Queen's University
36th Annual Anesthesiology Research Day

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Elizabeth VanDenKerkhof, RN, MSc, DrPH

Scientific Adjudicators:

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MD, FRCPC

Rene Allard
MD, FRCPC

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Institutional support:

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SCIENTIFIC PROGRAM OUTLINE

0800 – 0810 **Opening Remarks and Introduction of Guest Lecturer – Dr. Joel Parlow**

0810 – 0820 **Introduction of Research Day Presentations – Dr. Ian Gilron**

0820 – 0950 **Oral presentations (6)**

0950 – 1020 **Nutrition break**

1020 – 1135 **Oral presentations (5)**

1135 – 1235 *** LUNCH** (provided) *****

1235 – 1300 ***** Special presentation ***** – **Nader Ghasemlou, PhD,** Assistant Professor, DAPM & DBMS **– "*Bedside-to-bench and back: Start of the Translational Research in Pain (TRP) group at Queen's*"**

1300 – 1415 **Oral presentations (5)**

1415 – 1445 **Nutrition break**

1445 – 1530 **Oral presentations (3)**

EACH 10-MINUTE ORAL PRESENTATION WILL BE FOLLOWED BY A 5-MINUTE QUESTION PERIOD

The Judges will be:

Dr. Melanie Jaeger, Associate Professor, Queen's Department of Anesthesiology & Perioperative Medicine

Dr. Rene Allard, Assistant Professor, Queen's Department of Anesthesiology & Perioperative Medicine

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1530 Dr. Gregory Hare, Professor, Department of Anesthesia, University of Toronto

*** Guest Lecture ***

"Assessing and Treating the Risk of Perioperative Anemia: A translational approach from animal studies to improved clinical care."

Wine & Cheese to follow with * Awards Presentation * (Donald Gordon Center)

Oral Presentations

(*in alphabetical order, presentation order to be announced*) ---------- page 1/2

Liban AHMED, PGY2
"**Comparison of the efficacy of a novel periarticular analgesic injection to single shot ultrasound guided interscalene brachial plexus blockade as part of a multimodal analgesia regime in patients undergoing arthroscopic shoulder surgery**" (proposal)

Meredith BRIGGS, MD Candidate, Queen's University
"**Patients' Awareness and Knowledge of the Specialty of Anesthesiology and Roles of the Anesthesiologist"** (data presentation)

Mark BROUSSENKO, HBSc, MSc, MD Candidate, Queen's University
"**Analysis of a Call Distribution System in a Shared Practice Model**" (data presentation)

James CHENG, PGY3
"**Periarticular Versus Systemic Ketorolac in Total Knee Arthroplasty Patients: Is there a Difference?**" (update)

Jamei ENG, PGY2
"**Improving post-operative pain control by increasing the alkalinity of epidural solutions.**" (proposal)

Darryl HOFFER, PGY4
"**Adverse event reporting in acute postoperative pain randomized controlled trials.**" (update)

Aditi KANE, BHSc, MD Candidate, Queen's University
"**Urinary Retention Following Lower Limb Arthroplasty**" (data presentation)

Nicole KING, PGY4
"**A survey of scope of practice in Family Medicine Anesthesia**" (update)

Karmen KROL, PGY4
"**Measurement of cardiac output with the ultrasonic cardiac output monitor versus transthoracic echocardiography**" (update)

Mahmoud LABIB, PGY4
"**Optimizing the para median approach to thoracic epidurals, threading the eye of the needle: A pilot study**" (update)

Glenio MIZUBUTI, MD, MSc, Clinical Fellow
"**Analgesic and hemodynamic effects of continuous epidural analgesia compared to paravertebral block in liver resection patients.**" (proposal)

Oral Presentations

(*in alphabetical order, presentation order to be announced*) ---------- page 2/2

Curtis NICKEL, PGY2
"**Perceptions of Yearly Summative Examinations in the Queen's Anesthesia Simulation Program**." (proposal)

Gita RAGHAVAN, PGY3
"**Bilateral transverse abdominis plane block with or without magnesium for total abdominal hysterectomy and bilateral salpingo-oopherectomy – a randomized controlled trial.**" (update)

Navroop SANDHU, PGY2
"**Examining the Influence of Anesthetic Practices on Maternal Outcomes in a Resource Poor Setting (Tanzania).**" (proposal)

Michael YANG, HBSc, MSc, MD Candidate, Queen's University
"**Incidence and Risk Factors for Postoperative Hyperglycemia In Elective Surgical Patients With No Prior History of Diabetes.**" (data presentation)

Julie ZALAN, PGY3
"**Frailty indices as a predictor of postoperative complications: a systematic review**" (update)

Dana ZORATTO, PGY2
"**Does magnesium sulfate as a supplement in adductor canal blocks improve pain control after total knee arthroplasty?**" (proposal)

Poster Presentations

Meredith BRIGGS, MD Candidate, Queen's University
"Scopes vs. Blades: what are anesthesiologists using?"

Comparison of the efficacy of a periarticular analgesic injection to single shot ultrasound guided interscalene brachial plexus blockade as part of a multimodal analgesia regime in patients undergoing arthroscopic shoulder surgery

Liban Ahmed, PGY2 *Supervisor: Dr. John Murdoch*

Background

Arthroscopic shoulder surgery can be associated with significant post-operative pain that may be difficult to manage and may delay patient discharge.[1] This pain can be alleviated by the peri-operative performance of a single shot interscalene brachial plexus block. However, this technique remains relatively specialized, and it is not within the skill set of all anesthesiologists. Moreover, the block has significant side effects and complications which may preclude its use in some patients.[2-3]

In knee and hip arthroplasty surgery, analgesia has been significantly improved and simplified with the introduction of the periarticular injection of an analgesic mixture containing a local anesthetic, ketorolac, morphine, and epinephrine.[4-8] This mixture is injected in extra-articular tissues, primarily muscular planes around the joint, during the surgery by the surgeon performing the operation. Despite its efficacy in lower limb surgery, there have been no studies examining this periarticular technique for postoperative pain management in upper limb surgery.

Purpose

We propose to study the periarticular instillation of the same mixture used originally in lower limb surgery in shoulder arthroscopic surgery. We will compare the periarticular analgesic injection to a single-shot U/S guided interscalene brachial plexus block as well as standard care in a randomized controlled trial.

Study Design

Inclusion criteria will include ASA 1-3 patients, aged 18-80, having elective shoulder arthroscopic surgery at Hotel Dieu Hospital. Following signed informed consent, participants will be randomized to receive either a (1) pre-operative single shot interscalene brachial plexus regional block, (2) an intra-operative peri-articular injection, or (3) no injection ('standard care'). Participants will receive standardized premedication, a standardized general anesthetic, and standardized intra-operative analgesia and post-operative analgesia. The assessors will be blinded as best as possible as to which modality the participant received.

Outcomes

Postoperative data will be collected by the research nurses in the PACU and in a telephone follow up questionnaire 24 hours after surgery. The primary outcome will be analgesic requirements in the first 24 hours. Secondary outcomes will include pain scores in the first 24 hours, time to first analgesic requirement, opioid-related side effects, time to discharge, adverse events, and overall satisfaction with the analgesia.

Hypothesis

We are hypothesizing that the interscalene block will be more effective than the periarticular injection. We hypothesize that the periarticular injection will be more efficacious than 'standard' care.

References

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2. Verelst P, van ZA. Incidence of phrenic nerve block after interscalene brachial plexus block. Reg Anesth Pain Med 2011;36:411-2.
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Patients' Awareness and Knowledge of the Specialty of Anesthesiology and Roles of the Anesthesiologist

Meredith Briggs MS3, Sneha Lohan MS2, Anthony Ho MD FRCPC, Ronald R. Holden Ph.D, Brian Milne MD FRCPC, Rob Tanzola MD, FRCPC, Jorge Zamora MD FRCPC, Tarit Saha[1] MD FRCPC Anesthesiology, Queen's University - Kingston General Hospital, Kingston, Ontario, Canada

Background: Several international studies have demonstrated a lack of patient awareness regarding the roles and level of education of anesthesiologists both in and out of the operating room and limited understanding of anesthesiologists' roles in patient care [1-4] .The aim of this study is to examine patients' awareness about the medical specialty of anesthesiology. To that end, we have designed a questionnaire to determine patients' knowledge, awareness and opinions of anesthesiologists based on similar national surveys[1-2].

Methods: Following REB approval, we performed a prospective single-center observational study from September 2014 – January 2015. Consenting patients completed a multiple-choice questionnaire prior to elective surgery and before meeting the anesthesiologist. Total percentage scores were calculated and data were analyzed with Fisher's Exact Test. The questionnaire included patient demographics, prior anesthesia history and whether they had received a preoperative anesthesia assessment (PAA).

Results: 247 total patients were polled - 124 males (50.8%), 120 females (48.6%) and 3 (1.2%) unspecified. 149 (60.6%) of patients had a PAA prior to their proposed surgery, and 97 (39.4%) did not. 173 (71.5%) patients recognized anesthesiologists as medical doctors. 100 (44.1%) patients responded the primary role of the anesthesiologist was to assist the surgeon. 132 (58.4%) patients thought the surgeon was responsible for their medical well being during surgical emergencies. Post-operatively patients responded nursing staff is most responsible for: their safe recovery 142 (61.5%), treating nausea and vomiting 126 (55.5%) and pain management 115 (52.3%). Patients that had undergone PAA had a statistically significant improved understanding of addition roles of anesthesiologists outside the operating room.

210 (85.4%) patients had undergone prior surgical anesthesia. 146 (81.5%) patients recalled meeting their anesthesiologist before surgery and 169(94.9%) were satisfied with their previous anesthesia. Only 90 (51.4%) patients thought their anesthesiologist prepared them for how they would feel post-operatively and 119 (69.2%) felt they had time to ask questions before going to the OR.

Discussion: This study demonstrates the majority of patients undergoing elective surgery recognize anesthesiologists as medical doctors who have a similar level of training to surgeons. However, patients felt their safety was the responsibility of the surgeon and nurse in medical emergencies. This study demonstrates a need for improved communication in regards to roles of anesthesiologists in patient care.

References:

1. Lee, J. J., Lee, N. H., Park, C. M., Hong, S. J., Kong, M. H., Lee, K. H., ... & Song, S. O. (2014). Public awareness about the specialty of anesthesiology and the role of anesthesiologists: a national survey. *Korean journal of anesthesiology*, *66*(1), 12-17.
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Analysis of a Call Distribution System in a Shared Practice Model

Broussenko M, Tanzola R, McMullen M, Allard R, Saha T, Zamora JE, Engen D.
Presenting Author: Mark Broussenko, M.Sc Supervisor: Dr. Dale Engen

Introduction: The distribution of call in a shared practice model poses a significant challenge in terms of logistics and human resource planning. A shared practice setting typically uncouples remuneration provided for a call shift from the amount billed on that shift. Given that switching call is a real and necessary component of any call schedule, this leads to an underlying barter economy, with formal or informal systems of valuing call creating a currency of expected hours worked on a given shift. This study retrospectively reviewed the accuracy of an internal call value system in order to analyze its efficacy at equalizing, and appropriately distributing, workload.

Methods: Local research ethics board approval was obtained. Additionally, all staff members of the department of anesthesia whose billing and cases would be reviewed expressly consented to the study. A complete list of all billings by the department of anesthesia for the fiscal years of 2012-13 and 2013-14 was obtained. This was supplemented by a record of direct billings for patients not covered by a provincial plan. These lists were crosschecked against OR bookings in order to ensure an appropriate capture rate (>92% concordance). The following data was collected from each case, with all additional information being discarded: attending staff, time in/out, patient age, day and date, service code(s) billed and amount billed. The primary outcome was a measure of total hours worked compared against the maximum possible time worked on that shift. A secondary measure was the number of 'spill-overs'; cases that started during the day and continued into call shifts. Total amount billed, in-house work and home call work and institutional status of the staff (i.e. academic appointment, full/part-time status) were also evaluated.

