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Effect of preloading of intravenous crystalloid fluids on postoperative nausea and vomiting

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Abstract

Introduction: Postoperative nausea and vomiting (PONV) are among the most common adverse events following surgery. Preoperative fasting combined with anesthesia & surgical losses results in state of transient & relative gut ischemia through mesenteric hypoperfusion, which has been identified as one of the factors responsible for PONV.

Methodology: A Total of 120 patients undergoing different kinds of surgeries under General Anesthesia were randomly allotted to 4 groups of 30 patients each to receive 5ml/kg, 10ml/kg, 20ml/kg IV preloading of crystalloid fluids (RL) 30 minutes before induction & No fluids in control group (Group C) to compare their effect on PONV.

Result: Incidence of Nausea was highest in Group 5 and it was lowest in group 10 (p value <0.05). Comparison of Nausea between Group 10 & Group 20 shows no statistically significant difference (P value >0.05). Similarly Comparison between Group 5 & Group C shows no significant statistical difference (p value is >0.05).

We had observed that incidence of Vomiting & requirement of rescue antiemetic drug was lowest in Group 10 followed by Group 20 & than Group 5 (p value <0.05).

No. of patients who required treatment for vomiting (VAS PONV Score >5) was lowest in Group 10(n-5) followed by Group 20(n-7). It was highest in Group C (n-28).

Conclusion: Preoperative preloading of IV fluid therapy in the form of Ringer's lactate 10mg/kg is a simple, cost effective and safe means to reduce the occurrence of postoperative nausea and vomiting.

Key Word: Nausea, vomiting, IV fluid, gut ischemia

Introduction

Postoperative nausea and vomiting (PONV) are among the most common adverse events following surgery and anesthesia leading to lot of distress, delayed discharge, increased cost of treatment and resources. [1]

PONV has been considered as the –"Big Little Problem". [2] It can manifest as nausea, vomiting and retching that may last from minutes to days. A number of risk factors have been identified for PONV are gender, type of

anesthesia, surgical procedure, and post operative factor. [3] It is more common in women than men, in younger than older patients.

Recent researchers suggest that dehydration may be a precipitating factor in the occurrence of PONV. [4] The risk of dehydration is greater in patients, who receive preoperative bowel preparation, the elderly, children, and patients with ascites, burns, trauma, bowel obstruction or peritonitis and those who undergo surgeries in the afternoon.

If vomiting is not controlled, it may lead to dehydration, electrolyte imbalance, tension on sutures, bleeding, evisceration, aspiration pneumonia, increased cost of treatment, delayed discharged & unplanned readmissions. [5,6]

It is routine practice to keep patient fasting overnight before surgery. This fasting combined with anesthesia & surgical losses results in state of transient and relative gut ischemia through mesenteric hypoperfusion, which has been identified as one of the many factors responsible for PONV. [7,8]

Aims of the Study

Our aim of the study was to access the effectiveness of preoperative preloading of intravenous crystalloid fluids (Ringer lactate) on postoperative nausea and vomiting, to access the severity of nausea and vomiting in all study groups at different time periods post-operatively and to observe complications and adverse effects if any.

Materials and Methods

The study was conducted in 120 patients belonging to either age between 18-70 years or sex of ASA grade I & II, undergoing surgeries of less than 3 hours of duration. Patients with history of motion sickness, past history of emesis following surgery and middle ear problems and abnormal electrolytes were excluded from the study.

Written informed consent from the patients and institutional ethical committee approval was obtained. Patients were kept NBM for 10 hours before operation.

No pre-medication was given in the ward.

The patients were divided into four groups for preloading of ringer lactate in different dosage. In group 5 –5 ml/kg IV Ringer's Lactate, group 10- 10 ml/kg IV Ringer's Lactate, group 20- 20 ml/kg IV Ringer's Lactate and in group C- No preloading of any type of fluid.

Preloading was done 30 minutes before induction in all the patients except in Group C. After taking the patient on the OT table, IV line was established with 18 G intravenous catheter. Monitoring was done in the form of ECG, pulse oximeter for SpO2 and NIBP.

Pre oxygenation was done with 6 liters/min for 5 minutes. Induction was done with inj. Glycopyrolate (0.004 mg/kg) and inj. Fentanyl Citrate (2 µg/ kg). General anesthesia was administered with inj. Thiopentone Sodium 7mg/kg IV and intubation was facilitated using inj. Succinyl choline 2mg/kg IV. Patients were ventilated with 100% O_2 and intubated with appropriate size oral portex cuffed endotracheal tube. Bilateral air entry was checked and tube was fixed. Nasogastric tube was inserted and stomach content was aspirated.

Anesthesia was maintained with 50% O_2 + 50% N_2O + Isoflurane with controlled ventilation using circle absorbent circuit. inj. Vecuronium Bromide (0.08mg/kg) IV was used as non-depolarizing muscle relaxant. Intra-operative pulse, BP, SpO_2, ECG and $ETCO_2$ were monitored.

