

**ORIGINAL ARTICLE****Comparison of different non-pharmacological preoperative preparations on gastric fluid volume and acidity: a randomized controlled trial**

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**ABSTRACT**

**Objectives:** Aspiration of gastric contents is one of the major causes of general anesthesia related morbidity and mortality. This study aimed to compare the effects of using different non-pharmacological preparations preoperatively on gastric fluid volume and pH.

**Methodology:** This randomized, controlled trial was conducted at a teaching hospital in Shiraz, Southern Iran. Overall, 150 patients were randomly selected from elective surgery candidates, who were 17-95 years old, fulfilled the criteria of American Society of Anesthesiologists (ASA) grade-I or II, and in which tracheal intubation was indicated. The patients were allocated randomly to one of the following five groups: Group A: continuously chewed bicarbonate-containing gum for 2 hours before anesthesia induction until premedication. Group B: continuously chewed standard sugar free gum 2 hours before anesthesia induction until premedication. Group C: sucked lollipop 2 hours before anesthesia induction. Group D: drank pure water 10 ml/kg 2 hours before anesthesia induction. Group E (control group): without any intervention.

**Results:** The mean volume of gastric fluid was not significantly different among the study groups. In the group who chewed bicarbonate gum, the mean  $\pm$  SE gastric fluid pH was significantly higher than in other groups [ $5 \pm 1$  vs.  $3 \pm 1$  respectively,  $P < 0.001$ ].

**Conclusion:** Increased gastric fluid pH following the use of bicarbonate gum for pre-operative preparation may have implications for preventing aspiration and enhancing anesthesia care.

**Keywords:** Gastric fluid volume; Gastric fluid pH; Aspiration prevention

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**INTRODUCTION**

Optimal preoperative preparation makes surgical procedures safer and more acceptable for patients and the medical staff. Preparation using pharmacological and non-pharmacological interventions can reduce the patients' anxiety.<sup>1</sup>

Aspiration of gastric contents is one of the major

causes of complications associated with anesthesia.<sup>2,3</sup> It is suggested that preoperative anxiety can increase the gastric fluid volume and acidity.<sup>4,5</sup> Prophylaxis against aspiration may be considered in certain surgeries such as cesarean section.<sup>6,7</sup> Mendelson's syndrome is a chemical pneumonitis characterized by a bronchopulmonary reaction after aspiration of gastric contents during general anesthesia. Residual gastric volume of greater than 25 ml and pH of less than 2.5 increase the risk of

this syndrome. In this regard, pH is a more important factor than volume in determining lung injury.<sup>8</sup>

The effectiveness of reducing gastric acid secretion for decreasing the complications of aspiration remains to be determined.<sup>9-12</sup> Preoperative anxiety may rise from one week before the surgery and usually returns to normal levels in the postoperative period only after an uneventful recovery. Non-pharmacological preoperative preparation for reducing anxiety is cost-effective and well-accepted by patients.<sup>13,14</sup> Some researchers investigated the usefulness of non-medical substances for improving the pH and volume of the gastric contents. Results of randomized controlled trials have shown that sugar-free chewing gum can decrease the patients' anxiety and increase the salivary pH.<sup>15</sup>

We aimed to compare the effects of four methods of non-pharmacological preoperative preparation; chewing gums containing sodium bicarbonate, chewing standard sugar-free gums, sucking lollipop, and drinking pure water on gastric fluid contents and pH.

## METHODOLOGY

These randomized controlled trials were conducted during 2005-2006 in a teaching hospital in Shiraz, southern Iran. It was approved by the ethical committee of Shiraz University of Medical Sciences. All patients signed informed written consent. 150 patients were randomly selected from candidates of elective surgery, who were referred to Nemazee Hospital affiliated to Shiraz University of Medical Sciences. Eligible patients were aged 17 to 95 years of age, fulfilled the criteria of the American Society of Anesthesiologists grade-I or II (ASA I or II), and needed tracheal intubation. Those with any abnormality of the upper respiratory or upper gastrointestinal tract, hiatal hernia, gastro-esophageal reflux, or history of chronic medication use were not included in the trial.

The study participants were asked not to eat solid food for at least 8 hours and not to drink liquids for 3 hours preceding the anesthesia induction. Patients were allocated randomly to one of the following five equal groups: Group A: chewed bicarbonate-containing gum

2 hours before anesthesia induction, chewing regularly until premedication. Group B: chewed standard sugar-free gum 2 hours before anesthesia induction, chewing regularly until premedication. Group C: sucked lollipop 2 hours before anesthesia induction. Group D: drank pure water 10 cc/kg, 2 hours before anesthesia induction. Group E (control group) received no intervention.

Anesthesia was induced with pentothal and atracurium was infused for neuromuscular blockade. Anesthesia was maintained with halothane and nitrous oxide in oxygen. After tracheal intubation, a researcher who was not aware of the type of preoperative preparation, collected residual gastric contents using a gastric tube. An 18-Fr multi orifice Salem sump gastric tube was inserted orally and its correct placement was confirmed by the auscultation of bubbling sounds over the epigastria during insufflations of air through the catheter. By attaching the gastric tube to a suction device and by changing patient's position to head up, head down, left lateral, and right lateral residual gastric contents were collected and its volume and acidity were measured. Gastric acid was measured using a calibrated electronic pH meter. Gastric fluid volume was compared as absolute volume in milliliters.

