Original Research Article

Postoperative Nausea and Vomiting following General Anaesthesia : a prospective study on Gynaecological and Non- Gynaecological [DRG1]surgical patients in the University of Calabar Teaching Hospital, Calabar, Nigeria.

ABSTRACT

Introduction: Postoperative nausea and vomiting remains a significant problem in our clinical setting. This study at the University of CalabarTeaching Hospital, Calabar in Nigeria aims to investigate the incidence of postoperative nausea and vomiting among gynaecological and non-gynaecological patients undergoing surgery under general anaesthesia, compare the incidence as it affects males and females, identify predisposing factors and recommend preventive measures.

Methodology: One hundred and sixty six(166) adult patients aged 18 years and above were recruited prospectively excluding cases of full stomach, patients with nasogastric tubes and those who could not be followed up for 24 hours. The past history of motion sickness and postoperative nausea and vomiting was obtained and documented. General anaesthesia was induced with either sodium thiopentone or ketamine hydrochloride. Maintenance was inhalational with or without a relaxant technique. Intravenous pentazocine and subanaesthetic doses of ketamine were used for intraoperative analgesia. The patients were observed postoperatively and questioned at two hourly intervals for nausea or vomiting and pain was scored using the categorical rating scale. A data sheet was competed at the end of 2 and 24 hours. The data was entered on a microcomputer for analysis with aid of EPI INFO version 6 software. The level of significance was set at 95% confidence interval with P value less than 0.05.

Results: The overall incidence of nausea was 11.45% and vomiting 13.35% in the 166 patients studied. There was no significant difference in incidence between the gynaecological and non gynaecological patients. Female patients experienced more postoperative nausea and vomiting than male patients with 11.4% and 18.42% nausea and vomiting. Sodium thiopentone induction, long duration of surgery, muscle relaxant and moderate to severe postoperative pain increased the incidence of PONV

Conclusion: The use of prophylactic “balanced antiemesis” in high risk patients, avoidance of muscle relaxant reversal and adequate postoperative analgesia are recommended as preventive measures.

Key words: postoperative nausea, vomiting, general anaesthesia, surgery, Nigeria

INTRODUCTION

Postoperative nausea and vomiting (PONV) has been associated for many years with the use of general anaesthesia for surgical procedures. Knapp and Beecher gave excellent definitions several years ago of nausea and emesis and these are still useful today[1]. Nausea is described as the desire to vomit without expulsive muscular movements. It is a subjective experience which is expressed by the patient and cannot be evaluated by the observer.[1]Vomiting on the other hand, is the expulsion of stomach content in varying volume

and nature. When the stomach contents are not expelled, the expulsive efforts are termed retching. Though retching is indicative of an empty stomach, it is as unpleasant and stressful to the patient as vomiting. Retching and vomiting may be grouped together and termed "emetic episode."[2] The stimulus that leads to an emetic episode may originate centrally or peripherally.

The phenomenon of nausea and vomiting associated with surgery was first documented by John Snow in 1848.[3] The first public demonstration of surgical pain relief (anaesthesia) however, was by William Thomas Green Morton on October 16th, 1846 at the Massachuset general hospital and diethyl ether (ether) was the anaesthetic used. Ether posseses relatively good anaesthetic properties and is safe in unskilled hands because, it produces remarkably small alterations in blood pressure and pulse rate, rarely leads to cardiac irregularities and does not sensitize the myocardium to the actions of noradrenaline[4] and adrenaline. It appears to increase sympathetic and block parasympathetic nervous system activity in normal man. Its events occur slowly leading to the stages and signs of ether anaesthesia as described by Guedel. Many older adults clearly remember ether anaesthesia. The retching caused by ether could last for days. There was little improvement with the introduction of cyclopropane in the 1930s; however, no reduction in the incidence of PONV occurred until halogenated inhalational agents became available in the 1960s. In recent years, there has been a general trend towards a decrease in the incidence and intensity of PONV because of the use of less emetic anaesthetic agents, improved pre and postoperative medication, more refined anaesthetic techniques and identification of patient predictive factors.[5] Inspite of all these advances, nausea and vomiting still occur as the "big little problem".[6]In some cases, it may be the only distressing aspect of the entire perioperative experience for the patient. Postoperative nausea and vomiting, is a distressing side effect of general anaesthesia and may predispose the sufferer to inhalation of the vomitus with disastrous consequences. [DRG2]

A large number of gynaecological surgeries are carried out on day case basis. Gynaecological patients have been shown to be susceptible to PONV because of hormonal changes.[2, 7] Postoperative nausea and vomiting has been identified as an important cause of unplanned admission after day care surgery. The admission may result not only from uncontrolled nausea and vomiting, but also, from prolonged somnolence following treatment with potent anti-emetics.[8]
Several studies have been carried out on PONV mainly in Caucasians and in the temperate zones where there are well established Postanaesthesia Care Units (PACUs). In the West African sub-region, PACUs though available, are mostly ill-equipped and inadequately staffed. It is therefore desirable that postoperative morbidity such as PONV be avoided or prevented where possible especially in day care procedures in order to enhance the cost benefit to the patient.

This study therefore was aimed at investigating the incidence of postoperative nausea and vomiting in gynaecological and non gynaecological patients undergoing surgery under general anaesthesia at the University of Calabar Teaching Hospital, Calabar, Nigeria. ~~It compared the incidence as it affects males and females and identified possible predisposing factors. Recommendations for preventive measures were also made.~~[DRG3]

BACKGROUND[DRG4]

Nausea and vomiting are frequent postoperative events especially following general anaesthesia.[8] It is an important cause of unscheduled hospital admission following day care surgery.[9] The overall incidence depends on the criteria used in the different assessments.

General mechanism of PONV pathogenesis

There are different mechanisms responsible for the stimulation of nausea and vomiting. Nausea occurs due to a forebrain pathway while vomiting occurs due to a hindbrain central pattern generators.[10] Diverse stimuli stimulate the emetic center located in the medulla. This center receives various signals from visceral afferent nerves located in the gastrointestinal tract, chemoreceptor trigger zone(CTZ),higher cerebral cortex, cerebellum and vestibular

apparatus. An important feature is that the CTZ which is located in the fourth ventricle of the brainstem lies outside the blood-brain barrier and is therefore exposed to drugs, such as inhalational anaesthetics and opioids.[11]Dopamine, opioids, histamine, acetyl-choline, 5-hydroxytryptamine 3(serotonin 3) receptors have been shown to be related to the emetic center.[11] These diverse stimuli therefore implies that treatment with combinations of different drugs will be essential for the prevention of PONV.

