

# EMETOGENICITY-RISK PROCEDURES IN SAME DAY SURGERY CENTER OF AN ACADEMIC UNIVERSITY HOSPITAL IN UNITED STATES: A RETROSPECTIVE COST-AUDIT OF POSTOPERATIVE NAUSEA VOMITING MANAGEMENT

DEEPAK GUPTA\* AND HALIM HABER\*

## Abstract

**Background:** Despite the variable results of published studies, it is imperative for ambulatory surgery centers to self-audit local cost-implications for post-operative nausea and vomiting (PONV) management.

**Objective:** Our retrospective cost-audit assessed if there were comparative peri-anesthesia care cost-trends among patients who had undergone Low-Emetogenicity-Risk Procedures (LERP), Moderate-Emetogenicity-Risk Procedures (MERP) and Severe-Emetogenicity-Risk Procedures (SERP).

**Methods:** This study was a review of Same Day Surgery Center practices in an academic university hospital setting during a three-year period (2010-2012). The patient lists were accessed from CIS and CITRIX App Bar for time audit and OR (operating room) schedule reports. Subsequently, OR pharmacy department ran a search for peri-operative anti-emetics and opioids that were billed for the patients at Same Day Surgery Center for the review period. The primary outcomes were the comparative costs/charges of these medications and comparative durations/charges for these patients' stay in the post-anesthesia care unit (PACU). Secondary outcomes analyzed in the study included peri-anesthesia durations.

**Results:** A total of 8,657 patient records were analyzed. Almost all analyzed variables revealed statistically significant inter-variable positive correlations. The patients' age was significantly ( $P < 0.001$ ) different among LERP/MERP/SERP patients (LERP:  $48.8 \pm 14.7$  years; MERP:  $61.8 \pm 14.6$  years; SERP:  $51.3 \pm 14.5$  years). In regards to primary and secondary outcomes, the statistical significant differences among LERP/MERP/SERP patients (after correcting for both patients' age as well as patients' sex) were only achieved for preoperative times ( $P = 0.002$ ; Power = 0.9), operating room recovery times ( $P = 0.003$ ; Power = 0.9), PACU stay times ( $P < 0.001$ ; Power = 1.0), and PACU charges ( $P < 0.001$ ; Power = 1.0).

**Conclusion:** PACU stay times and PACU charges were significantly higher in patients who had undergone SERP as compared to patients who had undergone LERP or MERP at our Same Day Surgery Center.

---

\* MD.

Affiliation: Department of Anesthesiology, Wayne State University, Detroit, Michigan, United States.

**Corresponding author:** Halim Haber, MD. Clinical Associate Professor, Anesthesiology, Wayne State University/Detroit Medical Center, Box No 162, 3990 John R, Detroit, MI 48201, United States, Tel: 1-313-745-7233, Fax: 1-313-993-3889. E-mail: hhaber@med.wayne.edu

## Introduction

Prevention of postoperative nausea and vomiting (PONV) is a highly prioritized expectation among the patients who present for same day surgeries at ambulatory surgery centers<sup>1-3</sup>. Breast surgeries and strabismus surgeries are highly emetogenic surgical procedures<sup>4</sup> and are being increasingly performed as same day surgeries. Therefore, PONV management (including pre-emptive anti-emesis) is a warranted tool in the arsenal of anesthesia care personnel who practice anesthesia at ambulatory surgery centers. There have been studies<sup>5-7</sup> investigating cost-related efficacies for various anti-emetics regimens. Despite the variable results of published studies, it is imperative for ambulatory surgery centers to self-audit their institutional performance to both increase PONV prevention rates and improve their patients' PONV treatments. This self-auditing should also place particular emphasis on periodic assessment of local cost-implications for PONV management.

In this study, our retrospective cost-audit assessed if there were comparative peri-anesthesia care cost-trends among patients who had undergone Low-Emetogenicity-Risk Procedures (LERP), Moderate-Emetogenicity-Risk Procedures (MERP) and Severe-Emetogenicity-Risk Procedures (SERP). This study was a review of Same Day Surgery Center practices in an academic university hospital setting.

