severity of maternal hypotension.

While this study was small, women who received TENS at specific acupuncture sites on the forearm had an unmistakably lower incidence and severity of hypotension. Some pregnant women are at greater risk for hypotension and some anesthesia techniques are more likely to result in hypotension. These women may all have been at low risk of hypotension, we don’t have enough information to know. But, even if they were, a lowest median systolic BP that was 24 torr higher with TENS than without it has got to catch your attention. The body defends BP with the sympathetic nervous system, the rennin-angiotensin system, and the vasopressin system. All three are disabled or diminished by the high level sympathetic block that accompanies spinal or epidural anesthesia for cesarean section. If, as other studies seem to indicate, TENS at specific locations restores some of that sympathetic output, perhaps it could be developed into a valuable tool for use during spinal and epidural anesthesia.

I’m not suggesting that we all dive head first into this treatment based upon a single article. That said, I wouldn’t be surprised if little if any further study showed up in this area. I wouldn’t be surprised if this treatment did not make it into our OB anesthesia toolbox.

Given that TENS itself has been established as a treatment with low risk and there may be significant benefit to women undergoing cesarean section with regional anesthesia I have to wonder why. Does the association with acupuncture make it just too foreign?

Michael Fiedler, PhD, CRNA
RISK, BENEFITS AND COMPLICATIONS OF EPIDURAL STEROID INJECTIONS: A CASE REPORT

AANA J 2007;75:183-188

Snarr J

Abstract

Purpose The purpose of this report was to describe risks, benefits, and complications of epidural steroid injections for pain management.

Background Low back pain associated with radiculopathy occurs in about 2% of the United States population primarily in those between the ages of 25 and 45. Epidural steroid injections (ESI) are routinely performed to treat back pain associated with radiculopathy. About a half million ESIs are performed every year in the United States. Side effects are rare but can include discomfort, infection, steroid side effects, dural puncture headaches, epidural hematoma, and nerve injury. Clinicians who perform ESIs should be aware of indications, contraindications, and risks involved in performing these procedures.

Methodology An 87 year old male presented with bilateral lower extremity weakness, loss of sensation, and bowel and bladder incontinence. Magnetic Resonance Imaging (MRI) indicated that the patient had an epidural hematoma from T-10 to L-2 with compression of the intrathecal sac. The patient was taking warfarin for a history of cerebral vascular accident while being treated for lower back pain with an ESI. He was scheduled for an evacuation of the hematoma and spinal cord decompression. His INR was 2.3, PT was 23, and PTT was 31. The clotting disorder was treated prior to surgery with factor VII and fresh frozen plasma. The procedure was completed without further complications, however the patient did not improve neurologically.

Result Radicular pain is most frequently caused by nerve root inflammation and not mechanical compression. Research has demonstrated one of the major reasons for nerve root inflammation is disc herniation or rupture. ESI has evolved over the years. Originally large amounts of local anesthetics and steroids were administered because diagnosis of the affected area was imprecise. Modern imaging has provided more precision in the diagnosis and placement of the epidural needle allowing for reduction in the volume and concentration of medication. There are other treatments for low back pain but patients who do not respond to oral anti-inflammatory agents, rest, or physical therapy but have positive physical findings for radiculopathy associated with nerve root inflammation may respond well to ESI. The reason these patients respond to ESI is thought to include the inhibition of inflammation and leukocyte adherence demonstrated by glucocorticoids. Literature reports of the benefits of ESI are inconclusive. Reasons given for variable results include inaccurate placement of steroid, type and quantity of steroid used, volume of material injected, underlying pathophysiology, and duration of symptoms.

Some studies indicate inaccurate placement of the epidural can occur up to 40% of the time. The use of fluoroscopy is thought to improve epidural needle placement and produce a higher rate of symptom relief. However, cost is increased and clinical evidence is inconclusive to justify the routine use of fluoroscopy. Most clinicians suggest that the combination of ESI and a rehabilitation program is the most effective approach. Clinically, patients that had symptoms for less than three months had significant reduction in their symptoms with up to three ESIs. Chronic symptoms of greater than three months show less effective results.

