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Patterns of immediate post-anesthetic complications and associated factors among patients undergoing major surgery at Bugando Medical Centre, Mwanza, Tanzania

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Abstract

Background: The subject of post-anesthetic complications in the recovery room and their prevention has continued to generate interest in the last decade. Unfortunately, there is a paucity of published data regarding this subject in Tanzania and Bugando Medical Centre (BMC) in particular. This study sought to describe the patterns of immediate post-anesthetic complications and associated factors among patients admitted to the operating theatre recovery room following major surgery at BMC.

Methods: This was a cross-sectional study of patients aged 18 years and above admitted to the operating theatre recovery room following major surgery at BMC from March 2019 to May 2019.

Results: A total of 430 patients (M:F ratio = 1: 1.7) were studied. The median age at presentation was 35 [interquartile range, 27-52] years. A total of 294(68.4%) patients developed immediate post-anesthetic complications. Of these, postoperative nausea and vomiting were the most common post-anesthetic complication accounting for 43.5% of cases. American Association of Anesthesiologists (ASA) II (p = 0.017), general anesthesia (p = 0.011), and abdominal surgery (p = 0.023) were found to be statistically significantly associated with post-anesthetic complications on multivariate logistic regression analysis.

Conclusion: This study has demonstrated that the incidence of immediate post-anesthetic complications among patients admitted to the operating theatre recovery room following major surgery at BMC is unacceptably high despite recent advances in anesthetic techniques and the introduction of newer anesthetic drugs. We recommend that factors responsible for an increased incidence of immediate post-anesthetic complications at BMC should be addressed to reduce the occurrence of these complications.

Keywords: Immediate post-anesthetic complications, patterns, major surgery, recovery room, operating theatre, Tanzania

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Introduction

The recovery room in the operating theatre, also called a post-anesthetic care unit, is a specialized area in a hospital in which intensive monitoring and care are provided to all patients immediately after surgery (Allman., 2000; Smedley., 2012). The recovery room was established to monitor the vital signs

of patients following surgery and to identify any potentially serious problems before transferring the patient to the ward or the intensive care unit (Allman., 2000; Godden., 2015).

The immediate post-anesthetic period in the recovery room is a known period of high risk for anesthetic and or surgical complications to occur (Weiser et. al., 2008;Tennant *et. al*., 2012. The immediate post-anesthetic period is a time when surgical patients undergo many significant physiologic changes, even for relative health patients (Norsidah & Puvaneswari., 1997; Peskett., 1999; Allman., 2000; Weiser *et. al*.,2008; Smedley., 2012). Several studies have shown clearly that approximately 10% of all anesthetic-related complications occur in the recovery period (Hines et. al. 1992; Norsidah &; Puvaneswari., 1997; Tennant *et. al.,* 2012). Post-anesthetic complications cover a wide spectrum of severity from mildly distressing with no long-term sequelae to death or permanent disability (Tennant *et. al*., 2012). The presence of post-anesthetic complications in the recovery room is associated with increased length of hospital stay, increased perioperative morbidity, and prolonged overall recovery (Allman., 200.

Despite decades of research and advances in monitoring and anesthetic management, the incidence of complications in the immediate post-anesthetic period has been reported to be high in developing countries such as Tanzania where resources are limited (Polepole & Mwafongo., 2011) Several studies have identified several factors that increase the likelihood of post-anesthetic complications in the recovery room (Manninen *et. al*., 1999; Polepole &Mwafongo., 2011; Smedley., 2012; Godden., 2015). These can generally be categorized into surgical and anesthetic factors (Godden., 2015). Identification of factors that are responsible for the increase in the immediate post-anesthetic complications can assist the anesthetist in the judicious use of pharmacotherapy to ameliorate this problem, especially among the high-risk patients; and may lead to a cost-effective and efficient means of managing these complications (Tennant *et. al*., 2012).

Anesthetic complications in the immediate postoperative period (recovery room)have been reported mostly in the western population (Allman., 2000; Kehlet & Dahl., 203), but, in contrast, little has been documented in the literature in the Tanzania context, even though these complications are common in many operating theatres in the country including BMC (Polepole & Mwafongo., 2011; BMC-Medical record database,2017/2018 *unpubl*.). It is because of this existing knowledge gap, we thought it is necessary to conduct this study in our local setting on this subject. This study sought to describe the patterns of immediate post-anesthetic complications and associated factors among patients admitted to the operating are recovery room following major surgery at Bugando Medical Centre, a tertiary care hospital in northwestern Tanzania.

