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Double gloves: a randomized trial to evaluate a simple strategy to reduce contamination in the operating room

Anesth Analg 2015;120:848-52
Birnbach DJ, Rosen LF, Fitzpatrick M, Carling P, Arheart KL, Munoz-Price LS

Abstract

Purpose  The purpose of this study was to determine if double-gloving during intubation and removal of the outer gloves immediately after the procedure reduced cross-contamination in a simulated operating room environment.

Background  Anesthesia providers as a whole have been shown to do a poor job of adhering to hand hygiene guidelines. Previous research has demonstrated that cross-contamination occurs quite frequently in the operating room, especially after intubation. This cross-contamination can contribute to nosocomial infections and is associated with increased morbidity. Anesthesia providers commonly only wear a single pair of gloves during intubation. The investigators of this study hypothesized that if anesthesia providers double-gloved during intubation, and immediately removed the first set of gloves after intubation, that the frequency of operating room cross-contamination would be significantly decreased.

Methodology  Forty anesthesia residents scheduled to undergo individual or group scenarios in a simulated operating room environment were randomized to wear either a single set of gloves or to double-glove, with removal of the outer gloves immediately after intubation. Additionally, residents in the double-glove group were instructed by an OR nurse (nurse confederate) to remove the outer set of gloves immediately after intubation and before contact with their surroundings. Residents were unaware of the study design; that is, they thought they were only participating in simulation scenarios. The study was exempt from IRB review.

Prior to each simulation drill, the mouth of the mannequin was coated with 0.5 mL DAZO fluorescent marking gel (Ecolab, St. Paul, MN), which served as a surrogate marker of oral pathogens and blood that could potentially cross-contaminate operating room equipment and sites. Forty sites for potential cross-contamination were examined by a blinded observer using an ultraviolet light. Prior to and after data collection, all 40 sites and the mannequin were cleaned with an alcohol-based solution and with soap and water. Disposable equipment and supplies were replaced. Prior to the start of a new scenario, the operating room was verified to be clean using the ultraviolet light.

The primary outcome of this study was the difference in the number of contaminated sites (range 0-40) between the single and double-glove groups. The secondary outcome included the proportion of 40 sites contaminated with the fluorescent marker.
between the two groups. Statistical analysis was appropriate and a P < 0.01 was considered significant. Results are presented as either the mean ± standard error, or percentage.

**Result**  No differences were found in resident experience level and whether or not they participated in an individual or group simulation drill. Only three residents in the single-glove group removed their gloves after intubation. The rest continued to wear them during the remainder of the simulation scenario, which lasted a total of 6 minutes. The mean number of contaminated sites was 4.1 times higher in the single-glove group compared to the double-glove group (20.3% vs. 5%, P < 0.001). The most frequently contaminated locations were the:

- anesthesia machine surface towel (100% vs. 18%, P < 0.001)
- reservoir bag (82% vs. 9%, P = 0.002)
- suction tubing (73% vs. 0.0%, P = 0.001)
- oxygen valve (64% vs. 9%, P = NS).

Two residents in the double-glove group, without prompting, placed the contaminated laryngoscope blade in the outer glove. None of the residents in the single-glove group performed hand hygiene after removing their gloves after intubation.

**Conclusion**  Wearing two sets of gloves and immediately removing the top layer after intubation significantly reduces the rate of cross-contamination. Anesthesia providers should consider implementing this practice.

![Figure 1. Rates of Cross-Contamination](image)

**Note:** Only significant differences (P < 0.01) were found for the anesthesia machine towel, reservoir bag, and suction tubing.
Comment
This is one of those studies that I think demonstrates how well-done simulation research might have the potential to change practice and reduce nosocomial infections. I would have never thought of double-gloving during intubation and immediately removing just the outer layer, although after reading this study I think I am going to start doing this. Even though this was a simulated environment, I think the results are pretty compelling!

The one weakness this study has is that the residents in the double-glove group were told by the nurse immediately after intubation to remove their outer set of gloves, whereas the single-glove group was not. The study would have been better designed if they had a third group who double-gloved but did not have the nurse remind them to remove their outer glove layer after intubation and a fourth group who single-gloved but did have the nurse remind them to remove their gloves. Could it be the combination of double-gloving and a reminder that is most beneficial?