Results: When compared with an optimal system of assigning call – where 1 hour assigned carries a consistent expected amount of work associated – the current system was very inefficient, with significant variance in expected workload. Additionally, expected work varied substantially (46% +/-15%) between shifts assigned during the week and on the weekend. A review of secondary measures revealed a high number of spillover cases (n= 2934) accounting for 48% of total work done during call hours. Using strategies from similar size centers, a predictive model of call system distribution with time horizon = 1 year, showed a potential 14% increase in efficiency and a 17% decrease in time on call spent not providing patient care, with no decrease in available call coverage.

Conclusion: A fair valuation of call shifts is necessary for institutional efficiency and staff morale. Perceived inequalities in the distribution of call can be efficiently evaluated and addressed using retrospective analysis and effectively addressed with dynamic business processes. Solutions from similar industries with complete coverage (i.e. shipping, software support, public utilities) can also be effective at addressing staffing issues in healthcare.

Periarticular Versus Systemic Ketorolac in Total Knee Arthroplasty Patients: Is there a Difference?

Author: Dr. James Cheng PGY-2 Supervisor: Dr. John Murdoch

Background

In recent years, periarticular infiltration (PAI) has become a common mode of analgesia for the management of post-operative pain in arthroplasty patients. Many drugs have been investigated for potential use as part of a PAI mixture. Among these, Ketorolac was one of the first drugs incorporated into the mix.[1,2] The rationale for injecting ketorolac into traumatized tissue is because of its anti-inflammatory properties, which can block prostaglandin synthesis and decrease local inflammation.[3] This in turn will prevent the sensitization of peripheral neurons to nociceptive stimuli and decrease post-operative pain. Indeed, studies have shown that adding ketorolac to a PAI mix will result in lower post-op pain score.[4] What is unclear, however, is whether there are any advantages to administering ketorolac in this fashion versus systemically.

Purpose/Hypothesis

The purpose of this investigation is to determine whether periarticular ketorolac will offer any advantage over systemic ketorolac in terms of opioid usage and pain control. We hypothesize that systemic ketorolac will provide the same analgesic effect as periarticular ketorolac in post-total knee arthroplasty patients.

Study Design

Single Center, blinded, randomized-controlled trial

Intervention

1. control group – PAI mixture of ropivacaine 300mg, saline, epinephrine 0.3mg diluted with normal saline to 120mL
2. Group S (Systemic) – PAI mixture of ropivacaine 300mg, epinephrine 0.3mg diluted with normal saline to 120mL. At time of PAI, ketorolac 30mg IV.
3. Group P (PAI) – PAI mixture of ropivacaine 300mg , epinephrine 0.3mg, ketorolac 30mg diluted with normal saline to 120mL. At time of PAI, Saline 1cc IV.

Outcomes

The primary outcome will be post-operative visual analog scale (VAS) pain scores (at rest and with activity) in PACU, 4 hours post-op, POD-1, and POD-2. We will also look at post-op PCA opioid usage and time to first opioid dose. Secondary outcomes will include rate of bleeding, patient satisfaction, time to readiness to discharge, and incidence of nausea/vomiting and constipation.

Reference

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Improving post-operative pain control by increasing the alkalinity of epidural solutions.

Jamei Eng PGY2
Supervisors: Dr. Richard Henry, Dr. John Murdoch

Despite the evolution of various other regional anesthetic techniques, epidurals are still thought to provide exceptional pain control. In patients with significant cardiac or respiratory conditions, epidurals are even more important in postoperative management than PCAs. Despite having a well-trained physician placing the epidural, and positive intraoperative clinical signs, patients are often in PACU complaining of pain. Failure rates for epidurals have reportedly been around 30% for both thoracic and lumbar epidurals. There are numerous reasons for epidural failures, the most common being epidural catheter migration or misplacement of the catheter, resulting in inadequate analgesia.

Current practice with laboring women that have epidurals heading to the OR for a cesarean section consists of administering a bolus of lidocaine in their epidural in order to obtain a rapid onset of surgical block. One of the common adjuncts particularly used in epidurals that had been previously placed includes sodium bicarbonate. In theory, lidocaine enters the epidural space as both its ionized and unionized form. The unionized form allows for migration across the lipid membrane in order to exert is action on the nerve root. The addition of sodium bicarbonate, creates a more alkaline environment, thus increasing the proportion of local anesthetic in its unionized form. By increasing the amount of local anesthetic reaching its target of action, the onset of block is faster, the depth of block is greater, and potentially may even affect the spread of epidural blockade.

Currently, there is no published data available detailing the use of sodium bicarbonate in non-obstetrical surgery. In this study, we hope to determine whether there may be a role of sodium bicarbonate in postoperative epidurals, specifically thoracic epidurals. Preliminary steps include determining the pH of our standard epidural solutions, and determining the pH after the addition of sodium bicarbonate. Secondly, if ethics approval can be obtained, a pilot study will be conducted with 10 randomly chosen patients to receive bicarbonate just prior to arrival to the post anesthetic care unit. Primary outcome measures will include patient pain scores as well as level of sensory block within 24 hours postoperatively. Secondary outcome will look at duration of time until inadequate block.

Adverse event reporting in acute postoperative pain randomized controlled trials.

Darryl N. Hoffer, Shannon M. Smith, Joel Parlow, Rene Allard, Ian Gilron

Quality documentation in randomized controlled trials is important to ensure reliability and to assist the interpretability of studies. The Consolidated Standards of Reporting Trials (CONSORT) is a continually updated statement of recommendations formed to help standardize and improve the quality of randomized controlled trial (RCT) reporting. An extension to the CONSORT statement in 2004 addresses reporting of adverse events. However, a recent study showed that randomized controlled trials of pain medications in three major pain journals frequently failed to meet recommendations for adverse event reporting. The use of two anticonvulsants – pregabalin and gabapentin – for the treatment of acute postoperative pain is relatively novel, and their use for this indication is off-label. Therefore, documentation of their adverse events is of particular importance. Our study assessed the quality of adverse event reporting in acute postoperative pain RCTs using studies of pregabalin and gabapentin as a convenience sample.

We reviewed studies of primary reports of RCTs of pregabalin and gabapentin use in acute postoperative pain for adherence to the 10 recommendations from the "CONSORT Extension for Harms," adverse event assessment method, and reporting of timing and severity. Articles were searched in the MEDLINE online database.

We identified 30 RCTs with pregabalin and 60 with gabapentin. The average number of recommendations met was 6.2 out of 10. The most common method of AE assessment was direct questioning of specific AE's by investigators. The AE assessment method was not described in 18% of trials. AE's were reported at different time points in 37.5% of pregabalin studies and 16.7% of gabapentin studies. In conclusion, significant improvements need to be made in adverse event reporting for acute postoperative pain RCTs.

Urinary Retention After Lower Limb Arthroplasty

Primary Authors

Aditi Kane B.H.Sc, MD Candidate (2016), Melanie Jaeger, M.D., FRCPC (Supervisor)

Co-Author(s)

Michael Baxter, B.H.Sc, MD Candidate (2017), Michael Yang, H.B.Sc, M.Sc, MD Candidate (2016), Janet Van Vlymen, MD, FRCPC, Wilma Hopman, M.A, D. Robert Siemens, MD, FRCSC

INTRODUCTION: Post-operative urinary retention (POUR) after lower limb total joint arthroplasty (TJA) is a common cause of morbidity. The incidence of POUR is highly variable, but is commonly reported as 30-50% (1,2). More recently, peri-operative care has been streamlined toward a multi-modal, fast-track approach, which may have affected the incidence. Our primary objective was to assess the incidence of POUR, as defined by need for a catheter, following lower limb TJA. Our secondary objectives were to identify risk factors associated with the onset of POUR, and describe the association between POUR and postoperative length of stay (LOS).

METHODS: This prospective, observational study was conducted after institutional research ethics board approval and informed consent. All consecutive patients undergoing lower limb TJA from June to September 2014 were included. Pre-operatively, subjects completed an International Prostate Symptom Score (IPSS) questionnaire and a post-void residual (PVR) bladder scan was completed. Peri-operative management was consistent with the current standard of care. In our institution, patients are not routinely catheterized unless they are unable to void within 6-8 hours and a PVR is >500ml, at which time an intermittent catheterization (IC) is performed and consideration is given to an indwelling catheter if >1 IC is needed. Standard demographic and peri-operative data were collected in addition to bladder volume prior to discharge from the Post-Anesthetic Care Unit and LOS. Chi-square tests, t-tests and nonparametric (Mann-Whitney) tests were used to determine the association between postoperative urinary retention and baseline parameters. Regression analysis was performed to determine the contribution of individual factors to POUR.

RESULTS: Of 128 patients, the incidence of POUR was 37.5%. For male participants, the incidence was 50.7% (38/75). In univariate analysis, factors associated with any need for catheterization included gender, age, IPSS and pre-operative PVR. Contrary to previous reports, POUR was not associated with type of anesthetic, use of intrathecal opioids, postoperative opioid use, or ASA classification. In multivariate analysis, the only factors independently associated with POUR were age (OR:1.59, 95% CI: 1.05-2.40, p=0.028 for every 10 years of age) and male gender (4.78, 2.02-11.30, p<0.001). While pre-operative IPSS fell just short of significance (1.06, 0.99-1.13, p=0.056) in the whole cohort, it was significant for male participants (1.08, 1.002-1.170, p=0.045). In multivariate analysis, POUR was independently associated with increased LOS (p=0.002), as was age (p<0.001), blood loss (p=0.025), and opioid requirements on postoperative day #1 (p = 0.007)! . Indeed, presence of POUR appeared to increase LOS by almost one full day.

DISCUSSION: A significant number of patients still suffer from POUR following TJA even with contemporary peri-operative management, and this complication is highly associated with increased LOS. Older men, particularly those with higher IPSS scores, are at highest risk of POUR. Further investigation and intervention should target this group.

References

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A Survey of Scope of Practice in Family Medicine Anesthesia

Dr. Nicole King and Supervisors: Dr. Mike Cummings, Dr. Brian Mahoney.
Thanks to Dr. Chris Richardson

Background

Family practice anesthetists have been providing valuable care in underserviced and remote locations for many years. While specialized anesthesia training is required for complex procedures in tertiary centers, family physicians with additional training in anesthesia can safely provide surgical and obstetric services for many Canadians closer to home. Until recently, however, there have been few national regulations for family practice anesthesia. There was no standardized national curriculum, no assessment of competence process for physicians trained outside of Canada, and no requirements for anesthesia specific continuing medical education. These issues have been identified for some time and many changes are currently being made to family practice anesthesia training programs and maintenance of competence requirements. However, there is little published data on the scope of practice of family physician anesthetists actually in practice in Canada. This information could be extremely valuable to guide curriculum development and assessment of competence standards.

Study Design

We are surveying current Family Practice Anesthetists (FPAs) to define their scope of practice and provide valuable data on which to base further curriculum development, evaluation and assessment, and continuing education.

Update: We have developed a survey to assess FPA scope of practice including questions on demographic information, site characteristics of the facilities in which FPAs practice, scope of case work, airway management and technical skills, and CME. We have created an online version of this survey for electronic distribution and ease of response and data analysis. We have obtained ethics approval and are currently exploring options for distribution. There is currently no comprehensive list of practicing FPAs so we plan to distribute the survey widely via email using a combination of existing mailing lists. Responses will be kept anonymous and electronically coded to ensure no duplication. After the deadline for survey completion, data will be analyzed to establish the scope of practice and range of variation across Canada.