Patients and Methods

Study design and setting

This was a cross-sectional study of patients admitted to the operating theatre recovery room following major surgery at Bugando Medical Centre from March 2019 to June 2019. The study was conducted in the operating theatre recovery room of Bugando Medical Centre. Bugando Medical Centre is the tertiary health institution serving the whole of the north-western part of Tanzania, serving a population of about 17 million people. It is a 960-bed referral hospital located in Mwanza City on the southern border of Lake Victoria. It is also a teaching hospital for the Catholic University of Health and Allied Sciences (CUHAS). The hospital has one main operating theatre which has ten rooms and one recovery room. These rooms are used for general surgery, orthopedic surgery, otorhinolaryngology, ophthalmology, obstetrics and gynecology, urology, cardiothoracic, and neurosurgery operations. One theatre for obstetrics is located in the labor ward and this operates only during the day. The recovery room is within the vicinity of the operating theatre and is equipped with emergency equipment such as; oxygen, intravenous fluids, suction, airways, and emergency medications. The recovery room is open 24 hours a day, and it is staffed by nurses that have been trained in anesthesia for one year. All

patients scheduled to undergo elective surgical procedures are usually seen by the surgeon a day before surgery either in the ward or at the surgical or gynecological outpatient clinics. Before being scheduled for operation, all patients are usually fully investigated and prepared according to the diagnosis. The operating list is prepared by the surgeons, verified by the head of the firm, and sent to the theatre. The head of the firm who in most cases a senior consultant surgeon, confirms bookings and supervises these (scheduling) activities. A pre-surgical anesthetic assessment of the patient's fitness for surgery and anesthesia is usually performed a day before the operation by the anesthetist. Patients undergoing emergency surgery are usually seen at the emergency department, Intensive Care Unit (ICU),or wards by an on-call surgical team, resuscitated, and send to the operating theatre for emergency operation. After the operation all patients are admitted to the recovery room, from there they may be discharged to the apparent wards if fully recovered from anesthesia or to the ICU in case of failure to recover fully from anesthesia.

Study population &selection criteria

The study subjects include all patients from general surgery, orthopedics, otorhinolaryngology, obstetrics and gynecology, urology, cardiothoracic, plastic, and neurosurgery department scheduled to undergo major elective and emergency surgery and subsequently admitted to the operating theatre recovery room of Bugando Medical Centre during the period of study. Patients aged 18years and above admitted in the recovery room after surgical procedures as elective or emergency by using either general or loco-regional anesthesia during the period of study were enrolled in the study. The study included only patients who consented for the study. Patients who were unable to give consent for the operation and those who died on the table were excluded from the study. Patients who went straight to the ICU and wards without passing through the recovery room were also excluded from the study. Patients who underwent major surgery were subsequently admitted to the recovery room and who met the inclusion criteria were recruited serially until the desired sample size was reached.

Recruitment of patients

Recruitment of patients to participate in this study was done during the pre-anesthetic visits of patients scheduled to undergo major elective and emergency surgery. Patients were screened for inclusion criteria and those who met the inclusion criteria were enrolled in the study after informed consent. All patients enrolled in the study were assessed preoperatively, intraoperatively, and postoperatively. Preoperatively, all patients underwent preoperative anesthetic assessment using the American Society of Anesthesiology (ASA) classification (Duncan et al., 1992). Patients were assessed for preoperative medical conditions and smoking status. Patients were subjected to surgery either under general or regional anesthesia according to the anesthesiologist's decision.

Intraoperatively, the type of anesthesia, type of surgery, duration of anesthesia, and surgery were documented. Post-operatively, in the recovery room patients were monitored for vital signs. Peripheral oxygen saturation was measured and monitored using a Datex-Ohmeda, Inc, Trust Sat pulse oximeter, and pulse rate was measured and monitored using Datex-Ohmeda, Inc, Trust Sat pulse oximeter, systolic blood pressure, and diastolic blood pressure were measured using a Geratherm GP- 6621 digital blood pressure machine. The respiratory rate was counted manually per min and the axillary temperature was measured using a mercury thermometer. All patients were under continuous monitoring for Oxygen saturation and pulse rate by a pulse oximeter.

Data collection

A structured, coded and pre-tested data collection tool designed for the study was used. Information to be collected included; demographic information, American Society of Anesthesiology class, nature of the surgical procedure (emergency v/s elective), surgical specialty (general surgery, obstetrics, and gynecology, urology, cardiothoracic, plastic and neurosurgery general), non-invasive measurements of

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systolic blood pressure, diastolic blood pressure, Oxygen saturation (SaO2), and pulse rate will be recorded. Anesthetic technique and duration of anesthesia were recorded as obtained from the anesthetic chart.
The time of admission and discharge from recovery was recorded. Patients were observed for the occurrence of any postoperative complications and thereafter discharged to either ICU or in the ward.

Statistical data analysis
Data were entered using epi-Data version 3.1(Atlanta, US) and analyzed using STATA version 13 (College Station, Texas, US). The median (+IQR) and ranges were calculated for continuous variables whereas proportions and frequency tables were used to summarize categorical variables. Chi-square ($\chi 2$) test was used to test for the significance of the association between the independent and dependent variables in the categorical variables. The level of significance was considered as a p-value of less than 0.05. Study variables that were found to be statistically significant in univariate analysis were subjected to multivariate logistic regression analysis to determine predictor variables that predict the immediate postoperative complications.

Results

Patient's characteristics
Between March 2019 and June 2019, a total of 450 patients were admitted to the recovery room following major surgery and were recruited for eligibility in the study. Of these, 20 (4.4%) were excluded from the study due to failure to meet the inclusion criteria. Thus, a total of 430 patients, representing 95.6% of cases were available for the final analysis as shown in Figure 1 below. Their ages at diagnosis ranged from 18 to 97years with a median age of 35 [IQR, 27-52] years. The modal age group was 21-30years accounting for 31.6% of cases (Figure 2). Two hundred seventy (62.8%) were females and 160 (32.2%) were males giving a male to female ratio of 1: 1.7 with a female predominance in each age group. The majority of patients, 217(50.5%) had normal body weight (BMI range, 20-25). Eleven (2.6%) patients were smokers. Pre-existing medical illness was reported in 34 (7.9%) patients.