Pharmacogenetics of PONV

Most pharmocogenetic studies associated with PONV have focused on opioid-induced nausea and vomiting (OINV). However, these studies have thrown more light on the genetic mechanism of PONV. In this regard the OPRMI gene encoding opioid *mu* receptors have been extensively studied. The risk of PONV is high in homozygous patients with the A118 variant of OPRMI. Therefore individuals homozygous for the A118 genotype showed the lowest severity of pain and the highest incidence of nausea despite receiving smaller amount of morphine by patient controlled analgesia (PCA).[12] Receptors regarded as related to PONV and OINV include 5-HT(subunit A and B) receptor, [13] muscarinic type 3 receptors, dopamine type 2 receptors, [14] cathecol-0-methyl-transferase, [15] alpha 2 adrenoceptors, [16] adenosine triphosphate-binding cassette subfamily B member 1,[17] cytochrome p450 super family enzyme and UDP-glucoronosyl-transferase. [18]

PONV risk factors

The factors identified in the triggering of PONV have been subdivided into the following groups with related conditions:

A. Background factors[19, 20, 21] such as patients' age and sex, habitus, motion sickness, history of PONV, use of antiemetic, full stomach and anxiety.

B. Anaesthesia and surgery related factors[21] such as preanaesthetic medication, anaesthetic induction agent, type and duration of surgery, anaesthetic maintenance agent, agent for reversal of muscle relaxation, postoperative pain and its relief as well as movement and transportation of the patient.

Pharmacological Therapies

The mechanism underlying the pathogenesis of PONV as mentioned above is complex. Therefore drug combinations of the different classes of antiemetic drugs are encouraged for effectiveness, particularly in high risk patients. If PONV occurs despite administration of antiemetics, rescue antiemetics should be selected from drugs belonging to a different class from that administered previously. [11]The doses of drugs in each class and their side effects are presented in Table 1

Table 1 Doses and side effects of Antiemetics [11]

Drug	*Dose*	*Side effect*
Cholinergic antagonists		Dry mouth, drowsiness, impaired eye accommodation
Scopolamine	Transdermal patch	
Histamine antagonists		Sedation, dry mouth, constipation
Dimenhydrinate	1-2mg/kg IV	
Promethazine	12.5-25mg IV	
Serotonin antagonists		Headache, prolongation of QT interval
Ondansetron	4-8mg IV	
Dolasetron	12.5mg IV	
Granisetron	0.35-1mg IV	
Ramosetron	0.3mg IV	
Tropisetron	2mg IV	
Palonosetron	0.075mg IV	
Dopamine antagonists		Sedation , restlessness, extrapyramidal effects
Metoclopramide	10mg IV	

Droperidol	0.25-0.625mg IV	
Phenothazines		Sedation, lethargy, skin sensitization
Chlorpromazine	10mg IV	
NK_1 antagonists		Constipation, pruritus
Aprepitant	40mg PO	
Corticosteriods		Gastrointestinal upset, insomnia
Dexamethazone	4-5mg IV	

METHODOLOGY

Consecutive adult patients aged 18 years and above scheduled for elective surgery under general anaesthesia were recruited prospectively. Both in-patients and out-patients of American society of Anaesthesiologists (ASA) physical status I-III were studied..
The following patients were excluded from the study:

I. Those for emergency procedure or full stomach
II. Patients with gastric outlet obstruction
III. Patients on antiemetic treatment
IV. Patients who required naso-gastric tube for management
V. In cases where 24 hour follow up was not possible

The patients were reviewed preoperatively during which their demographic data and relevant history were obtained including previous history of postoperative nausea and vomiting or motion sickness. The terms nausea, retching and vomiting were explained to each patient. All patients received atropine premedication.

General anaesthesia was induced with either Ketamine hydrochloride 2mg/kg intravenously or a sleep dose of Sodium thiopentone. Patients induced with ketamine were given 10mg diazepam just before the induction agent to prevent postoperative hallucinations. The choice of induction agent and anaesthetic technique was at the discretion of the principal anaesthetist in each case. Maintenance was inhalationally by face mask or endotracheal intubation. Intubated patients were allowed to breath spontaneously or paralysed and ventilated. Endotracheal intubation was facilitated by 1mg/kg of suxamethonium chloride. In patients where a relaxant technique was adopted, pancuronium 0.1mg/kg was used. Intraoperative analgesia was achieved with either of pentazocine 30mg at induction and 6mg every 30 minutes or subanaesthetic doses of ketamine 0.5mg/kg every 20 minutes. Anaesthesia was maintained with 100% oxygen in halothane. Nitrous oxide was not used because it was not available. At the end of surgery, residual muscle relaxant was reversed using premixed 2.5mg neostigmine and 1.2mg atropine in all patients who received pancuronium. Postoperative analgesia was prescribed by the surgical team. A data sheet was produced for each patient as shown in appendix 1.

Postoperative Follow-up: in the recovery room, the patients were interrogated and a questionnaire filled. The period was subdivided into 0-2hours and 2-24 hours. At the end of each interval, an anaesthetic registrar assessed whether retching or vomiting had occurred and asked if the patients felt nauseated. Nausea as explained preoperatively to the patients meant unpleasant sensations at the back of the throat and epigastrium, cold sweating, salivation, disinterest in surroundings and awareness of the urge to vomit. Retching included laboured spasmodic, rhythmic contractions of the diaphragm, chest and abdominal wall muscles. The forceful sustained contraction of the above listed muscles was regarded as vomiting. Patients who had retching with or without vomiting were categorized as having vomiting.The results were scored as none, nausea, and vomiting. Pain was scored as mild, moderate and severe using the categoric rating scale. The single worst score in any of the time periods was used for analysis. The observations were recorded during the first 24 hours postoperatively.

The data were entered on a microcomputer for anlaysis with the aid of EPI-INFO (version6) epidemiologic statistical software package. Data were analysed both qualitatively and quantitatively. Quantitative data were presented in the form of frequency tables, pie chart and bar charts. Where necessary, categoric variables were compared using chi-square and Fisher's exact tests while student's T test and analysis of variance (ANOVA) was used for the

continuous data. The level of significance was set at 95% confidence interval with p value less than 0.05.