## Methods

After institutional review board approval for retrospective audit with waived consent, medical records for patients aged 18 years and above who presented to Same Day Surgery Center for their surgeries during a three-year period (2010-2012), were reviewed. The patient lists were accessed from CIS and CITRIX App Bar for time audit and OR (operating room) schedule reports. Subsequently, OR pharmacy department ran a search for the common anti-emetics that were billed for the patients at Same Day Surgery Center for the review period. The reported anti-emetics included ondansetron, metoclopramide, dexamethasone, diphenhydramine, scopolamine, promethazine, prochlorperazine and droperidol.

Simultaneous reports were also run for peri-operative opioids as a potential confounding factor for PONV. The primary outcomes were the comparative costs/charges of these medications and comparative durations/charges for these patients' stay in the post-anesthesia care unit (PACU). Patients' surgical procedures were post-hoc-categorized as LERP, MERP and SERP (Appendix A). Secondary outcomes analyzed in the study included peri-anesthesia durations, such as pre-operative times (in the pre-operative holding area), pre-incision times (operating room entry to surgical incision), surgery times (skin incision to skin closure) and operating room recovery times (skin closure to operating room exit).

For statistical analysis, correlations between continuous variables were analyzed using Pearson correlation coefficients. Comparisons of continuous variables were analyzed using appropriate ANOVA tests. Categorical proportions were analyzed using the Chi Square test (Fisher Exact Tests). The final analysis for significance among LERP/MERP/SERP patients was performed based on corrections for confounding factors namely patients' age as a covariate, and patients' sex as independent variable for the compared outcomes/variables. P values of <0.05 were considered as statistically significant.

## Results

As shown in CONSORT diagram (Fig. 1), a total of 8,657 patient records were analyzed. From these patients (n = 8657), almost all of the ten analyzed variables (Table 1) revealed statistically significant inter-variable positive correlations. The only non-significant correlations were charges for parenteral opioids, oral opioids and combined drugs not correlating with pre-operative times; and charges for oral opioids and parenteral anti-emetics not correlating with charges for parenteral opioids. The correlation coefficient for PACU stay times and PACU charges was almost 1 (= +0.99) as PACU charges were directly calculated from PACU stay times as per 219 USD for first 30 minutes and 179 USD for each additional 30 minutes. Similarly the correlation coefficient for parenteral opioids charges and combined drugs charges (sums of charges for parenteral opioids, oral opioids

*Appendix A*

*Lists of Same Day Surgery Center's surgical procedures that have been post-hoc-categorized according to their emetogenic potential*