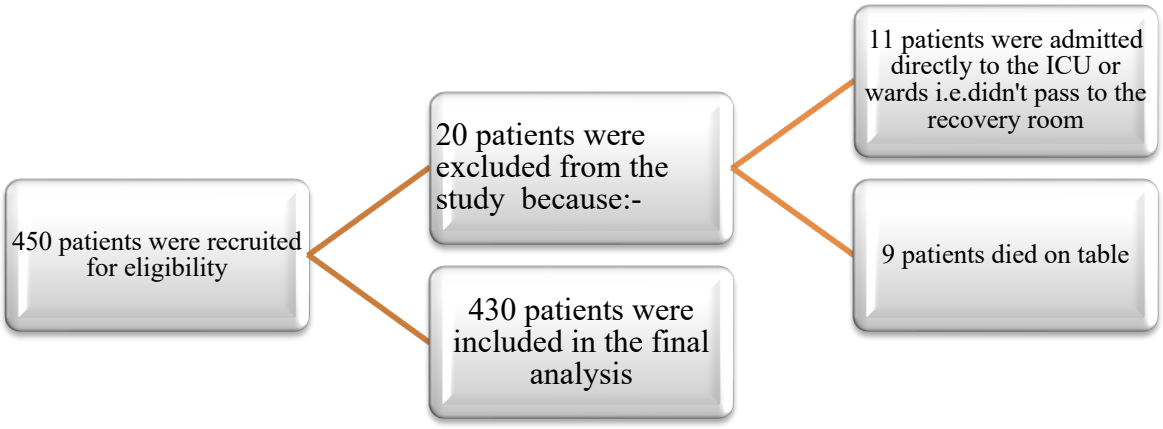

Figure 1: Patient's recruitment flow chart among patients admitted to the operating theatre recovery room at Bugando Medical Centre

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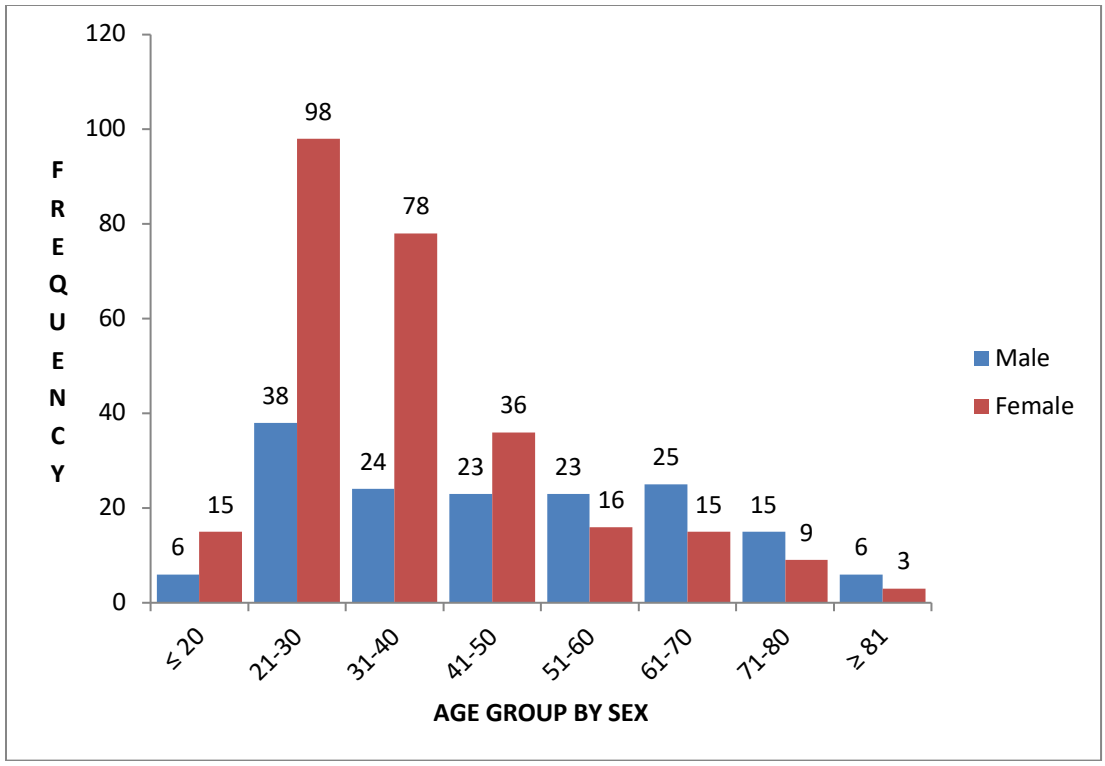

Figure 2: Age group distribution by sex among patients admitted to the recovery room following major surgery

Preoperative characteristics

All patients scheduled for major surgery in this study were assessed preoperatively using the American Society of Anesthetists (ASA) pre-operative grading as follows; 226(52.6%) had ASA I, 195(45.3%) had ASI II and 9 (2.1%) had ASA III. The majority of patients, 246 (57.2 %) were booked for elective surgery and had the highest number of patients booked for operation (44.7%) followed by orthopedic surgery in 14.2% of patients. Cardiothoracic surgery and dental/maxillofacial surgery had the least number with 0.9% and 0.2% of patients booked for operations respectively (Figure 3).