Dennis Spence, PhD, CRNA

Other Studies in Anesthesia Abstracts related to cross contamination of the OR environment:
• Multiple reservoirs contribute to intraoperative bacterial transmission - January 2014 issue.
• Prevention of intravenous bacterial injection from health care provider hands: the importance of catheter design and handling - September 2012 issue.
• Multiple reservoirs contribute to intraoperative bacterial transmission - April 2012 issue.

The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.
The effects of continuous positive airway pressure on postoperative outcomes in obstructive sleep apnea patients undergoing surgery: A systematic review and meta-analysis

Anesth Analg 2015;120:1013-1023
Nagappa M, Mokhlesi B, Wong J, Wong DT, Kaw R, Chung F

Abstract
Purpose The purpose of this systematic review and meta-analysis was to examine differences in adverse postoperative respiratory events, perioperative Apnea-Hypopnea Index (AHI), and hospital length of stay in patients with obstructive sleep apnea (OSA) who used or did not use continuous positive airway pressure (CPAP) during the perioperative period.

Background Obstructive Sleep Apnea is a common sleep-breathing disorder with a prevalence of approximately 25% to 30% in surgical patients. In bariatric patients the incidence can be greater than 70%. OSA is associated with significant perioperative morbidity and mortality, especially when undiagnosed. Large cohort studies have demonstrated that patients with untreated OSA have higher rates of cardiovascular complications during the perioperative period when compared to patients with OSA treated with CPAP (OR = 2.2).

It is recommended that, unless contraindicated, OSA patients currently treated with CPAP should continue it during the perioperative period. Some studies suggest that patients undiagnosed with OSA preoperatively, but identified as being at high risk for having OSA in their pre-surgical work up, be started on Auto-Titrating Positive Airway Pressure (APAP). Patients started on auto-titrating positive airway pressure (APAP) had a significantly reduced postoperative Apnea Hypopnea Index and decreased frequency of hypoxemia compared to OSA patients who did not receive APAP. Unfortunately, other studies on perioperative CPAP have not demonstrated a reduction in length of stay or postoperative adverse events.

Methodology This was a systematic review and meta-analysis. Articles were incorporated if they included:

1. age >18 with information on OSA
2. use of CPAP either preoperatively and/or postoperatively
3. reported data on postoperative adverse events, preoperative and postoperative AHI, and length of stay
4. study design: case series to randomized controlled trials

The quality of the study designs were assessed with the Cochrane Risk of Bias tool. Differences in postoperative adverse events, Apnea-Hypopnea Index, and hospital length of stay were compared between patients who did or did not use CPAP.

Result There were six studies on 904 patients included in this review which examined postoperative adverse events (CPAP group n = 471 vs. no-CPAP n =
In the CPAP group, 216 had preoperative CPAP only, 43 had CPAP postoperatively only, and 212 had preoperative and postoperative CPAP. There were four studies which reported hospital length of stay (CPAP group n = 278 vs. no CPAP group n = 300). Two studies reported differences in Apnea-Hypopnea Index (AHI) (preoperative AHI n = 100 vs. postoperative AHI n = 51).

Of the six studies, three were observational (n = 625), two were randomized controlled trials (n = 263), and one was a case series (n = 16). Four of six studies used both preoperative and postoperative CPAP. One study used CPAP only preoperatively (prospective cohort study n = 268), and one study only used CPAP postoperatively (randomized controlled trial n = 86).

Perioperative use of CPAP reduced the risk of adverse events in OSA patients by 12% (RR = 0.88); however, this finding was not statistically significant. Two studies compared the preoperative and postoperative Apnea-Hypopnea Index in patients using CPAP. There were 151 patients who used CPAP preoperatively and 51 who used it postoperatively. The preoperative Apnea-Hypopnea Index without CPAP was 37 events per hour vs. 12 events per hour in patients who used postoperative CPAP. One randomized controlled trial found that auto-titrated positive airway pressure (APAP) significantly reduced the postoperative Apnea-Hypopnea Index on the third postoperative night compared to a control group. The Apnea-Hypopnea Index was 32 events per hour in the control group but only 3 events per hour in the APAP group. There was a trend towards a decreased length of hospital stay in the CPAP group when compared to the no-CPAP group (4 ± 4 vs. 4.4 ± 8 days, P = 0.05).