References

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Measurement of cardiac output with the ultrasound cardiac output monitor versus transthoracic echocardiography: the final update

Karmen Krol, MD; John Murdoch MD; Michael McMullen MD

Reliable measurements of cardiac output (CO) have been achieved using invasive procedures such as pulmonary artery catheter insertion, transesophageal echocardiography, and more recently, placement of esophageal Doppler probes. Intermittent, though non-invasive, methods like transthoracic echocardiography (TTE) remain valid, though impractical for intraoperative determinations of CO given surgical constraints on patient positioning limiting precordial access for image acquisition. With considerations related to the invasiveness of a device (and the attendant risks involved), and the cost of disposable components of devices, regular use of these methods tends to be more strictly reserved. There is extensive utility, however, in the ability to perform perioperative CO measurements in order to develop and facilitate the safe hemodynamic management of surgical patients particularly those whose status is unstable. The Ultrasonic Cardiac Output Monitor (USCOM) is a handheld, non-invasive device designed to measure direct and generate derived hemodynamic parameters, with no disposable components. It has been clinically validated for the hemodynamic management of patients preoperatively and in critical care settings. We have proposed a clinical pilot study to assess the utility of USCOM in measuring the cardiac output in patients undergoing elective lower extremity orthopedic procedures under spinal anesthesia. The intent was twofold: 1) to compare USCOM data with those acquired with the use of TTE for patients prior to, and following the induction of spinal anesthesia for their procedure, as well as during significant intraoperative events, and in the post-anesthetic care unit; and 2) to ascertain the utility of USCOM as a method to inform goal-directed use of intravenous fluids and vasoactive agents. The early data from the enrolled patients will be reviewed and presented for potential review.

Optimizing the para median approach to thoracic epidurals, threading the eye of the needle: A pilot study

Mahmoud Labib PGY4 Supervisor: Dr. Ronald Seegobin

Background

Thoracic epidurals offer an effective postoperative analgesia in major abdominal and thoracic surgeries. Success rates are variable as is the time taken for catheter placement. Any aids to maximizing success rate and minimizing insertion time would be useful. Reaching the epidural space is technically more challenging for thoracic epidurals than for lumbar epidurals. The acute caudal angulation of the spinous process, especially at the high-thoracic spine, makes the midline approach more difficult. The classic paramedian approach is favored by many clinicians for thoracic epidurals.

Determining the optimum angle to midline could be challenging and is vital for reaching the inter laminar space. The angle quoted in the literature is 10-24 degrees. However, to our knowledge, no one has used spine imaging of any modality to measure this angle.

Objective

1. Generate digital 3D models of the spine developed from an age related archive of CT scans at the KGH.
2. Extract anthropomorphic measurements of thoracic and lumbar vertebral laminae
3. Determine the minimum degrees of needle angulation towards the midline to reach the inter laminar space in the classic paramedian thoracic epidurals.

Methods

For our pilot study, we collected forty CT scans done for abdominal/pelvis pathology at Kingston General Hospital. We will examine 6 thoracic vertebrae for each subject, T7-T12, and 4 lumbar vertebrae for a total of 240 thoracic and 160 lumbar vertebrae. The CT images of the abdomen/pelvis will be extracted into a 3D- voxel-capable program to allow 3D spatial measurements. Using trigonometry the optimal position of entry of needle and subsequent angulation to facilitate the paramedian approach will be calculated.

Results:

This project aims to provide a 3D model of thoracic/lumbar vertebrae with theoretical optimal points of entry of needle and subsequent angulation to allow a rational approach to the epidural/intrathecal space. This remains a work in progress. There are three major components: 1. Base data collection; 2. Software evaluation and choice; 3.Platform optimization Examples will be shown of interim progress.

Analgesic and hemodynamic effects of continuous epidural analgesia compared to paravertebral block in liver resection patients

Glenio Mizubuti MD, MSc, John Murdoch, MD, Anthony Ho, MD

The best mode of analgesia delivery after hepatectomy is currently unknown. Many institutions routinely use continuous epidural analgesia (CEA). CEA provides adequate analgesia, but is associated with high failure rates (20-37%) [1, 2] and sometimes significant hemodynamic disturbances (hypotension) requiring an increased amount of intravenous fluids [1] and blood products [3] to maintain homeostasis. Furthermore, its safety has been the subject of debate in liver resection patients due to the elevated risk of epidural hematoma and its serious neurological consequences. These limitations highlight the need to explore other options for analgesic control after hepatectomy, such as paravertebral block (PVB). PVB has minimal hemodynamic impact [4] and has been proven to provide similar analgesia with lower incidence of pulmonary complications [5], side effects (pruritus, urinary retention, nausea and vomiting, hypotension) [5, 6] and failure rates (6.1%) [5-7] when compared to CEA in thoracic surgery. Furthermore, PVB has a better safety profile (lower risk of spinal hematoma) in the presence of moderate hemostatic deficiencies [8, 9]. Therefore, PVB has been suggested as a safer analgesic alternative in hepatectomy patients [10]. Despite this, there are no studies comparing the efficacy of CEA and PVB as analgesic techniques after hepatectomy. We propose a non-inferiority randomized controlled trial to determine whether PVB produces a similar analgesic profile to CEA in hepatectomy patients through a right subcostal incision, while being associated with fewer side effects and complications. We propose a pilot study at the Kingston General Hospital (KGH) to test for feasibility and to gather the data required for power analysis and sample size calculations for a larger multicentre trial. The primary outcome of this study will be pain scores (visual analogue scores – VAS) at rest and on coughing at 30 min after arrival to the post-anesthetic care unit (PACU), and 4, 8, 24, 48, and 72 hours thereafter. Secondary outcome measures will include cumulative opioid consumption, the time to first request of opioids, peak expiratory flow rate (PEFR), success and therapeutic failure rates of CEA and PVB, catheter re-siting rate, intraoperative mean arterial pressure, central venous pressure, urine output and acid-base data, total volume of intravenous fluids (crystalloids, colloids, and blood products) and vasopressors given perioperatively as well as in the first 72 hours postoperatively, the number of days to resume a full oral diet, the hospital length of stay, and any complications. Additionally, postoperative adverse events will be recorded, including hypotension requiring medical intervention, respiratory depression, sedation levels, urinary retention, and pruritus. Our hypothesis is that VAS scores, cumulative opioid consumption, and the time to first opioid request will be similar in the PVB and CEA groups. However, we anticipate that patients receiving PVB will present higher PEFR and require fewer vasopressors and blood products, and less intravenous fluids, and will present lower failure/catheter re-siting rates as well as fewer side effects (pruritus, urinary retention, nausea/vomiting) and complications, and a reduced hospital length of stay compared to patients receiving CEA. The parameters needed to estimate power and sample size for this study do not yet exist. Therefore, we propose running the current study at KGH as a pilot to generate the data needed to estimate power and sample size, which will guide a larger, multicentre trial.

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Perceptions of Yearly Summative Examinations in the Queen's Anesthesia Simulation Program

C. Nickel, M. McMullen

Background: Medical programs and licensing bodies have been adopting simulation based education and assessment methods over the past ten to fifteen years. The majority of the current curricula in training programs rely on formative assessment in the format of debriefing to help guide learning. However, recently there has been a renewed exploration of using high fidelity simulation as a high stakes summative assessment method. In Canada, this is occurring with the implementation of competency based medical education (CBME) and the CanNASC simulation program. As well, high stakes or summative exams based on high fidelity simulation have already been added to licensing exams in both Israel and the United Kingdom.
Current literature demonstrates many potential benefits to simulation as an assessment method including the ability to identify gaps in safe anesthesia resident practice, assessing procedural skills, and the ability to assess non-medical knowledge competencies such as crisis resource management. This is able to occur in a safe environment and allows exploration of rare or complicated scenarios. The adoption of competency based medical education will also require a variety of new and old assessment methods and simulation will likely play a larger role in resident assessment.
Queen's University currently uses a traditional model of simulation education with multiple scenarios throughout the five PGY years. Each scenario is accompanied by a debrief session meant to link the scenario to key learning points and close gaps in knowledge. Until recently, there was no summative or formal evaluation process attached to any of the simulation sessions. The introduction of the CanNASC project in the PGY 4 and 5 years has begun to introduce critical summative assessments into these scenarios. However, the program lacks a defined simulation assessment tool or simulation In-Term Evaluation Report for all residents.

Objective: The objective of this study will be to investigate the fundamental perceptions of program administrators in postgraduate medical education and faculty facilitators in medical simulation surrounding the adoption of a simulation curriculum that incorporates yearly summative or examinations. These themes will in turn inform the creation and validation of a site specific simulation assessment tool and sITER. Finally, the tool and sITER will be evaluated at other simulation centres and anesthesia programs.

Methodology: This study will use purposive sampling to identify and recruit program administrators and faculty facilitators. Participants will undergo semi-standardized interviews, using focus group or traditional methods, with a schedule of questions and probes that has been developed and pilot tested. The transcribed interviews will then undergo thematic content analysis.

Expected Outcomes: This study will enable important benefits and barriers to simulation assessment at Queen's University to be brought forward and help to identify the fundamental aspects desired in simulation assessment. It will develop themes for the basis of creating a simulation tool and sITER for later validation and use. As well, it will aid in the discussion surround the logistical implementation of simulation assessment in our residency program.

Bilateral transversus abdominis plane block with or without magnesium for total abdominal hysterectomy and bilateral salpingo-oopherectomy – a randomized controlled trial

Authors: Gita Raghavan, Anthony M.H. Ho, Glenio B. Mizubuti

Background: Transversus abdominis plane (TAP) block is a popular analgesic technique for abdominal surgery with an incision between the sixth thoracic and first lumbar vertebrae. Local anesthetic is injected under ultrasound guidance resulting in a very low risk of complications (peritoneum or bowel penetration) and very few side effects. Previous studies suggest that TAP blocks are superior to intravenous morphine without neuraxial anesthesia in abdominal surgery.[1] TAP blocks are often performed post-operatively in women who have undergone total abdominal hysterectomy +/- bilateral salpingo-oophorectomy (TAH-BSO) to provide effective analgesia while minimizing the systemic side effects of intravenous opioids.

Rationale/Hypothesis: Several adjuncts have been trialed with local anesthetics in TAP blocks to further improve the quality and duration of analgesia. Magnesium, the second most abundant intracellular cation after potassium, is a natural analgesic that acts via antagonism of N-methyl-D-aspartate (NMDA) receptors. When added to local anesthetic in neuraxial, femoral and brachial plexus blocks, it has been shown to improve the quality of analgesia. We hypothesize that adding a moderate amount of magnesium sulfate to the local anesthetic used in TAP blocks will result in improved duration and quality of analgesia in patients undergoing TAH +/-BSO.

Outcomes: the primary outcomes will be the time to first dose of post-operative opioid and cumulative opioid consumption at 2, 4, 8, 12, 16, 20 and 24 hours. Secondary outcomes will include VAS pain scores at rest and with coughing, cumulative acetaminophen consumption, patient satisfaction on their postoperative analgesia and side-effects at 24 hours (poor = 1, fair = 2, good = 3, excellent = 4), pruritus (none = 0, mild = 1, moderate = 2, severe = 3) and nausea (none = 0, mild = 1, moderate = 2, vomiting = 3). These will all be assessed at the above-mentioned time points.

Methods: We will conduct a double-blind randomized controlled trial consisting of three treatment groups. Women will be randomized to receive bilateral TAP blocks with 20mL bupivacaine 0.25% and 5mL saline per side (Group A), bilateral TAP blocks with 20mL bupivacaine 0.25% and 5mL magnesium sulfate (MgSO4) 10% solution per side (Group B), or no TAP blocks (Group C). Data collection will be complete by 24 hours after the end of surgery for each participant.

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Examining the Influence of Anaesthetic Practices on Maternal Outcomes in a Resource Poor Setting (Tanzania)

AUTHORS: Navroop Sandhu, Jennifer Carpenter, Susan Haley

Approximately 800 women worldwide die from complications related to pregnancy and childbirth every day [1]. A staggering 62% of these deaths occur in sub-Saharan Africa. This highlights the alarming disparity that exists between the developed and developing world in terms of maternal morality rates (MMRs), 16/100,000 compared to 230/100,000, respectively. Attempts have been made to lessen this inequality, most recently through the focus on improving maternal health outcomes as part of the Millennium Development Goals created at the Millennium Summit of the United Nations in 2000 [2]. Specifically, the fifth MDG targets a decrease in MMR of 75% by 2015 compared to 1990 levels. Unfortunately, we are still a long way off from achieving this goal, as the MMR globally had been reduced by less than 50% since the institution of the MDGs [1].