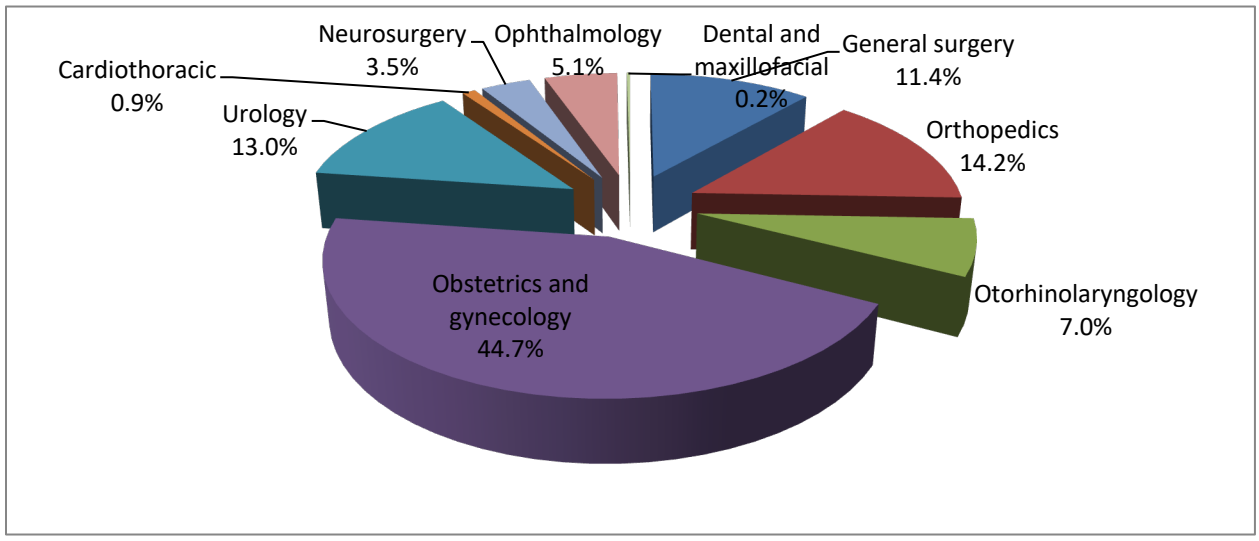

Figure 3: Distribution of patients according to surgical specialties

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Intraoperative characteristics

The majority of surgeries in this study were performed under loco-regional anesthesia in 296(68.8%) patients and general anesthesia in 134 (31.2%) patients. Most of the anesthesia was provided by nurse anesthetists supervised by anesthesiologists in 226 (99.1%) patients and by anesthesiologists in the remaining 4(0.1%) patients. Cesarean section was the most frequent surgical procedure performed in 146 (34%) patients (Table 1). The duration of operation ranged from 5 to 240 minutes with a median of 45 minutes [IQR, 30- 60minutes].

The majority of the patients, 241 (56.1%) had the duration of surgery from 30-59minutes, followed by the duration of more than 60 minutes and less than 30 minutes in149(34.7%) and 40 (9.3%) patients, respectively. On the other hand, the duration of anesthesia ranged from 17 to 270 minutes with a median of 60 minutes [IQR, 45- 80minutes]. The majority of patients, 224 (52.1%) had the duration of anesthesia last for more than 60 minutes. This was followed by the duration of 30-59 minutes and less than 30 minutes in 192(44.7%) and 14 (3.3%) patients, respectively.

Table 1: Surgical indications and procedures for major surgeries at Bugando Medical Centre

Indication/procedure	Response	Frequency	Percent
Surgical indications	Delivery Indications	146	34.0%
	Acute abdomen	14	3.3%
	Fractures and dislocation	53	12.3%
	Benign prostate hyperplasia	25	5.8%
	Cataract	17	3.9%
	Gynecological diagnosis	40	9.3%
	Goiter	11	2.6%
	Urethral stricture	20	4.6%
	Chronic tonsillitis	6	1.4%
	All tumors at different sites	10	11.9%
	Others	11	11.2%
Surgical procedures	Cesarean section	146	34%
	Laparotomy	25	5.8%
	ORIF/EXFIX	50	11.6%
	TURP	25	8.8%
	Eye surgery	17	3.9%
	Hysterectomy and myomectomy	34	7.9%
	Thyroidectomy	11	2.6%
	Surgery for strictures	20	4.6%
	Tonsillectomy	6	1.4%
	Excision and biopsy	39	9.1%
	Others	58	13.5%

Keys: ORIF= Open reduction and internal fixation; EXFIX=External fixator, TURP = Transurethral resection of the prostate