**Conclusion** Perioperative use of CPAP (preoperative and/or postoperative) did not reduce the rate of adverse events in patients with OSA. There was a trend towards a decreased length of stay and a reduced postoperative Apnea-Hypopnea Index in OSA patients treated with CPAP.

**Comment** This is one of those studies that makes you scratch your head. I would have expected CPAP use preoperatively to reduce the rate of postoperative complications. However, the results of this systematic review failed to find a positive benefit. There are several reasons for this. First, the studies included varied in methodology for CPAP use. Some used preoperative and postoperative CPAP, others only preoperative CPAP or just post-op CPAP. Definitions and timing of measurement of postoperative adverse events differed from study to study and multiple study designs were included, not just randomized controlled trials. Furthermore, several of the reviewed studies initiated CPAP in newly diagnosed OSA patients in the days prior to surgery, while others included OSA patients who had been using CPAP for a longer period of time. These patients may have been more comfortable and compliant with use of the CPAP. For example one previous study by Liao et al. randomized 177 patients with moderate OSA to APAP or no APAP; APAP was started 2-3 days prior to surgery and continued through postoperative night five. Liao
et al. found significant improvements in the postoperative AHI but had a very high drop-out (46%) and noncompliance rate (45%) in the treatment group. Only 48% of the subjects in the APAP group used it for >4 hours each study night. The number one reason for noncompliance with APAP was PONV and/or pain.

It may be that more time is needed to get patients compliant with CPAP/APAP, and if it is initiated postoperatively, patients will require good pain and PONV control. Anesthesia providers should educate nurses on OSA and its treatments, and they should utilize multimodal analgesia and consider prophylactic antiemetic administration in patients with OSA on CPAP.

Despite the inconclusive findings of this study on perioperative CPAP use in OSA patients, I still think anesthesia providers should continue to recommend patients use it postoperatively and consider initiating it in patients undergoing major surgery who may have moderate to severe undiagnosed OSA.

Dennis Spence, PhD, CRNA

The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.
INTRAOPERATIVE CORE TEMPERATURE PATTERNS, TRANSFUSION REQUIREMENT, AND HOSPITAL DURATION IN PATIENTS WARMED WITH FORCED AIR

Anesthesiology 2015;122:276-285
Sun Z, Honar H, Sessler DI, Dalton JE, Yang D, Panjasawatwong K, Deroee AF, Salmasi V, Saager L, Kurz A

Abstract

Purpose The purpose of this study was to describe the incidence of hypothermia in patients undergoing surgeries lasting longer than 60 minutes with forced-air warming and to identify predictors of blood transfusions and extended hospital stay.

Background The Surgical Care Improvement Project recommends that patients should be normothermic at the end of surgery. Normothermia is defined as a core temperature of at least 36°C. Hypothermia (<37°C) is associated with surgical wound infections, decreased drug metabolism, prolonged recovery, and is uncomfortable for patients. The most common method to actively warm patients is with forced-air warming devices. However, despite use of forced-air warming, many patients still experience hypothermia. This study sought to describe the patterns of hypothermia and its association with blood transfusions and increased hospital stay in 58,814 adults having surgery lasting longer than 60 minutes who were warmed with forced-air devices at the Cleveland Clinic.

Methodology This was a retrospective review of data on 58,814 adult patients who underwent noncardiac surgery under general anesthesia lasting more than 60 minutes. All were warmed with forced air and had esophageal (core) temperatures recorded. Data were collected at the Cleveland Clinic from 2005-2013. The incidence and duration of core temperature thresholds of <36.0°, <35.5°, and <35.0°C were recorded. Multivariable regression techniques were used to identify predictors of hypothermia (<37°C reported as degrees per hour) while controlling for year, type, and duration of surgery; body mass index; age; preoperative platelet count; preoperative hemoglobin; estimated blood loss; and individual anesthesia provider.

Result There were 58,814 patients included in the analysis. The median age range of patients was between 53 years and 60 years, with older patients having a larger drop in temperature. The most common type of surgical procedure was digestive, followed by orthopedic, gynecologic, nervous system, and urologic (Table 1). Urologic procedures had the highest rate of hypothermia <36°C (38.5%) and eye procedures had the lowest rate (8.3%).