The vast majority of global maternal deaths can be attributed to haemorrhage, sepsis, and hypertensive disorders of pregnancy [3]. A lack of proper anaesthetic care has been ascribed as one of the limiting factors in providing life-saving interventions that could prevent maternal deaths in these resource-poor settings [4]. Proper anaesthetic care can help in managing rapidly emergent situations, like blood pressure and fluid control, control of a difficult airway, management of haemorrhage, and identification of septic patients, to name a few. In the developed world there has been a push towards anaesthetics being delivered by specially trained non-physician providers in places such as the United States, the Netherlands, and Sweden. Comparatively, in parts of the developing world, trained physicians or nurses are seldom available thereby decreasing the likelihood that these vital services would be provided by an adequately trained professional.

Coincidentally the global rate of caesarean sections (CS) has also increased dramatically over the last few decades [5]. Indeed, the rate of CS is rising in the developing world [6] and has been considered to be an indicator of improved emergency obstetrical care in sub-Saharan Africa [5]. Several studies, however, have shown that this is not the case, and highlight an increase in unnecessary operative deliveries and poor obstetrical care in hospitals [5-8].

Tanzania is no exception to this and accounts for 3% of global maternal deaths [1]. Litorp *et al*. [9] examined CS rates, indications, and maternal and perinatal outcomes from 2000-2011 at a large teaching hospital in Tanzania. The rate of operative deliveries was found to have increased from 19% in 2000-2002 to 49% in 2010-2011, but an improvement in maternal outcomes was not seen. In fact, overall maternal mortality was found to increase during the course of the study from 463/100,000 live births in 2000-2002 to 650/100,000 in 2009-2011. Moreover, an evidence based audit conducted at two rural hospitals in Tanzania found that 26% of all operative deliveries occurred due to inappropriate indications, and an additional 38% of cases had no clear indication [10].

For my research project, I am interested in investigating how current anaesthetic practices in Tanzania may contribute to maternal outcomes and the rise in CS rates. I plan on conducting a feasibility study to determine if I can find a link between anaesthetic practices, CS rates, and maternal outcomes from hospital records. I will be examining admission data, anaesthetic records, operative records, and discharge data over one year's time to determine if a large-scale retrospective chart review can be done. I want to extract the following data from the records: (1) the indication for CS, (2) anaesthetic technique, (3) the level of training of the practitioner, (4) the type of anaesthetic used, (5) the success rate, (6) details of the management of difficult situations (*i.e*., haemorrhage, difficult airway, hypotension, sepsis, high-spinal, etc.), (7) the anaesthetic monitoring used, (8) fluid management, and (9) maternal mortality rate. I plan on looking at why one type of anaesthetic is used over others (i.e., is it a lack of training, lack of resources, etc.) as the secondary outcome of my study.

Ultimately, I plan on conducting a retrospective chart review to examine the changing trends in obstetrical care since the implementation of the MDGs (over the last 15 years) in Tanzania. I want to understand how anaesthetic practice in Tanzania has changed over time and how it can still be improved to aid towards reaching the target of MDG #5. My long terms goals include using the results of my study to implement an educational program to decrease the potential contribution of anaesthesia to maternal death during operative deliveries.

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Incidence and Risk Factors for Postoperative Hyperglycemia In Elective Surgical Patients With No Prior History of Diabetes

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Objectives: Postoperative hyperglycemia increases the risk of surgical site infections, length of hospital stay, and can increase mortality. Although recent studies have shown that elevated glycosylated hemoglobin (HbA1c $\geq$ 6.0%) is common among hospitalized patients, it is not known if this is predictive of postoperative hyperglycemia. The objectives of this prospective observational study were to 1) determine the incidence of postoperative hyperglycemia (blood glucose > 10 mmol/L) in elective surgical patients with no previous history of diabetes 2) assess whether preoperative elevated HbA1c is associated with postoperative hyperglycemia and 3) identify other factors that may predict postoperative hyperglycemia. Thus, future interventional studies could target this group with strategies to prevent postoperative hyperglycemia and its associated adverse effects.

Methods: Following local ethics committee approval, 275 patients consented to participate in the study. Patients $\geq$ 18 years of age having elective surgery requiring hospital admission postoperatively were eligible to participate. Patients with planned ICU admission and patients taking oral hypoglycemic agents or insulin were excluded. Preoperatively, participants had capillary blood glucose (CBG) and HbA1c measured and they completed the CANRISK diabetes-screening questionnaire. Standard demographic and perioperative data were collected. CBG was ordered on arrival to PACU, before meals and at 22:00h for 2 days or until discharge. Postoperatively, if CBG>10 mmol/L on two or more occasions, the surgical service was notified and they determined the most appropriate management. The incidence of postoperative hyperglycemia was calculated as the percent of participants with CBG>10 mmol/L on at least one occasion. The chi square test was used to assess for potential risk factors for postoperative hyperglycemia including elevated HbA1c, CANRISK score, and fasting blood glucose on the first morning postoperatively (FBG-POD1).

Results: Thirty-four participants were excluded because they were discharged home from PACU. Of participants admitted to hospital, 14.5% (35/241) had at least one episode of postoperative hyperglycemia. HbA1c was elevated in 18.4% (44/239) of all participants and 6.7% (16/239) had a value that was consistent with a provisional diagnosis of diabetes (HbA1c $\geq$ 6.5%). Postoperative hyperglycemia was common (68.8%) in participants with HbA1c $\geq$6.5%. However, 11% of participants with a normal HbA1c also had at least one episode of hyperglycemia. Those participants with the combination of an elevated HbA1c and FBG-POD1 had the highest incidence of postoperative hyperglycemia (91.7%, 11/12).

Conclusions: A significant number (14.5%) of elective surgical patients with no previous diabetic history experienced postoperative hyperglycemia. Approximately two thirds of those with postoperative hyperglycemia had a provisional diagnosis of diabetes based on their HbA1c value. The best predictor of postoperative hyperglycemia was the combination of elevated HbA1c and elevated fasting blood glucose on POD1.

Frailty Indices As A Predictor Of Postoperative Complications: A Systematic Review

Dr. Julie Zalan – PGY 3 Anesthesiology
Staff Supervisors – Rosemary Wilson and Mike McMullen

Introduction: Over the next 30 years, the Canadian healthcare system will treat an unprecedented number of older adults, many with multiple chronic diseases. Frailty is a state of reduced physiologic reserve associated with increased susceptibility to disability[1]. It is a global phenotype introducing vulnerability which limits a person's ability to respond to stressors[1]. Despite significant frailty, many individuals will be considered for and will ask for highly aggressive care that has uncertain chance of success and may well result in prolonged disability and suffering. Indices exist which incorporate cognition, mobility, function and co-morbidities, to assign a frailty score. Low and high scores correlate with fitness and severe frailty respectively, which effectively estimate important outcomes[2], such a survival/mortality, morbidity and institutionalization. Recent incorporation of this tool in the peri-operative context has shown its predictive value in estimating risk and outcomes postoperatively. Frailty has been identified as an independent risk factor for in-hospital mortality, morbidity including delirium, functional decline, and prolonged ventilation; increased length of stay, as well as discharge to institutional care[3,4]. The power of this tool in the pre-operative period to predict postoperative outcomes may help patients make informed decisions about their care, to best preserve their quality of life, which may or may not include continuing with surgery. If surgery is decided, additional supports (geriatric multidisciplinary team, intensive care unit, alternate level of care etc.) may be anticipated, and this in turn can help the health care team and policy makers plan resource allocation.

Objective: To describe and compare the predictive value of existing frailty indices for peri-operative morbidity and mortality.

Question: What is the relationship between a frailty score and postoperative outcomes?

Completed To Date: A protocol and abstract were submitted to the Joanna Briggs Collaboration (JBI) for registration. An initial search of MEDLINE, CINAHL, EMBASE, PSYCHINFO was completed. Sensitivity analysis was performed twice. Five hundred and twenty six articles were obtained. Following removal of duplicates, 499 abstracts/titles were reviewed independently by two assessors (JZ and RW): 317 were excluded, 156 were included for full text review and 26 required additional information.

A knowledge synthesis proposal, Letter of Intent, was submitted to TVN 2015 Frailty Measures Grant Competition.

Next Steps: Articles will be independently reviewed by two independent assessors. Any conflicts of opinion will be independently resolved by a third assessor. Studies will be included if they were published in English, employ experimental, observational, or descriptive methods. All surgical specialties will be included, as will all age groups and both sexes. Articles supporting frailty scores where validity data are not provided will be excluded.

Data extraction and analysis will be performed using JBI MASTARI and CReMS software.

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Does magnesium sulfate as a supplement in adductor canal blocks improve pain control after total knee arthroplasty?

Resident: Dana Zoratto, PGY2 Supervisor: Dr. Shyam

Background and Rationale

Total knee arthroplasties (TKA) are widely recognized as effective treatments for degenerative joint disease. The number and prevalence of TKAs have increased significantly over the last quarter century with over 57,000 performed in Canada in 2012-2013 alone. One of the many challenges of TKAs is balancing postoperative analgesia with safe early ambulation to facilitate efficient hospital discharges. Multimodal approaches have been instituted including periarticular injections of local anesthetic, patient-controlled intravenous narcotics, and various regional techniques. Various medications have also been investigated including the addition of magnesium to both systemic and regional techniques to improve both duration and efficacy of analgesia. This research looks specifically at whether the addition of magnesium sulfate to an adductor canal block will increase the duration of a sensory block to the knee while maintaining normal quadriceps strength in patients undergoing TKAs. We hypothesize that patients who receive the magnesium sulfate will have prolonged analgesia with better ambulation and thus shorter hospital lengths of stay.

Study design

This study is designed as a single-centered, double-blinded, randomized controlled-trial with three groups of 40 participants each to compare (1) current standard of care (spinal anesthetic with epimorph, periarticular injection and patient-controlled analgesia), to a group receiving (2) standard of care plus an adductor canal block with only local anesthetic, and to a group receiving (3) standard of care plus an adductor canal block with both local anesthetic and magnesium sulfate.

Outcome Measures

Primary outcome: time to first analgesic request (first use of PCA pump after surgery)

Secondary outcomes: (1) cumulative PCA morphine-equivalent consumption in the first 24-hours postoperatively; (2) number of steps taken on postoperative days 1 and 2; (3) VAS pain scores at 2, 4, 8, and 24 hours post-adductor canal block injection; (4) hospital length of stay; and (5) side-effects (nausea, respiratory depression, pruritus, falls, etc).

Critical Appraisal

By: **Sophie Breton**, MD, PGY-1, Queen's Anesthesiology & Perioperative Medicine

Publication title: "***Recruitment of lung volume during surgery neither affects the postoperative spirometry nor the risk of hypoxaemia after laparoscopic gastric bypass in morbidly obese patients: a randomized controlled study***"

Authors: ***A.A. Dufresne1, G.A. Hans1, P.J. Goffin1, S.P. Bindelle1, P.J. Amabili1, A.M. DeRoover2, R. Poirrier3, J.F. Brichant1 and J.L. Joris1***

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According to the World Health Organization, in 2014, 39% of adults were overweight and of those, 13% were obese.[i] This epidemic of obesity will lead to anesthesiologists having to deal with increasingly challenging patients in the operating room. Thus, it is important to adjust our practices to overcome the difficult physiological issues that coexist with obesity.

Introduction

Morbidly obese patients have different respiratory physiology compared with healthy patients. They can have a greatly decreased functional residual capacity (FRC) and expiratory reserve volume (ERV), intermediately decreased residual volume (RV) and total lung capacity (TLC). They can also have a mild decrease in both the forced vital capacity (FVC) and forced expiratory volume after 1 second (FEV1). They also have a decreased chest wall compliance, which leads to increased atelectasis especially when supine. They often breathe faster and have a decreased tidal volume.[ii] Obesity causes transmission of high intra-abdominal pressures to the thorax, which decreases FRC & ERV and causes increased work of breathing.[iii]

The second problem being addressed in this study concerns the physiological effects of pneumoperitoneum on lung volumes and respiration. The increased abdominal pressure caused by the insufflation of CO_2 causes amongst other things, a decreased respiratory compliance and increased airway pressures.[iv] Coupled with the respiratory effects of obesity, these patients are more difficult to ventilate adequately.