Postoperative characteristics

The duration of stay in the recovery room immediately after major surgeries ranged from5 to 80 minutes with a median of 16 minutes [IQR, 15-20 minutes]. The majority of patients, 376 (87.4%) stayed in the recovery room for less than 30 minutes. The remaining 40 (9.3%) and 14 (3.0%) patients stayed for 30-59 minutes and≥ 60 minutes, respectively. A total of 294(68.4%) patients developed immediate post-anesthetic complications (Figure 4). Of these, postoperative nausea and vomiting (PONV) was the most common post-anesthetic complication accounting for 41.6% of cases (Figure 4). Tables 2 &3 below show

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preoperative and intra-/postoperative factors associated with post-anesthetic complications according to univariate and multivariate logistic regression analyses, respectively. According to multivariate logistic regression analysis, ASA II (OR 2.1; 95% CI [1.1-3.7]; p-value =0.017), general anesthesia (OR0.3; 95% CI [0.1-0.6]; p-value = 0.017) and laparotomy (OR 37.1; 95% CI [1.6-841.2];p-value = 0.023) were found to be statistically significantly associated with post-anesthetic complications.

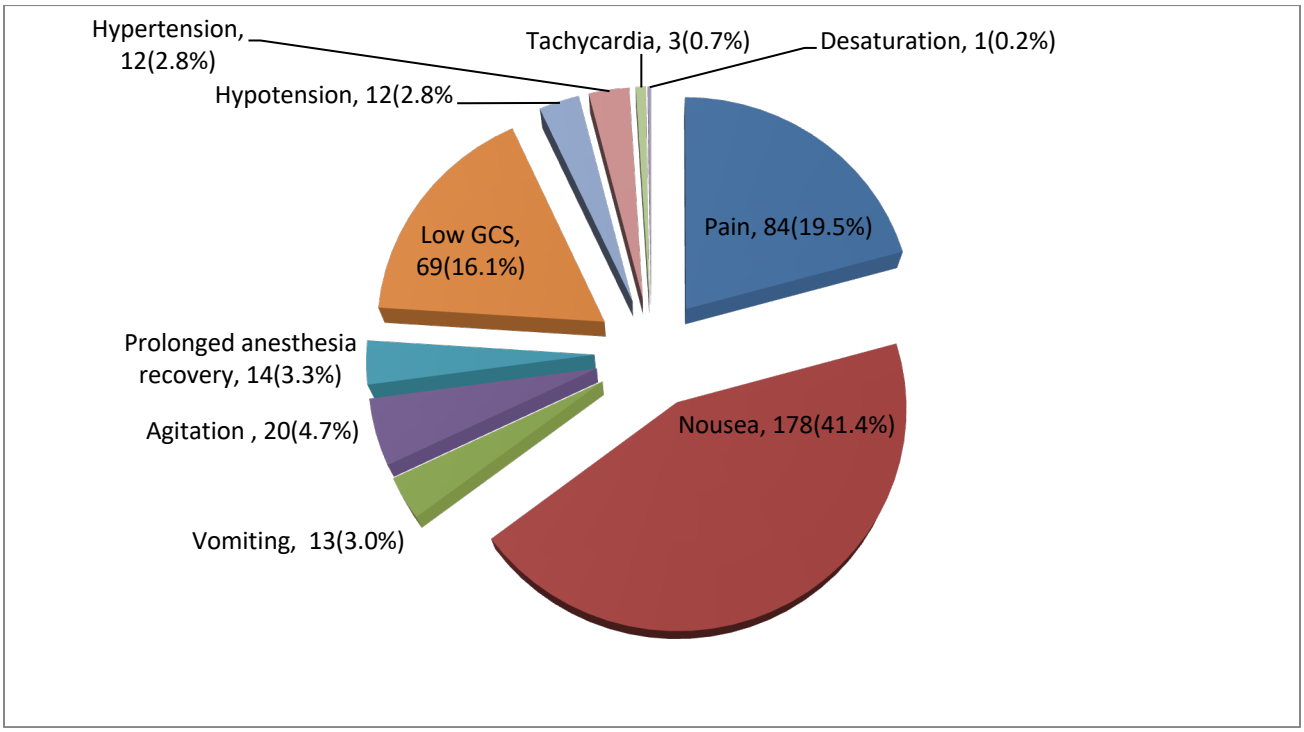

Figure 4: Distribution of patients according to post-anesthetic complications

Table 2: Preoperative factors associated with post-anesthetic complications according to univariate and multivariate logistic regression analyses

Predictor (independent) variables	Immediate post-anesthetic Complications		Univariate		Multivariate	
	Yes =294 N(%)	No =136 N (%)	OR[95%CI]	p-value	OR[95%CI]	p-value
Age (year)						
18-39	187(73.1)	69(26.9)				
40-59	63(62.4)	38(37.6)	0.6[0.4-1.0]	**0.048**	0.8[0.4-1.5]	0.476
60-97	44(60.3)	29(39.7)	0.6[0.3-1.0]	**0.037**	0.9[0.4-2.0]	0.728
Sex						
Male	100(62.5)	60(37.5)				
Female	194(71.9)	76(28.1)	1.5[1.0-2.3]	**0.044**	1.4[0.7-2.9]	0.341
Smoke						
Yes	8(72.7)	3(27.3)				
No	286(68.3)	133(31.7)	0.8[0.2-3.1]	0.753		
Pre-existing						
Yes	23(67.6)	11(32.4)				
No	271(68.4)	125(31.6)	1.0[0.5-2.2]	0.925		