Overall, core body temperature decreased the first hour, then progressively increased. The mean lowest temperature during the first hour was 35.7 ± 0.6°C. At 45 minutes after induction 64% of patients had a temperature lower than 36°C and 29% had a temperature lower than 35.5°C. Close to 50% of...
patients had temperatures lower than 36°C, and 20% had a temperature lower than 35.5°C for more than an hour. Twenty percent of patients had temperatures lower than 36°C for more than 2 hours, and 8% of patients were below 35.5°C for more than 2 hours (Figures 1 and 2). Despite these findings, 91% of patients had core temperatures ≥ 36°C at the end of anesthesia.

Hypothermia was independently associated with increased need for a blood transfusion and prolonged hospital stay. Patients with core temperatures ≤35.5°C at the end of surgery were 22% more likely to require a blood transfusion (P < 0.05). In patients with temperatures between 0.5°C to 4°C below 37°C, hospital stay was prolonged by approximately 0.3 days; from 2.4 to 2.7 days (P < 0.05).

**Conclusion**

Despite active warming with forced-air warming devices, patients undergoing surgeries longer than 60 minutes still experienced prolonged hypothermia. More than half of patients had a temperature lower than 36°C, and close to a

---

**Table 1. Hypothermia Rates by Surgical Service**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>% (N)</th>
<th>&lt;36°C</th>
<th>&lt;35.5°C</th>
<th>&lt;35°C</th>
<th>Case End Temp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% of hypothermia in each category</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digestive</td>
<td>28.1% 16,525</td>
<td>27%</td>
<td>6.5%</td>
<td>0.9%</td>
<td>36.3°C</td>
</tr>
<tr>
<td>Orthopedic</td>
<td>14.1% (8,272)</td>
<td>29.1%</td>
<td>9.2%</td>
<td>2.1%</td>
<td>36.2°C</td>
</tr>
<tr>
<td>Gynecological</td>
<td>11.3% (6,637)</td>
<td>32.4%</td>
<td>8%</td>
<td>1.1%</td>
<td>36.2°C</td>
</tr>
<tr>
<td>Nervous</td>
<td>11.0% (6,466)</td>
<td>33.2%</td>
<td>9.1%</td>
<td>2%</td>
<td>36.2°C</td>
</tr>
<tr>
<td>Urological</td>
<td>10.5% (6,162)</td>
<td>38.5%</td>
<td>11.6%</td>
<td>1.8%</td>
<td>36.2°C</td>
</tr>
</tbody>
</table>

**Note:** Includes top 5 procedures. Temp = temperature. “Case End Temp” is median value.

---

**Figure 1. Changes in Temperature**

Note: Results are median (Q1 = 25% to Q3 = 75%).

**Figure 2. Hypothermia Over Time**

Note: Results are median (Q1 = 25% to Q3 = 75%).
third had temperatures lower than 35.5°C during the first hour of surgery. Thereafter, temperatures progressively increased to a mean of 36.3°C at the end of surgery. Hypothermia was associated with a significantly increased need for a blood transfusion and non-clinically significant increase in hospital length of stay.

Comment
Redistribution of body heat from the central to peripheral compartments is the primary cause of hypothermia during the first hour after induction of anesthesia. Despite active warming with forced-air warming devices, virtually all patients developed hypothermia. Temperatures then progressively increased and most patients were >36°C at the end of surgery. Patients undergoing longer surgeries tended to be more normothermic at the end of surgery. This is probably related to the use of active warming and redistribution of heat back to the central compartment. Therefore, I think it is important that even patients undergoing short surgical procedures are actively warmed with forced-air warming devices.

It was not surprising to see that hypothermia increased the need for blood transfusion. Hypothermia impairs the coagulation cascade and impairs platelet function. Likewise, it is not surprising that hypothermia slightly increased the length of stay. This could be related to the increased amount of time to treat hypothermia in the recovery room. Even though the increase was small (0.3 days), it could still potentially increase costs, especially if it prolongs the recovery room stay or requires blood administration.

