



**EFFICACY OF INTRAVENOUS FLUID ON PREVENTION OF POST-OPERATIVE
NAUSEA AND VOMITING FOR THYROIDECTOMY PATIENTS AT AYDER
COMPREHENSIVE SPECIALIZED HOSPITAL MEKELLE UNIVERSITY, NORTHERN
ETHIOPIA**

Kore Menjie Benwu*, Hagos Gebregziabher Gebremedhinand and Dessaleng Belay Mihrete

Mekelle University College of Health Science Department of Anesthesia.

***Corresponding Author: Kore Menjie Benwu**

Mekelle University College of Health Science Department of Anesthesia.

DOI: 10.20959/ejpmr20175-2903

Article Received on 28/02/2017

Article Revised on 20/03/2017

Article Accepted on 10/04/2017

ABSTRACT

Background: Nausea and vomiting are commonly happening complications after thyroidectomy surgery. Pulmonary aspiration, fluid and electrolyte disturbances are the early complications of nausea and vomiting which could be happen after thyroidectomy surgery. Although there are many anti-emetics drugs are available but benefit is observed on few of them and some of the drugs have life threaten complications. **Objective:** The aim of this study was to assess the efficacy of bolus intravenous fluid for the prevention post-operative nausea and vomiting at, Mekelle University Ayder comprehensive Referral Hospital. **Methodology:** Cohort study was carried out at Mekelle University Ayder comprehensive Specialized Referral Hospital from August 30–December 30, 2016 using probability sampling technique. **Result:** Incidence rate of nausea and bolus intravenous preoperative fluid administration was significantly associated in which incidence of nausea in non-exposed group was 2 times more likely to happen when compared to patients in exposed group in late postop time. Number of vomit was also statically associated with the pre-operative fluid administration of the patient ($p < 0.05$). Regarding to anti-emetic used patients assigned in the non-exposed group were subjected for antiemetic 3 times more than patients those who were assigned in the exposed group in late postop time. **Conclusion and recommendation:** The incidence rate of post-operative nausea and vomiting and anti-emetic used in each phase of post-operative period was highly associated with pre-operative administration of intravenous fluid in the bivariate analysis, further studying mainly addresses on amount of bolus fluid should be considered.

KEYWORDS: Anesthesia, postoperative, fluid, preoperative.

INTRODUCTION

Postoperative Nausea and Vomiting (PONV) are two of the most common and unpleasant side effects following anesthesia and surgery. It defined as nausea and vomiting occurring with-in 24 hrs after surgery which affects between 20% and 30% of ASA I and II patients; the figure will increase to 70-80% for ASA III and above patients. PONV results in increased patient discomfort and dissatisfaction and in increased costs related to length of hospital stay. Serious medical complications such as pulmonary aspiration, although uncommon, are also associated with vomiting^[1].

Patients often express fear about PONV when questioned before surgery. Its importance compared with other possible postoperative sequelae varies but is generally high. When questioned about issues of concern, 22% of 800 patients gave PONV the highest level of concern, compared with 34% for postoperative pain and 24% for waking up during surgery^[2]. Anaesthesia has become remarkably safe, and while death and permanent damage

have become rare occurrences, other sequelae of anaesthesia are gaining more importance. Postoperative nausea and vomiting still is the most troublesome adverse event encountered in the Post Anaesthesia Care Unit (PACU), despite advances in prevention and treatment^[2].

Ambulatory surgery and anesthesia can offer a large number of advantages to patients, health care providers and hospitals. However, it is unfortunately associated with a number of unpleasant postoperative experiences such as pain, nausea, vomiting, dizziness and thirst it is not effective way. Short acting anesthetic agents have provided major advantages in the field of acute pain. However, despite the availability of new antiemetic agents, the incidence of other postoperative adverse effects, especially nausea and vomiting, has remained significantly unchanged^[3].

Although there are many antiemetic medications available for PONV prophylaxis, a quantifiable benefit is

observed only in a fraction of patients, and the use of some of these drugs may be costly and/or associated with adverse events such as headache, cardiac arrhythmia, or extrapyramidal symptoms^[4, 5].

It is a routine practice to keep patient fasting overnight before surgery; this combined with anesthetic and surgical losses results in state of transient and relative gut ischemia through mesenteric hypoperfusion, perioperative. Therefore Gut hypoperfusion has been identified as one of the many factors responsible for PONV^[5, 6].

Studies were conducted in different countries and most of them come up to a conclusion that administration of intravenous fluid has significant role on the prevention of post-operative nausea and vomiting. However, there is a conflict among the literature on the duration of the prevention. Some of the authors agree administration of intravenous fluid decrease PONV only in early post-operative period while the others agree on it can prevent the whole post-operative time^[12-14]. Thus the significance of this study is to assess the efficacy of intravenous fluid on prevention of post-operative nausea and vomiting at Ayder comprehensive specialized hospital Mekelle University Northern Ethiopia to support evidence based practice.

