Electrical Acupuncture--Another Option to Reduce PONV

Effect of P6 Acustimulation on Post-Operative Nausea and Vomiting in Patients Undergoing a Laparoscopic Cholecystectomy.
Frey UH, Funk M, et al:


Acustimulation by Reliefband reduces PONV in the early postoperative period with ≥3 risk factors for PONV.

Background: Postoperative nausea and vomiting (PONV) is one of the most frequent complaints that leads to delay in discharge and sometimes warrants admission to a medical facility. Various pharmacologic therapies have been tried and are being used today. P6 acustimulation (electrical acupuncture) has been used with good results, but the timing of its use is still debatable.

Objective: To study the effects of reduction in PONV using P6 acustimulation and the timing of its application (preinduction vs postinduction) in patients undergoing laparoscopic cholecystectomy.

Design/Methods: This was a randomized double blind controlled study conducted in 200 patients. They were divided into 4 groups: 57 patients having acustimulation before induction; 44 patients having acustimulation after induction; 55 patients having sham acustimulation before induction; and 44 having sham acustimulation after induction. The acustimulation was in the form of a relief band, which is portable, noninvasive, battery operated, and supplies stimulus in the form of current of 31 Hz up to 35 mA to the skin by metal electrodes and the current is transcutaneously applied on the wrist between tendons of flexor carpi radialis and palmaris longus. Data collection included demographics and risk factors for PONV preoperatively. Patients were evaluated at 2, 6, and 24 hours for nausea, vomiting, and retching.

Results: 260 patients were evaluated. The incidence of PONV was significantly lower in the acustimulation group up to 2 hours versus placebo. No significant difference was noted in the 6- to 24-hour period for either nausea or vomiting. There was definitely a risk reduction of 33.9% in early nausea with acustimulation in patients with 3 to 4 risk factors. Discussion: This study showed that the relative risk reduction of PONV after acustimulation was 31% as compared to other studies of 25%. This was apparent only in the early period of 2 hours irrespective of whether the patients were in the preinduction or postinduction group, while no effect was seen later. This was seen with a maximum of ≥3 risk factors. The limitations of this study were that the patients with active Reliefband® observed some degree of tingling in the hands, which could have led to patient bias, despite the fact that all patients were counseled. Also, there was no difference in the pre- and postinduction groups.

Conclusions: Acustimulation by Reliefband reduces PONV in the early postoperative period with ≥3 risk factors for PONV.

Reviewer's Comments: This is an interesting study showing that technologies other than drugs can reduce PONV in laparoscopic cholecystectomy and can be of help in the early postoperative period. (Reviewer-Sunita Goel, MD).

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Keywords: P6 Acustimulation, PONV, Laparoscopy

Print Tag: Refer to original journal article
The use of epidural analgesia for postoperative pain management following adolescent scoliosis surgery improves pain scores and patient satisfaction.

Objective: To determine whether the use of epidural analgesia for postoperative pain management following scoliosis surgery is beneficial compared to the traditional use of intravenous opioids.

Design: Meta-analysis.

Participants: 120 adolescent patients undergoing scoliosis surgery.

Methods: The authors began by performing a search utilizing the MEDLINE database from January 1966 to October 2008. A total of 4 randomized clinical trials were found that compared the use of epidural analgesia to intravenous opioids for postoperative pain management. The primary outcome being assessed was postoperative pain scores at 24, 48, and 72 hours. Secondary outcomes involving nausea, pruritus, rescue analgesics or total opioid usage, return of bowel function, and patient satisfaction were also reviewed. Of the 4 studies included for the meta-analysis, 2 of the studies utilized a 2-epidural catheter technique for each patient. One catheter was placed at the top of the incision, while the second catheter was placed at the lower end of the incision. With the 2-catheter technique, 0.3% ropivacaine was continuously infused. For the remaining 2 studies reporting a single catheter technique, the epidural infusions consisted of 0.0625 to 0.125% bupivacaine with or without the addition of fentanyl 2.5 μg/mL. All catheters were placed by the surgeon intraoperatively.

Results: Postoperative pain scores were significantly lower in the epidural groups at 24, 48, and 72 hours. The incidence of nausea and pruritus, total opioid usage, and return of bowel function was lower in the epidural groups in 2 studies, but similar in the other 2 trials. However, patient satisfaction scores were significantly higher for the epidural groups.

Conclusions: The use of epidural analgesia for postoperative pain management following scoliosis surgery provided significantly improved pain control at 24, 48, and 72 hours, as well as higher patient satisfaction. Even greater benefit such as decreased opioid usage and earlier return of bowel function can be achieved with the use of a 2-epidural catheter technique.

Reviewer's Comments: At our institution, the use of epidural analgesia for pediatric patients following scoliosis surgery is routine. We do not limit its use to just adolescents. We also utilize the addition of an intrathecal dose of opioid early on at the beginning of surgery, with placement of the epidural catheter by the surgeon prior to surgical closing. Each patient is then followed by our Acute Pain Service. A current review of our last 50 patients has not demonstrated an increased incidence of respiratory depression or other associated opioid side effects. (Reviewer-Michelle L. Schlunt, MD).

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Keywords: Scoliosis, Epidural Analgesia, Opioids, Postoperative Pain Management

Print Tag: Refer to original journal article
The success rate is similar when comparing sciatic nerve blockade proximally versus individual nerve injections at the popliteal fossa level.

**Objective:** To determine if blocking the tibial and common peroneal nerves separately, utilizing ultrasound guidance, is faster in onset compared to performing blockade at a location above the sciatic nerve bifurcation.

**Participants:** Adult patients scheduled for foot or ankle surgery.

**Methods:** Upon enrollment, patients were randomized to 1 of 2 groups: (1) the sciatic group where the sciatic nerve block was performed at a location above its bifurcation and (2) the tibial-peroneal group where each nerve was blocked separately in the popliteal fossa. A 22-gauge Tuohy needle was introduced in the lateral in-plane approach under ultrasound guidance. The local anesthetic mixture used consisted of 1.5% mepivacaine with 1:300,000 epinephrine, 100 μg clonidine, and additional sodium bicarbonate for a total volume of 30 mL. For the sciatic group, a single injection depositing all 30 mL of the local anesthetic mixture was done. For the tibial-peroneal group, each nerve was identified and then 15 mL of the local anesthetic mixture was deposited at each nerve. Circumferential spread was visualized in real-time during injection in both groups. Sensory and motor assessments were evaluated by a blinded investigator beginning 10 minutes after block completion. Repeat assessment was done every 3 minutes following until a maximum time of 46 minutes was reached.

**Results:** Time to block completion and success rate was similar between the 2 study groups. The time to complete sensory loss for both tibial and common peroneal nerves was significantly faster compared to the single proximal injection technique. However, only the tibial nerve demonstrated faster achievement of complete motor block. The time to complete motor block for the common peroneal nerve was similar in both groups.

