
IMPORTANCE: Frailty is a measure of decreased physiological reserve that is associated with morbidity and mortality in major elective and emergency general surgery operations, independent of chronological age. To date, the association of frailty with outcomes in ambulatory general surgery has not been established.

OBJECTIVE: To determine the association between frailty and perioperative morbidity in patients undergoing ambulatory general surgery operations.

DESIGN, SETTING, AND PARTICIPANTS: A retrospective cohort study was conducted of 140,828 patients older than 40 years of age from the 2007-2010 American College of Surgeons National Surgical Quality Improvement Program Participant Use File who underwent ambulatory and 23-hour-stay hernia, breast, thyroid, or parathyroid surgery. Data analysis was performed from August 18, 2016, to June 21, 2017.

MAIN OUTCOMES AND MEASURES: The association between the National Surgical Quality Improvement Program modified frailty index and perioperative morbidity was determined via multivariable logistic regression with random-effects modeling to control for clustering within Current Procedural Terminology codes.

RESULTS: A total of 140,828 patients (80,147 women and 60,681 men; mean [SD] age, 59.3 [12.0] years) underwent ambulatory hernia (n = 71,455), breast (n = 51,267), thyroid, or parathyroid surgery (n = 18,106). Of these patients, 2,457 (1.7%) experienced any type of perioperative complication and 971 (0.7%) experienced serious perioperative complications. An increasing modified frailty index was associated with a stepwise increase in the incidence of complications. In multivariable analysis adjusting for age, sex, race/ethnicity, anesthesia type, tobacco use, renal failure, corticosteroid use, and clustering by Current Procedural Terminology codes, an intermediate modified frailty index score (0.18-0.35, corresponding to 2-3 frailty traits) was associated with statistically significant odds ratios of 1.70 (95% CI, 1.54-1.88; P < .001) for any complication and 2.00 (95% CI, 1.72-2.34; P < .001) for serious complications. A high modified frailty index score (≥0.36, corresponding to ≥4 frailty traits) was associated with statistically significant odds ratios of 3.35 (95% CI, 2.52-4.46; P < .001) for any complication and 3.95 (95% CI, 2.65-5.87; P < .001) for serious complications. Anesthesia with local and monitored anesthesia care was the only modifiable covariate associated with decreased odds of serious 30-day complications, with an adjusted odds ratio of 0.66 (95% CI, 0.53-0.81; P < .001).

CONCLUSIONS AND RELEVANCE: Frailty is associated with increased perioperative morbidity in common ambulatory general surgery operations, independent of age, type of anesthesia, and other comorbidities. Surgeons should consider frailty rather than chronological age when counseling and selecting patients for elective ambulatory surgery.
surgical complications), functional decline, mortality, post-hospitalization discharge destination, and prolonged hospitalization among older adults undergoing elective surgery were included. Study characteristics and prognostic factors associated with the outcomes of interest were extracted independently by two reviewers. Random effects meta-analysis models were used to derive pooled effect estimates for prognostic factors and incidences of adverse outcomes.

RESULTS: Of the 5692 titles and abstracts that were screened for inclusion, 44 studies (12,281 patients) reported on the following adverse postoperative outcomes: postoperative complications (n =28), postoperative mortality (n =11), length of hospitalization (n =21), functional decline (n =6), and destination at discharge from hospital (n =13). The pooled incidence of postoperative complications was 25.17% (95% confidence interval (CI) 18.03-33.98%, number needed to follow = 4). The geriatric syndromes of frailty (odds ratio (OR) 2.16, 95% CI 1.29-3.62) and cognitive impairment (OR 2.01, 95% CI 1.44-2.81) were associated with developing postoperative complications; however, there was no association with traditionally assessed prognostic factors such as age (OR 1.07, 95% CI 1.00-1.14) or American Society of Anesthesiologists status (OR 2.62, 95% CI 0.78-8.79). Besides frailty, other potentially modifiable prognostic factors, including depressive symptoms (OR 1.77, 95% CI 1.22-2.56) and smoking (OR 2.43, 95% CI 1.32-4.46), were also associated with developing postoperative complications.