There are a few absolute contraindications to performing ESIs. They are, systemic and injection site infection, bleeding disorders or
anticoagulation therapy, allergy to the planned medication, and patient refusal. Side effects and complications include the rare possibility of immunosuppression from the steroid which increases the risk of infection, inadvertent dural puncture which could result in post dural puncture headache (PDPH) in as many of 50% of such cases, local trauma to soft tissue, nerve damage resulting in long term neurological complications, and the formation of an epidural hematoma which may occur in approximately 1:200,000 neuraxial injections.

Expansion of a hematoma in a closed space like the epidural space can cause spinal cord compression and nerve injury. The injury can be permanent if not treated rapidly. Epidural hematomas may result because of vascular malformations, coagulopathies, and anticoagulant therapy, but they may also occur spontaneously without known cause. Evaluation of patients who have taken anticoagulants (including certain herbal remedies) or those with a history of haemostatic problems is prudent, before performing an ESI. Early recognition and treatment of an epidural hematoma is important. Symptoms of an epidural hematoma may include a new onset of parathesia and weakness, bowel and bladder dysfunction, and back pain.

The American Society of Regional Anesthesia and Pain Medicine has recommended that patients on Warfarin discontinue its use five to seven days before an ESI and a normal INR be documented. They also suggest that there is no reason to delay ESI when patients are taking NSAIDs.

**Conclusion**

Low back pain and radiculopathy is a major disability problem in the United States. ESIs are a common treatment for this problem. This case report indicates how important it is for those performing ESIs to know the indications, contraindication, and complications associated with ESIs.

**Comment**

This case report points out a rare but significant side effect of Epidural Steroid Injections. Although complications from Epidural Steroid Injections are reported to be rare, they can result in permanent neurological damage. Simple preparation and evaluation of a patient’s history and physical status can often prevent the most devastating complications. Proper evaluation prior to performing an ESI is essential to high quality care. We must always be on guard against the erosion of quality care that can be caused by production pressure, financial considerations, or inadequate preparation.

Even with the best preparation unfortunate events can happen. This is why it is critical to properly instruct the patient to look for side effects associated with complications, and report the development of such side effects immediately. It is also important to evaluate the risks and benefits to each patient. Any significant risk should be avoided.

This paper has done a reasonable job of presenting a simple historical perspective, risks, complications, and benefits of epidural steroid injections. It does not explore the rapidly changing face of pain management for lower back pain. In the past few years, the benefit of treating back pain with traditional ESIs has been questioned. Changes in the perceived benefit of treating lower back pain and radiculopathy with ESIs may result in a significant drop in the number of ESIs performed in favor of specific nerve root injections and other therapy. Regardless of the direction this treatment takes, it will continue to be important for providers who perform these procedures to be knowledgeable of the risks, benefits, complications and treatment options for patients with lower back pain.

Steven R Wooden, MS, CRNA

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Epidural Steroids in the Management of Chronic Spinal Pain: A Systematic Review

Pain Physician 2007;10:185-212


Abstract

Purpose This review evaluated the effectiveness of various types of epidural steroid injections for pain in the cervical and lumbar regions.

Background Back pain is the most commonly reported of all chronic pain complaints. In the United States, epidural procedures to treat back pain have more than doubled to 1.7 million procedures from 1998 to 2005. However, the benefit of these procedures remains controversial. Although the mechanism of action for epidural injections are not well understood, it is thought that the administration of local anesthetics interrupts nociceptive input and interrupts the pain-spasm cycle while steroids reduce inflammation by inhibiting either the synthesis or release of inflammatory mediators. There are three different approaches typically taken to access the effected tissue in the epidural space. They include the interlaminar (midline), transforaminal (selective nerve root), or caudal approaches. In addition, these approaches can be used for pain treatment in the cervical, thoracic, and lumbar regions of the spine.

The purpose of this review was to evaluate the current effectiveness and complications of the various approaches to treating different types of chronic spinal pain.

Methodology A literature search was performed for studies evaluating patients with chronic spinal pain which had a duration of at least three months. The interlaminar, transforaminal, and caudal approaches to treatment were evaluated. The primary measurement used was the presence of short term (less than six weeks) and long term (greater than six weeks) pain relief. Secondary measurements included physical and psychological improvement, return to work, and complications.