<b>Low-Emetogenicity-Risk Procedures (LERP)</b>	<b>Moderate-Emetogenicity-Risk Procedures (MERP)</b>	<b>Severe-Emetogenicity-Risk Procedures (SERP)</b>
Amputation Finger(s)	Abdominoplasty	Biopsy Breast
Amputation Hand	Biopsy Conjunctiva	Biopsy Breast Excisional
Arthrodesis Carpal/Metacarpal	Biopsy Lacrimal Gland	Biopsy Breast w/Needle Localization
Arthroplasty Metacarpal	Biopsy LEEP	Capsulectomy Breast
Arthroplasty Thumb	Biopsy Testes	Cholecystectomy Laparoscopic
Biopsy Chest Wall	Bleb Needling	Excision Breast Mass
Biopsy Lymph Node	Blepharoplasty (OPH)	Excision Breast Mass Bilateral
Biopsy Lymph Node Axillary	Blepharoplasty (PLA)	Excision Breast Wide w/Sentinal Node Bx
Biopsy Temporal Artery	Cannulation Tear Duct	Eye Muscle Surgery
Block Celiac Plexus	Chelation Band Keratopathy	Insert Breast Expander
Block Celiac Plexus Neurolytic w/ Alcohol	Cryosurgery Eye	Insertion Skin/Tissue Expander
Block Celiac Plexus Radiofrequency	Cutler Beard Eye Stage 2	Ligation Tubal Laparoscopic
Block Epidural	D&C	Lumpectomy Breast
Block Epidural Caudal	D&C Hysteroscopy	Mammoplasty Augmentation
Block Facet	D&C Suction	Mammoplasty Reduction
Block Ganglion	Dacryocystorhinostomy (OPH)	Mastectomy
Block Nerve	Dacryocystorhinostomy Endo (OPH)	Mastectomy Bilateral
Block Nerve Facet	Dacryocystorhinostomy External (OPH)	Mastectomy Modified Radical
Block Nerve Selective	Decompression Orbit	Mastectomy Partial
Block Superior Hypogastric Neurolytic	Dilation Probe Irrigate Tear Duct	Mastectomy Radical
Block Sympathetic Lumbar	Drainage Choroidal Effusion	Mastopexy
Block/Injection Joint Lumbar Facet	DSEK	Recession-Resection Eye Muscle
Bronchoscopy w/EBUS	Enucleation	Reconstruct Breast
Bunionectomy	Evisceration Eye	Reconstruct Breast w/Expander
Capsulotomy	Exam Under Anesthesia Eye	Reconstruct Nipple Areolar
Closed Reduction Finger	Excision Abdominal Mass	Repair Eye Muscle Laceration
Closed Reduction Finger	Excision Abdominal Mass	Repair Eye Muscle Laceration
Closed Reduction Finger Perc Pinning	Excision Chalazion	Revision Breast Scar
Closed Reduction Hand	Excision Facial/Head Mass	
Closed Reduction Metacarpal Perc Pinning	Excision Orbital Dermoid	
Closed Reduction Wrist Perc Pinning	Excision Pterygium	
Cystectomy Pilonidal	Excision w/Biopsy Neck Mass/Lesion	
Debridement Decubitus Ulcer	Extcap Cataract Extract w/IOL Implant	
Dissection Axillary Node	Extcap Cataract Extract w/IOL Implant and Trabeculectomy	

<b>Low-Emetogenicity-Risk Procedures (LERP)</b>	<b>Moderate-Emetogenicity-Risk Procedures (MERP)</b>	<b>Severe-Emetogenicity-Risk Procedures (SERP)</b>
Dissection Lymph Node	Flap Latissimus	
Exam Under Anesthesia Rectal/Anal	Flap Rotation	
Excision Axillary Mass	Flap Tram	
Excision Back Mass	Ganciclovir Implant	
Excision Bone Cyst	Graft Dermal Orbit	
Excision Buttock Mass	Graft Skin Full Thickness (PLA)	
Excision Ganglion Cyst	Graft Skin Split Thickness (PLA)	
Excision Ganglion Cyst (ORT)	Herniorrhaphy Umbilical	
Excision Groin Mass	Herniorrhaphy Ventral	
Excision Hidradenitis	Hydrocelectomy	
Excision Hip Mass	Hysteroscopy	
Excision Keloid	Injection Silicone Oil	
Excision Lesion	Insert Orbital Implant	
Excision Limb Mass	Insertion Ahmed Valve	
Excision Mass Upper Limb	Insertion Crawford Tube	
Excision Rectal/Anal Mass	Insertion Implant Lens Secondary	
Excision Scar	Insertion Molteno Implant	
Excision Shoulder Mass	Insertion Radioactive Plaques	
Exostectomy	Insertion Retisert Implant	
Fistulectomy Anal	Insertion Valve w/Scleral Graft	
Fistulectomy Anal	Insertion Valve w/Scleral Graft	
Flap Cross Finger	Iridectomy	
Fulguration Wart(s)	Laser Photocoagulation	
Fusion Hand/Wrist	Lensectomy/Vitrectomy	
Graft Bone	Ligation Spermatic Vein	
Harvest Bone Marrow	Lipectomy	
Hemorrhoidectomy	Liposuction	
Herniorrhaphy	Liposuction Abdomen	
Herniorrhaphy Inguinal	Marsupilization Bartholin Cyst	
Incision & Drainage	Orbitotomy	
Incision and Drainage	Orchiectomy	
Injection Caudal Epidural	Phacoemulsification Cataract Implant	
Insert Cath Epidural Tunneled Titanium	Photocoagulation Pan Retinal	
Insert Catheter Epidural	Reconstruct Canthus	
Insert Catheter Hemodialysis	Reconstruct Ear	
Insert Catheter/Port	Reconstruct Eyelid	
Insert Pump Pain	Reconstruction Orbital w/Graft	
Irrigate & Debride (ORT)	Remove Corneal Sutures	
ORIF Hand	Remove Frgn Body Intraocular	
ORIF Metacarpal/Carpal	Remove Frgn Body Orbit	