Intraoperatively IV fluids were administered at 6ml/kg in all groups. After completion of surgery, neuromuscular blockade was reversed with inj. Glycopyrolate (0.008mg/kg) and inj. Neostigmine (0.05mg/kg) IV. Extubation was done after adequate muscle power and tone. Patient was shifted to post operative ward.

Patients were asked to rate their nausea on a 100-mm VAS at 15-min intervals throughout recovery (0 = no nausea; 100 = the worst imaginable nausea). A score of 50 mm or greater was considered significant. Episodes of vomiting and the need for rescue medication, and the time, dose, and route of all post-operative drugs were noted. Patients were monitored for frequency of nausea and vomiting, VAS PONV score, requirement of rescue antiemetic at 0-6hr, 6-12hour and 12-24 hour in post-operative period.

Inj. Ondansetron (4 mg) IV stat was given as a ―rescue antiemetic when VAS PONV Score was more than 5. After giving rescue antiemetic, patients were not followed further for our study purpose.

Vomiting was defined as expulsion of stomach contents through the mouth. Retching was defined as involuntary attempts for vomit that did not expulse stomach contents.Complete response was defined as no PONV and no administration of rescue antiemetic medication during the first 24 hours of anesthesia.

Nausea and vomiting were evaluated as PONV score as mentioned Table 1

Statistical analysis was performed with Chi-square test for discrete variables, such as incidence of nausea, vomiting, complete response and requirement of anti-emetic using EXCEL & EPI INFO-7 software.A p value <0.05 was considered significant.

Results

There is no statistical difference between all the groups regarding demographic data. (P value >0.05)Table 2

Incidence of nausea is higher in Group C compare to all other groups and was more statically significant in early 0-6 hours. Among other Groups incidence was highest in Group 5 and it was lowest in Group 10 (p value <0.05)

We compared incidence of nausea between Group 10 & Group 20, it is statistically not significant (P value >0.05). While comparison between Group 5 & Group C shown no significant statistical difference (p value is >0.05) (Table 3)

Incidence of vomiting is higher in Group C lowest in Group 10. (P value <0.05)(Table 4) compare to all groups and was more significant in 0-6 hour‘s duration.

Good complete response is seen highest in Group 10 followed by Group 20 & than Group 5. It was lowest in Group C.

We had observed that requirement of rescue antiemetic drug was lowest in Group 10 followed by Group 20 & than Group 5; it was highest in Group C. (Table 5)

In Group 20, 3 patients developed conjunctival edema among them one patient had also developed bilateral basal crepitations may suggestive of fluid overload. (Table 6)

Number of patients who required treatment for vomiting (VAS PONV Score >5) was lowest in Group 10(n-5) followed by Group 20(n-7). It was highest in Group C (n-28).

Discussion

This prospective, randomized, controlled trial has shown a reduced incidence of PONV using pre-operative fluid supplementation with crystalloid (Ringer’s lactate) at rate of 10ml/kg as compared to no preloading of IV fluids.

Nausea and vomiting are frequently considered discomfort by patients in post- operative period. With the change in emphasis from an inpatient to outpatient hospital and office- based medical/surgical environment, there has been increased interest in this –“Big Little Problem” of postoperative nausea and vomiting. [2]

PONV is distressing to patients and potentially affect the post-operative recovery, there by hospital stay. Although unpleasant and embarrassing feeling, PONV may lead to significant morbidity leading to dehydration, electrolyte imbalance, and aspiration of vomiting in lungs. Surgical

complication like wound dehiscence, bleeding underneath the skin flaps and loss of vitreous fluid following intraocular surgery may follow with severe PONV. The etiology and consequences of PONV are complex and multi factorial, may vary with patient to patient and varies in different medical and surgery related factors.

Yogendran et al. [9] who administered high (20 mL/kg) or low (2 mL/kg) infusions of isotonic electrolyte solution over 30 min preoperatively. He did not find any significant difference in nausea at 30 min, 60 min, or at discharge between the two groups.

As in previous studies [3,10] showed a significant reduction in the incidence of post-operative nausea and vomiting as well as in the VAS scores during the 24 hours following anesthesia. There was no significant difference in the incidence of nausea up to 1 h; however, the VAS scores differed significantly in this early post-operative period. [11]

There was little inconvenience to infuse RL at rate of 20 ml/kg in 30 minutes.

NaCl 0.9% 30ml/kg was shown to induce hyperchloraemic metabolic acidosis. [12] Saline administration (22ml/kg) resulted in a 10% reduction of functional residual capacity and a 6% reduction of diffusing capacity in healthy volunteers. [13]

Liberal fluid is a good idea where major trauma and fluid shifting are unlikely, but more careful fluid management may be beneficial in more stressful operations. [14]

Excessive intravascular volume administration may result in pulmonary oedema,[15] electrolyte abnormalities, cerebral edema in children and adults with low muscle mass and heart disease are at increased risk of adverse effects. We had also experienced the side effects of large volume infusion in our study.

In our study 3 patients in Group 20 developed conjunctival edema and one patient out of them develop bilateral basal crepitations suggestive of fluid overload.