Result The interlaminar approach in the lumbar region was evaluated using 11 randomized trials. The lumbar trials resulted in positive results for short term pain relief (less than six weeks) in 7 of the 11 studies. Two of 11 studies showed positive results for long term pain relief (greater than six weeks). Studies that reported negative short term and long term pain relief included patients with disc herniation, spinal stenosis, and post laminectomy syndrome. One study described patients who received lumbar interlaminar epidural injections with bupivacaine (10 mL of 0.25%) and triamcinolone (80mg) at zero, three, and six weeks. It reported significant improvement at three weeks which was lost at six weeks. Another study evaluated the effects of injections in the lumbar epidural space and interspinous ligament on the reduction in back surgery. That study showed no reduction in the rate of back surgery.

In the cervical region, two randomized trials were included. Both trials for cervical pain relief were positive for both short and long term relief.

The review indicated that interlaminar epidural steroid injections were strongly effective for short term pain relief and only limited for long term pain relief. Cervical injections showed moderate results for both short and long term relief. The evidence was inconclusive for axial neck pain, axial low back pain, and lumbar spinal stenosis.
For transforaminal injections, seven randomized, eight prospective, and seven retrospective studies were evaluated. Six of the trials showed effective results for lumbar disc herniation and radiculopathy with mixed results in four of the six for short and long term results. The seventh trial showed no benefit for post surgery syndrome. Two of the prospective studies showed positive results for cervical transforaminal injections. The remaining prospective studies evaluated lumbar transforaminal injections and most were positive. One study looked at the long term effects of transforaminal injections in treating lumbar radicular pain leading to the reduction in need of surgical intervention. It found 29 of 55 patients cancelled their scheduled back surgery and, after five years, 17 of those patients still had not needed surgery. The review demonstrated significant cost effectiveness for transforaminal injection in both quality of life and surgery avoidance. The transforaminal approach was strong for short term relief and moderate for long term relief in the lumbar region, while the relief for cervical pain was moderate in both short and long term. Relief was limited for post laminectomy syndrome and inconclusive for axial low back pain, axial cervical pain, and lumbar disc extrusions.

For the caudal approach, eight randomized trials and five prospective studies were included. Five of the trials were positive for short term relief and four for long term relief. All five of the prospective caudal studies showed positive results. The cost effectiveness of fluoroscopic caudal epidural injections was greater than transforaminal injections. Overall, caudal injections were strong for short term relief and moderate for long term relief.

The incidence of complications was also evaluated for all approaches. Complications included dural puncture, spinal cord trauma, infection, hematoma, abscess, subdural injection, intracranial air injection, epidural lipomatosis, pneumothorax, nerve damage, headache, death, brain damage, increased intracranial pressure, intravascular injections, vascular injury, cerebral vascular or pulmonary embolus, steroid effects, and radiation damage. The incidence of minor complications was reported to be between 8.1% and 20.5% in the studies evaluated. Major complications were very rare, but resulted in severe injury.

**Conclusion**

A systematic literature review was accomplished for three types of epidural injections to treat spine pain. Lumbar interlaminar injections for radicular pain provided effective short term relief and limited long term pain relief. Cervical interlaminar injections provided moderate short and long term relief of cervical spine pain.

Transforaminal injections provided effective short and long term relief for lumbar nerve root pain but only moderate relief for lumbar radicular pain in post lumbar laminectomy syndrome.

The caudal approach provided effective short term pain relief and moderate long term relief for lumbar radiculopathy and post lumbar laminectomy syndrome.

The review referred to an Australian National Health Council’s advisory committee recommendation that lumbar interlaminar epidural steroids are not effective in acute sciatica, but supports the potential usefulness of transforaminal steroids in disc prolapse. At the same time the review suggested that one could argue the anatomy of the epidural space should allow for any one of the three approaches to be just as effective as the others.

The delivery of steroid by any of these methods resulted in direct deposit to the effective area. Oral or parenteral routes of administration selectively target organs with high blood flow, but blood flow may be limited at the site of spinal injury.

**Comment**

This is an interesting review that is currently making its rounds across the country in political and scientific debates concerning the effectiveness of the traditional interlaminar approach to epidural steroid delivery for spinal pain. The interlaminar approach, typically done without fluoroscopic guidance, is thought to have less risk and take less skill to place than the transforaminal approach. The
transforaminal approach requires fluoroscopic guidance, costs more to administer, and requires additional skills.