Low-Emetogenicity-Risk Procedures (LERP)	Moderate-Emetogenicity-Risk Procedures (MERP)	Severe-Emetogenicity-Risk Procedures (SERP)
ORIF Thumb	Remove Radioactive Plaques	
ORIF Wrist	Remove Silicone Oil	
Release Carpal Tunnel (ORT)	Repair Anterior	
Release Trigger Thumb/Finger	Repair Canalicular Laceration	
Removal Foreign Body	Repair Corneal Laceration	
Remove Catheter/Port	Repair Dehiscence Eye Wound	
Remove K-Wire	Repair Ectropion	
Repair Artery Radial	Repair Entropion	
Repair Laceration Tendon/Artery/Nerve (PLA)	Repair Laceration Lid (PLA)	
Repair Mallet Finger	Repair Orbital Fracture	
Repair Mallet Finger	Repair Orbital Fracture	
Revision Amputation Finger(s)	Repair Ptosis	
Tenolysis	Repair Retinal Detachment	
Transposition Ulnar Nerve	Repair Ruptured Globe	
	Reposition Lens	
	Revision Ahmed Valve	
	Revision Bleb	
	Scleral Buckle	
	Septorhinoplasty	
	Shunt Express Eye	
	Tap Anterior Chamber	
	Tarsorrhaphy	
	Thyroidectomy (GEN)	
	Trabeculectomy	
	Transplant Cornea	
	Vasectomy (Surgical)	
	Vasovasostomy	
	Vitrectomy	
	Vitrectomy Anterior	
	Vitrectomy Pars Plana 20 Ga w/Scleral Buckle	
	Vitrectomy Pars Plana 20 Gauge	
	Vitrectomy Pars Plana 23 Ga w/Scleral Buckle	
	Vitrectomy Pars Plana 23 Gauge	
	Vitrectomy Pars Plana 25 Ga	
	Vitrectomy Pars Plana 25 Ga w/Scleral Buckle	
	Vitreous Washout	

and parenteral anti-emetics) was almost 1 ( $= +0.98$ ) as oral opioids charges and parenteral anti-emetics charges nullified each other's effects on correlations by having opposite regression directions ( $-0.01$  and  $+0.01$  respectively). Even though medications databases indicated that 60% medications were administered by anesthesia providers (as indicated by Manual Charge) and 40% medications were administered by PACU nursing staff (as indicated by Charge on Administration), the administered medications could not be categorized whether they were given as prophylaxis or as rescue dosing for analgesia and/or anti-emesis. One interesting observation was that the patients' medication charges were multiples of  $x$ -times factor to hospital's medication costs [Median  $x$ : 10 (Range  $x$ : 9-124); Mode  $x$ : 10; Mean  $x$  ( $\pm$  SD): 18 ( $\pm$  22)].