It is a known problem that obesity and general anesthesia cause decreased FRC and promote atelectasis. There have been multiple studies done to try to determine the best ventilation strategies for morbidly obese patients undergoing surgery. It has been found that there is no difference between pressure-controlled ventilation and volume-controlled ventilation.[v] It has also been determined that in obese patients, preoxygenation is more effective with the head up position versus supine.[vi] There are multiple studies that have shown the advantage of using PEEP + recruitment maneuvers for improving lung volumes and decreasing atelectasis in morbidly obese patients.[5 vii viii ix x]

In this study, the hypothesis being tested is that in morbidly obese patients undergoing laparoscopic bypass surgery, the use of intraoperative recruitment maneuvers, when performed with PEEP of 10cm H_2O would improve postoperative spirometry and reduce hypoxemia during the first postoperative night. The ideal ventilation strategy for morbidly obese patients undergoing general anesthesia has not yet been found. By discovering methods to reduce the amount of intraoperative lung atelectasis, we can better ventilate these patients and reduce the quantity of postoperative breathing complications and reduce length of stay.

Methodology

This study was a randomized double-blind controlled single center study. The patients could be assigned to one of two groups: 10cm H_2O PEEP or 10cm H_2O PEEP plus two recruitment maneuvers of 40mm Hg x 40 seconds (one after induction of pneumoperitoneum and the other after exsufflation). They were assigned to these groups by a computer that generated random numbers. The researchers who recorded and analyzed the data and the patients were unaware of the group assignment.

The population used for this study was morbidly obese patients, having a BMI of over 35kg/m^2 and an ASA of II or III. The justification for using this population is that it has previously been shown that recruitment maneuvers improved intraoperative oxygenation and lung mechanics in morbidly obese patients undergoing laparoscopic surgery.[7] The question to be answered was whether these advantages continued post-operatively as morbidly obese patients have increased risks for hypoxemia post abdominal and thoracic surgeries.[xi] The control group in this study is part experimental, part historical. It has been shown that using PEEP and recruitment maneuvers, decreases atelectasis, increases lung/chest wall compliance and improves oxygenation.[5 7 8 9 10] Therefore, since the control group would also have PEEP, this is a historical treatment. However, all above-cited studies used tidal volumes of 8-10mL/kg of ideal body weight. In this study they tried using protective mechanical ventilation (low-tidal volume of 6mL/kg of IBW) with PEEP for both groups, which is experimental, as these two had not been previously combined in morbidly obese patients.

It is said that for clinical research, power should be at least 80% in order to detect a difference between study groups.[xii] This study has calculated that a sample size of 22 patients in each group would give them 80% power to detect a difference in functional residual capacity between groups at a confidence level of 0.05. They consequently enrolled 50 patients to have 25 in each group, which is more than adequate. However, although there were 25 people in each group, there were some spirometry and somnolter analyses missing which reduced the sample size data to a range of 20-25 subjects depending on the data group. In theory this would reduce the power to less then 80% for some parts of the study. In a typical anesthesiologist's practice it is quite common to have morbidly obese patients undergoing laparoscopic surgeries.

The ethics committee of the hospital approved this study. It is ethically sound because both the control group and the experimental group are receiving standard of care general anesthesia and postoperative analgesia. They were induced, intubated and awakened using the same drugs and techniques. They were ventilated using a volume controlled ventilation with a low tidal volume and the respiratory rate was adjusted to maintain an appropriate end tidal CO_2. The only difference between the two groups was the use of recruitment maneuvers intraoperatively. There were no moments during this randomized controlled trial when patients were at risk; no recruitment maneuvers had to be interrupted secondary to hemodynamic instability.

The exclusion criteria for this study were patients who were younger then 18 and older then 65 years old, a prior diagnosis of obstructive sleep apnea(OSA), a history of having a pneumothorax or right heart failure. Patients who have OSA were excluded because the standardized postoperative management would be to use CPAP or BiPAP in these patients and therefore would skew oxygen saturation data on the first postoperative night. Patients with prior pneumothorax were excluded because they are more at risk of having barotrauma from high airway pressures.[xiii] Patients with right heart failure are more at risk because recruitment maneuvers increase intra-thoracic pressure and thus decrease venous return and consequently cardiac output.[13]

The hypothesis of this study was that in morbidly obese patients undergoing laparoscopic gastric bypass surgery, the use of intraoperative recruitment maneuvers, when performed with PEEP of 10cm H_2O, would improve postoperative spirometry and reduce hypoxemia during the first postoperative night. The experimental protocol was well designed to test the hypothesis. They measured the FRC, FVC and FEV1 at the preoperative assessment and at postoperative day 1 with the same closed-circuit helium dilution and whole body plethysmography. However, for the second part of the hypothesis, they only measured postoperative SpO_2 and apnea-hypopnea index. Thus, it is impossible to see if recruitment maneuvers allow SpO_2 to return to normal after surgery. This study cites this discrepancy as one of their weaknesses.

This study is detailed enough to be reproducible. All the doses for the anesthetic and for the postoperative analgesia are included and the method of ventilation is well described. The equipment used for measurement of spirometry and compliance of the respiratory system is included as well. The validity of a study refers to its design and

to whether it measures what it is supposed to measure. The internal validity of the study was obtained by having both a treatment and control group and having participants randomly assigned to either, which eliminates selection bias. The study was also double-blinded which eliminates the measurement bias. The external validity looks at how applicable the results are to the general population. For this study, I believe the results can be applied to both the healthy population and to the obese population undergoing laparoscopic surgery. Healthy patients also develop atelectasis while under general anesthesia albeit at a lesser extent than obese people. Therefore, advancements in ventilation strategies during laparoscopic surgeries apply to a large population.

The primary endpoint to this study was to determine if there was a change in the FRC at postoperative day 1. The secondary endpoints included change in other aspects of spirometry (FVC, FEV1) and a change in the oxygen saturation and apnea-hypopnea index at postoperative day 1. The protocol of this study was well designed to reach these endpoints. However, for the purpose of the study, they should have included a preoperative measurement of oxygen saturation and apnea-hypopnea index in order to have a baseline to make a comparison.

Investigators who were blinded to group allocation did the data collection. The analysis was done using paired Student's t-test and Wilcoxon matched-pairs signed-rank for within group comparisons, and unpaired Student's t-test and Mann-Whitney test for between group comparisons. Student's t-tests are used to calculate if there is a difference between sample means. The Wilcoxon test and the Mann-Whitney test are used to compare the median between two groups in order to distinguish if they are from the same population. The Wilcoxon test is for paired groups and the Mann-Whitney test for unpaired groups. In this study it is appropriate to use these tests because of the small sample size.

Results

The two groups were comparable in all aspects: patient demographics, STOP BANG score and duration of anesthesia/pneumoperitoneum. The patient demographics that were analyzed were: age, weight, height, BMI, sex and smoking status. The only differing aspects were that in the control group there were only 25% males compared to 56% in the experimental group and the control group had 47% smokers compared to 14% in the experimental group. Unfortunately, there were some data that was not interpretable or missing in both groups. In the control group, 4/25 postoperative spirometries were missing. In the experimental group, 2/25 postoperative spirometries were missing and 5/25 oxygen saturation tracings were uninterpretable. No data was eliminated. In the article, the results are presented mostly in tables and with one graphic. The median of patient demographics, anesthesia duration and pneumoperitoneum duration are presented in a table. The authors compared thoracopulmonary compliance pre-recruitment maneuver and following both recruitment maneuvers. Results showed that intraoperative recruitment maneuvers improve compliance and that the effect of the second maneuver was larger than the first. The results of this study also show that the FRC, FVC and FEV1 on postoperative day 1 was decreased similarly in both groups despite the use of recruitment maneuvers. SpO_2 and apnea-hypopnea index during postoperative night 1 were similar for both groups.

Discussion

The main conclusion of this study is that when using protective mechanical ventilation (low tidal volume and PEEP of 10 cm H_2O), the addition of two intraoperative recruitment maneuvers did not improve postoperative lung function (FRC, FVC and FEV1) and oxygenation nor did it decrease the apnea-hypopnea index in morbidly obese patients undergoing laparoscopic abdominal surgery. All the results presented in this article support this conclusion. The results address the hypothesis of the study and the authors explain why they think their hypothesis was wrong. The authors explain that the lack of reduction in FRC postoperatively (even in the control group) is due to the use of pre-oxygenation strategies to reduce atelectasis and the use of intraoperative protective ventilation. Most studies[5 7 8 9 10] used tidal volumes of 8-10mL per kg of IBW versus the protective ventilation used in this study was 6mL per kg of IBW. Since the FRC in the control group did not reduce significantly postoperatively, it is not surprising that the recruitment maneuvers did not add any therapeutic benefit. There is another study[10] that compared the use of protective ventilation + PEEP + recruitment maneuvers with ventilation of 9mL per kg of IBW.

This study had concluded that protective ventilation combined with recruitment maneuvers improved lung spirometry after laparoscopic surgery. However, since their control group did not get the protective ventilation it is impossible to separate the effects of protective ventilation with PEEP from the effects of the recruitment maneuvers. Studies in the literature [5 7 8 9 10] have shown that using PEEP + recruitment maneuvers helped reduce atelectasis postoperatively in morbidly obese patients. Thus this study is showing that perhaps there are others ways of reducing atelectasis and improving lung volumes such as using protective ventilation with low tidal volume. I do not believe that there is an alternative interpretation to the data; it clearly does not show any difference in FRC postoperatively between the control and experimental group. For this study, the authors have used $P<0.05$ as statistically significant. Therefore, some of the results are statistically significant while others are not: P values range from <0.001 to 0.52. It is interesting to see that within a group, the preoperative and postoperative difference of FVC and FEV1 are statistically significant (<0.001) but when comparing both groups, the P value falls to 0.52 for the FVC and 0.39 for the FEV1. When looking at the FRC results, one can notice that both the comparisons within the groups and between the groups are not statistically significant (P values of 0.14/0.056 and 0.35 respectively).

There are a few limitations to this study including the aforementioned lack of preoperative records for oxygen saturation and apnea-hypopnea index. The authors also mention that the measures are from postoperative day 1 or the first postoperative night. They could have measured lung spirometry and oxygenation a few hours postoperatively to see if benefits of recruitment maneuvers were better seen in the immediate postoperative period. One study found that in the first two hours following surgery the patients getting PEEP and recruitment maneuvers had higher oxygen saturation.[8] Ideally, there should have been more patients in the study to account for possible loss of data or difficulty interpreting it. Because of this, for some group comparisons there are only 20 or 21 patients, which falls short of the 22 required to have a power of 80%.

There have been multiple studies done in morbidly obese patients about which type of ventilation to use; and the use of PEEP with or without recruitment maneuvers. Some of these studies were done focusing on intraoperative changes and others on postoperative changes. As the authors suggest at the end of the article, the role of protective ventilation using low tidal volume and PEEP is adequate to optimize postoperative lung function but this needs to be further studied. It would also be interesting to study if protective ventilation + PEEP + recruitment maneuvers affect postoperative apnea-hypopnea index and oxygenation in patients diagnosed with obstructive sleep apnea, as decreased volumes contribute to upper airway collapse.

Applicability of the paper

By reading this article I have learned about the importance of adequate ventilation in morbidly obese patients undergoing laparoscopic surgery. By doing research around this article, I have also learned a great deal about the effects of pneumoperitoneum and the effects of obesity on lung ventilation. What I will retain from this article is that using a low tidal volume + PEEP +/- recruitment maneuvers will diminish the reduction of FRC postoperatively. I have also learned that recruitment maneuvers improve thoracopulmonary compliance and that the second recruitment maneuver had an even larger effect; perhaps adding more recruitment maneuvers could help maximize lung compliance? The results of this study will definitely make me more conscientious when ventilating morbidly obese patient undergoing laparoscopic surgery. Going forward, I will have more strategies to use in order to reduce atelectasis and improve postoperative lung function.