This review appears to have a bias toward the transforaminal approach. It takes on so many variables, and addresses so many issues that descriptions of its results are very confusing at times. Like any other analysis of multiple studies, it is nearly impossible to find homogeneity. Each study had different primary measurements, the authors’ interpretation of results contained a variety of expressions, and trying to combine these various factors into a single outcome will often lead to the incorporation of author biases. I believe this is the case here.

There is no doubt that there is a place for each of these approaches, and applying the proper technique or combination of techniques to address a specific patient complaint should be the goal. If this review does anything positive, it provides some evidence that certain approaches appear to be more effective for specific pathology. The only problem is that patients often present with multiple pathologies creating spinal and radicular pain. It can be said that a lower cost, less risky interlaminar or caudal approach can be described as a “shotgun” approach, and a transforaminal approach is more specific, but the cost and risks are higher. A multimodal approach utilizing interlaminar epidural steroids, physical therapy, chiropractic, oral anti-inflammatory, and back mechanic education is a traditional and effective approach to back pain management. This review does not provide enough evidence to change this traditional approach in my opinion. The introduction of transforaminal specific nerve root steroid injection can undoubtedly add to success with certain patients, but there are added costs and risks.

I found it odd that the review would include comments from an Australian committee which refutes the effectiveness of interlaminar epidural steroids. This statement did not seem to fit in the document and only strengthens the suspicion of bias.

Probably the best statement made was one suggesting that the epidural anatomy could lead one to believe that any of the three approaches should be just as effective. All of this supports the importance of proper patient evaluation, identification of the pathology, leading to the selection of the most effective method of treatment.

Steven R Wooden, MS, CRNA
EVALUATION OF PROPOFOL FOR REPEATED PROLONGED DEEP SEDATION IN CHILDREN UNDERGOING PROTON RADIATION THERAPY

Br J Anaesth 2007;99:556-560

Buehrer S, Immoos S, Frei M, Timmermann B, Weiss

Abstract

Purpose The purpose of this observational study was to assess the safety and efficacy of a fixed dose propofol infusion in spontaneously breathing children undergoing repeated, prolonged, deep sedation with propofol in a remote environment.

Background Proton Radiation Therapy (PRT) is highly focused on targeted tissues, and, as a result, requires a carefully positioned and motionless patient throughout a treatment. Multiple treatments are required over a period of several weeks. No personnel may remain with the patient during treatment. The settings on infusion devices in the treatment room cannot be changed without interruption of the PRT. As a result, a stable infusion rate of the sedation drug is desired. Repeated doses of CNS depressant drugs are associated with the development of tolerance and a need to increase the dose over time.

Infants and young children often require sedation in order to remain motionless for radiologic procedures. Propofol and sevoflurane have both been used for sedation in such circumstances. Sevoflurane has produced emergence agitation and vomiting following sedation. While propofol has a fairly narrow margin of safety in adult patients, the margin of safety is generally wider in infants and children.

Methodology This prospective, observational study included infants and children undergoing repeated, and relatively prolonged, sedation with spontaneous ventilation and an unsecured airway. Children receiving opioids or sedatives for purposes other than sedation for PRT were excluded from the study. All children had central venous access in place. Each child underwent a PRT on Monday, Tuesday, Thursday, and Friday of each week during a course of treatment lasting approximately six weeks. They had no solids or full liquids for 4 hours pre-procedure and no clear liquids for 2 hours pre-procedure.

Sedation was induced with 0.1 mg/kg midazolam IV followed by multiple doses of 0.5 – 1 mg/kg propofol IV until adequate sedation was achieved. Sedation was maintained with a constant infusion of 167 µg/kg/min propofol (10 mg/kg/h). ECG, non-invasive blood pressure, oxygen saturation, and CO₂ were monitored throughout. Two liters / min oxygen was delivered and CO₂ monitored via nasal cannula. Children were positioned in a mould of their body either supine or prone. Children were visible during the procedure via closed circuit video.

Result Eighteen children ages 1.4 to 4.2 years were included; 13 girls and 5 boys. Many of the children had infection, weight loss, intra-cerebral hypertension, or were receiving parenteral nutrition. The 18 children underwent a total of 497 PRT procedures. Duration of sedation averaged 55.7 minutes per procedure. Total sedation time averaged 25.6 hours per patient. The sedation protocol successfully prevented movement during all procedures. The median oxygen saturation value was 99.3% (range 95% to
100%). The average propofol bolus dose for induction was 3.7 mg/kg. All children then received a 167 µg/kg/min infusion of propofol during the duration of the procedure.