CONCLUSION: Geriatric syndromes are important prognostic factors for postoperative complications. We identified potentially modifiable prognostic factors (e.g., frailty, depressive symptoms, and smoking) associated with developing postoperative complications that can be targeted preoperatively to optimize care.


BACKGROUND: The role of obesity as a risk factor for difficult intubation remains controversial. We primarily assessed the association between body mass index (BMI) and difficult tracheal intubation.

METHODS: We analysed electronic records of more than 67,000 adults having elective non-cardiac surgery requiring tracheal intubation at the Cleveland Clinic between 2011 and 2015. The association between BMI and difficult intubation, defined as more than one intubation attempt, was assessed using multivariable logistic regression adjusting for pre-specified confounders.

RESULTS: Amongst 40,183 patients with BMI <30 kg/m² and 27,519 with BMI ≥30 kg/m², 9% required more than one intubation attempt. Increasing BMI up to 30 kg/m² was significantly associated with increased odds of more than one intubation attempt [odds ratio (OR): 1.03; 97.5% confidence interval (CI): 1.02, 1.04] per unit increase in BMI, P<0.001. However, the odds of difficult intubation remained unchanged once BMI exceeded 30 kg m-2 (P=0.08). The results were similar when analysis was restricted to patients without history of airway abnormalities in whom intubation was attempted using a standard direct laryngoscope (OR: 1.03; 99.4% CI: 1.01, 1.04) per kg m-2 increase in BMI <30 kg/m²).

CONCLUSIONS: Increasing BMI was associated with increasing odds of difficult intubation in the lean range. At higher BMI, the odds of difficult intubation remain elevated, but there is no additional increase in odds with further increase in BMI. Obese patients were thus harder to intubate than lean ones, but difficult intubation was no more likely in morbidly obese patients than in those who were only slightly obese.


BACKGROUND: The use of intraoperative opioids may influence the rate of postoperative complications. This study evaluated the association between intraoperative opioid dose and the risk of 30-day hospital readmission.

METHODS: We conducted a pre-specified analysis of existing registry data for 153,902 surgical cases performed under general anaesthesia at Massachusetts General Hospital and two affiliated medical centres.
We examined the association between total intraoperative opioid dose (categorised in quintiles) and 30-day hospital readmission, controlling for several patient-, anaesthetist-, and case-specific factors.

RESULTS: Compared with low intraoperative opioid dosing [quintile 1, median (inter-quartile range): 8 (4-9) mg morphine equivalents], exposure to high-dose opioids during surgery [quintile 5: 32 (27-41) equivalents] is an independent predictor of 30-day readmission [odds ratio (OR) 1.15 (95% confidence interval 1.07-1.24); P<0.001]. Ambulatory surgery patients receiving high opioid doses were found to have the greatest adjusted risk of readmission (OR 1.75; P<0.001) with a clear dose-response effect across quintiles (P for trend <0.05), and were more likely to be readmitted early (postoperative days 0-2 vs 3-30; P<0.001). Opioid class modified the association between total opioid dose and readmission, with longer-acting opioids demonstrating a stronger influence (P<0.001). We observed significant practice variability across individual anaesthetists in the utilisation of opioids that could not be explained by patient- and case-specific factors.

CONCLUSIONS: High intraoperative opioid dose is a modifiable anaesthetic factor that varies in the practice of individual anaesthetists and affects postoperative outcomes. Conservative standards for intraoperative opioid dosing may reduce the risk of postoperative readmission, particularly in ambulatory surgery.


BACKGROUND: We hypothesised that intraoperative non-depolarising neuromuscular blocking agent (NMBA) dose is associated with 30-day hospital readmission.

METHODS: Data from 13,122 adult patients who underwent abdominal surgery under general anaesthesia at a tertiary care hospital were analysed by multivariable regression, to examine the effects of intraoperatively administered NMBA dose on 30-day readmission (primary endpoint), hospital length of stay, and hospital costs.