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ASA						
I	141(62.4)	85(37.6)				
II	146(74.9)	49(25.1)	1.8[1.2-2.7]	**0.006**	2.1[1.1-3.7]	**0.017**
III	7(77.8)	2(22.22)	2.1[0.4-10.4]	0.359	2.2[0.3-13.8]	0.407
BMI						
Underweight	11(100.0)	0(0.0)				
Normal weight	144(66.4)	73(33.6)	1.0[0.5-1.9]	0.966		
Overweight	103(69.7)	45(30.4)	1.1[0.6-2.2]	0.691		
Obese	36(66.7)	18(33.3)				
Surgical Specialty						
General surgery	29(59.2)	20(40.8)				
Orthopedics	39(63.9)	22(36.1)	1.2[0.6-2.6]	0.61	0.9[0.3-3.7]	0.993
Otorhinolaryngology	18(60.0)	12(40.0)	1.0[0.4-2.6]	0.943	1.3[0.3-4.7]	0.716
Obstetrics and gynecology	143(74.5)	49(25.5)	2.0[1.0-3.9]	**0.037**	0.5[0.0-5.0]	0.572
Urology	36(64.3)	20(35.7)	1.2[0.6-2.7]	0.591	3.5[0.9-13.3]	0.067
Cardiothoracic	3(75.0)	1(25.0)	2.1[0.2-21.3]	0.541	1.30[0.1-16.]	0.839
Neurosurgery	15(100.0)	0(0.0)				
Ophthalmology	10(45.5)	12(54.5)	0.6[0.2-1.6]	0.284	2.2[0.3-17.2]	0.468
Dental and maxillofacial	1(100)	0(0.0)				

Table 3: Intra- and postoperative factors associated with post-anesthetic complications according to univariate and multivariate logistic regression analyses

Predictor (independent) variables	Immediate post-anesthetic Complications Yes =294 N(%)	No =136 N (%)	Univariate OR[95%CI]	p-value	Multivariate OR[95%CI]	p-value
Age (year)						
18-39	187(73.1)	69(26.9)				
40-59	63(62.4)	38(37.62)	0.6[0.4-1.0]	**0.048**	0.8[0.4-1.5]	0.476
60-97	44(60.3)	29(39.7)	0.6[0.3-1.0]	**0.037**	0.9[0.4-2.0]	0.728
Nature of surgery						
Emergency	135(73.4)	49(26.6)				
Elective	159(64.6)	87(35.4)	0.7[0.4-1.0]	0.055		
Type of Anesthesia						
General anesthesia	107(79.8)	27(20.2)				
Locoregional anesthesia	187(63.2)	109(36.8)	0.4[0.3-0.7]	**0.001**	0.3[0.1-0.6]	**0.001**
Anesthesia provider						
Nurse	294(68.1)	136(31.9)				
Doctor	0(0.0)	4(100.0)	2.46*[0.30-+Inf]	0.434		
Diagnosis						
Delivery Indication	104(71.7)	41(28.3)				
Acute abdomen	11(78.6)	3(21.4)	1.4[0.4-5.4]	0.586	0.03[0.001-1.3]	0.071
Fracture and dislocation	36(67.9)	17(32.1)	0.8[0.4-1.6]	0.603	1242694[0-.]	0.99
Benign prostate hyperplasia	14(56.0)	11(44.0)	0.5[0.2-1.2]	0.12	0.2[0.01-2.6]	0.209
Cataract	7(41.2)	10(58.8)	0.3[0.1-0.8]	**0.014**	0.2[0.01-3.9]	0.275
Gynecological diagnosis	32(80.0)	8(20.0)	1.6[0.7-3.7]	0.296	0.5[0.02-11.5]	0.659
Urethral stricture	6(54.5)	5(45.4)	0.5[0.1-1.6]	0.237	0.1[0.01-1.5]	0.091

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All tumors at different sites8	14(70.0)	6(30.0)	1.0[0.3-2.6]	0.873	0.3[0.02-4.5]	0.397
Tonsillitis	3(50.0)	3(50.0)	0.4[0.1-2.0]	0.266	0.1[0.01-2.3]	0.157
Procedure						
Caesarea section	104(71.7)	41(28.3)				
Laparotomy	24(96.0)	1(4.0)	9.5[1.2-72.2]	**0.03**	37.1[1.6-841.2]	**0.023**
ORIF and EXFIX	33(66.0)	17(34.0)	0.8[0.4-1.5]	0.446	0.045[0-.]	0.99
TURP	14(56.0)	11(44.0)	0.5[0.2-1.2]	0.12		
Eye surgery	7(41.2)	10(58.8)	0.3[0.1-0.8]	**0.014**		
TAH and myomectomy	26(76.5)	8(23.5)	1.3[0.5-3.1]	0.577	2.1[0.1-46.4]	0.634
Surgery for strictures	6(54.5)	5(45.5)	0.5[0.1-1.6]	0.237		
Excision and biopsy	8(20.51)	31(79.49)	1.0[0.3-2.6]	0.873		
Tonsillectomy	3(50.0)	3(50.0)	0.4[0.1-2.0]	0.266		
Excision and biopsy	21(53.8)	18(46.2)	0.5[0.2-1.0]	**0.036**	1.0[0.04-17.2]	0.909
Duration of surgery (minute)						
<30	24(60.0)	16(40.0)				
30-59	156(64.7)	85(35.3)	1.2[0.6-2.4]	0.564	1.0[0.5-2.2]	0.968
>60	114(76.5)	35(23.5)	2.2[1.0-4.5]	**0.039**	1.3[0.6-3.0]	0.546
Duration of anesthesia (minute)						
<30	12(85.7)	2(14.3)				
30-59	126(65.6)	66(34.4)	0.3[0.1-1.5]	0.141		
>60	156(69.6)	68(30.4)	0.4[0.1-1.8]	0.216		
Duration of stay (minute)						
<30	250(66.5)	126(33.5)				
30-60	31(75.6)	10(24.4)	1.6[0.7-3.3]	0.24		