MATERIALS AND METHODS

Study design, area and period

A cohort study was conducted among patients who were scheduled for thyroidectomy procedure from surgical ward using structured interview questionnaire using simple random sampling technique. The study was conducted from August 30-December 30, 2016 Mekelle university Ayder comprehensive specialized Referral Hospital.

Sampling

Sample size was calculated using Epi-info software version 7 for cohort study design on efficacy of intravenous fluid for the prevention of PONV in exposed and non-exposed groups was 4.6% and 30% respectively using information obtained from a published research article done by Kathy G *et al.*^[14]. Assuming marginal error 0.05 and 10% non-respondent rate; accordingly, the estimated sample size was 89. From these patients 31 of them become from exposed group and 58 patients became non-exposed group.

Data collection

Pre-tested structured questionnaire was prepared by reviewing previously done studies on the topic of efficacy of intravenous fluid on prevention of post-operative nausea and vomiting^[1, 15-17]. The questionnaire was first prepared in English and then translated into Amharic, then to Tigrigna which is the local language of the patient in the study area. The data were collected using structured interviewer administered questionnaire prepared to address demographic character of the patients, clinical factors which can affect the incidence

rate of PONV and incidence rate of PONV in different phase. The questionnaires were administered to all patients whose age is greater or equal to 18 years, Eighteen year was selected because patient below this age is highly susceptible for post-operative nausea and vomiting according to most literatures, who were scheduled from wards during the data collection period, and who volunteered to participate in the study and those of who fulfilled the inclusion criteria were interviewed in the morning of the surgery and after surgery in the PACU and wards^[4]. In addition, patients provided demographic information including age, gender, Body Mass Index (BMI), fasting time, anti-emetic used, smoking history, Last Menstrual Period (LMP), and ASA class. The questionnaire also contained questions which can affect the incidence of PONV such as blood loss, and dose of reversal agents. And the questioner had also a part which was prepared to assess incidence rate of PONV, pain score, anti-pain and anti-emetic used in the different phase of post-operative time. Patients those who get bolus crystalloid fluid by the anesthesia provider assign as exposed group and patients those who don't get any additional fluid assign as non-exposed group.

Data quality control

Data were collected by two senior anesthetists after one day training was given about the objectives and procedures of the data collection by the investigators. Questionnaire was pre-tested was done on 5 % of the patients a week before the actual data collection time to assess clarity, understand ability, flow and consistency, and revised prior to the start of data collection. Data completeness and consistency was checked by the investigators. Data cleaning and editing took place; missed values were statistically handled to help address concerns.

Data analysis

Data were entered using Epi Info version 7 and exported to, and then analyzed using SPSS version 20. First, descriptive statistics were carried out to explore the socio-demographic characteristics of patients, and the results were summarized as frequencies and percentages between exposed and non-exposed group, binary and multiple logistic regressions were employed. Variables associated with incidence rate of PONV in bivariate analyses were included in the multiple logistic models and P-values less than 0.05 were considered to be statistically significant in all cases.

Operational Definitions

Early post-operative time: early post-operative time is used starting from the time when the patient reaches to post anaesthesia care unit to six hours.

Late post-operative time: Late post-operative time was considered from six hours of patient reach to post anaesthesia care unit to twenty four hours.

Ethical consideration

After the purpose of the study was explained, a written informed consent was obtained from patients before data collection. Patients were informed that participating in the study was voluntary and that refusal to participate would not compromise the medical care or the surgical care. The right to withdraw from the study at any time was also assured. The interviews were conducted in a private room in the patient preparing room to ensure privacy. Coding was used to eliminate names and other

personal identification of respondents throughout the study process to ensure participants confidentiality.

RESULT**Socio demographic status of patients**

From a total of 89 respondents, all were included in the study as they were complete and showed consistency of response. Complete study analysis was done for 89 patients, with response rate of 100%. Demographic characteristics (age, sex, BMI), NPO time and amount of blood loss are shown in table1.

Table 1: Shows demographic status of operated patient at Ayder comprehensive specialized hospital Mekelle University, Northern Ethiopia, 2016.