Fig. 1  
CONSORT Diagram

COMPLEMENTARY DATABASES (Anesthesiology/Pharmacy)	Patients' Lists Accessed from Procedures Database (Dept. of Anesthesiology)	Patients' Lists Accessed from Medications Database (Dept. of Pharmacy)
<b>Total Patients Records Available</b>	<b>12552</b>	<b>9340</b>
Deleted Records as Missing Records in the Complementary Database	3733	549
Deleted Records as Multiple Procedures during Single Hospital Admission	38	10
Deleted Records as Age below 18 years or Unknown	73	73
Deleted Records as Multiple Day Medication administrations beyond Surgery's Date	31	31
Deleted Records as Incomplete Peri-Anesthesia Time Records	20	20
<b>Final Patient Records Analyzed</b>	<b>8657</b>	<b>8657</b>

After categorizing the patient records among LERP, MERP and SERP based on the emetogenicity of the surgical procedures, the patients' age was significantly ( $P < 0.001$ ) different among these three groups (LERP:  $48.8 \pm 14.7$  years; MERP:  $61.8 \pm 14.6$

years; SERP:  $51.3 \pm 14.5$  years). Therefore, when ANOVA analysis was performed for the variables with patients' sex and emetogenic risk category of surgical procedures as two independent factors, patients' age was required to be analyzed as a covariate for this ANOVA analysis. Hence, even though the means table for this analysis of variables (Table 2) appear to have clinically significant differences, the statistical significant differences among LERP, MERP and SERP categories (after correcting for both patients' age as well as patients' sex) were only achieved for preoperative times ( $P = 0.002$ ; Power = 0.9), operating room recovery times ( $P = 0.003$ ; Power = 0.9), PACU stay times ( $P < 0.001$ ; Power = 1.0), and PACU charges ( $P < 0.001$ ; Power = 1.0). Among LERP/MERP/SERP patients, one reason for the absence of statistical significance for other variables (preincision times, surgery times, parenteral opioid charges, oral opioid charges, parenteral anti-emetic charges and combined drugs charges) was low statistical power (1-beta) for those variables (Power  $< 0.6$ ; after patients' age and patients' sex correction).

## Discussion

In the Society for Ambulatory Anesthesia PONV Guidelines (2007)<sup>8</sup>, ten procedures were documented as risk factors for PONV in adults. For our center's retrospective cost-audit, we sub-categorized the first four procedures (laparoscopy, laparotomy, breast and strabismus) as SERP and the remaining six procedures (plastic, maxillofacial, gynecological, abdominal, neurologic, ophthalmologic and urologic) as MERP. Although Society for Ambulatory Anesthesia PONV Guidelines (2014)<sup>9</sup> updated only cholecystectomy, gynecological and laparoscopic surgeries (compared to general surgeries) as emetogenic-risk procedures, we based our retrospective cost-audit on 2007 PONV Guidelines that were current standard practices for the studied three-year period (2010-2012).

As far as patients' medication charges being multiples of  $x$ -times factor to hospital's medication costs, these were based on local pharmacy charge masters<sup>10</sup> that take into account complex and varied interactions of medications' prices (in wholesale markets), categories and routes of administrations,

Table 1 (a)  
Pearson correlation coefficients among the recorded variables

n = 8657	Pre-Operative Time	Pre-Incision Time	Surgery Time	Operating Room Recovery Time	Post Anesthesia Care Unit Stay Time
Pre-Operative Time	Not Applicable	0.07**	0.09**	0.1**	0.13**
Pre-Incision Time	0.07**	Not Applicable	0.54**	0.4**	0.39**
Surgery Time	0.09**	0.54**	Not Applicable	0.37**	0.4**
Operating Room Recovery Time	0.1**	0.4**	0.37**	Not Applicable	0.44**
Post Anesthesia Care Unit Stay Time	0.13**	0.39**	0.4**	0.44**	Not Applicable
Post Anesthesia Care Unit Charges	0.13**	0.38**	0.39**	0.44**	0.99**
Parenteral Opioid Charges	0.01	0.16**	0.16**	0.1**	0.19**
Oral Opioid Charges	0.02	0.04**	0.03*	0.09**	0.12**
Parenteral Anti-Emetic Charges	0.04**	0.25**	0.33**	0.3**	0.21**
Combined Drugs Charges	0.02	0.21**	0.22**	0.15**	0.23**