**Conclusions:** Time to complete sensory loss for the sciatic nerve was faster when blockade of the tibial and common peroneal nerves was done separately in the popliteal fossa compared to a more proximal single injection above the sciatic nerve bifurcation.

**Reviewer's Comments:** This study was interesting to me because I have always just assumed that individual injection of each of the tibial and common peroneal nerves at the popliteal fossa would take longer and leave more room for block failure. This attests to the major step that has been achieved with utilizing ultrasound. We can see and insure preferential local anesthetic spread around the intended nerve, as well as more accurate localization of the nerve itself. (Reviewer-Michelle L. Schlunt, MD).

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Keywords: Sciatic Block, Ultrasound

Print Tag: Refer to original journal article
The use of psychostimulants to hasten the recovery period after anesthesia is clearly in need of further evaluation.

**Background:** With increasing numbers of surgical procedures being performed as outpatient cases, strategies that can shorten postoperative care unit time and speed recovery of patients could improve efficiency of outpatient surgical units.

**Objective:** To assess whether modafinil, used in the treatment of narcolepsy, improves recovery following sedation/analgesia.

**Design:** Prospective randomized placebo-controlled blinded study.

**Participants:** Almost 70 patients undergoing extracorporeal shock wave lithotripsy for urologic stones were evaluated. Patients were excluded if they were ASA 3, 4, or 5 or had visual or motor impairment that prohibited completion of the psychomotor tests, known liver or renal impairment, psychiatric illness, or seizures.

**Methods:** Patients were randomized to 1 of 2 sedation and analgesia groups and to receive either modafinil (200 mg) or placebo. The 2 sedation protocols used a combination of midazolam and fentanyl while the other group used propofol and remifentanil. Patients were targeted to a sedation level of Ramsay 2 or 3. The digital symbol substitution test (DSS) and trail making test (TMT) were used to assess psychomotor function at baseline and 15 minutes and 1 hour after the procedure. Objective measures of sedation were assessed by the Observer's Assessment of Alertness and Sedation (OAA/S) and the Aldrete Score. A visual rating scale was used to obtain subjective assessments of energy and tiredness in the recovery room and by telephone the next day.

**Results:** More male patients were in the remifentanil/propofol/modafinil group than in the corresponding placebo group. No other demographic or intraoperative differences were noted. Total doses of sedation and analgesic medications were similar between placebo and modafinil groups. No significant differences were noted in performance of the DSST between modafinil and placebo groups. In terms of the secondary endpoints, several differences were demonstrated. Patients who received modafinil reported less tiredness than placebo in the groups that received midazolam and fentanyl. Dizziness was more commonly reported in the modafinil group in those that received remifentanil and propofol. Energy scores were lower in both placebo groups after the procedure. No differences were noted in the TMT tests, OAA/S, or Aldrete scores between modafinil- and placebo-treated groups. On the day after the procedure, only a higher appetite score in the group that received remifentanil/propofol/placebo was found to be significantly different. No other side effects of modafinil were demonstrated.

**Conclusions:** Administration of modafinil to patients receiving longer-acting forms of sedation/analgesia does not improve psychomotor function.

**Reviewer's Comments:** The use of psychostimulants to hasten the recovery period after anesthesia is clearly in need of further evaluation. Whether the modafinil would have any effect if perhaps volatile agents were used is yet to be determined. (Reviewer-Allen Miranda, MD).

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**Keywords:** Modafinil, Psychomotor Function, Sedation

**Print Tag:** Refer to original journal article
Use of the LMA Supreme™ in the prone position by experienced users is feasible. However, the authors caution that there is currently insufficient data to ensure that this is a safe practice.

**Background:** The traditional approach to airway management for prone procedures is to intubate the trachea. Although controversial, a small body of evidence suggests that laryngeal mask airways (LMAs) may be able to be used in appropriate cases for general anesthetics in the prone position.

**Objective:** To evaluate whether the insertion of the LMA Supreme™ and its use for maintenance of anesthesia is feasible in the prone position.

**Design:** Prospective study.

**Participants:** 40 adults undergoing a variety of surgeries in the prone position were evaluated. Exclusion criteria included pulmonary disease, morbid obesity, known or predicted difficult airway, lengthy surgery, or risk for pulmonary aspiration.

**Methods:** Patients positioned themselves prone. Standard monitors and Bispectral Index (BIS) were used. Preoxygenation was performed and a standardized anesthetic was used with propofol and fentanyl for induction and propofol and remifentanil for maintenance. Mask ventilation was performed until the BIS was <50 and the LMA Supreme was inserted. Time to insertion of the LMA was defined as picking up the LMA until connecting to the anesthesia circuit. A failed insertion was defined as removing the LMA from the mouth. A gastric tube was inserted and a fiberoptic view of the position of the LMA was performed in about half the patients. Mechanical ventilation was utilized, and after surgery the LMA was inspected for blood and the patients asked about sore throat.

**Results:** Insertion and utilization of the LMA was successful in every patient. There were no airway management-related complications and there was no difference in performance between any of the anesthesiologists. The average time to insertion was 21 seconds. The vast majority graded the insertion as easy and accomplished insertion on the first attempt. None required 3 attempts to insert the LMA. Gastric tube insertion was easy and the fiberoptic view of the glottis was rated at "full" in 90% of patients. The same number of patients that had blood staining of the LMA had a sore throat, but the authors do not state whether they are the same individuals.

**Conclusions:** Use of the LMA Supreme in the prone position by experienced users is feasible. However, the authors caution that there is currently insufficient data to ensure that this is a safe practice.

**Reviewer's Comments:** Although I am not sure that this will catch on as a standard airway technique for prone cases, developing some facility in inserting LMAs in the prone position may be useful in cases where endotracheal tubes are dislodged or MAC cases lose their airway. (Reviewer-Allen Miranda, MD).

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Keywords: LMA Supreme™, Prone Position, General Anesthesia

Print Tag: Refer to original journal article
Midazolam Vs Clonidine--Which Is the Better Pediatric Premedication?

Premedication With Clonidine Is Superior to Benzodiazepines. A Meta Analysis of Published Studies.

Dahmani S, Brasher C, et al:
Acta Anaesthesiol Scand 2010; January 18 (): epub ahead of print

Despite the concerns about heterogeneity, clonidine may be superior to midazolam in terms of producing sedation, decreasing postoperative pain, and emergence agitation.

**Background:** Preoperative sedation of pediatric patients is a common practice. No ideal agent exists but benzodiazepines and more recently α-agonists such as clonidine have been used.