Variables	Exposed group		Non-exposed group		P value
	Frequency	percent	Frequency	percent	
Age (yr.)	41.43	25-56*	43.67	22-65*	
Sex Male	14	45.18	24	41.38	0.987
Female	17	54.82	34	58.62	0.790
Total	31	100	58	100	
BMI(kg/cm ²)	22.84	17-26**	21.67	15-29**	0.801
NPO time(hr.)	10.01	10-16***	11.21	7-14***	0.891

*= age range

**=body mass index range

***=NPO time

As shown above from the table, from total eight nine patients 38(42.70%) were males and 51(57.30%) were females. There were no base line difference between the two groups in terms of Age, BMI and NPO hrs. The mean age in exposed group was 41.43(25-56) while it was 43.67 (22-65) in non-exposed group. Similarly the NPO time and BMI was comparable, which were 10.01

(10-16) and 22.845 (17-26) in exposed group and 11.21(7-14) and 21.67(15-29) in non-exposed group respectively.

Clinical factors that affect incidence of PONV.

Clinical factors which affect the incidence of post-operative nausea and vomiting is summarized in Table 2.

Table 2: Clinical factors which affect the incidence of post-operative nausea and vomiting, in Ayder comprehensive specialized hospital Mekelle, northern Ethiopia, 2016

Variables	Exposed group		Non-exposed group		P value
	Frequency	percent	Frequency	percent	
Amount of blood loss <500ml	26	83.87	43	74.14	0.8469
500-1000ml	5	16.13	15	25.86	
1000-1500ml	0	0	0	0	
>1500ml	0	0	0	0	
Total	31	100	58	100	
Dose of reversal agent < the recommended dose	12	38.71	19	32.76	0.5241
recommended dose used	19	61.29	39	67.24	
>the recommended dose	0	0	0	0	
Total	31	100	58	100	
Duration of surgery <1hour	6	19.35	13	22.41	0.4328
1-2hrs	25	80.65	43	74.14	
> 2hrs	0	0	2	03.45	
Total	31	100	58	100	
Duration of anaesthesia <1hour	6	19.35	13	22.41	
1-2hrs	25	80.65	43	74.14	0.4328
> 2hrs	0	0	2	03.45	
Total	31	100	58	100	

Using standard rule of blood loss measurements, blood loss was recorded in both groups. As shown from the

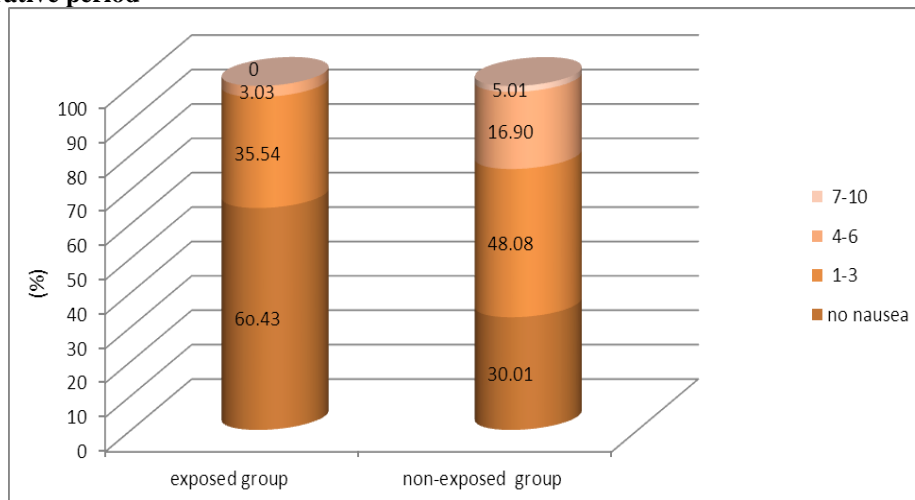
above table, out of eight nine patients 26(83.87%) and 43(74.14%) patients loss <500ml, 5(16.13%) and

15(25.86%) patients loss 500-1000ml. And none of the patients bleed greater than 1000ml. After the end of surgery before the extubation reversal agent was administered by the one who provide the anaesthesia and the dose of the reversal agent is recorded and out of 31 patients 12(38.71%) patients took less than the recommended dose and 19(61.25%) patients took the normal recommended dose in exposed group; similarly out of 58 patients 19(32.76%) patients received reversal agent which was less than the recommended dose and

39(67.24%) patients took the reversal agent which was the normal recommended dose in non-exposed group.

Concerning the anaesthesia and surgical time, 6(19.35%) and 13(22.41%) patient finished their operation and anaesthesia within one hour while 25(80.65%) and 43(74.14%) need one to two hours to complete their surgery and anaesthesia in exposed and non-exposed group respectively. and two patient in non-exposed group took greater than two hours to finish their operation and awake from the anaesthesia.

