Original Article

Comparison of the effect of preoperative administration of Ringer's solution, normal saline and hypertonic saline 5% on postoperative nausea and vomiting: A randomized, double blinded clinical study

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ABSTRACT

Objectives: Postoperative nausea and vomiting (PONV) are among the most common complications following surgery and anesthesia. Preoperative intravenous fluid therapy is one of the prophylactic methods against PONV. Preoperative administration of hypertonic solutions has already been used for controlling intraoperative hypotension. This study was conducted to assess their efficacy to reduce PONV.

Methodology: Ninety patients were enrolled in the study. The patients were allocated randomly, according to a random number table, to three groups. Group A received intravenous saline (15 cc/kg) thirty minutes before induction of anesthesia. Group B received intravenous ringer (15cc/kg) thirty minutes before induction of anesthesia. Group C received hypertonic saline 5% (2cc/kg) half an hour before the induction of anesthesia. Patients were assessed as to the presence of nausea, vomiting and VAS scores in the recovery room, six, twelve and 24 hours after the surgery. Serum sodium level was checked when leaving the recovery room. Data were recorded through questionnaires in data sheets.

Results: The analysis indicates that nausea severity in group C (hypertonic saline 5%) was significantly less than other groups. Vomiting frequency distribution was not significantly different among the three groups in the recovery room. The distribution frequency of vomiting six and twelve hours following the surgery was remarkably less in group C. When leaving the recovery room, serum sodium level in group C was significantly higher than other groups. However this level was still within the normal range and none of the patients manifested the signs or symptoms of hypernatremia.

Conclusion: This study suggests that hypertonic saline can reduce PONV more significantly than ringer's solution and normal saline.

KEY WORDS: PONV, Normal saline, Ringer's lactate, Hypertonic saline 5%.

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INTRODUCTION

Postoperative nausea and vomiting are among the most common complications following surgery and anesthesia.[1-4] PONV has been reported as the second most frequent complaint in postoperative patients[5,6], which afflicts approximately 20 to 30 % of postoperative cases.[5] Most patients rate it to be worse than

the postoperative pain.[5] PONV is such an undesirable experience that the majority of patients are willing to endure moderate pain, decreased alertness and extra payment for effective antiemetic treatment.[7] Postoperative vomiting/retching can cause serious complications, such as increased intraocular pressure, increased intracerebral pressure[8], aspiration[1,5], wound dehiscence, subcutaneous emphysema, pneumothorax[5], dehydration and even death[4], especially in pediatric and geriatric patients.[9] PONV can delay patient discharge from post anesthesia care unit (PACU) and from the hospital.[10,11] It may even result in unanticipated hospitalization following ambulatory anesthesia.[5] Consequently, it leads to a considerable increase in health-care costs.[3,11,12]

Several studies have focused on methods to prevent PONV.[3,8,9] Preoperative intravenous fluid therapy is one of the prophylactic methods against PONV.[13-17] Preoperative intravenous fluid therapy can also decrease postoperative pain[15], and intra operative hypotension.[18,19] Preoperative administration of hypertonic solutions has already been used for controlling intraoperative hypotension[18-20], but no clinical trials have so far been conducted to assess their efficacy to reduce PONV.

METHODOLOGY

This study was a double blinded randomized prospective clinical trial, performed in 2009-2010 in Alzahra Hospital in Isfahan, Iran. After approval of the ethics committee of Isfahan University of Medical Sciences, and written informed consents, 90 patients, ASA (American Society of Anesthesiology) classes I or II were enrolled in the study. The patients were between 15 to 70 years of age who were scheduled to undergo lower abdominal surgery under general anesthesia. Patients were excluded in case of using preoperative antiemetics, ASA >III, presence of nausea or vomiting before the operation, history of gastrointestinal problems, history of vestibular problems, motion sickness and PONV in previous surgeries. Serum sodium level was evaluated the day before the operation.