RESULTS

A hundred and sixty six patients were studied 56 gynaecological and 110 non gynaecologiccal. The age range from 18 to 70 years in the two groups. The mean age in the gynaecology group was 34.4 years (± 10. 49) while the mean age of the non-gynaecological patients was 37.8 years (± 14.12). There were 52(31.33%) males and 114(68.67%) females. The duration of anaesthesia ranged from 15 to 180 minutes in the gynaecological patients group mean 73.7(± 44. 08). In the non-gynaecological group, the duration range from 20 to 315minutes with a mean of 102.8 (± 53.77). The difference was statistically significant P=0.006, using the students*t* test and analysis of variance. The mean Packed cell volume (PCV) of the gynaecological patients was 34.8% (± 3.4) ranging from 26% to 41%, in the non gynaecological group, it was 37.8% (± 4.4) ranging from 21% to 45% table 2.

TABLE 2. Characteristics of patients

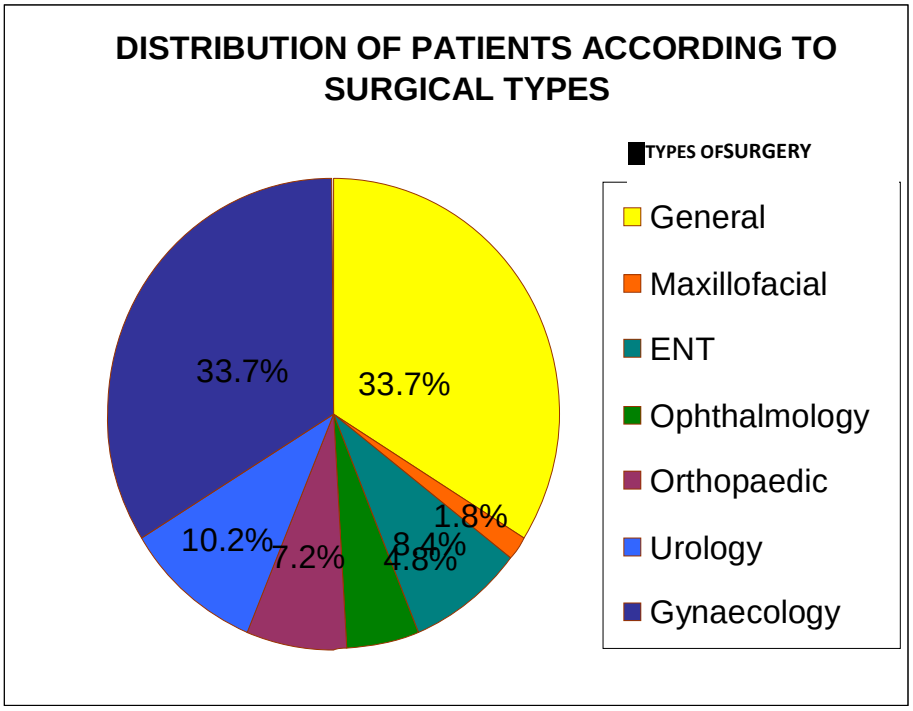
The results are presented as mean (SD)

	GYNAE GROUP	NON GYNAE GROUP
N	56	110
SEX M/F	0/56	52/58
WEIGHT KG	64.54 (9.97)	62.7 (11.58)
HEIGHT CM	163.8 (6.3)	166.2 (7.6)*
PCV%	34.8 (3.4)	37.8 (4.4)*
DURATION (MINS)	73.7 (44.08)	102.8 (53.77)*
AGE (YEARS)	34.4 (10.49)	37.8 (14.12)

*P<0.05

The distribution of patients according to surgical types are shown in Figure 1.

Figure 1



Out of the 166 patients studied, 41(24.7%) had PONV. Of these, 7(17.1%) were males and 34(82.9%) were females. Nineteen patients (11.45%) had nausea only, 16(9.6%) had nausea, vomiting while 6(3.6%) had vomiting only. All the patients who vomited with or without nausea were thus 22(13.25%). Among the 56 gynaecological patients in the study, 7(12.5%) had only nausea while 10(17.86%) vomited. In the non gynaecological patients, 12(10.91%) had nausea and 12(10.91%) vomited.
The difference in incidence of nausea and vomiting in the two groups was not statistically significant (p=0.408) as shown in Table 3.

Table 3. Incidence of postoperative nausea and vomiting among gynaecological and non- gynaecological patients

Group	**Number of patients (%)**			
	nausea	vomiting	None	Total
Gynae	7(12.5)	10(17.86)	39(69.64)	56(100)
non-Gynae	12(10.91)	12(10.91)	86(78.18)	110(100)
Total	19(11.45)	22(13.25)	125(75.30)	166(100)

X^2= 1.793, DF=2, p=0.408

When PONV was evaluated according to sex as shown in table 4, More females had PONV than males and it was significant (p=0.014). Out of the 52 male patients studied, 6(11.54%) had postoperative nausea and 1(1.92%) vomited. In females, 13(11.40%) had postoperative nausea while 21(18.42%) vomited.

TABLE 4. Incidence of postoperative nausea and vomiting among Male and Female patients

PONV	GYNAE	NON GYNAE		TOTAL
		MALE	FEMALE	
NAUSEA	7(4.2)	6(3.6)	6(3.6)	19 (11.35%)
VOMITING	10(6)	1(0.6)	11(6.6)	22 (13.25%)
NONE	39(23.5)	45(27.1)	41(24.7)	125 (75.3%)
TOTAL	**56(33.7)**	**52(31.3)**	**58(34.9)**	**166 (100%)**

X^2= 8.604, DF=2, p=0.014

Among the female patients, 56 had gynaecological and 58 non gynaecological surgery. Seven (12.50%) gynaecological and 6(10.31%) non gynaecological females had postoperative nausea while the incidence of vomiting in the 2 groups was 17.86% and 18.97% respectively. The difference was not statistically significant with a p value of 0.93.

Nine patients had past history of PONV, 5 of them had PONV episodes in this study while 4 did not. This was found to be statistically significant with a Fisher exact 2- tailed p value of 0.0419(Table 6). There were 2 patients with a history of motion sickness and 2 of them had nausea postoperatively.