Incidences of nausea and vomiting in exposed and non-exposed group in early post-operative period
Early post-operative period

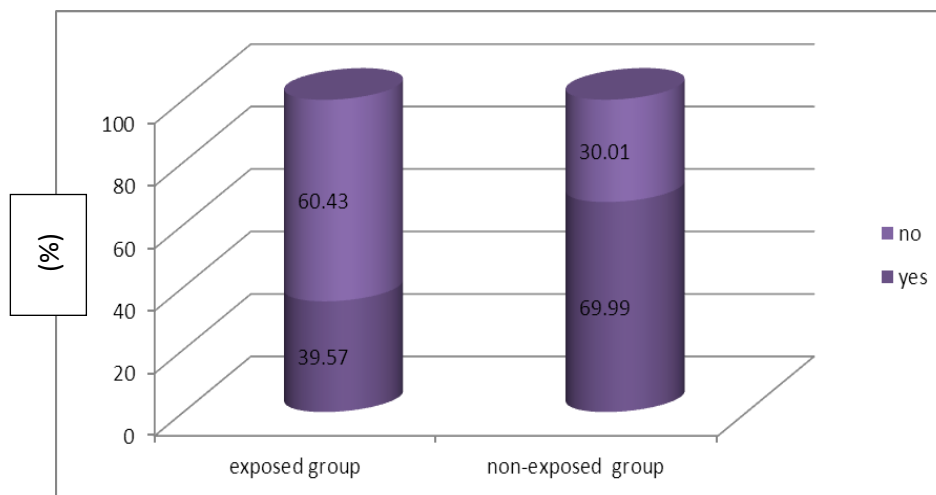


Nausea scale in early post-operative period peperiod.

Figure 2: shows nausea scale in exposed and control group in early post-operative time in Ayder comprehensive specialized hospital Mekelle, northern Ethiopia, 2016.

Using VAS 0- is considering as no nausea and 10 is considering as the worst imaginable nausea, nausea scale was recorded and 11(35.54%) and 28(48.08%) of the total patient had nausea scale of 1-3, 1(3.03%) and

9(16.90%) patients experienced nausea scale of 4-6 in exposed and non-exposed group respectively. And three patients from the non-exposed group had severd nausea with a nausea scale of 7-10.



Incidence rate of nausea in early post-operative period

Figure3: Incidence of nausea in early post-operative period in post anaesthesia care unit Ayder comprehensive specialized hospital Mekelle, northern Ethiopia, 2016.

As described in Figure3, from total 31 patients in exposed group 12(39.57%) patients experienced nausea and 41(69.99%) of 58 patients experience nausea in

non-exposed group. The severity of the nausea on VAS was recorded and described on fig.2.

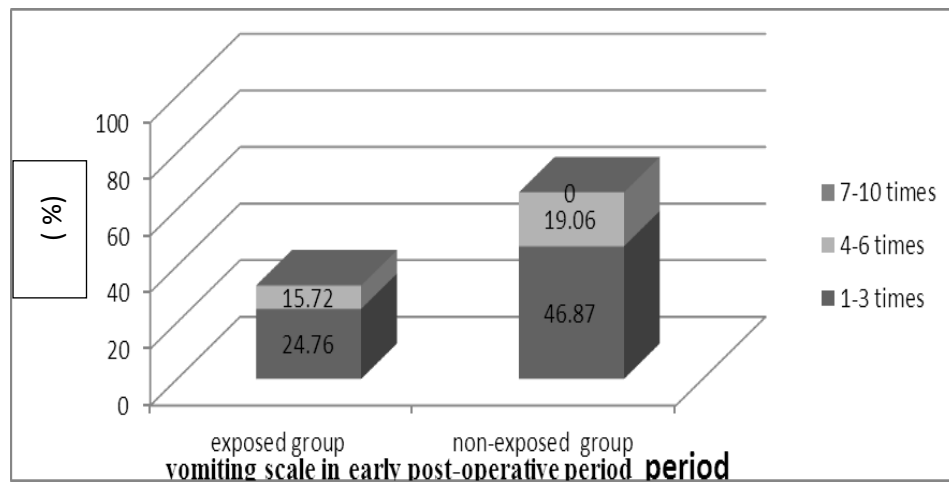


Figure 4: Incidence of early post-operative vomiting in Ayder comprehensive specialized hospital Mekelle northern Ethiopia.2016.

Starting from right after extubation number of vomits was recorded, from a total of 31 patients in exposed group 8(24.76) patients vomit 1-3 times, whereas out of 58 patients in non-exposed group 27(46.87%) patients

experienced vomiting 1-3 times and 5(15.72%) patients in exposed and 11(19.06%) patients vomit 4-6 times in early post-operative time.



Figure 5: Incidence of vomiting in early post-operative time in Ayder comprehensive specialized hospital Mekelle, northern Ethiopia 2016.

Similar to that of nausea, number of vomit in early post-operative time was recorded in both exposed and non-exposed group; out of 31 patients enrolled in exposed group 14(43.48%) patients experience vomiting whereas

out of 58 patients assigned in the non-exposed group 35(60.93%) patients had vomiting in early post-operative period.