Dennis Spence, PhD, CRNA

The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.
Hand hygiene knowledge and perceptions among anesthesia providers

Anesth Analg 2015;120:837–43
Fernandez PG, Loftus RW, Dodds TM, Koff, MD, Reddy S, Heard SO, Beach ML, Yeager MP, Brown JR

Abstract

Purpose The purpose of this study was to describe anesthesia providers’ knowledge and perceptions of hand hygiene and to identify predictors that might improve compliance with the World Health Organization’s guidelines on the five critical moments in which hand washing can reduce hospital-acquired infections.

Background Compliance with hand hygiene by health care providers is poor. This poor compliance contributes to healthcare-associated infections. For example, intravenous stop–cock bacterial contamination by anesthesia providers has been found to be associated with higher rates of postoperative infections. World Health Organization guidelines on hand hygiene describe five critical moments in which hand washing (or use of hand sanitizer unless grossly contaminated) can reduce hospital-acquired infection:

1. before patient contact
2. before an aseptic task
3. after body fluid exposure risk
4. after patient contact
5. after contact with patient surroundings

A previous study examining compliance with four structured questions based on the World Health Organization guidelines was associated with improved hand hygiene in health care providers. Investigators in this study sought to modify the survey to characterize anesthesia providers’ knowledge and perceptions on hand hygiene.

Methodology This was a cross-sectional national survey of members of three large academic medical centers (N = 396) and a random selection of members of the American Society of Anesthesiologists (N = 3,346). Investigators adapted questions from a previous survey on knowledge and perceptions of hand hygiene. Five questions, based on the World Health Organization five critical moments for hand hygiene, were adapted to reflect the perceived importance of hand hygiene in anesthesia practice.

Do you wash your hands:

1. before a preoperative examination (before patient contact)
2. before placing a peripheral IV catheter (aseptic technique)
3. after intubating (exposure to secretions)
4. after palpating a pulse (after patient contact)
5. after adjusting operating room bed height (exposure to the environment)

Answering no to any one of the five questions that asked about these practices was defined as having incomplete hand hygiene knowledge. Content analysis was evaluated prior to dissemination of the survey.

Other questions in the survey evaluated the frequency of hand hygiene per hour of anesthesia time and perceptions of hand hygiene. Logistic regression was used to identify factors associated with poor knowledge of hand hygiene guidelines.

Result There were 3,742 respondents for a survey response rate of 22%. The majority of respondents were Anesthesiologists (85%), followed by CRNAs (6.5%), residents (6.4%), SRNAs (2.4%) and...
Anesthesia Assistants (0.3%). Approximately 46% worked in academic medical centers and the other 54% in private practice. Fifty-five percent of respondents had between one and fifteen years’ experience, with 22% having between one and five years’ experience.

Only 18% of respondents answered yes to all five questions on hand hygiene knowledge; the mean number of “yes” answers was 2.9 (Figure 1). The lowest level of knowledge was for the need for hand hygiene after exposure to a source of environmental contamination; only 21% reported they understood the importance of hand hygiene after touching the bed control to adjust the height of the operating room table. There was a reduced risk of incomplete knowledge on the five questions for hand hygiene if respondents answered yes to washing their hands after contact with the environment (OR = 0.23, P<0.001), respondents felt they could influence their colleagues to wash their hands (OR = 0.43, P<0.001), respondents were more likely to disinfect the environment (OR = 0.55, P = 0.004), and if respondents intended to adhere to hand-washing guidelines (OR = 0.56, P = 0.008).

Respondents’ perceptions of their hand hygiene practices are listed in Table 1 and Figure 2. Overall, the results suggest that respondents had poor knowledge and compliance with the World Health Organization’s five moments for hand hygiene. Only 39% felt achieving excellent hand hygiene was easy, 65% felt they could improve their hand hygiene compliance, and a majority (85%) felt poor hand

Figure 1. Knowledge of WHO Opportunity-Based Hand Hygiene

![Fig 1](image_url)
hygiene contributes to contamination of patients. Only 29% performed hourly hand hygiene (Figure 1).

Conclusion Anesthesia providers had poor hand hygiene knowledge, especially knowing the importance of washing their hands after exposure to contaminated patients (checking a pulse) or environmental reservoirs (i.e., bed control). Greater emphasis should be placed on improving anesthesia providers’ knowledge and compliance with the World Health Organization’s five critical practices for improving hand hygiene.