Table 5.Past history of PONV and the Incidence of PONV

History of PONV	**Occurrence of PONV**		
	Yes	No	TOTAL
Yes	5	4	9
No	36	121	157
Total	41	125	166

X^2(Yates corrected)= 3.28, P value (Fisher exact 2-tailed) =0.0419

Body mass index (BMI) had no significant effect on the incidence of PONV. Only 10patients had BMI above 30 and 1 of them had postoperative nausea, while 3 vomited , as shown in Table 7

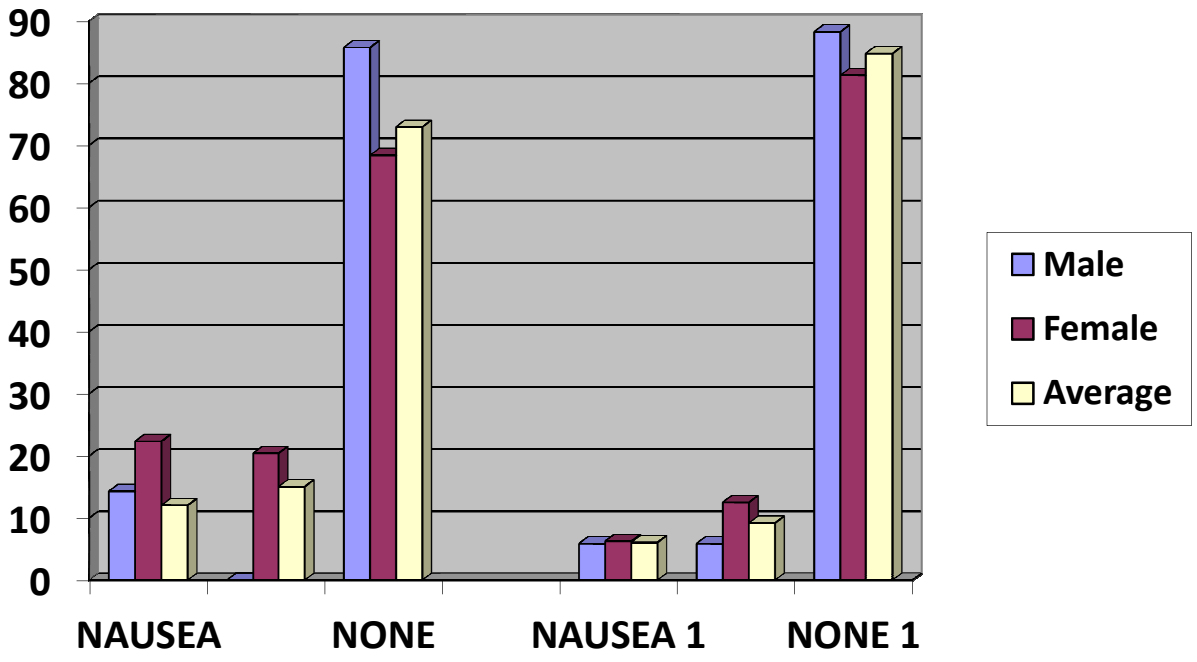
Table 6.Body Mass Index (BMI) and postoperative nausea and vomiting

BMI(Kg/m^2)	Number of Patients (%)			
	Nausea	**Vomiting**	**None**	**Total**
<20	5	2	22	29
20-29	13	17	97	127
30-40	1	3	6	10

X^2= 2.61, DF=2, p=0.27

One hundred and thirty three were below 50 years of age. Sixteen (12.03%) of them experienced postoperative nausea (5 males and 11 females) while 20 females vomited. The difference in the incidence of PONV between males and females in this age group was statistically significant p= 0.01. This is shown in figure 2

FIGURE 2 showing incidence of postoperative nausea and vomiting by sex for age < 50 years and age 50 years and above



NOTE: Nausea 1, Vomiting 1 and None 1 are for age 50 years and above, while Nausea, Vomiting and None are for age less than 50 years.

Table 7 INDUCTION AGENTS AND PONV

group	**number of patients**			
	Nausea	Vomiting	None	Total
ketamine	5(5.81)	9(10.47)	72(83.72)	86(100)
Thiopentone	14(17.50)	13(16.2)	53(66.25)	80(100)
Total	19(11.45)	22(13.25)	125(75.3)	166(100)

X2= 7.67, DF=2, p=0.02

Thirty seven patients received anaesthesia by face mask, 10 had endotracheal anaesthesia breathing spontaneously while 119 patients had relaxant technique. Nineteen of them experienced postoperative nausea, while 18(15.13%) vomited postoperatively. Among the 47 patients who received no muscle relaxant, 4(8.5%) patients vomited postoperatively. This consisted of 1 of the 10 patients who received endotracheal anaesthesia and 3 of the 37 patients who had anaesthesia by face mask. The difference in the incidence of PONV between patients who received muscle relaxant and who did not, was statistically significant. Table 8.

Table 8 MUSCLE RELAXANT AND PONV

GROUP	**NUMBER OF PATIENTS**			
	Nausea	Vomiting	None	Total
Pancuronium	19(15.97)	18(15.13)	82(68.9)	119(100)
NoRelaxant	0	4(8.5)	43(91.5)	47(100)
TOTAL	19	22	125	166(100)

X^2= 10.9, DF=2, p=0.004

Pentazocine used for intraoperative analgesia was associated with a 15.2% incidence of postoperative nausea and 14.4% vomiting. Subanaesthetic doses of ketamine was associated with 9.76% incidence of vomiting. This difference was statistically significant. P=0.02. Table 9

Table 9 INTRAOPERATIVE ANALGESICS AND PONV

ANALGESIC	**NUMBER OF PATIENTS**			
	Nausea	Vomiting	None	Total
PENTAZOCINE	19(15.2)	18(14.4)	88(70.4)	125(75.3)
KETAMINE	0	4(9.8)	37(90.2)	41(24.7)
TOTAL	19	22	125	166(100)

X^2= 5.51, p=0.02

The duration of anaesthesia for 64 patients was 120 minutes or less while for 102 patients it was more than 120 minutes. The influence of the duration of anaesthesia on the incidence of PONV was not statistically significant. P=0.08. This is shown in table 11.