RESULTS: Clinicians used cisatracurium (mean dose [SD] 0.19 mg kg\(^{-1}\) [0.12]), rocuronium (0.83 mg kg\(^{-1}\) [0.53]) and vecuronium (0.14 mg kg\(^{-1}\) [0.07]). Intraoperative administration of NMBA was dose-dependently associated with higher risk of 30-day hospital readmission (adjusted odds ratio 1.89 [95% Confidence Interval (CI) 1.26-2.84] for 5th quintile vs 1st quintile; P for trend: P<0.001), prolonged hospital length of stay (adjusted incidence rate ratio [aIRR] 1.20 [95% CI 1.11-1.29]; P for trend: P<0.001) and increased hospital costs (aIRR 1.18 [95% CI 1.13-1.24]; P for trend: P<0.001). Admission type (same-day vs inpatient surgery) significantly modified the risk (interaction term: aOR 1.31 [95% CI 1.05-1.63], P=0.02), and the adjusted odds of readmission in patients undergoing ambulatory surgical procedures who received high-dose NMBA vs low-dose NMBA amounted to 2.61 [95% CI 1.11-6.17], P for trend: P<0.001. Total intraoperative neostigmine dose increased the risk of 30-day readmission (aOR 1.04 [1.0-1.08], P=0.048).

CONCLUSIONS: In a retrospective analysis, high doses of NMBA were given during abdominal surgery was associated with an increased risk of 30-day readmission, particularly in patients undergoing ambulatory surgery.


We retrospectively investigated the incidence of potential sugammadex-induced anaphylaxis at a single center in Japan over a period of 3 years. The overall incidence of intraoperative hypersensitivity reaction was 0.22% (95% confidence interval [CI], 0.17%-0.29%), and the incidence of anaphylaxis was 0.059% (95% CI, 0.032%-0.10%). The total number of patients who received sugammadex during the study period was 15,479, and the incidence of anaphylaxis associated with sugammadex was 0.039% (n = 6; 95% CI,

BACKGROUND: Rocuronium-induced neuromuscular block that spontaneously recovered to a train-of-four count of four can be reversed with sugammadex 0.5 or 1.0 mg/kg. We investigated whether these doses of sugammadex can also reverse vecuronium at a similar level of block.

METHODS: Sixty-five patients were randomly assigned, and 64 were analyzed in this controlled, superiority study. Participants received general anesthesia with propofol, sevoflurane, fentanyl, and vecuronium. Measurement of neuromuscular function was performed with acceleromyography (TOF-Watch-SX, Organon Teknika B.V., The Netherlands). Once the block recovered spontaneously to four twitches in response to train-of-four stimulation, patients were randomly assigned to receive sugammadex 0.5, 1.0, or 2.0 mg/kg; neostigmine 0.05 mg/kg; or placebo. Time from study drug injection to normalized train-of-four ratio 0.9 and the incidence of incomplete reversal within 30 min were the primary outcome variables. Secondary outcome was the incidence of re paralysis (normalized train-of-four ratio less than 0.9).

RESULTS: Sugammadex, in doses of 1.0 and 2.0 mg/kg, reversed a threshold train-of-four count of four to normalized train-of-four ratio of 0.9 or higher in all patients in 4.4 ± 2.3 min (mean ± SD) and 2.6 ± 1.6 min, respectively. Sugammadex 0.5 mg/kg reversed the block in 6.8 ± 4.1 min in 70% of patients (P < 0.0001 vs. 1.0 and 2.0 mg/kg), whereas neostigmine produced reversal in 11.3 ± 9.7 min in 77% of patients (P > 0.05 vs. sugammadex 0.5 mg/kg). The overall frequency of re paralysis was 18.7%, but this incidence varied from group to group.

CONCLUSIONS: Sugammadex 1.0 mg/kg, unlike 0.5 mg/kg, properly reversed a threshold train-of-four count of four vecuronium-induced block but did not prevent re paralysis.