**Statistical analysis:** Data were analyzed using the SPSS software (SPSS Inc., Chicago, IL, USA). The normal plot and Shapiro-Francis W-test showed that the volumes of residual gastric content were not normally distributed. Therefore, the Mann Whitney U-test was used to compare this variable between groups in each set of groups. The 95% confidence limits (CL) for medians for the volume and pH in each group were calculated using the SINTERVAL commend (sign test) in Minitab release. CL's for the median differences between groups were calculated. One-way analysis of variance (ANOVA) was used for comparison of mean values in different groups. The statistical significance was considered as P value < 0.05.

## RESULTS

After excluding the non-eligible patients, 150 patients completed the trial. The groups under study were not

**Table 1: Characteristics of patients in different groups receiving pre-operative preparation**

	Bicarbonate chewing gum	Sugar-free chewing gum	Sucking lollipop	Drinking pure water	Controls	P-value
Gender (Male/female)	17/13	15/15	13/17	16/14	15/15	>0.05
Age (years) mean(SD)	31(8)	35(11)	32(15)	37(9)	34(16)	0.392
Weight (Kg) mean(SD)	65(10)	62(8)	65(20)	63(9)	65(8)	0.717
Height (cm) Mean(SD)	166(9)	167(7)	168(6)	168(7)	169(7)	0.592

NS: Non significant

**Table 2: Comparison of the volume and pH of gastric contents between the groups. Values given as Mean(SE\*)**

	Bicarbonate chewing gum	Sugar-free chewing gum	Sucking lollipop	Drinking pure water	Controls	P-value
Volume(ml)	25(5)	27(5)	20(5)	26(6)	18(8)	>0.05
pH	5(1)	3(1)	3(1)	3(1)	2(1)	<0.001

\*SE: Standard error; NS: Non-significant

different in terms of age, height, weight, and gender distribution (Table 1).

As presented in Table 2, the mean volume of gastric fluid was not significantly different among the studied groups. In Group A, who chewed bicarbonate gum, gastric fluid pH was significantly higher than in the other groups ( $P < 0.001$ ).

## DISCUSSION

This trial aimed to improve the quality of anesthesia care, and to reduce the complications related to pulmonary aspiration of gastric contents. We found that chewing bicarbonate gum was effective in reducing the acidity of gastric fluid, and may be effective in reducing Mendelson syndrome and related complications.

Aspiration of gastric contents and its life-threatening consequences, notably aspiration pneumonitis and respiratory failure, has caused anesthetists to strictly follow prolonged preoperative fasting standards. Usually, it is recommended not to use clear fluids/liquids for at least 2 hours, and solids for at least 6-8 hours preceding the anesthesia induction. This fasting may result in irritability, anxiety, thirst, and hunger in the peri-operative period.<sup>16</sup>

In a randomized controlled trial, 60 non-smokers were assigned to receive regular, sugar-free chewing gum preoperatively or to continue the overnight fast. They were compared with 44 patients who were habitual smokers using 2 mg nicotine gum or not. The non-smokers using chewing gum had significantly larger gastric residue than the controls without significant difference in gastric fluid acidity. The corresponding figures were not significantly different among the non-smokers. The researchers concluded that sugar-free chewing gum could decrease the patient's anxiety and could increase the salivary pH, but since it increased gastric fluid volumes, it should not be used on the morning of surgery.<sup>15</sup>

As stated in the guideline of the ASA, "Enhancements in the quality and efficiency of anesthesia care include, but are not limited to, the cost-effective utilization of preoperative preventive medication, increased patient

satisfaction, avoidance of delays and cancellations, decreased risk of dehydration or hypoglycemia from prolonged fasting, and the minimization of preoperative morbidity."<sup>17</sup> As chewing bicarbonate gum fulfilled most of these criteria, it can be considered as an effective method for enhancement of preoperative preparation and the quality of anesthesia care.

The patient's anxiety increases with fasting,<sup>15</sup> and use of non-pharmacological substances may decrease this anxiety.<sup>18</sup> Chewing itself decreases anxiety by releasing enkephalin like V substances in brain.<sup>17</sup> In our study, the gastric fluid pH was significantly higher in the group receiving bicarbonate sugar-free gum than in other groups. This increase can be caused by increase in saliva flow rate and washout of gastric secretions.<sup>19</sup>

The effects of using chewing gum on preoperative residual gastric volume are controversial. Dubin and colleagues observed that the gastric contents of patients who chewed sugar-free gum up to immediately before the induction of anesthesia was not significantly different from controls.<sup>20</sup> Whereas, Soreide and coworkers found that healthy non-smoking adults using sugar-free chewing gum on the day of surgery had a slight increase in gastric fluid volume.<sup>15</sup> In our study, using chewing gum did not increase the gastric residue. The difference of these studies might be because of a false-negative (beta-error) in the previous study,<sup>20</sup> with only 15 patients in each group, whereas our trial comprised 30 patients in each group to overcome this error. The clinical significance of the difference in gastric fluid volume in these studies remains to be determined.

It should be noted that patients chewing bicarbonate standard gum or lollipop or pure water were at risk according to the criteria of a gastric volume  $> 0.4$  cc/kg and PH  $< 2.5$ . Use of these at-risk criteria might overrate the risk of regurgitation and gastric acid as aspiration syndrome in healthy adults.<sup>21,22</sup>

Our findings suggest that the increased gastric fluid pH with using bicarbonate gum for pre-operative preparation may have implications for prevention of Mendelson's syndrome.

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