Comment I hate to say that the results of this study do not surprise me. We are probably one health care
provider that touches the patient and contaminated environment the most, and as such we do contribute to hospital-acquired infections. Results of this study and others support this (see Anesthesia Abstracts March 2011; Anesthesia Abstracts January 2014).

So what can we do? I think keeping a bottle of hand sanitizer close by and wiping down with a cleaning solution or wipe all potential sources of contamination regularly (i.e., bed control, anesthesia bag, etc). Every time you touch the patient or environment you should try to wash your hands or use hand sanitizer. Also encourage colleagues, students, and residents to do the same. Call people out (tactfully) if you have to.

**Dennis Spence, PhD, CRNA**

The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.
To pretreat or not pretreat: Prophylactic anticholinergic administration before dexmedetomidine in pediatric imaging

Anesth Analg 2015:121:479-85

Abstract

Purpose The aim of this clinical study was to compare the effect of administration or omission of a prophylactic anticholinergic on hemodynamics in pediatric patients receiving dexmedetomidine sedation for imaging studies. Secondly, a subgroup analysis was performed on Down syndrome patients.

Background The practice of providing sedation to pediatric patients with large doses of dexmedetomidine is increasing. Dexmedetomidine’s clinical properties are well documented. At large doses, the loading/bolus dose causes a transient biphasic hemodynamic change. The administration of a prophylactic anticholinergic can potentially combat bradycardia and hypotension. Therefore, there is a need for guidelines for the administration or omission of an anticholinergic before sedation with dexmedetomidine.

Methodology A retrospective chart review was performed on 163 pediatric patients who received dexmedetomidine as the sole anesthetic agent for MRI scans at the Cincinnati Children’s Hospital Medical Center from July 2006 until March 2012. Seventy-five anesthetic records were handwritten while 88 were electronic medical records. To report the study, the Strengthening of Reporting of Observational Studies in Epidemiology (STROBE) guidelines were followed.

An inhalation induction of sevoflurane with or without nitrous oxide was performed first. An IV catheter was inserted following the inhalation induction. Sevoflurane and nitrous oxide (if used) were immediately discontinued. At the discretion of the anesthesiologist, patients either received or did not receive a weight-based dose of either glycopyrrolate or atropine. Subsequently, a dexmedetomidine loading dose was administered over 10 minutes and an infusion begun. Patients were then placed on a nasal canal oxygen with a CO₂ end-tidal port while breathing spontaneously. EKG, SpO₂, capnography, and noninvasive blood pressure were monitored during the imaging procedure. HR was monitored continuously and documented every minute, while BP was documented every five minutes. If the patient moved voluntarily during the scan, an additional bolus of dexmedetomidine was administered and the infusion rate adjusted as necessary. Upon completion of the MRI scan, the dexmedetomidine infusion was discontinued and patients were transferred to the PACU. As patients met standard PACU discharge criteria, they were discharged.

Extracted data were age, weight, gender, ethnicity, ASA class, presence of Down syndrome, and other
associated co-morbidities. The dose of the
dexmedetomidine bolus and infusion rates were
recorded. Anticholinergic administration data was
noted. The extracted hemodynamic data included:
HR, SBP, DBP, SpO_2, and respiratory rate. These
hemodynamic indices were noted at baseline, during
the imaging process, and following arrival to the
PACU.

Analysis for the percentage change in HR, systolic BP,
and diastolic BP consisted of the acquisition of a
baseline value followed by a minimum value over
seven consecutive time points. The change between
the baseline value and the initial PACU value was also
examined. In an attempt to detect any difference
between the anticholinergic group versus the no-
anticholinergic group, a t-test was performed on the
hemodynamic change measures.

**Result**  Charts from 163 children were reviewed.
The average patient age was 94.5 months and the
average weight was 32.1 kilograms. The 10 minute
dexmedetomidine loading dose was 1-2 µg/kg with an
infusion rate ranging from 1-3 µg/kg/hour. The
anticholinergic dose was 10 µg/kg for both atropine
and glycopyrrolate.

When no prophylactic anticholinergic was
administered, HR and systolic BP were significantly
reduced, while there was no significant change in
diastolic BP. The no-anticholinergic group HR
decreased by 27% from baseline, compared to a
decrease of 17% in the anticholinergic group.
Following these decreases vital signs recovered. Then,
in the anticholinergic group, systolic BP increased
20% compared to baseline vs. a 10% increase in the
no-anticholinergic group.