The patients were allocated randomly, according to a random number table, to three groups. Group A received intravenous saline (15cc/kg) thirty minutes before induction of anesthesia. Group B received intravenous ringer (15cc/kg) thirty minutes before induction of anesthesia. Group C received hypertonic saline 5% (2cc/kg) half an hour before the induction of anesthesia. Anesthesia routine monitoring, including pulse oximetry, capnography, electrocardiography and non- invasive blood pressure monitoring (NIBP), were used for each patient. Systolic, diastolic, mean arterial blood pressure and heart rate were recorded before anesthesia induction, every five minutes within the first 15 minutes of anesthesia induction and then every fifteen minutes until the end of the operation.

Induction of anesthesia included fentanyl (2µg/kg), sodium thiopental (5 mg/kg), atracurium (0.6 mg/kg). Isoflurane (MAC 1), N_2O (50%), O_2 (50%) and morphine (0.1 mg/kg) were used for anesthetic maintenance. patients were assessed as to the presence of nausea, vomiting and VAS scores in the recovery room, six, twelve and 24 hours after the surgery. Serum sodium levels were checked in all patients when leaving the recovery room.

All fluids and data sheets were labeled with the randomization number of the patient. The patients, the researcher who filled the questionnaires and the anesthesiologist were all blinded to the patient group assignment.

Data, which were recorded through questionnaires in data sheets, were analyzed by means of Chi square and variance analysis tests in SPSS-18. A statistical level of $p<0.05$ was assumed as significant.

RESULTS

In this study 90 patients were studied which were allocated to three groups of thirty patients. The sample size was calculated through the following formula:

$$n= (Z1+Z2)^2 [P1 (1- P1) + P2 (1- P2)] / (P1-P2)^2$$

A minimum of 26 patients was calculated for each group. However, we included 30 patients in each group. According to variance analysis and chi square tests there were no significant differences between the demographic features of the three groups. (Tables-I)

Table-I: Patient characteristics continuous variables are presented as mean ± standard deviation (range).

	Normal Saline	*Ringer*	*HypertonicSaline 5%*	*P value*
Age (years)	40.87±13.8 (15-70)	43.6±16.3 (15-70)	41.3±16.3(15-70)	0.77
Female: Male	15:15	17:13	17:13	0.84
BMI	25.22±3.14 (17.48-31.64)	24.68±3.62 (18.43-31.98)	24.43±2.90 (18.87-30.07)	0.64
Duration of anesthesia (hours)	1.45±48	1.29±0.42	1.40±0.48	0.38

Table-II: Postoperative nausea severity (VAS). Data are presented as mean ± standard deviation.

Time (hours after surgery)	*Normal Saline*	*Ringer Saline 5%*	*Hypertonic*	*P- value*
Recovery	0.47±0.1	0.43±0.11	1.17±0.8	p<0.05
6 hours	4.4±2.5	5.4±2.5	2.2±1.3	p<0.05
12 hours	6.2±1.9	5.7±2.4	3.6±2.4	p<0.05
24 hours	3.9±2.8	3.4±2.0	1.8±0.2	p<0.05

Postoperative nausea was recorded as VAS scores on the entrance to recovery room and within the first 24 hours following the surgery. Mean nausea VAS score in group A was 0.47 in the recovery room and 3.9, 24 hours after the surgery. Mean nausea VAS score in group B was 0.43 in the recovery room and 3.4, 24 hours after the surgery. Mean nausea VAS score in group C was 1.17 in the recovery room and 1.8, 24 hours after the surgery. Variance analysis on the data indicates that mean VAS scores are significantly different among the three groups. (p=0.007) The analysis indicates that nausea severity in group C (hypertonic saline 5%) was significantly less than other groups. (p<0.05) Moreover, the scores change significantly within each group during different hours (p<0.001). (Table-II)

Vomiting was recorded in the recovery room and within the first 24 hours following the surgery. (Table-III) Vomiting frequency distribution was not significantly different among the three groups in the recovery room. (p=0.12)

Vomiting distribution frequency assessed six and twelve hours following the surgery, was significantly different among the three groups. The distribution frequency of vomiting was remarkably less in group C. (p<0.05) The frequency distribution of vomiting was not significantly different among the three groups 24 hours following the anesthesia. (p=0.11)

Pre and postoperative mean serum sodium level was assessed and recorded. Mean serum sodium level was not significantly different among the group before the operation. (p=0.83) However, when leaving the recovery room, serum sodium level in group C (saline hypertonic 5%) was significantly higher than other groups. (p=0.01) Moreover, in group C, postoperative serum sodium level was significantly higher than the preoperative. (p=0.007) However, this level was still within the normal range (135-155 mg/dl), and none of the patients manifested the signs or symptoms of hypernatremia.