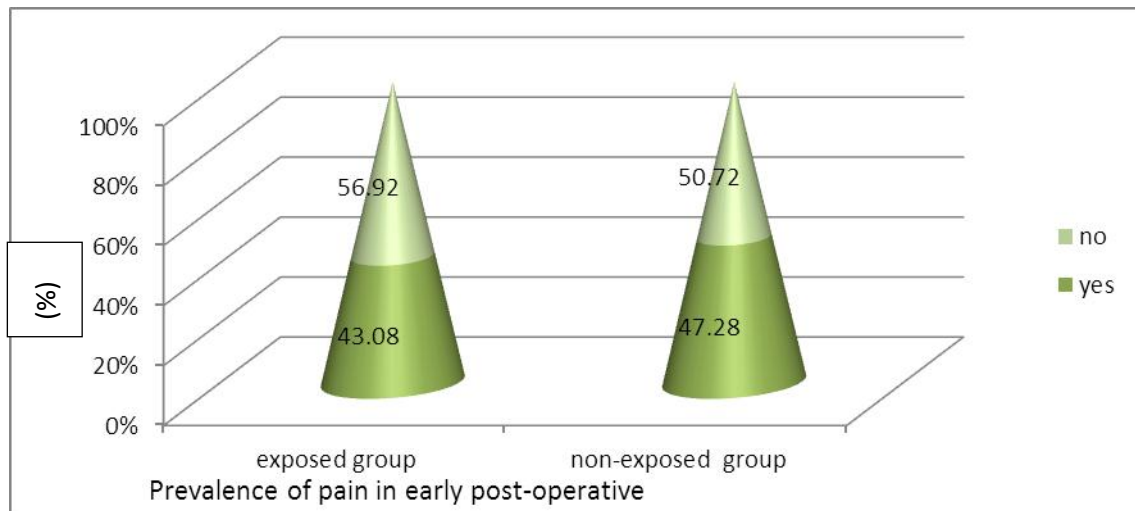
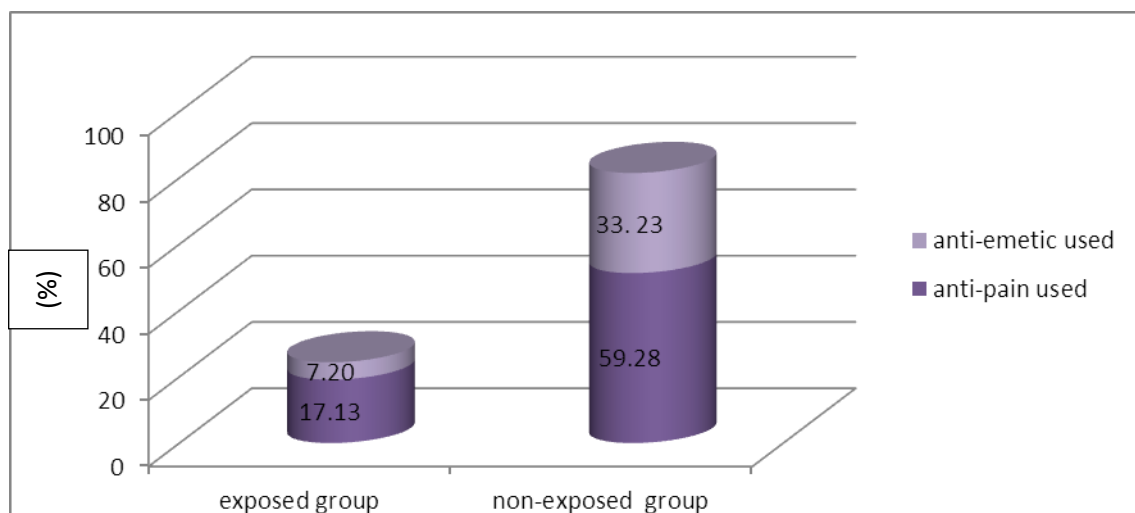


Figure 6: Prevalence of pain in early post-operative period in Ayder comprehensive specialized hospital Mekelle, northern Ethiopia 2016.

Using VAS, 0 is considering as no pain and 10 is considering as the worst imaginable pain, pain scale was recorded and patients were asked if they have pain or not, out of 31 patients randomized in exposed group

13(43.08%) patients had pain with a pain level of 1-3 on VAS and from all 58 patients assigned in non-exposed group 27(47.28%) patients had pain with similar pain level.