Fifty-two of the patients were previously diagnosed
with Down syndrome. Similar HR results were found
in the Down syndrome group. The decrease in HR
was 25% in the no-anticholinergic group, but only
15% in the group that received an anticholinergic. Of
note, the increase in systolic BP was exaggerated in
the anticholinergic group, 22% vs 0.6% in the no-
anticholinergic group.

In both groups, Down syndrome and non-Down
syndrome, the change in HR, systolic BP, and diastolic
BP were not significantly different compared with
baseline and PACU values.

**Conclusion**  A transient but clinically
insignificant increase in HR and SBP was found when
a prophylactic anticholinergic was administered to
children receiving a dexmedetomidine infusion for
MRI imaging studies. Furthermore, the prophylactic
anticholinergic was associated with a brief excessive
increased systolic BP compared to patients who did
not receive an anticholinergic.

**Comment**  There are two relevant topics that need to be
discussed. First is a review of pediatric bradycardia
and the potentially catastrophic events that can ensue.
Secondly the clinical relevance of the evidence
produced by the study needs further explanation.

As we age, our hearts become more compliant and
able to vary stroke volume as situations require.
Pediatric patients often do not have this capacity. The
developing heart is rather noncompliant, and, as a result, unable to alter stroke volume. The younger a patient is, the more noncompliant and less contractile the heart; therefore, pediatric patients, as a whole, are considered to be “heart-rate dependent.” Due to the noncompliant pediatric ventricles, their cardiac output is almost entirely dependent on an adequate heart rate.

In general, bradycardia is considered a heart rate less than 65 beats per minute (bpm) and in neonates anything less than 100 bpm. Bradycardia leads to decreased oxygen delivery to vital organs, followed by a morbid downward spiral of cardiac arrhythmia potentially producing complete cardiac collapse.

Healthy children suffer from bradycardia stemming from an inhalation induction with sevoflurane at a rate around 12%. Children diagnosed with Down syndrome (Trisomy 21) experience bradycardia at a rate of 57% following a sevoflurane inhalation induction. Furthermore, the bradycardia in the Down syndrome population is typically more severe and occurs more abruptly. Given the negative chronotropic effects associated with dexmedetomidine, it comes as no surprise that the prophylactic treatment of bradycardia with an anticholinergic seems necessary.

Here’s how I translate the findings of this study into clinical practice. There are various flaws throughout the study. A major issue is the lack of randomization, nevertheless, the study is the first of its kind and therefore the data provides insight. Secondly, there was no way to delineate whether the bradycardia was the result of the sevoflurane induction or the administration of dexmedetomidine. Lastly, the study lacked an age-related hemodynamic analysis, which would have made this study more clinically applicable. A summary of the data can be found in the abstract above, so what follows is a translation and bullet-point suggestions for clinical practice.

**In the non-Down syndrome population:**
- Unless dexmedetomidine is your sole anesthetic agent, these high doses will not be used
- With the high Dex doses and no prophylactic anticholinergic, no patient became hemodynamically unstable (requiring physical or pharmacological intervention)
- Expect a slowed HR and decreased BP, but do not expect clinical hemodynamic instability
- Hemodynamic relations directly reflect Dex dose and rate of infusion
- Most at-risk: (a) extreme hypovolemia, (b) increased vagal tone, and (c) neonates and infants; therefore, be cautious and or omit Dex administration in these populations
- When administering Dex, it is essential to understand its pharmacodynamics, especially the expected hemodynamic variations
- If you choose to prophylactically administer an anticholinergic when administering Dex, realize the hemodynamic effects can be clinically non-existent
- If bradycardia becomes clinically concerning, quickly discontinue the infusion

**In the Down syndrome population:**
- Expect more pronounced dexmedetomidine hemodynamic effects, especially in those with heart disease
- Dex loading dose and/or high infusion doses may not be appropriate
- Anticholinergics are associated with exceptionally high systolic BPs
- There are various clinical and other pharmacological maneuvers to prevent bradycardia in this population
- If bradycardia is clinically concerning, quickly discontinue the infusion
This is the big take-away. The younger the patient, the more prone they are to anesthetic-induced bradycardia. Typically, anticholinergics combat this bradycardia. Unfortunately, anticholinergics are not the complete solution to dexmedetomidine-induced bradycardia. Clinical intuition is currently the best guide to determine administration of prophylactic anticholinergics prior to sole anesthesia dexmedetomidine infusion, as its prophylactic administration is not currently supported by evidence.