DISCUSSION

As discussed before, PONV continues to be one of the most distressing experiences following surgery.[5,14]

Table-III: Postoperative vomiting. Data are presented as number (percent).

Time (hours after surgery)	*Normal Saline*	*Ringer Saline 5%*	*Hypertonic*	*P- value*
Recovery	0	0	3 (10%)	P=0.12
6 hours	18 (60%)	10 (33.3%)	9 (30%)	P=0.04
12 hours	22 (26.7)	17 (56.7%)	8 (26.7%)	P=0.001
24 hours	12 (40%)	11 (36.7%)	5 (16.7%)	P=0.11

Although variable methods have been used to reduce PONV, it still remains common. Furthermore, PONV can lead to prolongation of hospitalization and increase of costs.[3,11,12] Therefore, several studies have focused on methods to prevent PONV. Even though some studies have suggested the administration of intravenous fluids for prevention of PONV[16], no trial has been conducted to assess the effect of hyper tonic saline 5% and to compare its effect with those of normal saline and Ringer's solution.

In the present study, we have compared the effect of hypertonic saline 5%, normal saline and Ringer's solution, and we have indicated that nausea severity and incidence of vomiting was significantly less in the group receiving hypertonic saline 5%. Besides, postoperative level of serum sodium was significantly more in this group. However, the level of serum sodium was still within the normal range, and none of the patients manifested the signs or symptoms of hypernatremia.

In a randomized blinded study, Goodarzi and his colleagues have also suggested that perioperative intravenous super hydration is an inexpensive and safe therapy for reducing postoperative nausea and vomiting.[13] Besides, Ali and his team revealed that supplemental preoperative fluid therapy can decrease PONV that can be due to its positive effect on splanchnic perfusion.[14] Another study conducted by Maharaj et al, has indicated that the administration of large volume preoperative IV administration of a balanced salt solution can significantly reduce the incidence and severity of PONV.[15] Magner et al have found that intraoperative administration of 30ml/kg of compound sodium lactate (CSL) compared with

Table-IV: Pre and postoperative serum sodium levels (mg/dl). Data are presented as mean ± standard deviation.

Time (hours after surgery)	*Normal Saline*	*Ringer Saline 5%*	*Hypertonic*	*P- value*
Preoperative	139.6±4.3	140±3.4	139.4±3.5	P=0.83
Postoperative	139.5±3.8	139.2±3.5	141.2±4.2	P=0.01
P-value	P=0.89	P=0.16	P=0.007	

10 ml/kg of CSL is more effective for reducing PONV and antiemetic use after anesthesia in gynecological laparoscopy.[17]

However, other studies were unable to show that administration of CSL could decrease PONV in gynecologic laparoscopy.[21,22] On the other hand, some studies indicate that large volumes of fluid may have detrimental effects on some patients.[17] Moreover, some previous studies have suggested that hypertonic saline can be used in situations in which intravascular volume needs rapid correction.[17,19] Veroli et al have demonstrated that hypertonic saline 5%, which is tolerated well but produces a moderate hypernatremia, is a suitable fluid when rapid preloading is desired.[18] Jarvela and colleagues have also confirmed a similar finding.[19,20]

The suggested mechanism through which perioperative hydration decreases PONV is the correction of intravascular volume deficit, thereby reducing the potential for splanchnic ischemia.[14,15] Gut ischemia, which may be due to perioperative hypovolemia is common during anesthesia and surgery. It can lead to release of serotonin which is a strong trigger of nausea and vomiting.[14]

CONCLUSION

This study suggests that hypertonic saline can reduce PONV more significantly than ringer's solution and normal saline.

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