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Critical Appraisal

By: **Yuri Koumpan**, MD, PGY-1, Queen's Anesthesiology & Perioperative Medicine

Publication title: "***Randomized comparison of two anti-emetic strategies in high-risk patients undergoing day-case gynaecological surgery.***"

Authors: ***White H, Black RJ, Jones M, Mar Fan GC.***

Br J Anaesth. 2007 Apr;98(4):470-6.

GENERAL

The study that will be reviewed in this appraisal originates from Australia, in association with the University of Queensland. The authors include H. White, Director of Intensive Care at Logan Hospital, Queensland; R.J. Black, Department of Anesthesia, Gold Coast Hospital, Queensland; M. Jones, School of Population Health, University of Queensland; G.C. Mar Fan, Director of Anesthetic and Acute Pain Management, Queen Elizabeth II Jubilee Hospital, Queensland.

The title of the paper makes reference to an anesthetic concern that is considered in virtually every surgical case requiring administration of systemic anesthetic agents, namely, the issue of nausea and vomiting. Patients and anesthesiologists alike value nausea and vomiting to be among the most unfavourable peri-operative outcomes, with some patients considering it an even worse outcome than pain[1,2]. In particular, the title tells us the study population is high-risk for this complication, as gynecological surgery is a well-known risk factor for post-operative nausea and vomiting[3]. Therefore, we can assume that this study will address a common – and very important – anesthetic issue.

INTRODUCTION

The problem being addressed is prevention of post-operative nausea and vomiting through an effective management strategy. Post-operative nausea and vomiting (PONV) is well-studied. As previously mentioned, it is a primary concern for both patients and anesthesiologists; furthermore, it may lead to delays in discharge and complications such as wound dehiscence and aspiration[4]. There are multiple patient, surgical, and anesthetic factors that contribute to PONV risk[2]. Untreated, the incidence in the general surgical population is 20-30%, and may be as high as 70-80% in high-risk patients[2]. Women undergoing gynecological day surgery are one such high-risk group, and as such warrant appropriate research to determine the optimal strategy to prevent PONV. The hypothesis being tested is the effectiveness of sevoflurane combined with dolasetron compared to propofol-based total intravenous anesthesia (TIVA) as prophylactic strategies in PONV prevention for gynecological day surgery. Both are commonly-used, evidence-supported strategies. Proving the efficacy of one method on the primary endpoints of the study (which will be discussed in detail further on) over the other should help guide clinicians on the optimal preventive strategy in this particular patient group, evidence that may perhaps be extrapolated to guide management of other patient cohorts that are high-risk for PONV.

METHODOLOGY

This study is a prospective, experimental human study. Informed consent was collected from participants and approval was received by an ethics committee; there is no further reason to doubt the ethical nature of the study. Justification of the study is evident based on previously discussed morbidity-associated risks of PONV such as delays in discharge, aspiration, wound dehiscence, and overall patient suffering and discomfort. The identification of an optimal preventive management strategy would thus be very useful. The inclusion criteria were female patients undergoing day-case gynecological surgery who were considered high-risk (>40%) for PONV; the risk was assessed with the validated Apfel's simplified risk score[5]. The risk score required at least 2 out of 4 criteria to be considered high-risk: female (all patients in this study), previous PONV or motion sickness, non-smoker, or anticipated post-operative opioid requirement.

Exclusion criteria were ASA IV or above, age <18, planned admission, known allergy to a study drug, pregnancy, refusal, or inability to provide consent. The exclusion of patients with an allergy, refusal, or inability to consent is obvious. The exclusion of patients <18 years of age validates the study results specifically towards adult patients, and helps eliminate potential departures from study methodology such as children requiring inhalational induction. It's also likely that these patients would have been undergoing gynecological procedures not homogenous with procedures in adult patients. Pregnancy would have been a possible confounding factor for incidence of PONV. The study specifically assessed day surgery cases, and secondary end-points of the study included length of hospital stay and number of unplanned admissions. Patients ASA IV or greater would presumably be at greater risk of

increased hospital stay and unplanned admissions, so excluding them helps reduce confounding factors.

Subjects were randomized to one of two groups using a computer-based, random number generator. The two groups were sevoflurane plus dolasetron, or propofol-based TIVA. A control group receiving inhalational anesthetic without dolasetron was not included, as this justifiably was not considered ethical in patients at high-risk for PONV. Patient allocations were sealed in opaque envelopes which were then opened by the anesthesiologist prior to induction. The patient was blinded to her assigned treatment group; however, it would not have been possible to blind the anesthesiologist.

The primary endpoints of the study were 1) the incidence and severity of PONV, and 2) the incidence of post-discharge nausea and vomiting (PDNV), defined as PONV between discharge and 24h. Secondary endpoints included duration of anesthesia, length of hospital stay, and the number of unscheduled admissions. By directly comparing the two anti-emetic strategies in a randomized, blinded trial, the study is correctly designed to determine which strategy is more likely to be superior in the context of the identified primary and secondary endpoints. The experimental protocol is well detailed, including the details of drugs and equipment, so that the study should be reproducible.

Patients in the TIVA group were induced and maintained using a propofol infusion with target serum concentration 2–8 μg/ml using a target-controlled infusion device. No further anti-emetics were administered to this group. Patients in the sevoflurane and dolasetron (SD) group were induced with propofol 1.5-2.5 mg/kg, and maintenance of anesthesia was with a mix of air/oxygen/sevoflurane. Dolasetron 12.5 mg was administered as a sole anti-emetic prior to the end of surgery. In both groups, clinical parameters were used to guide titration of sevoflurane and propofol to ensure adequate anesthesia. Prior to induction, patients in either group received midazolam 0-3 mg and fentanyl 0-200 μg as per discretion of the anesthesiologist. Airway management was achieved with either ET tube or LMA, and neuromuscular blockade as well as reversal was achieved as deemed necessary by the clinician. Adjuvant opioids during and after the surgery were administered by the anesthesiologist as necessary. This creates possible bias since the anesthesiologist was not blinded and perioperative opioid use increases the risk of PONV. However, the authors do well to document the number of patients receiving and the median doses of these opioids, which will be discussed further in the "results" section.

Patients were transferred to PACU afterwards. The nurses were blinded to their treatment allocation but did have access to the patient charts, creating potential for bias when measuring outcomes. Pain was measured with a visual analogue scale, and PONV was measured with a somewhat objective four-point scale (0= no nausea, 1=occasional nausea, 2=persistent nausea requiring treatment, and 3=vomiting). Treatment for PONV in the PACU was treated with a standardized protocol (ondansetron followed by prochlorperazine followed by dexamethasone). Pain, nausea and vomiting, and subsequent treatments were recorded in 30 minute intervals until discharge. After discharge, patients received a phone call 24h post-operatively to determine the incidence of PDNV and any treatments of such. However, the authors do not state who made the phone call, whether the calls used a standardized questionnaire, and whether or not the caller was blinded to treatment allocation.

The study protocol is clinically relevant as it uses commonly-used, evidence based PONV management strategies. In our center (Kingston General Hospital), prophylaxis against PONV in high-risk patients is often administered as ondansetron combined with dexamethasone with the use of volatile anesthetics. Ondansetron is of the same class of medications as dolasetron (5-HT3 receptor antagonist) and seems to be as equally effective at preventing PONV based on previous studies[3]; however, the combination with dexamethasone may further increase this effect[3], which should be considered when applying the results of this study to our practice. Similarly, patients in our practice receiving TIVA for PONV considerations would receive dual anti-emesis therapy with ondansetron and dexamethasone. This would enhance PONV prophylaxis compared to propofol TIVA alone.

Statistical analysis was performed using the computer program SAS and appropriate analytical tests are fully outlined in the study. All patients were analyzed on an intention to treat basis. A patient was defined to have a complete response if they had no nausea, vomiting, or no use of anti-nausea medication for 24h post-surgery. In total, there were 126 women in the study. This sample size was determined in advance to detect a reduction of PONV from 50% with inhalational anesthesia to 25% with propofol TIVA, with a type 1 error rate of 5% and power of 80%[6]. This power is of standard adequacy, although of course could be improved with an even larger study size.

RESULTS

The paper provides detailed data, graphs, and tables of results. There is no mention of subjects or data being eliminated. Intention to treat analysis was used, and the paper notes there were 4 protocol violations (one patient in the SD group who did not receive dolasetron, and three patients in the TIVA group, two of whom received dolasetron, and one who received dexamethasone prior to prochlorperazine in the PACU). Baseline characteristics of study participants are outlined in Table 1 of the paper. 58 women were randomized to TIVA, and 68 to SD. Overall, the baseline and treatment variables were well-balanced between the two groups

including risk factors for PONV that could act as confounding variables, such as the use of morphine, fentanyl, median fentanyl doses, and post-operative opioid use (Tables 1,2 and 5). There were no statistical differences in these variables between groups. Median morphine doses were not reported. One notable variable that was significantly different between the two groups was length of surgery (Table 3): 16.5 minutes (SD) vs. 22 minutes (TIVA), P=0.046. While increased length of surgery is a risk factor for PONV, absolute difference in median surgery time between the groups was 5.5 minutes, a short and likely clinically insignificant difference.

There was no statistically significant difference of pain score between groups (Fig. 1). Unexpected admissions were also similar in number (P=0.5). There were also no differences in time in PACU (P=0.1), time in day surgery (P=0.7), time to first meal (P= 0.15), and time from PACU till readiness for discharge (P=0.13), summarized in Table 4. Finally, there were no other statistically significant differences in pre-discharge variables including use of anti-emetic drugs, incidence of nausea or vomiting, or nausea and vomiting scores (Table 6 and 7, Fig. 2).

It is in the post-discharge period where the study demonstrated significant differences between treatment protocols (Table 6). Post-discharge nausea was lower in the SD group (15% vs. 37%, P=0.004), post discharge vomiting was lower in the SD group (9% vs. 23%, P=0.03), and complete response was greater in the SD group (72% vs. 52%, P=0.019). An adjusted odds ratio was calculated (Table 8), and the ratio of 2.7 suggests that the SD group patients have 2.7 times the odds of having a complete response compared to the TIVA group patients. The only other variables that were associated with a complete response in a multivariate analysis were body weight in 10 kg increments (odds ratio 0.68, P=0.005) and anesthesia duration (odds ratio 0.62, P=0.0001). There were no significant differences in these variables between the two groups.

DISCUSSION

The main conclusions of the study are firstly that both prophylactic regimens, TIVA and sevoflurane with dolasetron, have equal efficacy in the early post-operative period. Secondly, the study concludes that there is a significant reduction in PDNV in the SD group compared to the TIVA group. These conclusions are supported by the results and address the purpose of the study, which was to compare the post-operative and post-discharge effectiveness of two commonly used prophylactic PONV strategies.

The authors explain these findings by quoting the pharmacokinetics of propofol, which has a short context-sensitive half-time of 40 minutes for infusions of up to 8 hours[7]. Therefore, significant plasma levels of propofol would be unlikely after several hours, making its anti-emetic effects beneficial in the immediate post-operative period only. Although not quoted in the study, the elimination half-life of IV dolasetron is 6-8 hours[8], somewhat longer-acting that ondansetron which is 3-6 hours[9].

The interpretation of the data is consistent with the conclusions of the study, and there are no alternative interpretations with the data provided. These results are clinically significant as well; if we were to label the TIVA group as our control, the number needed to treat to obtain a complete response (no nausea, vomiting, or use of anti-nausea medications for 24 hours post-surgery) using sevoflurane and dolasetron would be 5.