BACKGROUND: Electronic neuromuscular monitoring is not widely used to determine either the reversal requirements for neuromuscular block before extubation of the trachea, or to determine if there is any subsequent postoperative residual neuromuscular block (PORNB).

OBJECTIVES: To investigate the incidence of PORNB using acceleromyography after spontaneous recovery of rocuronium-induced block and to compare this with the administration of sugammadex, neostigmine or a placebo.

DESIGN: Partially randomised, partially randomised, placebo-controlled, double-blind, four-group parallel-arm study.

SETTING: Single-centre study performed between October 2013 and December 2015 in a university hospital.

PATIENTS: Of the 134 eligible patients, 128 gave their consent and 125 of these completed the study.

INTERVENTIONS: Patients received general anaesthesia with propofol, sevoflurane, fentanyl and rocuronium. Neuromuscular transmission was measured by acceleromyography (TOF-Watch-SX; Organon Teknika B.V., Boxtel, the Netherlands) but the anaesthetist was blind to the results. If the anaesthetist deemed pharmacological reversal to be necessary before extubation of the trachea then patients were assigned randomly to receive either sugammadex (2.0 mg kg), neostigmine (0.05 mg kg) or a placebo. In the postanaesthesia care unit, an independent anaesthetist, unaware of the treatment given, assessed the neuromuscular function using acceleromyography.

MAIN OUTCOME MEASURES: The incidence of a normalised train-of-four ratio less than 0.9 on arrival in the recovery room.
RESULTS: In total, 125 patients were recruited. Neuromuscular block was allowed to recover spontaneously in 50 patients, whereas the remainder received either sugammadex (27), neostigmine (26) or placebo (22). The number of cases with PORNB were one (3.7%), four (15%), 13 (26%) and 10 (45%) after sugammadex, neostigmine, spontaneous recovery and placebo, respectively. Sugammadex and neostigmine were more effective than placebo [odds ratio (OR): 0.05, 95% confidence interval (CI): 0.005 to 0.403, P=0.005; OR: 0.22, 95% CI: 0.056 to 0.85, P=0.028, respectively]. Sugammadex performed better than spontaneous recovery (OR: 0.11, 95% CI: 0.014 to 0.89, P=0.039) unlike neostigmine (OR: 0.52, 95% CI: 0.15 to 1.79, P=0.297). Yet, antagonism (pooled data) was more effective than spontaneous recovery (OR: 0.3, 95% CI: 0.1 to 0.9, P=0.03).

CONCLUSION: Although pharmacological reversal based on clinical signs was superior to spontaneous recovery it did not prevent PORNB, irrespective of the reversal agent.


BACKGROUND: In Japan, routine clinical care does not normally involve the use of a monitoring device to guide the administration of neuromuscular blocking drugs or their antagonists. Although most previous reports demonstrate that sugammadex offers more rapid and reliable antagonism from rocuronium-induced neuromuscular blockade, this advantage has not been confirmed in clinical settings when no neuromuscular monitoring is used. In this multicenter observational study, we sought to determine whether sugammadex reduces the incidence of postoperative residual weakness compared with neostigmine when the administration of rocuronium and its antagonists is not guided by neuromuscular monitoring.

METHODS: This study was conducted in two 5-month periods that preceded and followed the introduction of sugammadex into clinical practice in Japan. Five university-affiliated teaching hospitals participated in this study. Neostigmine was used to antagonize rocuronium-induced neuromuscular blockade in the first phase, and sugammadex was used in the second phase. The timing and doses of rocuronium, neostigmine, and sugammadex were determined by the attending anesthesiologists without the use of neuromuscular function monitoring devices. To ascertain the incidence of postoperative residual neuromuscular weakness, the train-of-four ratio (TOFR) was determined acceleromyographically after tracheal extubation. Since our practice also does not usually involve calibration and normalization of accelerographic responses, both TOFR <0.9 and TOFR <1.0 were used as the criteria for defining postoperative residual weakness.