Anti- pain and anti-emetic use in early post-operative period

Figure 7: Anti-pain and anti-emetics used in early post-operative period in Ayder comprehensive specialized hospital Mekelle, northern Ethiopia, 2016

Anti-pain and anti-emetic was prescribed by the one who provide the anaesthesia whenever the patient complain of severe pain and if he/she have vomiting frequently, anti-pain and anti-emetic used was recorded. Figure 7 stated that, from all 31 patients grouped in exposed group

5(17.13%) patients took anti-pain and 2(7.20%) patient need anti-emetic to overcome the vomiting and out of 58 patients who were assigned to the non-exposed group 34(59.28%) patients needed anti-pain and 19(33.23) patients need anti-emetic to control the vomiting.

Late post-operative period**Table 3: Incidence rates of post-operative nausea, vomiting, pain and anti-pain and anti-emetic used in late post-operative period in Ayder comprehensive specialized hospital, northern Ethiopia, 2016.**

Variables	Exposed group	95% CI	Non-exposed group	95% CI	RR	P value
	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)		
Incidence rate of nausea	Yes 11(35.48)	13.22,51.04	38 (65.52)	53.40,78.16	2.00	0.0032
	No 20(64.52)	48.96,83.78	20(34.48)	18.59,46.14		
Total	31(100)		58(100)			
Incidence rate of vomiting	Yes 4(12.90)	13.22,51.04	20(34.48)	37.33,68.41	2.67	0.001
	No 27(87.10)	48.96,83.78	38(65.52)	34.68,60.67		
Total	31(100)		58(100)			
Pain	Yes 15(48.39)	30.15,66.94	19(32.76)	21.01,46.34		0.42
	No 16(51.61)	33.06,69.85	39(67.24)	53.66,78.99		
Total	31(100)		58(100)			
Anti-pain used	Yes 23(73.82)	55.39,88.14	30(51.78)	38.22,65.05		0.056
	No 8(26.18)	11.86,44.61	28(48.22)	34.95,61.78		
Total	31(100)		58(100)			
Anti-emetic usage	Yes 3(9.68)	0.32,18.70	19(32.76)	16.09,43.73	3.38	0.05
	No 28(90.32)	89.30,95.92	38(67.24)	60.29,79.19		
Total	31(100)		58(100)			

Bivariate analysis in the binary logistic regression model showed that the incidence rate of nausea and bolus intravenous fluid administration was significantly associated in which incidence of nausea in non-exposed group, which were not exposed to preoperative bolus of fluid, was 2 times more likely to happen when compared to patients in exposed group, those who were exposed to pre-operative bolus intravenous fluid administration (RR=2.00 [95% CI 13.22, 51.04]). Number of vomit was also statically associated with the pre-operative fluid administration of the patient ($p < 0.05$). Regarding to anti-emetic used patients assigned in the non-exposed group were 3 times more antiemetic used than patients those who were assigned in the exposed group (RR=3.38 [95% CI 16.09, 43.73]). From all 31 patients 15(48.39) from expose group and 19(32.36) patients from non-exposed group experienced different level of pain and concerning to the frequency of the pain among the group it was not statically significant ($p > 0.05$). Despite the prevalence of pain in both groups is similar, the anti-pain used to treat the pain had not big discrepancy and it was not statically significant ($p > 0.05$).

DISCUSSION**DEMOGRAPHICAL FACTORS**

Due to hormonal and genetic factors the incidence rate of post-operative nausea and vomiting is high in female patients^[13]. And Obesity increases the risk of post-operative nausea and vomiting. Its effect may be partly explained by difficult in managing the air way in over weight individuals and greater risk of introduction of air in to the stomach and they may have an increased residual gastric volume and they are liable to have more gastro oesophageal reflex. Further, increased body fat serves as a larger reservoir for lipid soluble emetogenic anaesthetic agents. A body mass index of more than 30 in patients had been associated with increase in PONV. This may be due to an increased intra-abdominal pressure and the pharmacokinetic effects of lipophilic

anaesthetic agents having prolonged half-lives in these patients. An increased BMI may increase the incidence of PONV in patients with other independent risk factors^[14].

Concerning to the above two variables which are the sex and the body mass index among the two group was similar and it is not statically significant with a P value of 0.790 and 0.801 respectively.

EFFECT OF INTRAVENOUS FLUID**Early post operative period**

The incidence rate of post-operative nausea in this study in early post-operative period account 39.57% and 69.99% in the exposed and non-exposed group respectively. The result of this study was similar to study done in Ireland; from all patients 26.03% of nauseated patients in early post-operative nausea period found on patients who were infused low amount of pre-operative fluid when compare to 2.90% incidence rate of nausea on high dose of pre-operative fluid^[18]. Similar study was done in Saudi Arabia shows that 20% of patients had early post-operative nausea on control group when compare to 5% of patients who took exposed to high dose of intravenous fluid^[19]. The high incidence rate of nausea in this study could be explained by the induction agent used for anaesthesia in the reference study was Propofol which is a known anti-emetic agent from all IV induction agents while the induction agent in this study is thiopental and the type of surgery in this study is ENT which is highly associated with incidence of nausea and vomiting and the amount of fluid administration was high when compare to this study.