Table 10 DURATION OF ANAESTHESIA AND PONV

PONV	***<120 MINS***	***>120MINS***	**TOTAL**
NAUSEA	3	16	19
VOMITING	10	12	22
NONE	51	74	125
TOTAL	64	102	166

X^2= 4.86, DF=2, p=0.08

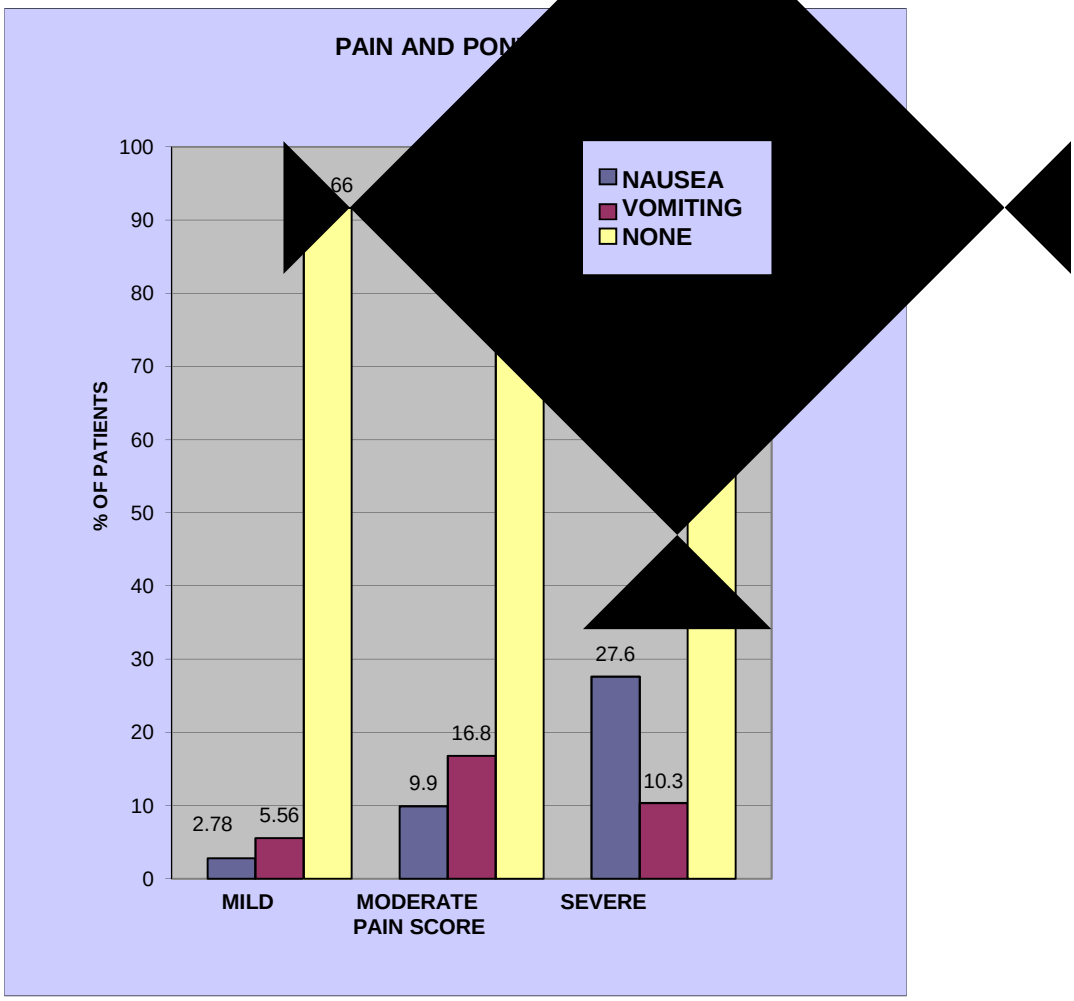
In the immediate postoperative period(within 2 hours), vomiting occurred more frequently than nausea as 7(4.22%) patients vomited while 3(1.81%) were only nauseated. Thereafter, 16(9.64%) had nausea only and 15(9.04%) vomited. Table 12

Table 11 24 HOURS POSTOPERATIVE PERIOD AND PONV

TIME AFTER SURGERY (HRS)	**NO OF PATIENTS (%) N=166**		
	NAUSEA	**VOMITING**	**TOTAL**
0-2	3(1.81)	7(4.22)	10(6.03)
>2-24	16(9.64)	15(9.04)	31(18.67)
TOTAL	19(11.45)	22(13.26)	41(24.70)

Figure 3 shows that, postoperative pain scores affected the incidence of PONV significantly. Thirty six patients (21.69%) had mild pain. One of them (2.78%) experienced postoperative nausea while 2(5.56%) vomited. One hundred and one patients(60.84%) had moderate pain and 10(9.90%) of them were nauseated while [redacted] vomited. Twenty nine patients(17.47%) had severe pain and 8(27.59%) were na[redacted]d while 3(10.34%) vomited. (p=0.007).

FIGURE 3



DISCUSSION

Postoperative nausea and vomiting (PONV) is one of the most common side effects of general anaesthesia.[22]The commonly reported incidence is between 1 and 43%.[22-26] This study reports the incidence of nausea of 11.45% while that of vomiting is 13.25%. This is lower than the 14.6% for nausea and 19.6% for vomiting reported by Soyannwo and others in Ibadan-Nigeria.[27] The lower incidence may be attributed to the anaesthetic agents used and the selection of patients. Most patients who vomited in the series were given nitrous oxide and pethidine as part of their general anaesthesia. A meta-analysis by Hartung [28]concisely summarized the results of several studies that convincingly argues for a positive association between nitrous oxide use and emesis. There are logical reasons for expecting PONV with nitrous oxide use. Both nitrous oxide and halogenated anaesthetics decrease lower oesophageal sphincter tone. Any of these agents may facilitate gas entering the stomach

during assisted mask ventilation. Belching, flatus, and gastric distention could then promote postoperative vomiting.

The patients in this study had routine overnight preoperative fast for elective surgery as practiced in our centre while the Ibadan study consisted of both fasted and unfasted patients for elective and emergency surgery respectively. The incidence rates reported both in this study and that of Ibadan, are however, lower than that reported in many Caucasian studies. Racial differences may play a role in the reduced incidence of PONV in Africans, [27,29] Bassey while studying gastroesophageal reflux found that, the lower oesophageal sphincter in Nigerians lies completely in the intra-abdominal position while that of Caucasians lies astride the oesophageal hiatus.[30] The lower oesophageal sphincter is important because it prevents reflux of gastric contents into the oesophagus and hence regurgitation or vomiting with the associated risk of aspiration particularly in recumbent and semiconscious subjects. Inhalational anaesthetics produce a reduction in the lower oesophageal sphincter pressure. This is seen in nitrous oxide with oxygen and is enhanced by the presence of halothane or enflurane.[31]
It is a recognized fact that preoperative fasting reduces the incidence of regurgitation and aspiration during general anaesthesia.[23,] A relatively empty stomach will not enhance vomiting even though nausea may be felt by the patient.[22] The patient with a full stomach is susceptible to postoperative emesis. Eating and digestion trigger the release of gastrointestinal tract hormones that may sensitize the area postrema in the brain stem and facilitate emesis. [32]