**Objective:** To perform a meta-analysis of studies comparing premedication with clonidine to benzodiazepines.

**Design:** Meta-analysis.

**Methods:** 10 studies were evaluated. Inclusion criteria included a comparison between clonidine and benzodiazepines, a randomized controlled study, a double-blinded study, and standardized anesthesia and analgesia protocol. Statistical analysis used the Cochrane Handbook and the QUORUM statements as guidelines. All but 1 of the studies used the oral route of sedation. The dose of the benzodiazepines was 0.2 to 0.5 mg/kg and the dose of clonidine was 2.0 to 5.0 μg/kg. Data evaluated included sedation at induction, emergence delirium, postoperative pain, duration of emergence, postanesthesia care unit (PACU) time, and postoperative nausea and vomiting (PONV).

**Results:** When midazolam is compared to clonidine in terms of sedation, clonidine is a superior sedative. No difference was seen with clonidine compared to diazepam. In terms of emergence delirium, clonidine again is superior to benzodiazepines. With respect to postoperative pain, clonidine use results in lower postoperative pain scores. Time from anesthesia discontinuation to extubation and PACU stay are similar between the 2 agents. The effect of premedication on PONV is complicated by the possible use of other PONV prophylaxis; however, clonidine is superior to diazepam when other PONV prophylaxis is not used and is equivalent to midazolam. Heterogeneity among the studies may be a complicating factor in terms of comparing the sedative efficacy of clonidine and diazepam. The effect of heterogeneity may also apply to duration of emergence and PONV.

**Conclusions:** Despite the concerns about heterogeneity, the authors conclude that clonidine is superior to midazolam in terms of producing sedation, decreasing postoperative pain, and emergence agitation. Compared with diazepam, clonidine is superior in terms of preventing PONV during strabismus surgery without PONV prophylaxis.

**Reviewer’s Comments:** This is an interesting review. Despite the usual precautions about meta-analyses, there appears to be reason to at least consider clonidine more frequently as a premedication for pediatric patients. In reviewing some of the studies, there appears to be minimal unfavorable hemodynamic effects from using clonidine in this fashion. (Reviewer-Allen Miranda, MD).

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Keywords: Midazolam, Clonidine, Preoperative Sedation

Print Tag: Refer to original journal article
Intracuff Pressure of LMA or Tire of Your Car—Which Has the Higher Pressure?

Use of Manometry for Laryngeal Mask Airway Reduces Postoperative Pharyngolaryngeal Adverse Events: A Prospective, Randomized Trial.

Seet E, Yousaf F, et al:

Anesthesiology 2010; 112 (March): 652-657

LMA cuff pressure should be measured routinely using manometry. Deflating the intracuff pressure to <44 mm Hg or 60 cm H₂O should be recommended as part of the anesthetic best practice.

Background: Sore throat is a common occurrence after laryngeal mask airway (LMA) use. More significant complications are less common. Some of the complications may be related to the cuff pressure being too high and leading to increased pressure against the pharyngeal structures.

Objective: To compare pharyngolaryngeal complications in patients managed with manometers to limit the LMA intracuff pressure with patients under routine care.

Design: Prospective randomized double-blinded study in which patients were excluded if they had a contraindication to LMA use.

Methods: Patients underwent surgery using a standard anesthetic and were spontaneously breathing. The cuff was inflated using a 20-cc syringe to achieve an audible seal. LMA intracuff pressure was evaluated using a hand-held airway pressure manometer. In the pressure-limited group, the cuff was deflated until the pressure was <44 mm Hg. A second pressure was recorded if surgery lasted >1 hour. At the conclusion of surgery, the LMA was removed and pharyngeal suctioning was not routinely performed. Data collected included experience of the anesthesiologist, ease of LMA insertion, number of attempts, use of oral airway, incidence of laryngospasm, total fentanyl used, and presence of blood on LMA. Sore throat, dysphonia, and dysphagia were evaluated at 1, 2, and 24 hours after surgery. Patient satisfaction scores were also recorded.

Results: 200 patients were studied. Demographics were similar between the 2 groups. In both groups, the initial pressure was approximately 110 mm Hg. The overall incidence of complications was significantly lower in the pressure-limited group. The reduction was great enough that only 3 patients need to be treated with a lower cuff pressure to prevent 1 complication. One hour after surgery, sore throat was similar between the 2 groups, but dysphagia and dysphonia were less frequent in the pressure-limited group. At the 2- and 24-hour times, all complications were less frequent in the pressure-limited group. Interestingly, none of the other variables evaluated were found to have an association with the occurrence of a pharyngolaryngeal complication. No severe injuries were noted and there were no significant differences in overall satisfaction between the 2 groups.

Conclusions: LMA cuff pressure should be measured routinely using manometry. Deflating the intracuff pressure to <44 mm Hg or 60 cm H₂O should be recommended as part of the anesthetic best practice.

Reviewer's Comments: After reading this study, I hooked a CVP monitor to the cuff of the LMA and was able to get the pressure to almost 300 mm Hg without much difficulty. Our respiratory therapy department uses manometry in the ICU to measure endotracheal cuff pressures and I intend to see what our routine LMA cuff pressure is. (Reviewer-Allen Miranda, MD).

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Keywords: Laryngeal Mask Airway, Intracuff Pressure, Manometry, Complications

Print Tag: Refer to original journal article
Safety and Efficacy of the HBOCs

Hemoglobin-Based Oxygen Carriers: Compassionate Use and Compassionate Trials.

Weiskopf RB:

Anesth Analg 2010; 110 (March): 659-662

Hemoglobin-based oxygen carriers have not been found to be safe in humans.

Discussion: Clinical trials are the most important part of the drug development process in determining whether new drugs are safe and effective, and how to best use them prior to FDA approval. However, there are situations that a patient's disease has no good treatment and the patient's treating physicians want to try a new drug under development, especially if the early results of a clinical trial suggest that the drug shows promise. The FDA's expanded access program provides a means to obtain investigational drugs. This program does not benefit the company, but most likely the patient. Biopure Corporation, the company that manufactures bovine-derived hemoglobin-based oxygen carrier (HBOC), participates in the expanded access program. Studies reporting case series from investigational new drugs have several limitations in determining the efficacy and safety of the new medication because there is no randomized allocation of treatment, no control group, not a standard protocol of data collection, and the population is not homogeneous. In this same issue of Anesthesia & Analgesia, a study by Mackenzie et al has all of the limitations listed above, which make the data scientifically weak. HBOCs carry and deliver oxygen to tissues. They have a <1 day half-life and thus it is thought that they postpone but do not eliminate transfusion in humans. Results from studies in cardiac surgery during the short period of hemodilution and in trauma patients have not defined the efficacy of HBOCs. The FDA expressed several safety concerns on the product, and the company filed for bankruptcy protection and put the product on prolonged clinical hold. Several other companies producing HBOC had similar issues with the FDA. HBOCs have not been found to be safe in humans. They increase the risk of death and myocardial infarction. Other adverse events include systemic and pulmonary hypertension, liver injury, and gastrointestinal symptoms. These negative effects have been attributed to nitric oxide scavenging and vasoconstrictive properties. Dr Weiskopf states that the 2 major trials on HBOC performed in the United States were exempt from informed consent under special regulation. The absence of informed consent raises the ethical issue of conducting a study without the participant's permission. Data from these studies have been published incompletely. The author believes that there is much to be learned in the area of HBOC from the data already gathered but not completely understood.