\*\* : Correlation is significant <0.01 (2-tailed)

\* : Correlation is significant <0.05 (2-tailed)

Table 1 (b)  
Pearson correlation coefficients among the recorded variables

n = 8657	Post Anesthesia Care Unit Charges	Parenteral Opioid Charges	Oral Opioid Charges	Parenteral Anti-Emetic Charges	Combined Drugs Charges
Pre-Operative Time	0.13**	0.01	0.02	0.04**	0.02
Pre-Incision Time	0.38**	0.16**	0.04**	0.25**	0.21**
Surgery Time	0.39**	0.16**	0.03*	0.33**	0.22**
Operating Room Recovery Time	0.44**	0.1**	0.09**	0.3**	0.15**
Post Anesthesia Care Unit Stay Time	0.99**	0.19**	0.12**	0.21**	0.23**
Post Anesthesia Care Unit Charges	Not Applicable	0.18**	0.12**	0.2**	0.22**
Parenteral Opioid Charges	0.18**	Not Applicable	-0.01	0.01	0.98**
Oral Opioid Charges	0.12**	-0.01	Not Applicable	0.03*	0.04**
Parenteral Anti-Emetic Charges	0.2**	0.01	0.03*	Not Applicable	0.2**
Combined Drugs Charges	0.22**	0.98**	0.04**	0.2**	Not Applicable

\*\* : Correlation is significant <0.01 (2-tailed)

\* : Correlation is significant <0.05 (2-tailed)

Table 2

Various recorded variables for comparative analysis among three types of ambulatory surgeries based on their emetogenic potential

Recorded Variable	Low-Emetogenicity-Risk Procedures (LERP)		Moderate-Emetogenicity-Risk Procedures (MERP)		Severe-Emetogenicity-Risk Procedures (SERP)	
	<i>Females</i> (n = 895)	<i>Males</i> (n = 548)	<i>Females</i> (n = 3310)	<i>Males</i> (n = 2502)	<i>Females</i> (n = 1288)	<i>Males</i> (n = 114)
Pre-Operative Time (mins)	109.0 ± 52.7	105.8 ± 45.6	113.2 ± 48.2	113.9 ± 53.3	164.3 ± 96.1	114.4 ± 54.7
Pre-Incision Time (mins)	20.9 ± 9.8	21.0 ± 8.6	19.2 ± 7.2	20.8 ± 8.2	28.3 ± 9.4	21.5 ± 7.0
Surgery Time (mins)	40.2 ± 35.3	42.8 ± 32.3	42.4 ± 43.7	58.7 ± 59.4	101.3 ± 69.7	47.3 ± 33.0
Operating Room Recovery Time (mins)	5.3 ± 4.3	5.6 ± 4.5	3.9 ± 4.3	5.0 ± 5.6	9.4 ± 5.5	11.9 ± 5.8
Post-Anesthesia Care Unit Stay Time (mins)	99.6 ± 55.5	103.6 ± 61.8	66.0 ± 38.7	69.8 ± 39.6	135.5 ± 53.5	106.5 ± 44.5
Post-Anesthesia Care Unit Charges (USD)	720.4 ± 336.6	742.9 ± 370.3	524.9 ± 232.4	545.5 ± 238.3	934.9 ± 323.7	770.1 ± 275.8
Parenteral Opioids Charges (USD)	23.3 ± 102.2	27.1 ± 98.3	9.2 ± 13.8	10.2 ± 18.4	26.3 ± 29.9	16.8 ± 19.6
Oral Opioids Charges (USD)	0.8 ± 2.1	0.9 ± 2.3	0.6 ± 1.8	0.6 ± 1.8	1.0 ± 2.4	1.8 ± 4.0
Parenteral Anti-Emetics Charges (USD)	4.8 ± 8.0	4.1 ± 6.8	4.8 ± 8.2	6.6 ± 9.1	6.5 ± 9.4	9.5 ± 7.5
Combined Drugs Charges (USD)	28.9 ± 102.1	32.2 ± 98.3	14.6 ± 16.8	17.4 ± 21.5	33.8 ± 31.5	28.1 ± 19.7

and pharmacists' involvements in dispensing the charged medications. Additionally, there is a standard sophisticated mark-up tables that also account for any overhead costs involved.