Gynaecological patients have been reported in several other studies to exhibit a high incidence of PONV.[33, 34] This study revealed that a greater percentage of gynaecological patients experienced PONV than their non-gynaecological counterparts. However, the difference between gynaecological and non-gynaecological patients in this study was not statistically significant. Incidences as high as 58% have been reported following major gynaecological surgeries.[21] Visalyaputra et al[35] reported 32% incidence of nausea in patients for gynaecological laparoscopy while vomiting occurred in 35% of cases in a study conducted in Thailand. In this study, 12.5% of the gynaecological patients had only nausea while vomiting occurred in 17.86% cases. Women are 2 – 4 times more likely to suffer PONV than men, and their symptoms may be more severe.[35] Our study confirms this finding as evident by postoperative vomiting and nausea of 18.42% and 11.40% respectively in women. The incidence of postoperative nausea and vomiting in males taken separately was 11.54% and 1.92% respectively. The greater incidence and severity of PONV in women may be linked to female hormones, as it has been found that most PONV occurs in the luteal phase of menstrual cycle [19-21]. There is no gender difference of PONV in children and elderly.[19-21] In our study, women below 50 years had 20.41% incidence of postoperative vomiting and 11.22% incidence of nausea while older women had a 12.5% incidence of vomiting and 6.25% of nausea. The mean menopausal age in our environment has been given as 48 years.[36] From this study, PONV appears to occur more frequently among premenopausal women.

Postoperative pain, particularly visceral and pelvic is associated with PONV.[19-21] In this study, there appeared to be a significant relationship between the severity of pain and the occurrence of PONV. The incidence of postoperative nausea and vomiting increased progressively with the severity of pain. Opioids are used to relieve moderate to severe pain but nausea and vomiting are their unwanted side effects. In the presence of severe pain however, opioids rather than acting as a causative factor of PONV, may help to ameliorate the severity.[10, 11, 21]Throughout the period of this study, potent opioids such as pethidine, morphine, fentanyl and alfentanil were unavailable. Pentazocine and subanaesthetic doses of ketamine were used for intraoperative analgesia. Pentazocine was associated with a higher incidence of PONV than ketamine. Pentazocine is an opioid agonist-antagonist and partial agonist. It has powerful agonistic actions at kappa opioid receptors as well as weak antagonist action at delta and mu receptors.[10] Nausea and vomiting are reported among the side effects of pentazocine but it is said to be less common than morphine.

The rate of recovery from anaesthesia also affects the incidence of PONV as sedation itself suppresses the emetic reflex. [21]Hence if recovery is rapid, the patient may reach a state of arousal where emesis can be triggered before the emetic stimuli have subsided. In addition,

when the patient becomes conscious, he will be aware of his condition and able to perceive and report nausea and pain. There may also be mismatched visual and vestibular inputs. In addition, the feeling of being out of control of the body, lightheaded and dizzy can make some patients anxious.Removal of such inputs may go some way to explaining why long periods of postoperative sleep may reduce the incidence of PONV.In this study, the use of sodium thiopentone for induction was associated with a higher incidence of PONV than ketamine hydrochloride. This differs from the observation of Thompson et al who found that ketamine is associated with more postoperative emesis than thiopentone or propofol.[37] Watcha and colleagues in 1992 however, pointed out that the frequent assumption that ketamine causes postoperative emesis could not be supported.[38] Boysen et al[39] have shown a higher incidence of PONV with thiopentone induction when compared with propofol.[40] Propofol has been recommended for day care procedures because of prompt recovery and its antiemetic property.

Patients paralysed with pancuronium in this study, were more likely to have PONV than those who were not paralysed (P=0.004). Muscle relaxants on their own do not have effects on PONV.[10]Antagonism of residual neuromuscular block with a mixture of neostigmine and atropine increased emesis despite the antiemetic action of atropine.In this study, all the 119 patients who received pancuronium were given neostigmine and atropine at the end of surgery to reverse its action. Neostigmine has been said to have significant emetic properties.[41] It is possible that its use caused the increased incidence of PONV observed among the patients who were paralysed. The presence of an endotracheal tube even without the use of muscle relaxants and subsequent reversal contributes to emesis in the postoperative period even though the tube is removed. This is induced by mechanical stimulation of the pharynx resulting in activation of glossopharyngeal afferents projecting to the brain stem. It has been reported that PONV is greater in patients maintained with an orotracheal tube than with a nasotracheal tube. This difference is ascribed to the angle at which the tube impacts the pharynx and presumably relates to different regional sensitivities for evoking the gag reflex from the pharynx.[21]

The experienced anaesthetist has fewer patients who suffer PONV than the inexperienced. This may result from a tendency of the inexperienced to maintain deeper levels of anaesthesia. Manual ventilation of the lungs using a face mask before tracheal intubation was associated with more nausea and vomiting when it was performed by an inexperienced anaesthetist compared with an experienced one.[42] This effect persisted for up to 6 hours after operation. The authors suggested that it may result from inadvertent distension of the stomach with anaesthetic gases.In this study, there was a 1.81% incidence of nausea and 4.22% incidence of vomiting in the first 2 postoperative hours. This constituted 24.39% of the entire PONV recorded in 24 hours. In a paediatric population reported by Amponsah, 31% of PONV occurred in the first 2 hours after surgery.[24] The same author stated that this is a very critical period for patients as they may still be under the influence of anaesthetic drugs with a high risk of aspiration. The fact that postoperative emesis occurs beyond the recovery room emphasizes the need for functional suction machines in surgical wards and competent adults to accompany patients home after day care surgery.The obese, urology,and otorhinolaryngology patients are commonly held by some authors to have increased incidences of PONV which was not the case in this series. Apfel et al[21]in a study published in 2012, concluded that there is no or insufficient evidence for a number of commonly held factors, such as preoperative fasting, menstrual cycle, and surgery type, and using these factors may be counterproductive in assessing a patient's risk for PONV.
Regional anaesthesia causes less nausea and vomiting than general anaesthesia though regional anaesthesia does not eliminate PONV.[35] Bridenbaugh et al[40] for instance, reported 38% incidence of nausea and vomiting after general anaesthesia for laparoscopy but only 4% when using epiduaral anaesthesia. Nausea and vomiting also occur following spinal anaesthesia as a result of hypotension and the incidence increases with a high spinal block. Ephedrine is effective in reducing emesis during spinal anaesthesia by preventing hypotension. Most of the nausea and vomiting associated with regional anaesthesia occur intraoperatively, but it may extend into the recovery room phase.