Reviewer's Comments: Despite many years of research, an ideal blood substitute is not available. Most of the initial attempts at synthesizing blood substitutes failed because of significant adverse effects. Currently, 2 main types of blood substitutes are in development and under investigation—hemoglobin-based oxygen carriers and perfluorocarbon emulsions. These products are available for commercial use in South Africa and Russia only. (Reviewer-Ioanna Apostolidou, MD).

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Keywords: Hemoglobin-Based Oxygen Carriers, FDA Status, Safety

Print Tag: Refer to original journal article
Earlier, compared with later, administration by inexperienced users of HBOC to patients with anemia was associated with improved chances of survival of acutely bleeding and hemolyzing patients.

**Background:** If human blood is not an option, hemoglobin-based oxygen carrier (HBOC) may be used as a substitute. The HBOC Hemopure®, a chemically stabilized bovine hemoglobin concentration (Hb), is not approved by the FDA in the U.S. because of the risk of myocardial infarction (MI), stroke, renal failure, hypertension, and death. The FDA allows HBOC use under the emergent or compassionate use (CU) code.

**Objective:** To identify variables associated with survival in patients receiving HBOC treatment.

**Design:** Observation case series report.

**Methods:** HBOC was used for CU in severely anemic patients after requesting an investigational new drug number by the FDA. Criteria for treatment was Hb <6 g/dL, signs of cardiac or renal ischemia, increasing lactate levels, and base deficit with Hb <10 g/dL, or a potential blood loss to a critical level. Loading dose was 2 to 4 U (30 g Hb/unit) and was repeated at 1 to 2 U every 20 hours. The primary end point was survival and hospital discharge. Adverse events on cardiac, renal, or central nervous system, liver enzymes, gastrointestinal disturbances, safety issues, and methemoglobinemia (metHb) increases were recorded. The severity of anemia was described by a compound variable, hemoglobin-duration deficit product.

**Results:** From the 79 patients who received FDA approval, 54 received 60 to 300 g HBOC for life-threatening anemia (median Hb = 4 g/dL). Survivors (42%) were significantly different from nonsurvivors (58%) in the time from anemia to HBOC infusion (3.3 vs 4.4 days) and the magnitude of Hb-deficit duration product. There was no difference in age, gender, and number of comorbidities between survivors and nonsurvivors except for higher prevalence of cancer in nonsurvivors. Serious adverse events (MI, stroke, acute renal failure) occurred in 31% of nonsurvivors versus 7% of survivors. None of these events were attributed to HBOC. Non-serious adverse events were hypertension, elevation of liver enzymes, and metHb levels. There were 24 patients who did not receive HBOC because their condition improved or they died. Their overall survival was 79%, but dropped to 50% when patients who were transfused were excluded.

**Conclusions:** Shorter anemia time by using HBOC was associated with better survival in acutely anemic patients that refused blood transfusion. The authors stated that there are factors besides an absolute Hb level that determine mortality. These factors are duration and rapidity of anemia onset, cardiopulmonary condition, underlying pathology, side effects of all treatments, and the intensity of medical care. Limitations of the study included the absence of a control group and a non-systematic collection of data.

**Reviewer’s Comments:** Two main types of blood substitutes, hemoglobin-based oxygen carriers and perfluorocarbon emulsions, are in development. They are available for commercial use in South Africa, but are not approved by the FDA in the U.S. due to the increased risk of death and MI. (Reviewer-Ioanna Apostolidou, MD).

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Keywords: Hemoglobin-Based Oxygen Carriers, Severe Anemia, Survival

Print Tag: Refer to original journal article
There is no CO detection when FGF is equal to or higher than the minute ventilation.

**Background:** Animal studies have shown that mild carbon monoxide (CO) exposure is neurotoxic in the developing brain. CO is formed when strong alkali carbon dioxide absorbents degrade volatile anesthetics.

**Objective:** To quantify the amount of CO present in the breathing circuit with fresh strong metal alkali carbon dioxide (CO$_2$) absorbent during general anesthesia in infants and children. The parameters associated with CO production were also assessed.

**Design:** Prospective observational study.

**Participants/Methods:** The study enrolled 15 children, 4 months to 8 years, undergoing general endotracheal anesthesia with mask induction. Children with cardiopulmonary dysfunction were excluded. Fresh strong metal hydroxide absorbent was used in the anesthesia machine. Anesthesia was induced with sevoflurane and was maintained with either sevoflurane or desflurane after intubation. Fresh gas flow (FGF) was fixed at 1.5 L/minute, 21% oxygen/air mixture. A CO sensor was placed in the inspiratory limb of the breathing circuit and measured inspired CO concentration every 5 minutes for 1 hour during general anesthesia. Carboxyhemoglobin (COHb) levels were measured at baseline and at the 1-hour time point.

**Results:** CO was found in all but 3 children aged <2 years (0 to 18 ppm, mean 3.7 ± 4.8 ppm). The ratio of fresh gas flow to minute ventilation ratio (FGF/V$_E$) was independently associated with the CO concentration (r=0.91; P <0.001). CO was not found when FGF/V$_E$ was ≥1. There was a weak association between CO concentration and female sex as well as the use of desflurane but not with anesthetic concentration. COHb levels at 1 hour increased from baseline in children aged >2 years and decreased in children aged <2 years corresponding to CO detection in older children. In line with this finding was the significant correlation between COHb and FGF/V$_E$ (r=0.62; P <0.02).

**Conclusions:** The authors speculated that CO in the anesthesia circuit was generated either from the breakdown of volatile agents by the CO$_2$ absorbent or from the endogenous catabolism of heme. There is no CO detection when FGF is equal or higher than the minute ventilation. The authors suggest avoiding low-flow anesthesia and strong metal alkali absorbents in order to prevent CO production.

**Reviewer's Comments:** Exposure of volatile anesthetics to desiccated carbon dioxide absorbents may result in the production of toxic products (eg, carbon monoxide, compound A, methanol, formaldehyde). To eliminate this byproduct formation, the Anesthesia Patient Safety Foundation (APSF) recommended using absorbents that lack strong metal alkali. Low CO levels have been shown to decrease human fetal growth and to impair auditory system growth in rats. Therefore, it is our responsibility to eliminate the CO risk in children by following the APSF recommendations as well as FGF equal or greater than the V$_E$. (Reviewer-Ioanna Apostolidou, MD).
100% Fraction of Inspired O2 Can Significantly Improve Regional Cerebral Oxygenation

The Influence of Inspired Oxygen Fraction and End-Tidal Carbon Dioxide on Post-Cross-Clamp Cerebral Oxygenation During Carotid Endarterectomy Under General Anesthesia.
Picton P, Chambers J, et al:

Anesth Analg 2010; 110 (February): 581-587

Increasing the inspired fraction of oxygen and the end-tidal carbon dioxide improves regional cerebral oxygenation during cross-clamp in both shunted and unshunted patients.

