

# Effect of gum chewing on gastric volume and emptying: a prospective randomized crossover study

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## Abstract

**Background.** Current fasting guidelines allow oral intake of water up to 2 h before induction of anaesthesia. We assessed whether gum chewing affects gastric emptying of 250 ml water and residual gastric fluid volume measured 2 h after ingestion of water.

**Methods.** This prospective randomized observer-blind crossover trial was performed on 20 healthy volunteers who attended two separate study sessions: Control and Chewing gum (chlorophyll flavour, with 2.1 g carbohydrate). Each session started with an ultrasound measurement of the antral area, followed by drinking 250 ml water. Then, volunteers either chewed a sugared gum for 45 min (Chewing gum) or did not (Control). Serial measurements of the antral area were performed during 120 min, and the half-time to gastric emptying ( $t_{1/2}$ ), total gastric emptying time, and gastric fluid volume before ingestion of water and 120 min later were calculated.

**Results.** Gastric emptying of water was not different between sessions; the mean (sdsd)  $t_{1/2}$  was 23 (10) min in the Control session and 21 (7) min in the Chewing gum session ( $P=0.52$ ). There was no significant difference between sessions in gastric fluid volumes measured before ingestion of water and 120 min later.

**Conclusions.** Chewing gum does not affect gastric emptying of water and does not change gastric fluid volume measured 2 h after ingestion of water.

**Clinical trial registration.** NCT02673307.

**Key words:** chewing gum; gastric emptying; ultrasound imaging

Preoperative fasting guidelines have been proposed to prevent pulmonary aspiration of gastric contents, one of the most feared complications related to general anaesthesia.<sup>1–3</sup> These recommendations allow oral intake of clear fluid up to 2 h before elective induction of general anaesthesia, whereas a light meal may be ingested up to 6 h before elective surgery. However, current guidelines vary or do not give clear recommendations with regard to preoperative fasting duration for chewing gum.<sup>1–3</sup>

The most liberal guidelines, endorsed by the European Society of Anaesthesiology, state that ‘patients should not have their operation cancelled or delayed just because they are chewing gum’.<sup>3</sup> These recommendations are based on the results of several studies that have reported either no increase or only a slight and clinically non-significant increase in gastric fluid volume when chewing gum after prolonged fasting.<sup>4–8</sup> However, no study has assessed the effect of chewing gum on gastric

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**Editor's key points**

- Fasting guidelines before anaesthesia are unclear with regard to chewing gum.
- The effect of gum chewing on gastric volume and emptying after water consumption was investigated in healthy volunteers.
- Chewing gum did not increase gastric volume or delay gastric emptying after water ingestion, suggesting that it might not increase risk for pulmonary aspiration of gastric contents.

emptying of water and on gastric fluid volume measured after the last ingestion of water, as allowed by the current fasting guidelines.<sup>2-3</sup> This effect remains uncertain because gum chewing was reported to increase gastric volume content,<sup>9-11</sup> but also to enhance gastric motility.<sup>9-14</sup>

We therefore conducted this prospective randomized crossover study that aimed to assess the effect of chewing gum on gastric emptying of water and to determine whether chewing gum significantly changed residual gastric fluid volume measured 2 h after ingestion of water in healthy volunteers.

**Methods**

This prospective randomized trial was registered at the French National Agency for Medicines and Health Products Safety (ANSM, no. 2016-A00009-42) on January 4, 2016, and in the public registry ClinicalTrials.gov, no. NCT02673307. It was approved by an institutional ethics committee (Comité de Protection des Personnes Sud-Est IV, N°L15-206, Lyon, France). All volunteers provided written informed consent before enrolment. The study was conducted between March 1, 2016 and October 5, 2016.

Healthy volunteers (20) were included in this crossover observer-blind study. The criteria for exclusion were upper gastrointestinal tract diseases, previous gastrointestinal surgery, history of diabetes mellitus, pregnancy, or smoking, and use of medication affecting gastric motility. Regular smokers were excluded because cigarette smoking can affect the gastric emptying of clear fluid.<sup>15-17</sup> Volunteers attended two separate study sessions, each at least 2 weeks apart, and were randomly allocated by coded envelopes to the following study sessions: Control (no gum chewed during the whole study period) or Chewing gum (sugared gum chewed during 45 min after the oral intake of 250 ml water). Randomization was performed using a computer-generated list. Allocation concealment was ensured by the use of coded, sealed opaque envelopes. Allocation was concealed until after consent was obtained. Volunteers had to follow the current recommendations regarding preoperative fasting that apply before elective surgery (6 h fasting for solids and 2 h fasting for clear fluids) before the start of the study. All tests started at 08.00 h.