The propofol induction dose required over successive weeks was fairly stable. Interindividual variability was greater than variability within individuals over time. In no case was the propofol infusion changed because of respiratory insufficiency, hemodynamic instability, or patient movement.

**Conclusion** Repeated, long duration, continuous infusion propofol sedation in infants and children was safe and effective during spontaneous respiration with supplemental oxygen. Motionlessness was uniformly achieved and cardiovascular stability was maintained.

**Comment**

In the pediatric population, it is often the choice to avoid sedation and opt for general anesthesia because of the variability of patient response. This study provides a reliable, safe method of achieving sedation with spontaneous ventilation and a motionless patient. In a previous study, Bloomfield et al. investigated the use of 2 mg/kg bolus followed by 6 mg/kg/h infusion to find that the oxygen saturation and heart rate were decreased more than with pentobarbital. The positive characteristics of propofol of rapid emergence without delirium and antiemetic effect were overshadowed by the negative effects. My concern of bradycardia related to propofol and the implications with a cardiac output in young children closely tied to the heart rate were not seen with this protocol. The infusion rate was never changed due to desaturation, respiratory depression, or hemodynamic instability. This study also highlights the lack of the development of tolerance to propofol for the eighteen participants undergoing multiple exposures (total 497) to the sedation protocol. As clinicians would, and unlike some previous studies, Buehrer et al. titrated the bolus to achieve the appropriate level of sedation and, then started the infusion. Although the n is small, the real world value of this observational study is that it demonstrates the use of propofol as a sedative in non-healthy pediatric patients to safely achieve immobility while maintaining spontaneous ventilation, oxygen saturation, and hemodynamic stability.

Terri M. Cahoon CRNA, MSN

PROTOCOL IMPLEMENTATION IN ANESTHESIA: BETA-BLOCKADE IN NON-CARDIAC SURGERY PATIENTS

Can J Anesth 2007;54:114-123

Baxer A, Kanji S

Abstract

Purpose  An adult tertiary- care teaching hospital that performs approximately 900 -1000 surgical procedures each month did an audit that included all ICU patients who had surgery before admission to the ICU, or who had surgery during their stay in the ICU. The audit identified an increase in the frequency of admissions of those diagnosed with peri-operative myocardial ischemia and/or infarction compared with the previous 18 months. The audit also noted that despite reports in the scientific literature describing the prevention of peri-operative myocardial ischemia and infarction using adrenergic blocking drugs, 76% of those who had suffered these events had significant risk factors but did not receive the blocking agents. The researchers hypothesized that the higher incidence of cardiac events was related to underutilization of potentially useful preventative strategies. It was their intent to create a greater awareness of the problem, develop and implement a protocol, and evaluate the protocol in terms of patient outcomes for those who were treated during the peri-operative period with beta-blockers.

Background  Current scientific literature is abundant regarding preventing (potentially) cardiac events during the peri-operative period by using adrenergic blocking drugs such as beta-blockers. Evidence based protocols have been developed which are synergistic with sound clinical judgment, standardization of interventions, and do appear to enhance clinical care. Successfully implementing a protocol, such as a peri-operative beta blockade protocol for non-cardiac surgery patients requires stakeholder acceptance, a plethora of education and training, and support systems. Additionally it requires ongoing evaluation. The researchers in this article admitted that while the use of beta blocking drugs for prophylaxis in the peri-operative period does still have some surrounding controversy, it was appropriate to attempt to increase their use as a strategy to prevent cardiac events in at risk patients.

Methodology  This research was carried out as a program/protocol development, implementation, and evaluation methodological type outcome study. After identifying the problem of the unacceptably high incidence of peri-operative cardiac events, the next step was to create a heightened awareness of the problem in all providers caring for these patients. Representatives from key areas, including, but not limited to, anesthesia and critical care medicine, formed a team to first create awareness of the problem. The objectives in creating awareness of the problem were to: disseminate information about the problem, develop a protocol to identify surgical patients at risk for cardiac events, to develop a tool to standardize and facilitate the administration of beta blockers to at risk patients during the peri-operative period, and to evaluate the acceptance and utilization of the program as well as to follow the cardiac event incidences after protocol implementation.