RESULTS: In the first phase, 109 patients received neostigmine (average dose 33 µg/kg) and 23 patients were considered (by clinical criteria) to have adequate recovery and did not receive neostigmine (spontaneous recovery group). In the second phase, 117 patients received sugammadex (average dose 2.7 mg/kg) for antagonism of rocuronium-induced blockade. The incidence (95% confidence interval) of TOFR <0.9 under spontaneous recovery, after neostigmine, and after sugammadex, was 13.0% (2.8%-33.6%), 23.9% (16.2%-33.0%), and 4.3% (1.7%-9.4%), respectively. The incidence (95% confidence interval) of TOFR <1.0 in these groups was 69.6% (47.1%-86.6%), 67.0% (57.3%-75.7%), and 46.2% (36.9%-55.6%), respectively. The use of sevoflurane in the neostigmine group and the short interval between the administration of the last doses of rocuronium and sugammadex were associated with a higher incidence of postoperative residual weakness.

CONCLUSIONS: This study demonstrated that the risk of TOFR <0.9 after tracheal extubation after sugammadex remains as high as 9.4% in a clinical setting in which neuromuscular monitoring (objective or subjective) was not used. Our finding underscores the importance of neuromuscular monitoring even when sugammadex is used for antagonism of rocuronium-induced neuromuscular block.


Sugammadex, a modified gamma-cyclodextrin, has changed clinical practice of neuromuscular reversal dramatically. With the introduction of this selective relaxant binding agent, rapid and reliable neuromuscular reversal from any depth of block became possible. Sugammadex can reverse neuromuscular blockade without the muscarinic side effects typically associated with the administration of
acetylcholinesterase inhibitors. However, what remained unchanged is the incidence of residual neuromuscular blockade. It is known that sugammadex cannot always prevent its occurrence, if appropriate dosing is not chosen based on the level of neuromuscular paralysis prior to administration determined by objective neuromuscular monitoring. Alternatively, excessive doses of sugammadex administered in an attempt to ensure full and sustained reversal may affect the effectiveness of rocuronium in case of immediate reoperation or reintubation. In such emergent scenarios that require onset of rapid and reliable neuromuscular blockade, the summary of product characteristics (package insert) recommends using benzylisoquinolinium neuromuscular blocking agents or a depolarizing agent. However, if rapid intubation is required, succinylcholine has a significant number of side effects, and benzylisoquinolinium agents may not have the rapid onset required. Therefore, prior administration of sugammadex introduces a new set of potential problems that require new solutions. This novel reversal agent thus presents new challenges and anesthesiologists must familiarize themselves with specific issues with its use (e.g., bleeding risk, hypermagnesemia, hypothermia). This review will address sugammadex administration in such special clinical situations.

Background Guidelines to promote the early recovery of patients undergoing major surgery recommend a restrictive intravenous-fluid strategy for abdominal surgery. However, the supporting evidence is limited, and there is concern about impaired organ perfusion. Methods In a pragmatic, international trial, we randomly assigned 3000 patients who had an increased risk of complications while undergoing major abdominal surgery to receive a restrictive or liberal intravenous-fluid regimen during and up to 24 hours after surgery. The primary outcome was disability-free survival at 1 year. Key secondary outcomes were acute kidney injury at 30 days, renal-replacement therapy at 90 days, and a composite of septic complications, surgical-site infection, or death. Results During and up to 24 hours after surgery, 1490 patients in the restrictive fluid group had a median intravenous-fluid intake of 3.7 liters (interquartile range, 2.9 to 4.9), as compared with 6.1 liters (interquartile range, 5.0 to 7.4) in 1493 patients in the liberal fluid group (P<0.001). The rate of disability-free survival at 1 year was 81.9% in the restrictive fluid group and 82.3% in the liberal fluid group (hazard ratio for death or disability, 1.05; 95% confidence interval, 0.88 to 1.24; P=0.61). The rate of acute kidney injury was 8.6% in the restrictive fluid group and 5.0% in the liberal fluid group (P<0.001). The rate of septic complications or death was 21.8% in the restrictive fluid group and 19.8% in the liberal fluid group (P=0.19); rates of surgical-site infection (16.5% vs. 13.6%, P=0.02) and renal-replacement therapy (0.9% vs. 0.3%, P=0.048) were higher in the restrictive fluid group, but the between-group difference was not significant after adjustment for multiple testing. Conclusions Among patients at increased risk for complications during major abdominal surgery, a restrictive fluid regimen was not associated with a higher rate of disability-free survival than a liberal fluid regimen and was associated with a higher rate of acute kidney injury.