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Comparison of Margin of Safety Following Two Different Techniques of Preoxygenation

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Abstract

Purpose The purpose of this study was to compare the margin of safety following preoxygenation using eight vital capacity breaths in one minute versus traditional tidal volume breathing for three minutes. Comparisons were made by measuring changes in arterial partial pressure of oxygen (PaO₂) and apnea-induced desaturation time.

Background Preoxygenation is a crucial part of induction of general anesthesia. In emergency situations, there would be great benefit in shortening the duration of effective preoxygenation. Tidal volume breathing is the volume representing the air displaced during normal inhalation and exhalation. Vital capacity is the amount of air a person can expel from the lungs after a maximum inhalation. It is also represented as inspiratory reserve volume plus tidal volume plus expiratory reserve volume.

Methodology This randomized clinical trial included 20 male and female ASA I and II patients undergoing general anesthesia with endotracheal intubation and invasive blood pressure monitoring. Patients were randomly assigned a group by a computer-generated sequence of random numbers. The Tidal Volume Group did Tidal Volume Breathing for three minutes with oxygen at 5 l/min. The Vital Capacity Group took eight Vital Capacity Breaths in one minute with oxygen at 10 l/min. The difference in fresh gas flows was justified since higher flows are required to avoid rebreathing if patients are taking Vital Capacity Breaths.

Prior to preoxygenation, monitors were placed including a radial arterial line for arterial blood sampling. After induction with propofol and succinylcholine, the time until apnea was measured. An endotracheal tube was placed at one minute and left open to atmosphere. Vecuronium and midazolam were then given. Patients were observed for the time in which desaturation to 90% occurred and for maximum desaturation. They were then immediately bag ventilated until oxygen saturation increased to 98% or above and put on a ventilator with a volatile agent. Arterial blood gas samples along with vital signs were taken before induction on room air for a baseline, immediately after preoxygenation, and at 90% desaturation. If there was tachycardia or hypertension, propofol was given to deepen anesthesia. Patients that had sustained tachycardia, hypertension, or developed arrhythmias were excluded from the study.

Result The difference in mean PaCO₂ at baseline was statistically significantly different between...
groups. Therefore, the two groups were compared for statistical significance using the percent change in PaCO$_2$ rather than comparing absolute values. There were no significant differences between groups in SpO$_2$ at baseline, after preoxygenation, or at maximum desaturation. Nor was there a difference in SBP, DBP, MAP, or HR between groups.

After preoxygenation, the Vital Capacity Group had a significantly higher PaO$_2$ value than the Tidal Volume Group (439 ± 62 vs 345 ± 21, P < 0.001). For pH after preoxygenation, the Vital Capacity Group also had a significantly higher pH than the Tidal Volume Group (7.45 vs 7.39, P = 0.044). The Vital Capacity Group also demonstrated a significantly longer time to apnea-induced desaturation to 90% compared to the Tidal Volume Group (6.9 ± 1.8 min vs 3.5 ± 0.4 min, P = <0.001).

**Conclusion**  
Eight Vital Capacity Breaths in one minute imparted a greater margin of safety than Tidal Volume Breathing for three minutes due to the significantly high arterial partial pressure of oxygen. This resulted in an approximate doubling of apnea-induced desaturation time in the Vital Capacity group. The investigators recommend four or more Vital Capacity Breaths as a reliable and faster alternative to preoxygenation by three minutes of Tidal Volume Breathing.

**Comment**  
This study caught my attention because we all would like to know a faster way for induction in an emergency situation. My concern would be the patient’s ability to effectively perform vital capacity breathing. Obesity, gender, position, and lung disease impact respiratory effort. Obesity and lung disease reduces chest compliance. Females and the supine position decreases functional residual capacity, which would impact vital capacity by decreasing expiratory reserve volume. Therefore, as with anything in anesthesia, patient selection is key.  

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