There are previous studies that support these findings. In perhaps the most relevant study, comparison between inhalational anesthesia + dolasetron, TIVA + dolasetron, and TIVA alone found that propofol TIVA, with or without dolasetron, did not reduce peri-operative vomiting or antiemetic requirement in day-case gynecological laparoscopic surgeries[10]. However, nitrous oxide was used as part of the inhalational anesthetic in this study, which is known to have pro-emetic properties. Additionally, there was a trend for greater complete response in the TIVA + dolasetron group vs. TIVA alone, but was not sufficiently powered to prove this. This would be an expected trend as routine prophylactic use of ondansetron has been shown in a systematic review to reduce PDNV[11].

Overall, this is a well-structured study that used appropriate research methods and analysis to identify its results and minimized bias (including no apparent funding bias), although outcome assessors were not identified. A main point that this article adds to existing literature is that post-discharge nausea and vomiting is an important consideration, and one that is separate from post-operative nausea and vomiting. If TIVA is used as a strategy to prevent PONV, a longer-acting agent should be implemented to prevent PDNV as well. Of potential drugs to provide such a benefit, ondansetron seems to be the best studied and is effective as minimizing PDNV[11].

Finally, since this study has been published, a recent meta-analysis from 2014 was released that compared TIVA propofol to sevoflurane and desflurane in ambulatory surgery[12]. The study encompassed 18 trials and 1621 patients. The incidence of PONV was lower with propofol than with inhalational agents (13.8% vs 29.2% respectively; p<0.001). Of important note, there was no difference in PDNV. Most of the studies, however, did not include the use of intra-operative anti-emetic agents. The only study in which dolasetron was used is the one that is the subject of this appraisal, in which we see a likely benefit in preventing PDNV. As mentioned before, ondansetron also has proven benefit in reducing PDNV[11]. With regards to disadvantages of TIVA, the meta-analysis demonstrated it to be on average more expensive by $11.29 per anesthetic.

In summary, despite the results of our discussed study, the literature suggests that TIVA generally does reduce PONV compared to inhalational anesthesia. The important distinction of this study compared to others however was the use of dolasetron in the inhalational anesthesia group, without any added anti-emetics in the TIVA group. We can therefore speculate that dolasetron provides an equal benefit in reducing PONV as TIVA alone. With regards to PDNV, this area remains lacking robust evidence and is not often distinguished from PONV. Most studies assessing PDNV note no difference between TIVA and inhalational anesthesia, but do not include the use of a longer-acting anti-emetic such as ondansetron or dolasetron.

When we synthesize this information, it makes sense that the most effective strategy at preventing PONV as well as PDNV in high-risk patients would be TIVA combined with a long-acting anti-emetic such as dolasetron or ondansetron (as well as dexamethasone for even better combined effect, though this is outside the scope of this discussion). The addition of ondansetron to TIVA has been shown to improve the anti-emetic properties of TIVA[13].

This study challenges the distinction between PONV and PDNV, one that is not well-differentiated in current studies. More research focusing on the benefits of TIVA combined with other anti-emetics focusing on the post-discharge period would be beneficial.

APPLICABILITY OF THE PAPER

Given that nausea and vomiting is a primary concern to patients and anesthesiologists alike, this paper is very significant to my learning. I've learned which patients are important to identify as high-risk for PONV, as well as effective strategies at preventing this complication. While TIVA alone offers benefit in this regard compared to inhalational anesthesia, the addition of dolasetron in this particular study was able to offset the difference. Therefore, when considering TIVA for a high-risk patient, it is important to add a second anti-emetic agent. This is done at our center with ondansetron and dexamethasone. Compared to dolasetron, ondansetron has more extensive evidence in preventing PONV and especially PDNV[11,13].

Finally, this study brings to my attention the important distinction of PDNV. This is a complication that is easy for anesthesiologists to ignore, given the lack of patient follow-up and reporting after discharge. In my practice I will ensure high-risk patients have been provided with appropriate prophylaxis to prevent this issue, and are educated with regards to their expectations once discharged and home management of PDNV.

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Critical Appraisal:

By: **Sarah Maxwell**, MD, PGY-1, Queen's Anesthesiology & Perioperative Medicine

Publication title: "***Effects of neostigmine reversal of nondepolarizing neuromuscular blocking agents on postoperative respiratory outcomes: a prospective study.***"

Authors: ***Sasaki N, Meyer MJ, Malviya SA, Stanislaus AB, MacDonald T, Doran ME, Igumenshcheva A, Hoang AH, Eikermann M.***

Anesthesiology. 2014 Nov;121(5):959-68.

Introduction

Non-depolarizing neuromuscular blockers (ND-NMB) are used during general anesthesia to produce muscle paralysis, which facilitates tracheal intubation and optimizes the surgical field. Acetylcholinesterase inhibitors such as neostigmine can reverse ND-NMB and prevent residual post-operative paralysis. However, ND-NMBs are associated with post-operative respiratory failure that is not necessarily reversed with neostigmine and neostigmine use may in fact produce a higher incidence of post-operative oxygen desaturation (Meyer et al., 2013). Intra-operative monitoring of neuromuscular transmission can detect residual paralysis and has previously been shown to have a protective effect against hypoxia in patients receiving neostigmine.

This study evaluates 2 null hypotheses and includes a post hoc analysis as well which include:
i. neostigmine reversal (independent of measured residual neuromuscular blockade) has no effect on oxygenation (primary outcome). This was measured using the ratio of peripheral oxygen saturation to the fraction of inspired oxygen (S/F).
ii. neostigmine reversal has no effect on postoperative hospital length of stay, hospital resource use, or the incidence of post-operative atelectasis (secondary outcome).
iii. high-dose neostigmine is associated with increased respiratory morbidity (post-hoc)
iv. the absence of appropriate neuromuscular monitoring before administering. 2y7 neostigmine would explain part of the association between neostigmine reversal and postoperative respiratory complications.

Neuromuscular monitoring can provide a qualitative and quantitative method of detecting residual muscle paralysis that could guide the appropriate use and dosage of neostigmine in order to avoid unnecessary adverse effects of the drug.

Methodology

This is a single center, prospective, observational, observer-blinded study. The PACU staff assessing the PACU train of four ratio (T4/T1) was blinded to all intra-operative information except whether patients received a ND-NMB. In addition, staff that retrieved clinical data from the hospital database had no knowledge of the intra-operative course. The primary outcome (oxygenation) is an objective measure where blinding is less critical than it would be with subjective measures.

This study was approved by the hospital ethics board and was conducted on humans where only standard clinical methods were used to obtain the results. Written, informed consent was waived given the observational nature of the study.

Inclusion and exclusion:

The cohort of patients were enrolled upon admission to the post anesthetic care unit (PACU) and were included in the study if they received general anesthesia and were administered a ND-NMB. The authors stated enrollment was 'dependent on the limited availability of study staff' and did not elaborate on whether all potential subjects were included. It would be interesting to know the capture rate of subjects in this study and whether those enrolled differed from those who were not to determine if there is any selection bias.

Patients were excluded if they were less than 18 years old, directly transferred to the intensive care unit or if their surgical procedures prevented T4/T1 measurement using ulnar nerve stimulation. Patients were also excluded if they were re-intubated for a second surgical procedure. These exclusion criteria help focus the study question on adult patients and eliminate potential confounders such as requiring an ICU bed post-op (i.e., patient may be intubated, have significant co-morbidities which may confound the primary outcome etc.).

Sample size:

The authors go into detail explaining sample size calculations. Their estimation was calculated using the primary end point, (S/F ratio), and a neostigmine

reversal rate of 63% based on their preliminary data (Grosse-Sundrup et al., 2012), and an S/F difference of 10 between patients receiving vs. not receiving neostigmine. For a corresponding power of 0.8 and an alpha error value of 0.05 the sample size calculated 3000 patients. The study enrolled 3000 patients and 2893 were used in the final analysis due to missing data points and therefore 96.4% of enrolled patients were analyzed. However, 77.7% received neostigmine (compared to the estimated 63%).

Generalizability to our institution:

The study reported one out of five patients who received ND-NMB did not have a single train of four count recorded. At our institution, neostigmine is commonly used to reverse ND-NMB as well. Intra-operative qualitative peripheral nerve stimulators are widely available in each operating room and while these are generally used on most patients (based on observation) there may be the occasional case, which does not contrary to expert recommendations (Brull et al., 2010). Similar to this study, it is likely our institution under uses neuromuscular monitoring to some degree as well and quantitative data in this area would be an interesting quality improvement study for the future. In addition, our institution has a more limited supply of quantitative peripheral nerve stimulators available. Wider availability of these could help with routine utilization as they can automatically calculate T4/T1 intra-operatively as an additional vital sign (similarly to non-invasive blood pressure recordings every 5 minutes).

Experimental protocol and validity:

The description of diagnosing residual neuromuscular blockade is well-described using acceleromyography of the adductor pollicis muscle using a quantitative TOF monitor. The study elaborates to describe the proper placement of the electrodes and the current they used to provide maximal muscle response which would help in the reproducibility of the study.

Calculation the TOF ratio (T4/T1) was performed quantitatively using the TOF-watch SX. The authors took steps to ensure the T4/T1 value was reliable - they applied two consecutive TOF stimuli in the PACU and if the difference was <5% the mean of the values was used. If the difference was >5%, TOF were measured continuously until two values differed by <5%. This was a method previously described (Butterly et al., 2010).

The study used 30mA to obtain maximum muscle response during the TOF stimulation, while supramaximal stimulation at 50mA is recommended (Fuchs-Buder et al., 2007). However, the authors address this discrepancy and justify this as it is in accordance with their center's clinical practice as it maximizes precision and minimizes patient discomfort.

Residual neuromuscular blockade was determined to be present if the T4/T1 at PACU admission was <0.9. This value was chosen because of prior literature associating it with respiratory morbidity (Kopman et al., 1997, Eriksson et al., 1997).

Oxygenation in PACU was assessed by the ratio of oxygen saturation (from pulse oximetry) to the fraction of inspired oxygen (S/F) as this ratio has previously been correlated to arterial partial pressure of oxygen to fraction of inspired oxygen ratio (Catterall et al., 1967). The author states the fraction of inspired oxygen was calculated based on oxygen flow rate documented from the PACU nursing flow sheet. However, the authors do not mention the oxygen device used (i.e., nasal prongs vs. simple mask vs. non-rebreathing mask) as the type of device would have important implications on determining the fraction of inspired oxygen for a given flow rate. In addition, an oxygen saturation of 100% does not correlate as well to specific pO2 (i.e. could relate to a p02 value anywhere between 90-500).

Secondary and exploratory outcomes included other objective measures such as mortality, hospital length of stay, unplanned post-operative ICU admission, re-intubation rates and PACU discharge time. Atelectasis, pulmonary edema and pneumonia were outcomes recorded from hospital billing data and these outcomes may be more influenced by the clinical judgment of the treating physician and possibly under-diagnosed or under documented as well.

Drug and equipment use:

Overall the authors document the specific equipment used well and document the type, dosage and time of each drug used. Because a wide variety of ND-NMB were used, the authors converted all doses to ED95 and included the conversion factors that were used based on previous literature (Naguib et al., 2005). For a more focused clinical question and to eliminate potential confounders further, the authors could have examined a single ND-NMB (i.e. rocuronium) but this would also have made the results less generalizable.

The authors go into detail explaining the statistical test and reason for choosing the test when examining the study variables. For instance, ordinal regression was appropriately used to analyze S/F ratio on length of stay as these variables have values which exist on an arbitrary scale where only the relative ordering between the values is significant (i.e., S/F ratio of 200 vs. 300). The authors also listed confounders that were controlled for in different tests.

Results

The authors describe the primary, secondary and exploratory outcomes concisely and list appropriate p-values, confidence intervals and clearly display significant results using bar and box plots (figure 1 -3).

Characteristics of patients receiving

neostigmine were compared to those who did not. There were no difference in postoperative residual neuromuscular blockade between patients who received neostigmine and those who did not. Other clinical characteristics (please refer to table 1) such as age, sex, BMI, opioid administration, type of inhalation anesthetic or ND-NMB did not differ significantly between the two groups. However, neostigmine was used more frequently in patients with high ND-NMB dose, lower terminal TOF count, high ASA score, short procedure duration, and certain surgical procedures (abdominal, thoracic or genitourological). This data is outlined extensively in table 1.