Keys: *ORIF= Open reduction and internal fixation; EXFIX=External fixator, TURP = Transurethral resection of the prostate; TAH = Trans-abdominal hysterectomy*

Discussion

In this study, post-anesthetic complications accounted for 68.4%, a figure which is low compared to 87.5% that was found in Dar es Salaam, Tanzania (Polepole &Mwafongo.,2011). A high figure of 83.0% was also reported in Jamaica by Tennant *et al* (2012). An analysis of immediate post-anesthetic complications seen in a large teaching hospital including over 60,000 patients found incidences of 0.04% for major and 9.4% for minor immediate postoperative complications (Cohen *et al*., 1986). However, a study that looked specifically at minor postoperative complications after general anesthesia in 4,173 patients reported an incidence of 41% (Myles *et al.,* 1997). Our figure is significantly high compared to what is reported in developed countries (Allman., 2000;Kehlet & Dahl., 2003). This difference in the incidence of post-anesthetic complications in these studies may be explained in part by the differences in exposure to risk factors for these complications.

In keeping with other studies (Polepole &Mwafongo., 2011; Tennant *et al*., 2012),the peak age incidence in this study was found to be in the second and third decade of life and tended to affect more females than males. The female predominance demonstrated in this study is by the results of other workers (Hines *et al*., 1992; Norsidah & Puvaneswari., 1997; Tennant *et al*., 2012) and this can be explained by the fact that the highest number of patients booked for the operation were from Obstetrics and gynecology specialty.

In the present study, postoperative nausea and vomiting (PONV) was the most common post-anesthetic complication accounting for 43.5% of cases, a figure which is higher than the overall global incidence of 25-30% among surgical patients (Van derBosch *et al*., 2005; Gan, 2006; Smith *et al.,* 2012).

Ssebuufu *et al.* (2009) in Uganda and Amponsah (2007) in Ghana reported the incidence of PONV within 24 hours after surgery to be 40.7% and 34.6%, respectively. A study by Chalya *et al* (2015) at the same institution reported the incidence of PONV to be 41.4%. One study from Guyana reported a significantly low incidence of postoperative nausea and vomiting (PONV) of2.9% (Hines *et al*., 1992). In high-risk patients, the incidence of PONV has been reported in the literature to be as high as 70-80% (Apfel *et al*., 2005).This difference in the incidence of PONV in these studies may be explained in part by the differences in exposure to risk factors such as the female gender, history of motion sickness or previous PONV, non-smoking, and the use of postoperative opioids.

Postoperative pain was the second most common anesthesia-related complication in our study which is in contrast to Polepole and Mwafongo (2011) in Tanzania who reported postoperative pain as the most frequent post-anesthetic complication followed by respiratory complications. Another study in Toronto which assessed over 5,000 high-risk patients in the recovery room found that the rate of excessive pain was 14.8% (Mayer & Liebeskind., 1974). The rate of excessive pain in the recovery room may vary depending on patient age, preoperative analgesic use, the surgical procedure, and strategies to reduce post-operative pain (Mayer & Liebeskind.,1974; Murray & Retief., 2016). Inadequately treated post-operative pain is a prevalent phenomenon worldwide that adversely affects patient experience and outcome (Mayer & Liebeskind., 1974; Murray & Retief., 2016). In a resource-limited environment with an expected high incidence of post-operative expected high incidence of postoperative pain, it is necessary to fully utilize basic analgesic modalities and to reserve more costly advanced methods for those who need them most. For this reason, the incidence and risk factors associated with a higher incidence of postoperative pain need to be identified.

Cardiopulmonary complications have been reported to occur in the recovery room from 2.3% to 15.3% of patients (Tennant *et al.,* 2012). A study of 18380 patients found an overall incidence of cardio-pulmonary complications of 7.2% of all admissions to the recovery room (Hines *et al*., 1992). The overall incidence in our study was 6.3% which is similar to this previous study. There were no major cardiovascular complications such as pulmonary edema or myocardial ischemia during the study period.