Objective: To determine whether increases in the fraction of inspired oxygen (FIO\(_2\)) or end-tidal carbon dioxide (PETCO\(_2\)) lead to a significant change in regional cerebral oxygenation (rSO\(_2\)) in patients undergoing carotid endarterectomy (CEA) under general anesthesia with and without shunt during the period of carotid cross-clamp.

Design/Participants: Prospective clinical study involving 20 adult patients for CEA.

Participants/Methods: 10 patients were assigned to elective shunting and 10 were planned to undergo CEA without shunting. Regional cerebral oxygenation was measured using the INVOS 5100B monitor. After carotid cross-clamping, FIO\(_2\) and minute ventilation were adjusted to achieve: (1) FIO\(_2\) of 30% and PETCO\(_2\) of 30 to 35 mm Hg; (2) FIO\(_2\) of 100% and PETCO\(_2\) of 30 to 35 mm Hg; and (3) FIO\(_2\) of 100% and PETCO\(_2\) of 40 to 45 mm Hg. Regional cerebral oxygenation was recorded from both the operative and nonoperative sides and arterial blood gas analysis performed.

Results: Carotid artery stenosis on the nonoperative side was significantly higher in the shunted group. Administration of 100% oxygen while maintaining PETCO\(_2\) in the range of 30 to 35 mm Hg in cross-clamped, unshunted patients resulted in an 8% increase in rSO\(_2\) on the operative side and 6% increase in rSO\(_2\) on the nonoperative side compared to the rSO\(_2\) of the group receiving 30% FIO\(_2\). In the cross-clamped, shunted patients, administration of 100% oxygen while maintaining the PETCO\(_2\) in the range of 30 to 35 mm Hg resulted in a 4% increase in rSO\(_2\) on both the operative and the nonoperative side compared with FIO\(_2\) of 30%. In cross-clamped, unshunted patients, rSO\(_2\) increased by 6% on the operative side and 5% on the nonoperative side at PETCO\(_2\) of 40 to 45 mm Hg compared with PETCO\(_2\) of 30 to 35 mm Hg. In cross-clamped, shunted patients, there was a 3% increase in rSO\(_2\) on the operative side and a 4% on the nonoperative side at PETCO\(_2\) of 40 to 45 mm Hg compared with PETCO\(_2\) of 30 to 35 mm Hg, having FIO\(_2\) at 100%.

Conclusions: Bilateral cerebral oxygenation is reliably increased in both unshunted and shunted patients by ventilation with 100% oxygen during the carotid cross-clamp with additional gains obtained by manipulating PaCO\(_2\).

Reviewer’s Comments: There are few limitations with the study: small sample size and the choice to measure PETCO\(_2\) but not PaCO\(_2\). The exciting news is the finding that providing 100% FIO\(_2\) can achieve a significant improvement in regional cerebral oxygenation and possible neurological outcomes. (Reviewer-K. George Bojanov, MD).

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Keywords: Carotid Endarterectomy, Post-Cross-Clamp Cerebral Oxygenation, Fraction of Inspired Oxygen, End-Tidal Carbon Dioxide

Print Tag: Refer to original journal article
In this study, tracheal intubation was accomplished with both fiberoptic visualization and DL. If there is poor direct visualization of the glottis, decompression of the airway by opening of the surgical incision may facilitate intubation of the trachea.

**Objective:** To explore the incidence, timing, and outcomes of neck hematoma after carotid endarterectomy (CEA).

**Design/Participants:** Retrospective study, including 3225 patients who had CEA over a 10-year period.

**Methods:** An anesthesia database was searched for patients who required a second anesthetic within 72 hours of their CEA surgery. Demographic data and information regarding airway management for both the initial CEA and the subsequent neck exploration were extracted. Maximum blood pressure after reestablishing carotid blood flow and time between leaving and returning to the operating room (OR) were recorded. Operative records were reviewed and identified sites of bleeding recorded. Patients were divided to 2 groups based on the difficulty associated with airway management. Demographic, surgical, and anesthetic factors were compared between groups.

**Results:** Only 44 (1.4%) of 3225 patients required subsequent neck exploration and hematoma evacuation. All patients received general anesthesia for the initial CEA and there were no records of difficult airway in any of those 44 patients. The time interval between completion of CEA and return to the OR for hematoma evacuation was 6.0 ± 6.0 hours. In 7 of 44 patients, the hematoma was identified in the postanesthesia care unit, followed by a return to the OR. The endotracheal tube was not removed after the initial CEA in 2 patients. One patient developed progressing airway compromise and after failed attempt at direct laryngoscopy (DL) had an emergent tracheotomy in the ICU. Of the remaining 41 patients, orotracheal intubation was performed immediately before induction of anesthesia in 24 patients and after induction in 17 patients. Awake fiberoptic intubation was attempted in 20 patients and was successful in 15 patients. DL was used in the remaining 5 patients, before or after anesthesia induction in 3 and 2 patients, respectively. Awake DL was used primarily in 7 patients with success in 5 patients. Of the remaining 2 patients, airway was secured via tracheostomy in 1 patient and after a second DL post-surgical release of the hematoma in the other. DL after induction was attempted in 15 patients and was successful in 13 patients. In the remaining 2 patients, a second DL was successful after surgical release of the neck hematoma. A larger proportion of patients with identified arterial bleeding had easy airway management. There was no difference between exiting and returning to the OR time in patients with arterial versus nonarterial bleeding.

**Conclusions:** Successful airway management for neck hematomas after CEA can be achieved using multiple techniques. Decompression of the airway by surgical incision opening may facilitate tracheal intubation.

**Reviewer’s Comments:** The importance of the study as I see it is in validation of the viability of DL for both primary and rescue airway management after failed fiberoptic intubation. (Reviewer-K. George Bojanov, MD).

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Keywords: Airway Management, Neck Hematoma, Carotid Endarterectomy

Print Tag: Refer to original journal article
Do Free Ropivacaine Concentrations Reach Toxic Levels?

Serum Ropivacaine Concentrations and Systemic Local Anesthetic Toxicity in Trauma Patients Receiving Long-Term Continuous Peripheral Nerve Block Catheters.
Bleckner LL, Bina S, et al:
Anesth Analg 2010; 110 (February): 630-634

This study found that local anesthetic doses used for continuous peripheral nerve block catheters did not result in clinically evident systemic ropivacaine toxicity.

**Objective:** To determine the concentration of bound and unbound plasma ropivacaine in acute trauma patients who had a prolonged indwelling peripheral nerve catheter(s).

**Design/Participants:** Prospective longitudinal case study including 15 patients with combat injuries during the Afghanistan or Iraq war.