At risk patients were identified using Lee’s revised cardiac risk index (see notes section) modified to include age greater than 70 years, and those undergoing major arthroplasty. The protocol was developed and revised through collaboration between the providers addressing issues and concerns from all disciplines involved. Eligible patients were identified by the anesthesiologist in the pre-anesthesia assessment phase of the peri-operative period who prescribed metoprolol 25-50 mg orally twice daily for up to four weeks prior to surgery. Dosing adjustments were made for patients >80 years with a heart rate < 70 bpm, or already taking other antihypertensive drugs including calcium channel blockers. If the patients were not prescribed beta blockers they were treated intra-
operatively or in the PACU with intravenous metoprolol. Target heart rates were established a-priori. Care was continued via established protocols on the nursing units including the ICU. Follow-up, dosage adjustment, documentation, and management of clinical problems were handled by an anesthesiologist. The primary goal of the protocol evaluation phase was two fold: to assess utilization and to evaluate the incidence of cardiac events. The patients were identified using a hospital database from January 2002 to April 2003, which was prior to protocol implementation. The same database was accessed from May 2003 to December 2004 which was after protocol implementation. The cardiac event rates before and after protocol implementation were recorded as cases/1000 surgeries.

**Result** While 334 patients were enrolled in the study, only 128 had follow up documentation returned to the anesthesia office. The number of patients who received beta blocking drugs during their hospitalization increased during the study period. In the two months after protocol implementation, the demographic data suggested a stable surgical population. The hospital ischemic/infarction incidence was reduced from 5.9 per 1000 surgical cases (0.59%) before protocol to 2.0 per 1000 (0.2%) after implementation. This decrease was statistically significant. In addition, the ICU incidence of events decreased from 2.6/1000 to 1.6/1000; this was also statistically significant. It was duly noted that not all high risk patients actually received the beta-blockers.

Side effects noted were minimal and included doses held for bradycardia (n=3), doses held for hypotension (n=2), a dose held secondary to “weak legs” (n=1) and one whose family doctor recommended holding due to previous questionable reaction.

**Conclusion** The multi-disciplinary education completed regarding the benefits of preventative administration of adrenergic blocking drugs for the non-cardiac surgery patients, as well as protocol development and assessment of a new process and reduction in peri-operative ischemic events was identified at a tertiary care hospital. There was an increased incidence of prescribing beta-blockers to identified high or at-risk patients, although compliance did not increase as much as the authors had hoped. There was, however, a significant reduction in incidences from pre-protocol implementation, of myocardial ischemia and/or infarction events.

**Comment**

The authors of this evaluation study make an excellent point in identifying that there is often a delay between the discovery of what appears to be evidence based therapies identified from sound scientific research and their actual implementation in to clinical practice. This is usually the result of the vast numbers of individuals and disciplines involved in instituting a new process even though the evidence supports the change. Considering that the United States Agency for Healthcare Research and Quality recommendations include the use of beta-blockers to reduce peri-operative cardiac events and mortality in at or high-risk patients, there remains a moderate number of providers who are unsure of the risk versus benefit ratio. Additionally, the resources needed and the multidisciplinary support required often times make it challenging at best to do what appears to be evidence-based and sound. Further research is still needed regarding peri-operative beta blockade, yet it does appear to have great potential and hopefully as more high level evidence is disseminated, we will solve the dilemma.

Mary A. Golinski, PhD, CRNA

1) The intent of the research was clearly stated and was not to evaluate the efficacy of beta-blockers in the setting of a clinical trial. The authors felt that there was enough scientific information that they could support prophylactic use of beta-blockers in a specific at-risk population.

2) Lee’s modified eligibility criteria for use of peri-operative beta-adrenergic blockade
2 or more of:

- Age > 70 years
- High/intermediate risk surgical procedures, defined as ip, intrathoracic, major arthroplasty, or suprainguinal vascular procedure
- Ischemic heart disease, previous MI or coronary artery surgery, angioplasty, history of past/present angina
- Heart failure, past or present
- Cerbrovascular disease, transient ischemic attach or cerebrovascular accident
- Diabetes mellitus
- Chronic renal insufficiency—baseline creatinine level ≥ 177 mmol/L (2.0 mg/dL)