Several factors have been reported in the literature to be associated with post-anesthetic complications in recovery rooms (Manninen *et. al*., 1999; Smedley., 2012; Godden., 2015). Most studies have reported that age is associated with an increased incidence of immediate post-anesthetic complications in the recovery room (Hines *et al*., 1992; Polepole & Mwafongo., 2011). In this study, age was not associated with immediate post-anesthetic complications. The reason for the association between age and increased incidence of immediate post-anesthetic complications is not yet clear and this warrants further investigation.

It has been shown in several studies that the female gender has a greater risk of immediate post-anesthetic complications, such as nausea and vomiting, headache and backache (Myles *et al*., 1997). In the present study, the female gender was more likely to have immediate post-anesthetic complications than their male counterparts, though this was not statistically significant in multivariate logistic regression analysis. One possible explanation for this observation is that it is more socially acceptable for women to express their discomfort, while males tend to underreport complications. This gender difference may also be attributed to variation in serum gonadotropin or other hormone levels (Myles *et al*., 1997).

Body mass index (BMI) has been reported in the literature to be associated with immediate post-anesthetic complications, such as nausea and vomiting (Gan, 2006; Ssebuufu *et al*., 2009; Smith *et al*., 2012). Obese patients have been reported as more likely to experience PONV (Gan., 2006). In the present study, there was no statistically significant association between BMI and immediate post-anesthetic complications. This association between increased BMI and PONV may be due to an increased intra- abdominal pressure and the pharmacokinetic effects of lipophilic anesthetic agents having prolonged half-lives in these patients. In this case, adipose tissue acts as a reservoir for inhaled

anesthetic agents, from which they continue to enter the blood stream even after their administration, has been discontinued (Smith *et al*., 2012).

Several studies have shown a strong association between ASA status and immediate post-anesthetic complications (Hines et al., 1992; Polepole & Mwafongo., 2011; Tennant *et. al.,* 2012). Increased ASA scores have been reported to be associated with an increased risk of immediate postoperative complications in the recovery room (Tennant *et. al*., 2012). In this study, we found a strong association between ASA II and immediate post-anesthetic complications. On the other hand, our finding is in keeping with Tennant *et. al.* (2012) who found no correlation between ASA III and the frequency of immediate post-anesthetic complications attributing this to the low number of ASA III patients in this study, making it difficult to make comparisons.

The anesthetic technique has been reported to be a predictor of immediate postoperative complications (Polepole &Mwafongo., 2011; Tennant *et. al.,* 2012).Compared with loco-regional anesthesia, general anesthesia is associated with an 11-fold increase in risk for immediate postoperative complications (Myles *et al*., 1997; Tennant et. al., 2012). Increased incidence of immediate postoperative complications such as nausea and vomiting with general anesthesia could be related to using volatile anesthetic with perioperative opioids. General anesthetic drugs decrease the level of consciousness by decreasing the action potential amplitude and frequency of the central nervous system (Tennant et. al., 2012). This disruption of normal neural electrical output can stimulate the chemoreceptor trigger zone (CTZ) and vomiting center (Tennant *et. al*., 2012). In this study, general anesthesia had a significant association with immediate post-anesthetic complications both in univariate analysis and multivariate analysis.

The effect of the type of surgical procedure on the incidence of immediate post-anesthetic complications has been debated in the literature (Hines et al., 1992; Polepole& Mwafongo., 2011; Tennant *et. al*., 2012). Some studies have suggested that the type of surgical procedure is associated with a high incidence of immediate post-anesthetic complications, whereas others have suggested that differences in the incidence of immediate post-anesthetic complications are mainly due to patient- or anesthesia-related factors (Myles *et al.,* 1997; It is unclear if the association is caused by the different anesthetic agents, the different lengths of operation, or the operation itself (Polepole &Mwafongo., 2011; Tennant et. al., 2012). In our study, laparotomy was found to be significantly associated with immediate post-anesthetic complications, a finding which is consistent with Ssebuufu *et al* (2009) in Uganda who reported an association between orthopedic operations and PONV.

The duration of surgery/anesthesia has been reported to affect the incidence of immediate post-anesthetic complications, with more frequent immediate post-anesthetic complications being reported after longer operations. With increasing duration of surgery and anesthesia, the risk of immediate post-anesthetic complications increases (Polepole & Mwafongo., 2011; Smedley., 2012; Godden., 2015). However, in this study, we observed no association between the duration of operation /anesthesia and the incidence of immediate post-anesthetic complications.

In conclusion, this study has demonstrated that the incidence of immediate post-anesthetic complications among patients admitted to the operating theatre recovery room following major surgery at BMC is unacceptably high despite recent advances in anesthetic techniques and the introduction of newer anesthetic drugs. We recommend that factors responsible for the increased incidence of immediate post-anesthetic complications at BMC should be addressed to reduce the occurrence of these complications.

Ethical consideration: Ethical clearance was sought from the Joint CUHAS/BMC Research, Ethics, and review committee. Permission to conduct the study was obtained from the hospital authority and anesthesia department. In this study, patients were requested to sign an informed written consent form the study. Patients were assured that the information collected was maintained under strict

confidentiality. Patients had the right to withdraw from the study at any time during the study. There was full disclosure of risks and benefits to all study participants. The study did not interfere with the decision of the attending doctor/Nurse.

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