From published reports, we reviewed two studies analyzing PONV costs. The first one was a retrospective database study (n = 3641) by Habib et al.<sup>11</sup> and the second one was a prospective study (n = 100) by Parra-Sanchez et al.<sup>12</sup> Habib et al.<sup>11</sup> reported prophylactic anti-emetics administration in 79% patients and rescue anti-emetics administration in 26% patients. Comparatively, in our study, 40% LERP patients, 41% MERP patients and 50% SERP patients

(42% overall patients; n = 8657) had received at least one parenteral anti-emetic agent during peri-anesthesia period (P <0.001); however, proportions of patients who had received at least one parenteral opioid during peri-anesthesia period were not significantly different (88% LERP patients, 89% MERP patients and 90% SERP patients; P = 0.17).

Parra-Sanchez et al.<sup>12</sup> reported significant PACU recovery costs differences (640 USD vs. 730 USD; P = 0.006) between patients without PONV vs. patients reporting PONV respectively. Comparatively, in our study, mean PACU charges were 720-743 USD for LERP patients, 525-546 USD for MERP patients

and 770-935 USD for SERP patients ( $P < 0.001$ ). An interesting observation (Table 2) was that patients who had undergone LERP stayed longer in PACU as compared to patients who had undergone MERP even though the parenteral anti-emetics charges did not follow a similar trend between LERP patients and MERP patients. However, parenteral opioid charges followed a similar trend (LERP patients' charges  $\gg$  MERP patients' charges). Thereafter, a sub-analysis using both parenteral opioid charges and patients' age as covariates reduced statistical significance for PACU stay times ( $P = 0.02$ ; Power = 0.7) and PACU charges ( $P = 0.007$ ; Power = 0.8). This loss in statistical significance suggested that pain management acted as an independent confounding factor for prolonged PACU stay in patients who had undergone LERP as compared to patients who had undergone MERP. To assess surgery times effect on PACU stay times and PACU charges across LERP/MERP/SERP, a further sub-analysis was performed with surgery time as an additional covariate besides parenteral opioid charges and patients' age as other covariates. Using these three covariates removed all statistical significance level for both PACU stay times ( $P > 0.99$ ; Power = 0.05) and PACU charges ( $P = 0.96$ ; Power = 0.06) suggesting that surgery times (besides patients' age and parenteral opioid charges) were an independent factor that confounded the differences in PACU stay times and PACU charges across LERP/MERP/SERP.

Our study has a few limitations. It was a retrospective study that only explored the anesthesia-based billed surgical procedures' database and pharmacy-based billed peri-anesthesia medications' database. Therefore, in our study, other data like preoperative risk factors for PONV, peri-operative pain scores vs. peri-operative emesis scores, intraoperative

medication administration timings vs. postoperative medication administration timings, and prophylactic medications vs. rescue medications were not available to be evaluated/compared. Our analysis was primarily based on categorizing the billed charges data according to the emetogenicity-risk procedures and absence of the above-mentioned potentially confounding variables may have skewed our results (means, level of significance and correlation coefficients).

## Conclusion

In summary, PACU stay times and PACU charges were significantly higher in patients who had undergone SERP as compared to patients who had undergone LERP or MERP at our Same Day Surgery Center.

## Acknowledgement

The authors are deeply indebted to the appreciative efforts of Ms Janice Dale, Data Analyst, Department of Anesthesiology, and Ms. Connie Tourangeau, Pharmacist, and Mr. Xavier Bell, Field Engineer, Department of Pharmacy, Harper Hospital, Detroit Medical Center, Detroit, Michigan, United States in regards to their retrospective enlisting of the same day surgery patients according to their surgical procedures as well as according to the medications that they had received per their databases. The authors are also grateful to Dr Ronald Thomas, Children's Research Center of Michigan, Wayne State University, Detroit, Michigan and George Mckelvey, PhD, Department of Anesthesiology, Harper Hospital, Detroit Medical Center, Detroit, Michigan, United States for their help during statistical calculations and analysis.