The study period started with initial ultrasound measurement of the antral cross-sectional area for each volunteer lying down in a semi-upright position, with the head of the bed elevated to 45°. Next, a sheet was stretched to mask the upper part of the body (but not the epigastric area) to the view of the investigator, thereby ensuring blinding. This investigator (E.L.) left the room while another investigator (L.B.) instructed the volunteer and opened the envelope containing the randomization. Each volunteer drank 250 ml water in ~10 s and either chewed

sugared gum [Hollywood®, Mondelez International, USA; chlorophyll (spearmint) flavour, with 2.1 g carbohydrate, 8 kcal] for 45 min (Chewing gum session) or not (Control session). Ultrasonographic measurements of the antral area were then performed 10, 20, 30, and 40 min after oral intake of water, and then at 20 min intervals, for a total study period of 120 min.

All measurements of the antral area were performed by a physician (E.L.) blinded to allocation, using real-time ultrasonography (SonoSite, Inc., Bothell, WA, USA; S-Nerve™, fitted with a 2–5.5 MHz probe) as described.<sup>18-19</sup> Anteroposterior ( $D_1$ ) and longitudinal ( $D_2$ ) diameters of a single section of the gastric antrum in the sagittal plane passing through the aorta were determined using the abdominal aorta and the left lobe of the liver as internal landmarks to obtain the same standardized scanning level consistently. Diameters were measured from serosa to serosa between antral contractions to provide a measure of the relaxed width of the antrum. These diameters were recorded by a second physician (L.B.), who calculated the cross-sectional antral area using the following formula:

$$\text{Antral area} = A_{\text{area}} = \pi \times D_1 \times D_2 / 4$$

The corresponding gastric fluid volume was calculated using a formula that applies to antral cross-sectional area measured in the semi-recumbent position:<sup>15</sup>

$$\text{Volume (ml)} = -215 + 57 \times \log(\text{antral area}) - 0.78 \times \text{age} - 0.16 \times \text{height} - 0.25 \times \text{weight} - 0.8 \times \text{ASA physical status classification.}$$

The ultrasonographic half-time to gastric emptying ( $t_{1/2}$ ) and the total gastric emptying time were defined as the time from the measurement of the baseline value of antral area until the antral cross-sectional area returned to half-maximal ( $t_{1/2}$ ) and to the basal value (total gastric emptying time).<sup>20-22</sup> Gastric emptying of water was also assessed by plotting the percentage increase in the basal value of the antral cross-sectional area after ingestion of 250 ml water against time.<sup>20</sup>

**Statistical analysis**

Statistical analysis was performed using MedCalc® version 12.1.4.0 for Windows (MedCalc Software, Ostend, Belgium) and Statistica® version 6.0 (Statsoft, Tulsa, OK, USA). After a Shapiro-Wilk W test for normality of distribution of the data, continuous data were expressed either as the mean (SD) or as the median [interquartile range (IQR)]. Values were compared between both sessions using either Student's paired t-test or the Wilcoxon signed rank test, as appropriate. Repeated measures of antral area and of gastric fluid volume were analysed using a linear mixed-effect regression model in order to take into account the repetition of the measurements, the effect related to the session (Chewing gum or Control), and the effect related to the order of the sessions in this crossover study. A value of  $P < 0.05$  was considered statistically significant.

The primary outcome was the effect of chewing gum on the gastric emptying of 250 ml water. Assuming that mean (SD)  $t_{1/2}$  would be 25 (8) min in the Control session,<sup>22-23</sup> the inclusion of 18 volunteers was required in order to show a difference of 10 min between sessions, using Student's paired t-test with  $\alpha = 0.05$  and  $\beta = 0.05$ . To account for potential protocol violations, we decided to include 20 volunteers.

**Results**

Of the 20 volunteers included and analysed, there were 15 men and five women, median (IQR) age 27 (26–30) yr, height 176

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