BACKGROUND: The purpose of this study was to determine whether significant variation exists in the use of protective ventilation across individual anesthesia providers and whether this difference can be explained by patient, procedure, and provider-related characteristics. METHODS: The cohort consisted of 262 anesthesia providers treating 57,372 patients at a tertiary care hospital between 2007 and 2014. Protective ventilation was defined as a median positive end-expiratory pressure of 5 cm H2O or more, tidal volume of <10 mL/kg of predicted body weight and plateau pressure of <30 cm H2O. Analysis was performed using mixed-effects logistic regression models with propensity scores to adjust for covariates. The definition of protective ventilation was modified in sensitivity analyses. RESULTS: In unadjusted analysis, the mean probability of administering protective ventilation was 53.8% (2.5th percentile of provider 19.9%, 97.5th percentile 80.8%). After adjustment for a large number of covariates, there was little change in the results with a mean probability of 51.1% (2.5th percentile 24.7%,
97.5th percentile 77.2%). The variations persisted when the thresholds for protective ventilation were changed.

CONCLUSIONS: There was significant variability across individual anesthesia providers in the use of intraoperative protective mechanical ventilation. Our data suggest that this variability is highly driven by individual preference, rather than patient, procedure, or provider-related characteristics.


BACKGROUND: Various methods for protective ventilation are increasingly being recommended for patients undergoing general anesthesia. However, the importance of each individual component is still unclear. In particular, the perioperative use of positive end-expiratory pressure (PEEP) remains controversial. The authors tested the hypothesis that PEEP alone would be sufficient to limit atelectasis formation during nonabdominal surgery.

METHODS: This was a randomized controlled evaluator-blinded study. Twenty-four healthy patients undergoing general anesthesia were randomized to receive either mechanical ventilation with PEEP 7 or 9 cm H2O depending on body mass index (n = 12) or zero PEEP (n = 12). No recruitment maneuvers were used. The primary outcome was atelectasis area as studied by computed tomography in a transverse scan near the diaphragm, at the end of surgery, before emergence. Oxygenation was evaluated by measuring blood gases and calculating the ratio of arterial oxygen partial pressure to inspired oxygen fraction (PaO2/FIO2 ratio).

RESULTS: At the end of surgery, the median (range) atelectasis area, expressed as percentage of the total lung area, was 1.8 (0.3 to 9.9) in the PEEP group and 4.6 (1.0 to 10.2) in the zero PEEP group. The difference in medians was 2.8% (95% CI, 1.7 to 5.7%; P=0.002). Oxygenation and carbon dioxide elimination were maintained in the PEEP group, but both deteriorated in the zero PEEP group.

CONCLUSIONS: During nonabdominal surgery, adequate PEEP is sufficient to minimize atelectasis in healthy lungs and thereby maintain oxygenation. Thus, routine recruitment maneuvers seem unnecessary, and the authors suggest that they should only be utilized when clearly indicated.


BACKGROUND: Intraoperative oxygen management is poorly understood. It was hypothesized that potentially preventable hyperoxemia and substantial oxygen exposure would be common during general anesthesia.

METHODS: A multicenter, cross-sectional study was conducted to describe current ventilator management, particularly oxygen management, during general anesthesia in Japan. All adult patients (16 yr old or older) who received general anesthesia over 5 consecutive days in 2015 at 43 participating hospitals were identified. Ventilator settings and vital signs were collected 1 h after the induction of general anesthesia. We determined the prevalence of potentially preventable hyperoxemia (oxygen saturation measured by pulse oximetry of more than 98%, despite fractional inspired oxygen tension of more than 0.21) and the risk factors for potentially substantial oxygen exposure (fractional inspired oxygen tension of more than 0.5, despite oxygen saturation measured by pulse oximetry of more than 92%).