The incidence rate of early post-operative vomiting in this study was 43.48% and 60.93% in exposed and non-exposed group respectively. The finding of this study is come agreement with the others developed countries, incidence of early-post-operative vomiting in high and

low amount of fluid administered group in Canada found 5% and 22%^[17] and similar result was also found in Ireland, it was 27% and 60% in exposed and non-exposed groups^[18].

Anti-emetic used to overcome the vomiting in this study in early post-operative period was 17.13% in exposed group and 59.28% in non-exposed group. It was similar with study done in Saudi Arabia which was 25% and 70% in exposed and non-exposed group respectively^[19]. But the finding of anti-emetic used in this study was show a big difference with a study done in Canada which was 2.6% and 22.12% in high and low volume of pre-operative bolus amount of fluid administered group respectively^[17]. The possible reason for this big variation could be explained by opioids was given in Canada patients for post-operative pain control and opioid are a known emetogenic agents.

Late post-operative period

In the binary logistic regression model, association test was done to identify the efficacy of intravenous fluid on late post-operative nausea. In this study, the factor that was independently and significantly associated with incidence of late post-operative nausea, vomiting and anti-emetic used was administration of bolus pre-operative intravenous fluid.

The result of this study showed that incidence of nausea in the late post-operative period was significantly associated with administration of bolus per-operative intravenous fluid. Patients who were not took pre-operative fluid nauseated 2 times greater than of who were exposed to pre-operative fluid [RR=2.00(95%CI=53.40, 78.16)]. This was consistent with a study done in USA.^[6]

As to the association factors with exposure to fluid status, the binary logistic model showed that vomiting incidence is closely related to the amount of intravenous fluid exposed. Patients who were not exposed to pre-operative bolus fluid had vomiting 3 times more than that of patients who gained bolus of intravenous fluid [RR=2.67(95%CI=37.33, 68.41)]. This finding was in conformity with the result in USA^[6]. Similarly anti-emetic used in this study was highly associated with the exposure status of pre-operative bolus intravenous fluid. Patients who were not exposed to intravenous fluid was subjected for anti-emetic agents 3 times more than those patients who were not took pre-operative intravenous fluid [RR=3.22(95%CI 16.09,43.73)]

CONCLUSION

The incidence rate of PONV and anti-emetic used in early and late phase of post-operative period was highly associated with pre-operative administration of intravenous fluid in the bivariate analysis. Among Patients who were from exposed group 24.76% of the patients vomit 1-3 times and 15.72% of patient had 4-7 times. While patients from non-exposed group 46.87%

of the patients had vomiting 1-3 times and 19.06% of the patients had 4-6 times.

ACKNOWLEDGMENT

First and foremost, I would like to express my deepest heartfelt and grateful gratitude to my patients who were participating on my study and for their time the real information that they gave me.

I would like to thanks for all staffs of Mekelle university Ayder referral hospital who were work in study area for their unreserved support.

REFERANCE

1. Geoff Mc Cracken, MB, BCh, Patricia Houston, MD, Guylaine Lefebvre, MD, Toronto Guideline for the Management of Postoperative Nausea and Vomiting No. 209, July 2008.
2. Peter S.A. Glass Professor and Chair SUNY Stony Brook, Watcha MF, White PF. Roll of anaesthesiologists on prevention of post-operative nausea and vomiting 1992; 77: 162–184.
3. Medicines Advisory Committee, Oxford assessment of post-operative complication on surgical patients Radcliffe Hospitals September 2007, Volume 5 No. 2 (part I)
4. Alain Borgeat, M.D., Georgios Ekatodramis, M.D., Carlo A. Schenker, M.D. post-operative nausea and vomiting in regional anaesthesia ASA, 2003; 98: 530–47.
5. Abdul-Hameed Chohedri, Masood Matin, Abbas Khosravim.E.J. The Impact Of Operative Fluids On The Prevention Of Postoperative Anesthetic Complications In Ambulatory Surgery, Anesth 2006; 18(6).
6. C. C. Apfel1, A. Meyer1,2, M. Orhan-Sungur, L. Jalota4, R. P. Whelan1 and S. Jukar-Rao Supplemental intravenous crystalloids for the prevention of post-operative nausea and vomiting. Perioperative Clinical Research Core, Department of Anaesthesia and Perioperative Care, University of California Francisco, British Journal of Anaesthesia 2012; 108(6): 893–902.
7. Sujata Chaudhary, A.K. Sethi, Pomona Motiani & Chirag Adatia Pre-operative intravenous fluid therapy with crystalloids or colloids on post-operative nausea & vomiting Indian J Med Res 127, June 2008, pp. 577-581.
8. Tong J. Gan, MB, FRCA, FFARCSI assessment of risk factor for post-operative nausea and vomiting, Duke University Medical Centre, Durham, NC Anaesthesia, Analgesia 2006; 102: 1884 –98.
9. Dimick JB, Chen SL, Taheri PA, Henderson WG, Khuri SF, Campbell DA Jr. Hospital costs associated with surgical complications: a report from the private-sector National Surgical Quality Improvement Program. J Am Coll Surg. 2004; 199(4): 531-537.
10. Ishwar Bhukal, N Srinivas, Sohan Lal Solanki, LN Yaddanapudi, Amit Jain Department of Anaesthesia