**Methods:** All participants had varying degrees of orthopedic trauma, and all had either a preexisting peripheral nerve catheter (n=13) or were scheduled to receive such a catheter in conjunction with planned surgical procedure (n=2). All catheters were infused with 0.2% ropivacaine. All boluses were infused with 0.5% ropivacaine. Serum ropivacaine concentrations were obtained on days 1, 3, 5, 7, and 10 and every 3 days thereafter. Ropivacaine blood level, catheter infusion rates, extra boluses, catheter location, signs of local anesthetic toxicity, weight, daily hematocrit, blood transfusions, and medications were recorded.

**Results:** 2 patients had peripheral nerve catheters placed at the time of enrollment. The rest of the patients had catheters placed before enrollment and were receiving 0.2% ropivacaine infusions for varying periods of time--between 18 and 126 hours. Twelve patients received boluses to provide anesthesia for surgery, consisting of 30 to 60 mL 0.5% ropivacaine. The median ropivacaine concentration on the first assessment was 0.07 mg/L. Median highest free ropivacaine concentration was 0.11 mg/L. Two study patients had free ropivacaine values in the "toxic" range--one 0.63 mg/L on day 3 and the other 0.59 mg/L on day 19. Neither of those 2 patients showed signs of systemic local anesthetic toxicity. There was no correlation in the duration the patient had been having ropivacaine infusion and the concentration of free ropivacaine. α₁-acid glycoprotein concentration was significantly increased in patients with indwelling catheters. There was no correlation between α₁-acid glycoprotein (an acute phase reactant that binds free ropivacaine) concentration and free ropivacaine concentration.

**Conclusions:** Local anesthetic doses used for continuous peripheral nerve block catheters did not result in clinically evident systemic ropivacaine toxicity.

**Reviewer’s Comments:** The study may be underpowered with respect to identifying clinical signs of toxicity from ropivacaine. I am sure that more studies are underway at the Walter Reed Army Medical Center that will throw more light on dosing and safety in using peripheral continuous nerve block catheters. (Reviewer-K. George Bojanov, MD).

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Keywords: Ropivacaine Serum Concentration, Local Anesthetic Toxicity, Trauma, Long-Term Continuous Peripheral Nerve Block Catheters

Print Tag: Refer to original journal article
To Administer NDMRs Before or After Mask Ventilation? That Is the Question

Conformation of the Ability to Ventilate By Facemask Before Administration of Neuromuscular Blocker: A Non-Instrumental Piece of Information?

Broomhead RH, Marks RJ, Ayton P:

Br J Anaesth 2010; 104 (March): 313-317

The routine practice of checkers (conformation of the ability to ventilate by facemask before administration of neuromuscular blockers) has no evidence base and therefore expert opinions are required urgently.

Background: Some anesthetists administer nondepolarizing muscle relaxants (NDMR) after confirming good mask ventilation of the patient; others administer NDMRs before mask ventilation.

Objective: To determine the current practice and the rationale for that practice.

Design: An online survey of anesthetists practicing in North/Greater London.

Participants: Trainee and consultant anesthetists.

Methods: A web-page link was provided with 2 scenarios and a series of questions. The number of years in anesthetic practice, the grade of the respondents (consultant, trainee) was determined. In scenario 1, an ASA 1 patient was scheduled for an ET (endotracheal tube). Participants were asked to select one from the following: (1) I never confirm that I can ventilate by facemask before giving the NDMR; (2) I virtually never confirm...; (3) there are occasions where I would deem both techniques more appropriate within this scenario; (4) I virtually always confirm that I can ventilate by facemask before giving the NDMR; and (5) I always confirm that I can ventilate by facemask before giving the NDMR. The participants filled in a questionnaire to justify their approach (recommended by peer publication, best practice, can wake patient up, department policy, and have always done it this way), as well as what technique the respondents would teach less experienced trainees. The second scenario is to help a colleague who cannot ventilate a patient who is not muscle relaxed. Participants were asked about the approach (deepen anesthesia, relax the patient with an NDMR or succinylcholine, insert a laryngeal mask airway (LMA), intubate, or other options.)

Results: 136 responded and 59 were consultants. Overall, 57% were checkers and 24% were noncheckers. Only 38% of the most senior groups (>16 years of practice) were checkers. The reason given for their approach (checkers and noncheckers) was the best practice. In total, 65% would teach to check and 11% not to check mask ventilation before administration of an NDMR. In scenario 2, the majority would try to place the LMA 85% and apply a muscle relaxant, NDMR 18% and succinylcholine 71%.

Conclusions: The routine practice of checkers has no evidence base and therefore expert opinions are required urgently.

Reviewer’s Comments: Relaxation makes mask ventilation often easier and since Sugammadex is on the market, reversal of the NDMR rocuronium is commenced very easily and safe. The problem is that Sugammadex is very expensive and not available in every hospital. (Reviewer-Olga Plattner, MD).

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Keywords: Anesthesia, Neuromuscular Blocking Drugs, Confirming Mask Ventilation

Print Tag: Refer to original journal article
Propofol and Anti-Inflammatory Effects

Propofol Has Anti-Inflammatory Effects on Alveolar Type II Epithelial Cells.
Ma L, Wu X, et al:
Acta Anaesthesiol Scand 2010; 54 (March): 362-369

Propofol inhibits in a concentration of 50 and 100 μmol the inflammatory response of alveolar epithelial type II cells treated with LPS.

**Background:** Lipopolysaccharide (LPS) triggers a physical association between the cluster of differentiation 14 (CD14) and Toll-like receptor (TLR4), which mediates inflammatory response to endotoxin. CD14 and TLR4 have been found on alveolar epithelial type II cells (ATII) and could play a role in the immune response. Propofol has a cytoprotective and immunosuppressive effect in LPS-activated macrophages. Whether propofol exhibits an immunomodulatory effect on ATII cells is unknown.

**Objective:** To investigate the effect of LPS through CD14 and TLR4 on the alveolar epithelial type II cells and the effect of propofol in different concentrations on inflammation.

**Design:** In vitro experimental study of Wistar rats (180 to 250 g).

**Methods:** ATII cells were isolated, washed, seeded, and cultured 18 to 20 hours from the animals according to the standard protocol. Alkaline phosphatase staining identified the ATII cells on the glass coverslips. Ultrathin sections were examined after special preparation with the transmission electron microscope. The cultured cells were randomly assigned to 1 of the following 5 groups: group C was untreated group was cultured for 3 hours in the absence of propofol and LPS; group LPS was treated with 1 μg/mL LPS for 3 hours; group P1 was treated with 1 μg/mL LPS and 25 μmol propofol for 3 hours; group P2 was treated with 1 μg/mL LPS and 50 μmol propofol for 3 hours; and group P3 was treated with 1 μg/mL LPS and 100 μmol propofol for 3 hours. Cell viability in each group was determined with trypan blue dye exclusion test. In 6 separate cultures of ATII cells according to randomized group, CD14 and TLR4 mRNA was detected. With the Western Blot, the CD14 and TLR4 protein expression was detected and prepared for immunocytochemistry and immunofluorescence imaging. ANOVA and a post-hoc Tukey's test were used for multiple-group comparisons and a $P<0.05$ was significant.