The medical impact of postoperative nausea and vomiting is said to be minor because it never becomes chronic and almost never kills although prolonged vomiting may lead to more

serious complications in rare cases. Postoperative nausea and vomiting may have an economic impact. As more patients undergo surgery under day care conditions, the humanitarian and economic implication of PONV are becoming increasingly important.[43]From the patient's perspective, it interferes with the patient's comfort. Surgical patients reported the fear of suffering PONV more often that the fear of postoperative pain.[21] Tramer.[44] stated that nausea and vomiting are biologically different phenomena. Nausea is not "a little vomiting". They should be reported and analysed separately.

Data on the risk factors and the underlying risk of PONV usually comes from clinical reports and so there still exists many unanswered questions. Randomized controlled trials on the incidence of PONV give inconsistent results which may be influenced by sex, age, race, nature of surgery and the drugs used.[21]It is still poorly understood why some patients vomit after surgery and others do not under similar conditions. Despite efforts to identify patient dependent and patient independent risk factors for PONV, the true underlying risk of PONV in the individual patient remains unpredictable.

Limitations of the study

Nitrous oxide was not available during the period of this study and so its effect does not form a part of these results.Attempt to use neuromuscular blockers without reversal at the end of surgery was not made. This could have been done using Atracurium which is degraded spontaneously in plasma or by monitoring residual neuromuscular blockade using nerve stimulators. The use of these would have verified or disproved the assertion that neostigmine reversal rather than the use of muscle relaxant increases the incidence of PONV.The effect of regional anaesthesia was not evaluated as the study concentrated on patients given general anaesthesia.

Possibilities for future research

The incidence of PONV needs to be further studied not only in adult patients in Nigeria but also in the paediatric age group and where other techniques of anaesthesia apart from general anaesthesia are employed. The current increased use of regional anesthesia and day case surgeries in our hospital will necessitate further clinical research in PONV and particularly in postdischarge nausea and vomiting (PDNV).The most recent development in PONV pharmacology is Aprepitant(SubstanceP receptor antagonist which acts by blocking NK_1 receptor). More studies are needed to be conducted for guidelines in our environment for these antiemetics. This will assist in the identification of risk factors with a view to minimizing the incidence. Prevention of PONV will achieve better patient comfort postoperatively.

CONCLUSION

In this study, the overall incidence of postoperative nausea was 11.45% and vomiting 13.25% of the 166 patients studied. There was no significant difference in the incidence of postoperative nausea and vomiting between gynaecological and non gynaecological patients (P=0.408). Sex had more influence on the incidence with females having 11.4% incidence of postoperative nausea and 18.42% operative vomiting while males had 11.54% and 1.92% incidences of postoperative nausea and vomiting respectively. Premenopausal females had a greater incidence of PONV than their postmenopausal counterparts. Sodium Thiopentone induction was associated with a greater incidence of PONV than induction using Ketamine Hydrochloride (P=0.04). Postoperative nausea and vomiting occurred more frequently among patients who were paralysed than those who were not. Moderate to severe postoperative pain increased the incidence of PONV significantly (P=0.007).

Recommendations[DRG5]

Women especially those who are premenopausal and patients with past history of PONV scheduled for surgery under general anaesthesia should have prophylactic balanced antiemesis preferably before extubation.The use of neuromuscular monitoring devices may eliminate the use of reversal agents and thereby prevent PONV. This is because in the absence of opioids or nitrous oxide, patients given general anaesthesia may have to be paralysed for most procedures except very superficial ones to ensure a smooth anaesthesia and surgery.Adequate postoperative analgesia will also reduce the incidence as pain has been found to be a significant factor in the occurrence of postoperative nausea and vomiting.

CONSENT All authors declare that informed consent was obtained from all the 166 patients for the purpose of this study.

ETHICAL APPROVAL The Health Research Ethics Committee of the University of Calabar Teaching Hospital gave approval for this study.

REFERENCES

1. Knapp M R, Beecher H K. Postanaesthesia nausea, vomiting and reteching.JAMA 1956; 160:376-385

2. Kortilla K. The study of Postoperative nausea and vomiting. Br J Anaesth 1992; 69 (suppl.): 20s-23s.

3. Snow J. On Narcotism by the inhalation of vapours, edn. 1991. London: Royal Society of Medicine Services Ltd., 1848.

4. Price HL, Circulatory actions of general anaesthetics. Clin Pharmacol Ther 1961:2:163

5. Cookson R. F: Mechanisms and treatment of postoperative nausea and vomiting. In: Davies C J, Lake-Bakaar G V, Grahame-Smith D G(eds).Nausea and vomiting: Mechanisms and treatment. Berlin, Springer-Verlag: 1986. P. 130-50

6. Kapur P A. The big “little problem”. Anesth Analg 1991; 73: 243-245

7. Scacel M, Sengupta P, Plantevino M. Mobidity after day case laparoscopy. A comparison of two techniques of tracheal anaesthesia. Anaesthesia 1986; 41: 537 – 541

8. Wetchler B V. Post-operative nausea and vomiting in Day case surgery.Br J Anaesth 1992; 69 (suppl.): 33s – 39s.

9. James R H: Day case Anaesthesia. In: Aitkenhead A R, Smith G (eds).Text book of Anaesthesia. 2nd edn. UK: Longman Group Ltd.; 1990. P. 519-25

10. Horn CC, Wallisch WJ, Homanics GE, Williams JP. Pathophysiological and neurochemical mechanisms of postoperative nausea and vomiting.Eur. J.Pharmacol 2014; 722: 55-66

11. Moon YE. Postoperative nausea and vomiting. Korean J. Anesthesiol 2014; 67(3): 164-170.

12. Sia AT, Lim Y, Lim EC, Goh RW, Law HY, Landau R et al. A118G single nucleotide polymorphism of human mu-opioid receptor gene influences pain perception and patient-controlled intravenous morphine consumption after intrathecal morphine for postcesarean analgesia .Anesthesiology 2008; 109: 520-526

13. Rueffert H, Thieme V, Wallenborn J, Lemnitz N, Bergmann A, Rudlof K etal Do variations in the 5-HT3A and 5-HT3B serotonin receptor gene(HTR3A and HTR3B) influence the occurrence of postoperative vomiting? Anesth. Analg 2009; 109:1442-1447.

14. Nakagawa M, Kuri M, Kambara N, Tanigami H, Tanaka H, Kishi Y et al. Dopamine D2 receptor Taq IA polymorphism is associated with postoperative nausea and vomiting. J. Anesth 2008; 22: 397-403.