Administration of excess fluid may cause several problems after surgery. The resulting increased demands on cardiac function, due to an excessive shift to the right on the Starling myocardial performance curve, may potentially increase postoperative cardiac morbidity. Fluid accumulation in the lungs may predispose patients to pneumonia and respiratory failure. The excretory demands of the kidney are increased. Excess fluid may decrease tissue oxygenation with implications for wound (anastomotic) healing. In contrast, the widespread use of 'dry' fluid regimen in pulmonary surgery with resulting decrease in pulmonary morbidity supports the safety of low-volume fluid regimen in high-risk patients undergoing major surgical procedures, A clear determination of whether preloading of IV fluid administration decreases PONV, is required for two reasons. First, large volume IV fluid administration has been demonstrated to transiently decrease pulmonary function in volunteers. [13]

Thus, aggressive fluid administration may not be entirely devoid of side effects. Second, the administration of large volumes of IV fluid imposes logistic and practical difficulties in a busy ambulatory facility, and there are associated cost implications. [16]

Many theories have been proposed to explain how fluid therapy reduces nausea, one theory suggested that preoperative hypo-perfusion of the gut mucosa and consequent ischemia might be one of the causes of post-operative nausea and vomiting. [17] Gut ischemia is common during anaesthesia and surgery, and results in release of serotonin, which is one of the most potent triggers of nausea and vomiting.

Mythen and Webb [7] showed that perioperative plasma volume expansion reduced the incidence of abnormal intramucosal pH in patients having elective cardiac surgery, and was associated with improved outcome. It was also found that administration of additional oxygen

decreases the incidence of post-operative nausea and vomiting. [7,8] However, even supplemental oxygen fails to increase tissue oxygenation during hypovolaemia.[18]

Other theory, C.C. Apfel et al. [19] believes that the effect of supplemental crystalloids on PONV may be mediated by antidiuretic hormone (arginine vasopressin, AVP). Although there is no preoperative hypovolaemia, anesthetics can induce a relative hypovolaemia through vasodilatation with reduced venous return and preload.

This leads to reduced central venous pressure with reduced negative feedback of the right atrial stretch receptors, leading to increased AVP release from the posterior pituitary. AVP is strongly associated with nausea and vomiting. A previous study reported that plasma AVP levels are increased right at the onset of surgery and are significantly higher in patients who experience PONV than in those who do not. [20 , 21]

One possible explanation is that rehydration induces long-lasting effects by replacing extracellular fluid and/or by dampening the secretion of emetic stress response hormones, whose plasma levels take time to diminish once elevated. [22]

It was also found that administration of additional oxygen decreases the incidence of post-operative nausea and vomiting. However, even supplemental oxygen fails to increase tissue oxygenation during hypovolaemia. [14]

Most of our patients become hypovolaemia before induction of anaesthesia due to overnight fasting, especially in those with bowel preparation. Preoperative fluid load before start of anaesthesia most likely decreases the volume deficit there by promoting euvolaemia. A positive effect on splanchnic perfusion might inhibit the impending intestinal ischemia. [23 , 24]

The efficacy of the routine use of prophylactic antiemetic remains controversial. Pharmacological prophylaxis has a limited effect, as measurable benefit is observed in only 20% of the patients receiving ondansetron to prevent PONV. Prophylactic antiemetic administration also increases the risk of adverse drug effects and side-effects, and increases the cost of care. [25]

Inappropriately high volumes of fluids when rapidly administered may cause patient morbidity. [26] A similar study in which 1 or 2 liters of normal saline was rapidly administered to volunteers demonstrated small but measurable reductions in TLC, FEV1 and FVC which persisted for 60 min and were not worsened after 2 liters of fluids. [27]

Crystalloid fluid administration may be a simple, inexpensive, non-pharmacological therapy that could reduce these symptoms, avoiding drug-related side-effects.

Conclusion

We concluded that pre-operative administration of intravenous crystalloid fluids (Ringer Lactate) at rate of 10ml/kg reduces the incidence of post-operative nausea & vomiting. It reduces requirement of rescue antiemetic, VAS, PONV Score. It is also devoid of any side-effect.

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Declaration of Conflicting Interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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Abbreviation

&-	And
ASA-	American Society of Anesthesiology
CTZ-	chemoreceptor trigger zone
ECG-	electrocardiogram
Etco2-	end tidal co2
GIT-	gastrointestinal tract
HT3-	hydroxyl tryptamine3 hr- hour
ICT-	intra cranial tension
inj.	injection
NS-	Injection normal saline i.v. /
IV -	intravenous
OT-	operation theatre
Kg-	kilogram
µg-	microgram
mg -	milligram
min -	minute
ml –	millimeter,
no -	number
NIBP-	noninvasive blood pressure
PONV-	postoperative nausea and vomiting
RBC-	red blood corpuscles
VAS-	visual analogue scale
%-	percentage
RL-	Ringer lactate
NTS-	nucleus tractus solitarius
IM-	Intramuscular
PO-	per oral