RESULTS: A total of 1,786 patients were found eligible, and 1,498 completed the study. Fractional inspired oxygen tension was between 0.31 and 0.6 in 1,385 patients (92%), whereas it was less than or equal to 0.3 in very few patients (1%). Most patients (83%) were exposed to potentially preventable hyperoxemia, and 32% had potentially substantial oxygen exposure. In multivariable analysis, old age, emergency surgery, and one-lung ventilation were independently associated with increased potentially substantial oxygen exposure, whereas use of volume control ventilation and high positive end-expiratory pressure levels were associated with decreased potentially substantial oxygen exposure. One-lung
ventilation was particularly a strong risk factor for potentially substantial oxygen exposure (adjusted odds ratio, 13.35; 95% CI, 7.24 to 24.60).

CONCLUSIONS: Potentially preventable hyperoxemia and substantial oxygen exposure are common during general anesthesia, especially during one-lung ventilation. Future research should explore the safety and feasibility of a more conservative approach for intraoperative oxygen therapy.


BACKGROUND: High inspiratory oxygen fraction (FIO2) may improve tissue oxygenation but also impair pulmonary function. We aimed to assess whether the use of high intraoperative FIO2 increases the risk of major respiratory complications.

METHODS: We studied patients undergoing non-cardiothoracic surgery involving mechanical ventilation in this hospital-based registry study. The cases were divided into five groups based on the median FIO2 between intubation and extubation. The primary outcome was a composite of major respiratory complications (re-intubation, respiratory failure, pulmonary oedema, and pneumonia) developed within 7 days after surgery. Secondary outcomes included 30-day mortality. Several predefined covariates were included in a multivariate logistic regression model.

RESULTS: The primary analysis included 73,922 cases, of whom 3035 (4.1%) developed a major respiratory complication within 7 days of surgery. For patients in the high- and low-oxygen groups, the median FIO2 was 0.79 [range 0.64-1.00] and 0.31 [0.16-0.34], respectively. Multivariate logistic regression analysis revealed that the median FIO2 was associated in a dose-dependent manner with increased risk of respiratory complications (adjusted odds ratio for high vs low FIO2 1.99, 95% confidence interval [1.72-2.31], P -value for trend <0.001). This finding was robust in a series of sensitivity analyses including adjustment for intraoperative oxygenation. High median FIO2 was also associated with 30-day mortality (odds ratio for high vs low FIO2 1.97, 95% confidence interval [1.30-2.99], P -value for trend <0.001).

CONCLUSIONS: In this analysis of administrative data on file, high intraoperative FIO2 was associated in a dose-dependent manner with major respiratory complications and with 30-day mortality. The effect remained stable in a sensitivity analysis controlled for oxygenation.


BACKGROUND: The main defence against bacterial infection is oxidative killing by neutrophils, which requires molecular oxygen in wounded tissues. High inspired-oxygen fractions increase tissue oxygenation. But, whether improving tissue oxygenation actually reduces surgical-site infection (SSI) remains controversial. We therefore tested the primary hypothesis that supplemental oxygen (80% vs 30%) reduces the risk of a 30-day composite of deep tissue or organ-space SSI, healing-related wound complications, and mortality.

METHODS: In an isolated suite of operating rooms, the inspired-oxygen concentration was alternated between 30% and 80% at 2-week intervals for 39 months. The analysis was restricted to patients who had major intestinal surgery lasting at least 2 h. Qualifying operations (5749) were analysed, including 2843 (49%) colorectal resections, 1866 (32%) lower gastrointestinal therapeutic procedures, 373 (6%) small-bowel resections, and 667 (13%) other colorectal procedures.

RESULTS: The 80% and 30% oxygen groups were well balanced on all of the demographic, baseline, and procedural variables. The oxygen intervention had no effect on the composite primary outcome or any of its components. The overall observed incidence of the composite outcome was 10.8% (314/2896) in the 80% oxygen group and 11.0% (314/2853) in the 30% group. The estimated relative risk was 0.99 (95% CI: 0.85, 1.14) for 80% vs 30%, P=0.85.