## References

1. JENKINS K, GRADY D, WONG J, CORREA R, ARMANIOUS S, CHUNG F: Post-operative recovery: day surgery patients' preferences. *Br J Anaesth*; 2001, 86:272-4.
2. MACARIO A, WEINGER M, CARNEY S, KIM A: Which clinical anesthesia outcomes are important to avoid? The perspective of patients. *Anesth Analg*; 1999, 89:652-8.
3. STOCKDALE A, BELLMAN M: An audit of post-operative pain and nausea in day case surgery. *Eur J Anaesthesiol*; 1998, 15:271-4.
4. GAN TJ: Risk factors for postoperative nausea and vomiting. *Anesth Analg*; 2006, 102:1884-98.
5. PUEYO FJ, LÓPEZ-OLAONDO L, SANCHEZ-LEDESMA MJ, ORTEGA A, CARRASCOSA F: Cost-effectiveness of three combinations of antiemetics in the prevention of postoperative nausea and vomiting. *Br J Anaesth*; 2003, 91:589-92.
6. SUBRAMANIAM B, MADAN R, SADHASIVAM S, SENNARAJ B, TAMILSELVAN P, RAJESHWARI S, JAGAN D, SHENDE D: Dexamethasone is a cost-effective alternative to ondansetron in preventing PONV after paediatric strabismus repair. *Br J Anaesth*; 2001, 86: 84-9.
7. HILL RP, LUBARSKY DA, PHILLIPS-BUTE B, FORTNEY JT, CREED MR, GLASS PS, GAN TJ: Cost-effectiveness of prophylactic antiemetic therapy with ondansetron, droperidol, or placebo. *Anesthesiology*; 2000, 92: 958-67.
8. GAN TJ, MEYER TA, APFEL CC, CHUNG F, DAVIS PJ, HABIB AS, HOOPER VD, KOVAC AL, KRANKE P, MYLES P, PHILIP BK, SAMSA G, SESSLER DI, TEMO J, TRAMÈR MR, VANDER KOLK C, WATCHA M: SOCIETY FOR AMBULATORY ANESTHESIA: Society for Ambulatory Anesthesia guidelines for the management of postoperative nausea and vomiting. *Anesth Analg*; 2007, 105:1615-28.
9. GAN TJ, DIEMUNSCH P, HABIB AS, KOVAC A, KRANKE P, MEYER TA, WATCHA M, CHUNG F, ANGUS S, APFEL CC, BERGSE SD, CANDIOTTI KA, CHAN MT, DAVIS PJ, HOOPER VD, LAGOO-DEENADAYALAN S, MYLES P, NEZAT G, PHILIP BK, TRAMÈR MR: SOCIETY FOR AMBULATORY ANESTHESIA: Consensus guidelines for the management of postoperative nausea and vomiting. *Anesth Analg*; 2014, 118:85-113.
10. Medpac.gov [http://www.medpac.gov/documents/dec05\\_charge\\_setting.pdf](http://www.medpac.gov/documents/dec05_charge_setting.pdf) Accessed on April 02, 2014.
11. HABIB AS, CHEN YT, TAGUCHI A, HU XH, GAN TJ: Postoperative nausea and vomiting following inpatient surgeries in a teaching hospital: a retrospective database analysis. *Curr Med Res Opin*; 2006, 22:1093-9.
12. PARRA-SANCHEZ I, ABDALLAH R, YOU J, FU AZ, GRADY M, CUMMINGS K 3<sup>rd</sup>, APFEL C, SESSLER DI: A time-motion economic analysis of postoperative nausea and vomiting in ambulatory surgery. *Can J Anaesth*; 2012, 59:366-75.