**Results:** The viability of the ATII cells was confirmed. The LPS stimulation increased the CD14 and TLR4 expression in the ATII cells. The CD14 and TLR4 mRNA was suppressed at the concentration of 50 and 100 μmol propofol in the LPS-treated cells; $P<0.05$.

**Conclusions:** Propofol inhibits in a concentration of 50 and 100 μmol the inflammatory response of alveolar epithelial type II cells treated with LPS.

**Reviewer’s Comments:** Previous studies have proven that propofol has an immunoregulatory effect and there are a few clinical studies that show that patients anesthetized with propofol have less postoperative pain than those anesthetized with isoflurane. (Reviewer-Olga Plattner, MD).

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Keywords: Propofol, Pain

Print Tag: Refer to original journal article
Background: Perioperative epidural analgesia provides good pain control in patients undergoing major operations.

Objective: To evaluate the efficacy of pain control and quality of life (QOL) between thoracic epidural analgesia (TEA) and patient-controlled opiate analgesia (PCA).

Design: Randomized prospective clinical study.

Participants: 68 patients undergoing thoracic and/or upper abdominal surgery.

Methods: Patients were randomly assigned to either thoracic epidural infusion (the catheter was placed at T3 to T10 level depending on the level of incision) or a PCA. If the TEA failed, the patient was transferred to PCA. All operations were performed under general anesthesia with neuromuscular block and inhalation agents. TEA was bupivacaine 0.1% with fentanyl 2 μg/mL with 5 to 10 mL/hour; for the PCA, morphine 1 mg/mL with a 7-minute lock-out was used. Post-operation, vital signs were recorded and the visual analog pain scale (VAS) and sedation score were recorded at 30-minute intervals over 4 hours and then up to 12 hours and 2 to 4 hours thereafter. The QOL was evaluated by a physician 24 hours after the operation and 1 week later (a questionnaire of 36 questions evaluating mental health, role-emotional, social functioning, physical functioning, role-physical, and body pain). Univariate and repeated measures analyses were performed. Differences in QOL between the groups were assessed with analysis of variance (AOV). A \( P < 0.05 \) was considered significant.

Results: 37 patients in the TEA group finished the study and 23 in the PCA group finished. Pain scores were lower in the epidural group at 6-, 12-, and 18-hour postop and on the second and third postop day. QOL was better in the epidural group and the mean length of hospital stay was shorter (14.5 days) compared with PCA patients (16.9 days). In total, 97.3% patients were satisfied in the epidural group compared with 74.0% in the PCA group.

Conclusions: The use of epidural analgesia is associated with better pain relief and better short-term QOL in patients undergoing major surgery.

Reviewer’s Comments: Less sedation and better mobilization improved the QOL in the epidural patient group. However, one should always be aware that there might be a complication like infection or hematoma with an epidural catheter and this has to be explained to the patient in detail in the consent form. (Reviewer: Olga Plattner, MD).

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Keywords: Analgesia, Patient-Controlled Analgesia

Print Tag: Refer to original journal article
In this study, Sugammadex was very effective in reversing rocuronium-induced neuromuscular blockade in a myasthenia gravis patient.

**Background:** Myasthenia gravis is an autoimmune disease affecting the neuromuscular transmission. Autoantibodies against the acetylcholine receptor reduce the total amount of acetylcholine receptors. **Objective:** To evaluate the efficacy of Sugammadex in a myasthenic patient paralyzed with the non-depolarizing muscle relaxant rocuronium. Sugammadex is a micro-cyclodextrin that encapsulates steroidal neuromuscular blocking drugs and facilitates the return of preoperative muscle function. **Case Report:** A 72-year-old male patient was scheduled for a prostatectomy and had myasthenia gravis since 1988. He had a thymectomy in 1989 and had only ocular symptoms. His daily medication was 10 mg pyridostigmine. The patient received his usual dose of pyridostigmine and was induced with sufentanil and propofol. Anesthesia was also maintained with propofol and sufentanil. In total, 22 mg of rocuronium was administered for a 95% muscle block followed by seven 3-mg boluses. The patient was intubated and all vital parameters were monitored. According to the neuromuscular monitoring (T1 remained at 16 ± 3% of baseline), 32.2 mg/hour rocuronium was infused. At the end of surgery, all drugs were stopped. After 17 minutes, the T2 was present and T1 was 48% of the baseline. Sugammadex 2 mg/kg (176 mg) was administered. Within 210 seconds, the train-of-four ratio had reached 90%. Train-of-four ratio was higher than 97% after 13 minutes and 30 seconds. After spontaneous breathing occurred, the patient could lift head and arms and fulfilled extubation criteria. The patient was extubated and transferred to intermediate care, and 48 hours later the patient was discharged to the ward.

**Conclusions:** Sugammadex was very effective in reversing rocuronium-induced neuromuscular blockade in a patient with myasthenia gravis.

**Reviewer’s Comments:** The combination of Sugammadex and rocuronium could replace the need for suxamethonium (which has many side effects) and its use in Europe has been debated. (Reviewer-Olga Plattner, MD).

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Keywords: Sugammadex, Myasthenia Gravis

Print Tag: Refer to original journal article
Severe late psychological sequelae were common and persistent in confirmed awareness patients participating in the B-Aware Trial.

Objective: To compare the incidence of post-traumatic stress disorder (PTSD), diagnosed using a questionnaire, in B-Aware Trial patients.

Design/Participants: The B-Aware Trial is a multicentered randomized controlled trial of bispectral index (BIS) monitoring to prevent awareness in 2463 adult patients at high risk of awareness for cardiac and noncardiac surgery under general anesthesia.

Methods: Patients were interviewed about awareness of 3 occasions postoperatively. The patients who reported awareness were screened for psychological consequences of any kind. In this study, each surviving awareness patient was matched with 4 controls for age, sex, cardiac or noncardiac surgery, date of surgery, and hospital. Primary outcome was PTSD. Medical records were reviewed and a face-to-face interview was conducted with each participant using the Clinician Administered PTSD Scale (CAPS). CAPS is a validated and structured clinical interview meeting the Diagnostic and Statistical Manual of Mental Disorders IV criteria targeted to a specific traumatic event and allowing assessment of the frequency and intensity of PTSD, as well as the level of functional impairment.