CONCLUSIONS: Supplemental oxygen does not prevent major infection and healing-related complications after major intestinal surgery.

BACKGROUND: The effect of ambient temperature, with and without active warming, on intraoperative core temperature remains poorly characterized. The authors determined the effect of ambient temperature on core temperature changes with and without forced-air warming.

METHODS: In this unblinded three-by-two factorial trial, 292 adults were randomized to ambient temperatures 19°C, 21°C, or 23°C, and to passive insulation or forced-air warming. The primary outcome was core temperature change between 1 and 3 h after induction. Linear mixed-effects models assessed the effects of ambient temperature, warming method, and their interaction.

RESULTS: A 1°C increase in ambient temperature attenuated the negative slope of core temperature change 1 to 3 h after anesthesia induction by 0.03 (98.3% CI, 0.01 to 0.06) °Ccore/(h°Cambient) (P < 0.001), for patients who received passive insulation, but not for those warmed with forced-air (-0.01 [98.3% CI, -0.03 to 0.01] °Ccore/[h°Cambient]; P = 0.40). Final core temperature at the end of surgery increased 0.13°C (98.3% CI, 0.07 to 0.20; P < 0.01) per degree increase in ambient temperature with passive insulation, but was unaffected by ambient temperature during forced-air warming (0.02 [98.3% CI, -0.04 to 0.09] °Ccore/°Cambient; P = 0.40). After an average of 3.4 h of surgery, core temperature was 36.3° ± 0.5°C in each of the forced-air groups, and ranged from 35.6° to 36.1°C in passively insulated patients.

CONCLUSIONS: Ambient intraoperative temperature has a negligible effect on core temperature when patients are warmed with forced air. The effect is larger when patients are passively insulated, but the magnitude remains small. Ambient temperature can thus be set to comfortable levels for staff in patients who are actively warmed.


Procedures in class B ambulatory facilities are performed exclusively with oral or IV sedative-hypnotics and/or analgesics. These facilities typically do not stock dantrolene because no known triggers of malignant hyperthermia (ie, inhaled anesthetics and succinylcholine) are available. This article argues that, in the absence of succinylcholine, the morbidity and mortality from laryngospasm can be significant, indeed, higher than the unlikely scenario of succinylcholine-triggered malignant hyperthermia. The Society for Ambulatory Anesthesia (SAMBA) position statement for the use of succinylcholine for emergency airway management is presented.


BACKGROUND: The Malignant Hyperthermia Association of the United States recommends that dantrolene be available for administration within 10 min. One approach to dantrolene availability is a malignant hyperthermia cart, stocked with dantrolene, other drugs, and supplies. However, this may not be of cost benefit for maternity units, where triggering agents are rarely used.

METHODS: The authors performed a cost-benefit analysis of maintaining a malignant hyperthermia cart versus a malignant hyperthermia cart readily available within the hospital versus an initial dantrolene dose of 250 mg, on every maternity unit in the United States. A decision-tree model was used to estimate the expected number of lives saved, and this benefit was compared against the expected costs of the policy.

RESULTS: We found that maintaining a malignant hyperthermia cart in every maternity unit in the United States would reduce morbidity and mortality costs by $3,304,641 per year nationally but would cost $5,927,040 annually. Sensitivity analyses showed that our results were largely driven by the extremely low incidence of general anesthesia. If cesarean delivery rates in the United States remained at 32% of all births, the general anesthetic rate would have to be greater than 11% to achieve cost benefit. The only cost-effective strategy is to keep a 250-mg dose of dantrolene on the unit for starting therapy.
CONCLUSIONS: It is not of cost benefit to maintain a fully stocked malignant hyperthermia cart with a full supply of dantrolene within 10 min of maternity units. We recommend that hospitals institute alternative strategies (e.g., maintain a small supply of dantrolene on the maternity unit for starting treatment).