Discussion

There was no difference in oxygenation in patients receiving neostigmine reversal irrespective of residual neuromuscular blockade (the primary outcome). Given this, the overall study is a negative study. The secondary findings include that although neostigmine reversal did not affect post-operative oxygenation, it was associated with increased atelectasis. Specifically, high-dose neostigmine was a strong predictor of atelectasis and prolonged hospital stay. However the difference in length of hospital stay reported is 2.9 vs. 2.8 days which may not be clinically significant. In addition this may be affected by numerous confounders not accounted for in the study such as the time different teams round in the morning, what time the patient's ride comes, the time discharge orders are written etc. Equally as important, the confidence intervals overlap on these values. Overall, unwarranted neostigmine use was associated with respiratory morbidity. These secondary findings can be used for asking further research questions and to plan future studies.

The study mentions their previous work where neostigmine reversal did not decrease the incidence of postoperative respiratory failure and found that it was in fact associated with a higher incidence of post-operative oxygen desaturation. It is possible that these observed effects are due to confounders such as a deep motor blocks which would not effectively be reversed with neostigmine. This study better addresses this by taking into account neuromuscular transmission monitoring to guide neostigmine use.

Applicability of the paper

This paper addressed an issue that is common in the practice of anesthesia. Use of ND-NMB are necessary for a range of anesthetic and surgical indications but carry with them the chance of residual paralysis and may need to be reversed. This paper attempted to highlight that reversal with neostigmine is not necessarily a benign process and its use should be guided by neuromuscular transmission monitoring. However they did not find any difference in oxygenation (primary outcome). Given that peripheral nerve stimulators are widely available and in conjunction with expert recommendation and the findings of this study, clinical practice should routinely use them. Although this is an observational study, the clinical question would be difficult to address using a randomized controlled trial. Further studies in this area would strengthen these results.

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Critical Appraisal:

By: **Samuel Walsh**, MD, PGY 1, Queen's Anesthesiology and Perioperative Medicine

Publication Title: "***Randomized prospective trial comparing two supraglottic airway devices: i-gel™ and LMA-Supreme™ in paralyzed patients***"

Authors: ***Joly N, Poulin L-P, Tanoubi I, Drolet P, Donati F, St-Pierre P.***

Can J Anesth. 2014;61:794–800.

Introduction:
"Cannot intubate, cannot ventilate" is one of the most stressful emergency situations in anesthesia. In the past, a cricothyrotomy was the only way to deal with such an emergency; supraglottic airway devices, or SADs, have since become a valuable tool. Periglottic airways facilitate ventilation by creating a seal around the glottic opening allowing for blind placement. In 1983, the LMA became the first supraglottic airway sold commercially(1). Since then, this product has become so ubiquitous that, much like Kleenex and tissues, many use the terms LMA and SAD interchangeably. Several companies have made similar products seeking to improve on the classic design, with newer models featuring a gastric drainage port and improved seal. Performance enhancements have allowed SADs to transition from emergency airways to viable alternatives to endotracheal intubations in select cases and patients(1). In the age of evidence-based medicine and given the economic realities of our health care system, having objective numbers to compare medical devices is of great value. This study compares the performance of two modern SADs: the i-gel and the LMA Supreme. The authors of the study are practicing anesthetists from Montreal hospitals affiliated with the University of Montreal. They have no declared conflicts of interest and the study was carried out in Canada.

Companies that produce medical devices are constantly updating and improving their products by adding new features. And even with the glossy brochures and "lunch and learn" sessions hosted by product reps, it can be difficult to keep up. Determining if the latest "new and improved" model actually improves patient outcome, and justifies the new and improved price tag, necessitates impartial studies carried out in real patient populations. Unlike picking a new electric toothbrush, however, the choices we make regarding which devices to carry and use in the OR can have significant implications on patient outcomes.
A Medline search for English studies on humans comparing i-gel and LMA models produced 36 results. Several studies focus on non-clinical scenarios, such as novices placing SGAs in a simulation setting or assessing the fit of the device using imaging or cadavers. 10 compared clinical performance with blind placement in adults. The studies ranged in size from 50 to one 100 subjects, differing in their use of paralyzed and spontaneously breathing patients and the types of surgery. Overall, most studies agree that leak pressure among new generation SGAs is similar, however there is disagreement regarding time of insertion, rate of complications, and ease of use(2–8). This study is unique in that it uses a large and much more generalizable cohort. It tests the hypothesis that either the i-gel or LMA Supreme is superior with a primary outcome of leak pressure. Secondary outcomes were failure rate, positioning of device, side effects, and speed of insertion. Given the widespread use of SGAs as rescue airways and alternative airways for scheduled surgery, there are several criteria that ought to be used when evaluating which device is superior. The ability to ventilate measured by leak pressure is important when using the device as an alternative airway. The speed of insertion and failure rate is important during routine surgery and especially in emergency situations.

Methodology:
This study was a prospective randomized unblinded comparison study. For obvious reasons, blinding was not possible, however the researcher placing the SGA did not learn which device would be used device until induction and the procedure up to that point was identical in both groups. There was no control group since the study simply compared two devices.
The subjects were adults with an ASA class of I-III who were scheduled to undergo orthopedic, plastic, urologic or general surgery in the supine or lithotomy position. Exclusion criteria included BMI over 35, symptomatic GERD, palate or facial deformity or a planned surgery of more than four hours. With the exception of the BMI limit, these exclusion criteria closely match the relative contraindications for SGA use in general practice. They also provided a sample that is extremely similar to the population found in our practice, including nationality. Not surprisingly, this study received approval from the institutional review board as both devices are already approved for use in general practice. The use of human subjects provides valuable data about the function of these devices that cannot be gathered as accurately using cadavers or other alternatives. This study is ethically

sound as the patients all received an anesthetic given in a safe and approved manor. Since treatment involved devices already in common use, there was no undue influence exerted on subjects to participate. The study's power was calculated for the primary outcome of cuff leak; researchers acknowledged it might be underpowered to detect differences in complication rates and other secondary outcomes.

Patients were randomized to either the i-gel group or the LMA group using a web-based randomizer. A research assistant then wrote the name of the each patient's assigned device in a sealed envelope, which was opened just prior to induction. The device was sized according to the manufacturers' weight recommendations. Patients were preoxygenated for 3 minutes before being induced with 1 to 3 mcg/kg of fentanyl and 1 to 3.5 mg/kg of propofol. The patient was then paralyzed with an unreported amount of a paralytic agent that was "left to the discretion of the anesthetist". The wide dosing range of induction agents combined with a lack of standardization of the paralytic would make exact replication of the study protocol difficult. It is important to note that anesthetists were prohibited from adjusting their doses of induction agent with regard to patient factors, introducing additional risk of harm given the wide range of patients recruited. After induction, device placement was attempted and, if unsuccessful, repeated once before attempting to use the second device or abandoning the SGA altogether and intubating the patient.

The time to placement was measured from mouth opening to the establishment of effective ventilation (as defined by a square capnograph tracing) and recorded by a research assistant. If successfully placed, the peak pressure required to provide tidal volumes was 8ml/kg. Leak pressure was then checked by closing the expiratory valve while maintaining the fresh gas flow at 3 liters per minute. The pressure at which the system reached equilibrium up to 40 centimeters of water was recorded. This procedure efficiently provided the data needed to test the hypothesis without significantly affecting the patient's surgery. Of note, the experimental procedure closely matches current clinical practice the only exception is that many anesthetists forgo the use of paralytics when using SGAs.

Correct positioning of the SGA was assessed through the ventilation channel with a fiberscope. The study utilized a positioning scale that had been adapted from an earlier study by Brimacome et al. Position was assigned a score of 1 to 4, with 4 being full view of only the vocal cords and 1 being a view of only the epiglottis in spite of adequate ventilation. After surgery was complete, patients were brought to the recovery room and interviewed. Patients were asked to rate dysphagia, dysphonia, and cough on a 4-point Likert scale. Time to ventilation data and leak pressure data were analyzed using a two-tail test. Pain scores were analyzed with a Mann-Whitney U test and Chi Square trends were used for the number of insertion attempts and glottic visualization scores. Each of these tests are well-established means of proving or disproving the null hypothesis and were appropriately selected for the types of data generated.

Results:

After randomization the groups were very similar, the characteristics are found in the table below.

	i-gel group	LMA Supreme group
Average Age	50	50
Average Height (m)	1.68	1.67
Average Weight (kg)	72	71
Average BMI	26	26
Gender (M/F)	17/33	13/37

With the exception of the distribution of men and women, the characteristics of the groups were balanced, although it would have been helpful to know the average mouth opening of each group. Four subjects from each group were removed from analysis for failing to receive their intended intervention. Two subjects from the i-gel group two were managed with the LMA Supreme and two had to be intubated. Similarly, three subjects from the LMA Supreme group were managed with the i-gel and one was intubated. The authors mentioned crossover between devices in the methods section of the paper, however no crossover analysis was included. It would be helpful to know whether these difficult patients would have changed the average time to ventilation for each device. Notably, five patients from the i-gel group and two from the LMA Supreme group were not interviewed after surgery; their data was excluded from adverse effect data but included in all other measurements and analysis. Overall the data is well presented in easy to read charts and graphs.

Discussion:

The study found that both devices preform very similarly. The major difference noted by the authors was slightly faster insertion of the i-gel and improved visualization though the ventilation port. The leak pressures of the i-gel and LMA were 23cm H2O and 21cm H2O, respectively. There was no statistically significant difference in the peak pressure required to generate a tidal volume of 8ml/kg, the success rate for each device, or the rate of side effects.

The i-gel took less time to insert with an average time of 19 seconds compared to 27 seconds for the LMA with a p value of 0.003. The i-gel also provided better visualization of the glottic opening. Visualization of the glottis was used in this study as a surrogate for the likelihood of success in intubating through the SGA. In 37 of the 46 patients in the i-gel group, a grade 4 view showing only the vocal cords was obtained. Six views

showed cords and posterior epiglottis, two showed anterior epiglottis and cords, and one showed only epiglottis. In comparison, the LMA had 22 grade 4 views, 13 grade 3, 8 grade 2, and one grade 1 view. This difference carried a p value of 0.01; statistically significant further study would be required to confirm whether this translates into a clinically significant difference when intubating through the SGA.

The authors' conclusions are readily apparent upon reviewing the data. They attribute the increased time to insert the LMA to the time required to inflate the cuff. With the exception of insertion time and visualization, the data supports the null hypothesis and implies that there is no statistical difference between the two devices. It is interesting to note that crossover between SGAs was successful five times out of 8, which suggests that the alternative shape may have been better suited to different patient's anatomy.

There doesn't appear to be an alternative interpretation of the data and the findings of this study are in keeping with most of the current literature(2–8). The conclusion that the two devices function equally well is not surprising, since each represents many years of refinement. This study represents one of the larger sample sizes and offers excellent generalizability to several surgical specialties. One limitation of this study is the lack of standardization of paralytic medication, which limits both the generalizability and reproducibility of the study. In addition, the use of a paralytic limits the ability to generalize the results to unparalyzed patients (a common population for SGAs). As noted above, the sample size may have been too small to detect differences in more subtle areas.

Reading this paper has eliminated a personal bias I inherited from anecdotal evidence about the efficacy of the i-gel SGA. Objectively, both devices provide similar performance when appropriately sized in appropriate patients. This stresses the importance of proper research design using objective measures. One specific area of my practice that this paper may change is my choice of SGAs in emergency situations, specifically. When using an SGA in routine care there is little advantage to the slightly increased speed of placement. And routine intubations through an SGA are also quite rare. However in an emergency situation the time taken to attach a syringe and inflate the cuff could be very important, as could the increased chance of successful blind intubation. As such, I would likely chose the i-gel in an emergency situation for its faster and simpler insertion process. A study to assess the clinical relevance of the improved glottic view would be a logical next step in testing the i-gel. Additional studies on varied populations could strengthen the data and provide improved generalizability for other populations.

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