Results: 13 of 2463 patients in the B-Aware Trial had confirmed awareness--2 in the BIS monitoring group and 11 in the routine care group. Six of those 13 patients had died. Four of 7 surviving awareness patients were matched with 4 controls each and 3 could only be matched with 3 controls each. Five of 7 confirmed awareness patients (71%) and 3 of 25 controls (12%) fulfilled the criteria for PTSD. The median time for symptom onset was 14 days after surgery and the median symptom duration was 4.7 years. The onset of symptoms was delayed for >3 weeks in 1 patient in the control group. Four of 5 aware patients who developed PTSD reported pain during the awareness episode, 4 reported inability to move, and 1 reported being terrified. One of the aware patients who did not develop PTSD recollected hearing talking. The other patient who did not develop PTSD reported being unable to move but no pain. Two of 5 aware patients with PTSD and both of the aware patients who did not develop PTSD reported psychological consequences within 30 days of surgery.

Conclusions: The incidence of PTSD was high in patients with confirmed awareness during the B-Aware Trial.

Reviewer’s Comments: It is difficult to draw firm conclusions based on the present study due to the small sample size. Further studies are needed in order to support the idea that long-term psychological follow-up should be offered to patients with awareness, regardless of their early postoperative psychological state. (Reviewer-K. George Bojanov, MD).

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Keywords: Intraoperative Awareness, Post-Traumatic Stress Disorder

Print Tag: Refer to original journal article
Pre-Warming Should Be Used in Patients at Risk for Postop Hypothermia

Resistive-heating or forced-air warming for the prevention of redistribution hypothermia.

De Witte JL, Demeyer C, Vandermaele E:

Anesth Analg 2010; 110 (March): 829-833

Post-anesthesia induction redistribution of body heat is partially prevented by 30 minutes of pre-warming.

Objective: To assess the efficacy of a resistive heating and a forced air warming system for 30 minutes pre-warming compared to a control group treated using current standards of care.

Design/Participants: Randomized prospective clinical study involving 27 adult patients scheduled for elective laparoscopic colorectal surgery.

Methods: Participants were randomly assigned to 1 of 3 groups (n=9 each): no pre-warming, pre-warming using resistive heating, and pre-warming with forced air. For the resistive heating, a Geratherm® presurgical whole body cover was applied for 30 minutes before anesthesia induction, preset at 42°C. Forced air warming was achieved with Arizant Healthcare Model 110 Perioperative Blanket and Model 750 Temperature Management Unit set at 42°C. All studies were done at 7:30 AM in order to minimize the effect of diurnal body temperature variation. All pre-warming devices were removed after 31 minutes and intraoperative temperature management started. Intraoperative warming was achieved using forced air warming with the Lithotomy Underbody Blanket Model 585 with temperature set at 42°C. Room temperature was set at 20°C. Core temperature was measured at the tympanic membrane using an aural probe before and esophageal temperature probe after anesthesia induction. Primary end point was esophageal temperature. Mean skin temperature and mean body temperature were calculated and recorded at all study times.

Results: Study groups were comparable to age, ASA physical status, and body mass index. Room temperature, anesthesia management, fluid administration, blood pressure, and duration of anesthesia and surgery were similar among the study groups. At the end of pre-warming, tympanic temperature was 35.9° ± 0.5°C in all groups. Esophageal temperature decreased for the first 40 minutes in all treatment groups. There was a significant difference in the esophageal temperature between the control (35.9° ± 0.3°C at 50 minutes) and the carbon fiber (36.5° ± 0.4°C at 50 minutes) groups measured between 40 and 90 minutes of anesthesia. Mean skin temperature was significantly lower in the control group compared to the other groups during pre-warming and until 70 minutes post-induction. At 60 minutes after arrival to the recovery room, mean tympanic temperature did not differ significantly among the groups. Conclusion: Pre-warming with resistive heating achieved a significantly higher esophageal temperature compared with the control group between 40 and 90 minutes of anesthesia.

Reviewer’s Comments: In the presented study, the statistical power was too low to allow a proper comparison between the 2 active treatment groups. Despite the fact that the forced air warming group achieved temperatures very close to the resistive heating group between 40 and 90 minutes, a statistically significant difference was measured only between the control and resistive heating groups. (Reviewer-K. George Bojanov, MD).

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Keywords: Redistribution Hypothermia, Resistive Heating, Forced Air Warming

Print Tag: Refer to original journal article
**Forced Air Comparable to Resistive Polymer Warming**

*Resistive-Polymer Versus Forced-Air Warming: Comparable Efficacy in Orthopedic Patients.*

Brandt S, Oguiz R, et al:

Anesth Analg 2010; 110 (March): 834-838

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Intraoperative warming with a resistive polymer system is as effective as warming with forced air for prevention of perioperative hypothermia.

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**Objective:** To compare the efficacy of a widely distributed forced air (FA) system with the resistive-polymer (RP) system.

**Design/Participants:** Prospective randomized clinical study involving 80 adult patients undergoing elective orthopedic surgery with general or combined general-regional anesthesia.

**Methods:** Patients were randomly assigned to 1 of 2 treatment groups (n=40 each): the FA warming group using the Bair Hugger upper body warming cover (model #552) paired with a model #750 warming unit set to high (43°C); and the RP warming group, using 2 Hot Dog warming blankets (model: Multi-Position Blanket) and the Hot Dog controller unit set to high (43°C). Each Hot Dog Multi-Position Blanket is half the size of a typical upper body FA blanket; thus combining 2 Hot Dog warming blankets results in 1 normal size upper body blanket. Mean body temperature was calculated before induction of anesthesia using multiple skin temperature probes. After anesthesia induction, the temperature probe was inserted either into the distal esophagus or the urinary bladder to measure core body temperature, after which active warming with the randomized warming device started. Core warming rate from 30 minutes post-induction to end of surgery, duration of surgery, type of anesthesia, IV infusions, blood loss, vasopressor therapy, and room temperature were recorded.

**Results:** Post-anesthesia induction core temperature decreased similarly for approximately 30 minutes in both groups. Subsequently, core temperature increased at similar rates in both groups (0.33°C/hour ± 0.34°C/hour and 0.29°C/hour ± 0.35°C/hour for groups FA and RP, respectively; P =0.6). There were no differences between the study groups with respect to the core temperature, mean body temperature, and mean skin temperature. No patient in this study needed postoperative warming in the recovery room. The environment temperature in close proximity to the workplace of the surgical and anesthesia team increased more in the FA group patients.

**Conclusions:** RP warming was as effective as FA warming and may be used as an appropriate method for prevention of perioperative hypothermia.

**Reviewer's Comments:** Advantages of RP warming include no moving parts, reusability, less warming of the OR environment, easy cleaning and disinfection, and lack of blowing air allowing the use of the device before surgical draping. Disadvantages include stiffness and tendency to form wrinkles and system efficacy depending on correct placement and correct skin contact. (Reviewer-K. George Bojanov, MD).

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Keywords: Warming, Efficacy, Resistive Polymer Warming, Forced Air Warming

Print Tag: Refer to original journal article