15. Kolesnikov Y, Gabovits B, Levin A, Volke E, Veske A. Combined catech-o-methyltransferase and mu-opioid receptor genepolymorphism affectsmorphine postoperative analgesia and central side effects. Anesth. Analg 2011; 112: 448-453.

16. Hikasa Y, Ogasawara S, Takase K, . Aipha adrenoceptor subtypesinvolved in the emetic action in dogs. J. Pharmacol Exp Ther 1992; 261: 746-754.

17. Choi EM, Lee MG, Lee SH, Choi KW, Chio SH, Association of ABCB1 polymorphism with the efficacy of ondansetron for postoperative nausea and vomiting. Anesthesia 2010; 65: 996-1000.

18. Wesmiller SW, Henker RA, Sereika SM, Donovan HS, Meng L, Gruen GS et al. The association of CYP2D6 genetype and postoperative nausea and vomiting in orthopedic trauma patients. Biol Res Nurs 2013; 15: 382-389.

19. Apfel CC, Laara E, Koivuranta M, Greim CA, Roewer N. A simplified risk score for predicting postoperative nausea and vomiting: conclusions fromcross validations between two centers. Anesthesiology 1999; 91: 693-700.

20. Koivuranta M, Laara E, Snare L, Alahuhta S. A survey of postoperative nausea and vomiting. Anesthesia 1997; 52:443-449.

21. Apfel CC, Heidrich FM, Jukar-Rao S, Jalota L, Hornuss C, Whelan RP etal. Evidence –based analysis of risk factors for postoperative nausea and vomiting.. Br J Anaesth 2012; 109:742-753

22. Cohen MM, Cameron CB, Duncan PG. Pediatric anaesthesia morbidity and mortality in the peri operative period. Anesth Analg 1990; 70:251-254.

23, Rowley MP, Brown TCK, Post-operative vomiting in children. Anaesth Intensive care 1982; 10:309-313.

24. Amponsah G. Postoperative nausea and vomiting in children in Tuen mun Hospital, Afr J Anaesth Int care. 1997:3:47-49

25. Cohen MM, Duncan PG, Pope WDB, Biehl D, Tweed WA, Mac William L. Merchant RN. The Canadian four centre study of anaesthetic outcomes: 11. Can outcome be used to assess the quality of anaesthesia care? Can J Anaesth 1992; 39:430 – 439.

26. Muir JJ, Warner MA, Offord KP, Buck CF, Harper JV, Kunkel SE. Role of nitrous oxide and other factors in postoperative nausea and vomiting: aq randomized and blinded prospective study. Anesthesiology 1987; 66:513-518

27. Soyannwo OA, Ajuwon AJ, Amanor – Boadu SD, Ajao OG,. Postoperative nausea and vomiting among Nigerians. East Afr med J 1998; 75:240-242.

28. .Hartung J. Nitrous oxide is enough to make you vomit. Anesthesiology 1993; 78:403-405.

29. Oduntan SA, Akinyemi OO. Postoperative vomiting in the African. West Afr Med J 1970;:176-179

30. Bassey O O. A Mathematical hypothesis that the location of the lower oesophageal sphincter affects its ability to control gastro-oesophageal reflux. West Afr J Surg. 1979; 3:116-122.

31. Coton BR, Smith G. The lower oesophageal sphincter and anaesthesia Br J Anaesth 1984; 56:37-46.

32. Carpenter DO, Neural mechanisms in emesis. Can J Physiol Pharmacol 1990,68:230-236.

33. Pierre S, Benias H, Pouymayou J. Aftel's simplified score may favorably predict the risk of postoperative nausea and vomiting. Can J. Anaesth 2002, 49: 237-242.

34. Stadler M, Bardiau F, Siedel L, Albert A, Bongaerts JG. Difference in risk factors for postoperative nausea and vomiting. Anesthesiology 2003, 98:46-52.

35. Visalyaputra S, Petchpaisit N, Somcharroch K, Choavaratana R. The efficacy of ginger root in the prevention of postoperative nausea and vomiting after outpatient gynaecological laparoscopy. Anaesthesia 1998; 53: 506 – 510.

36. Okonofua FE, Bamgbose JK, Lawal AA. Features of menopause and menopausal age in Nigerian Women. Int J Gynaecol Obstet 1990; 32:234-245

37. Thompson G E, Remington J M, Milman B S, et al. Experiences with outpatient anaesthesia Anesth Analg 1973; 52:881-887.

38. Watcha MF, White PF. Postoperative nausea and vomiting. Anesthesiology 1992; 771:162-184.

39, Boysen K, Sanchez R, Krintel J J, Hansen, Haar PM, Dyrberg V.Induction and recovery characteristics of propfol thiopentone and etomidate. Acta Anaesthesiol Scand 1989; 33:689 – 692.

40. Bridenbaugh LD, Soderstrom RM,. Lumbar epidural block anaesthesia for Outpatient laparoscopy. J Reprod Med 1979; 23:85-86.

41. King ML, Milazkiewicz R Carli F, Deacock AR. Influence of neostigmine on postoperative vomiting. Br J Anaesth 1988; 61:403 – 406.
42. .Hovorka J, Korttila K, Erkola O. The experience of the person ventilating the lung does influence postoperative nausea and vomiting. Acta Anaesthesiol Scand 1990; 34:203-205
43. Eberhart LHJ, Hogel J, Seeling W, Staack A.M, Geldner C, Georgieff M. Evaluation of three risk scores to predict postoperative nausea and vomiting. Acta Anaesthesiol Scand 2000: 44:480-488.
44. Tramer MR, Fuchas-Buder T. Omitting reversal of neuromuscular blockade: effect on postoperative nausea and Vomiting and risk of residual paralysis. A systematic review. Br J Anaesth 1999; 82:379-386

APPENDIX I

QUESTIONNAIRE/DATA SHEET

1. [DRG6]Name of Patient
2. Age
3. Sex
4. Hospital No.
5. Weight
6. Height
7. Body Mass index
8. PCV
9. History or Motion sickness
10. History of PONV
11. Physical status
12. Premedicant
13. Induction agent
14. Analgesic
15. Muscle relaxant
16. Reversal
17. Type of Surgery
18. Method of Anaesthesia
    (1) Face mask
    (2) Endotracheal
    (3) Relaxan

19. Duration of Anaesthesia

20. Time of recovery

SYMPTOMS	0-2 HRS	2-24 HRS
NAUSEA RETCHING VOMITING		
Pain Score Mild Moderate Severe		