- and Intensive Care, preoperative fluid administration for the prevention of post-operative nausea and vomiting, Postgraduate Institute of Medical Education and Research, Chandigarh, India <http://www.aeronline.org/text.asp> 2012/6/1/21/103366Year: 2012; 6(1): 21-24.
11. Kovac AL. Department of Anaesthesiology, University of Kansas Medical Centre, Kansas City 66160-7415, USA. Pre-operative intravenous fluid therapy with crystalloids or colloids on post-operative nausea & vomiting 2008; 127(6): 577-581.
 12. Royal College of Anaesthetists. Raising the Standard. 2000. Section 11.6 Acute Pain Services – Post Operative Nausea and vomiting <http://www.rcoa.ac.uk>
 13. Gladys Amponsah Department Of Anaesthesia, University of Ghana Medical School, effect of intravenous fluid on post-operative nausea and vomiting Ghana medical journal December 2007; 41(4).
 14. Current Concepts in the Management of Postoperative Nausea and Vomiting update anaesthesia British Journal of Anaesthesia 2010; 104(2): 158–66.
 15. Dr Gordon Yuill, Dr Carl Gwinnutt, A randomized study to compare the efficacy of two intravenous fluid regimens of normal saline on the incidence of postoperative nausea and vomiting Department of Anaesthetics, 14-Nov-2012.
 16. C M Ku, Ong Department of anaesthesia a Review of Current Literature on PONV Singapore Med J 2003; 44(7): 366-374
 17. J.J Manger, C Caule, E. Carton, J. Gardiner and D. Buggy Effect of intraoperative intravenous crystalloid infusion on postoperative nausea and vomiting after gynaecological laparoscopy: comparison of 30 and 10 ml kg⁻¹ British Journal of anaesthesia 2004; 93(3): 381-5.
 18. C. H. Maharaj, MB, BSc, FCARCSI, S. R. Kallam, MB, FCARCSI, A. Malik, MB, FCARCSI, P. Hassett, MB, FCARCSI, D. Grady, MB, FFARCSI and J. G. Laffey, MD, MA, BSc, efficacy of intravenous fluid on post-operative nausea and vomiting Department of Anaesthesia and Intensive Care Medicine, National University of Ireland. AANA Journal. April 2009; 77(2).
 19. Ahmed Turkistani, Khalid Abdullah, Essam Manaa, Bilal Delvi, Gamal Khairy, Badiah Abdulghani, Nancy Khalil, Fatma Damas, and Abdelazeem El-Dawlatly. Effect of fluid preloading on postoperative nausea and vomiting following laparoscopic cholecystectomy Department of Anaesthesia, College of Medicine, King Saud University, Kingdom of Saudi Arabia Saudi Journal of Anaesthesia. 2003; 50: 440–4. [PubMed]
 20. Marie Renard, MD, Edgard Engleman, MD Philippe Simon, MD postoperative nausea and pain in high risk patients anaesthesia and analgesia 2009; 108: 1788-93.
 21. Kazanci, D.; Yavuz, M. S.; Özgök, A.; Aydinli, B.; Cosar, A. European Journal of Anaesthesiology: Evidence-based Practice and Quality 12 June 2010; 27(47): 11.
 22. Susan Dabu-Bondoc, MD, Nalini Vadivelu, MD, Chantelle Shimonon, MSN, APRN, Annette English, PharmD, Boonsri Kosarussavadi, MD, Feng Dai, PhD, Kirk Shelley, MD, PhD and Jessica Feinleib, MD, PhD Reduces Postoperative Antiemetic Rescue Treatment Requirements and Post-anaesthesia Care Unit Length of Stay. 2000 Volume 4 Number 2. e-mail to susan.dabu-bondoc@yale.edu
 23. Kathy Guinn Lambert, CRNA, MSN preoperative fluid bolus and reduction of post-operative nausea and vomiting in patients undergoing gynaecological surgery AANA Journal. April 2009. Vol 77, No. 2 www.aana.com/aanajournal.aspx