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Effect of acute cigarette smoking on gastric contents in regular smoker volunteers. A prospective randomized cross-over study

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Abstract

Background: The authors sought to assess the effect of acute smoking on gastric contents in regular smoker volunteers. The primary endpoint was the variation in antral area during the 120-min study period after cigarette smoking.

Methods: Regular smoker volunteers were included in this prospective randomized single blind cross-over study. Volunteers attended two separate study sessions: Control and Smoking sessions. The study started with an initial ultrasound measurement of the antral area, immediately followed by a 30-min periods of waiting (Control session) or of two-cigarettes smoking (Smoking session). Ultrasound measurements of the antral area were then performed 30, 60, 90 and 120 min after the initial ultrasonography, allowing for the calculations of the variation rates in antral area during the periods 0–30, 0–60, 0–90 and 0–120 min in both sessions.

Results: The variation in antral area during the period 0–120 min was equivalent in both sessions, as the difference in the variation rates between both sessions was −1.2%, with 90% confidence interval of the difference including 0 and lying entirely within the range of equivalence of −10% to 10%. No equivalence was found for the periods 0–30, 0–60 and 0–90 min, because of a non-significant decrease in antral area in the Smoking sessions during these periods.

Conclusions: Preoperative acute smoking did not affect the variation in the gastric volume in regular smoker volunteers during the study period. These results allow for the suggestion that acute preoperative smoking does not probably change the risk of pulmonary aspiration of gastric contents in healthy regular smokers.

Clinical trial registration: NCT 02080598.

Key words: anaesthesia, general; gastrointestinal contents; smoking; volunteers

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Editor's key points

- Cigarette smoking may alter the rate of gastric emptying.
- For this reason many hospitals insist that patients refrain from smoking during the preoperative fasting period.
- The authors used ultrasound to study the effects of smoking on gastric volume in fasted subjects.
- No significant effects were found.

Preoperative fasting is one of the main preventive measures recommended for minimizing the risk of pulmonary aspiration of gastric contents, one of the most feared complications as a result of general anaesthesia.[1–4]

In clinical practice, anaesthetists are regularly faced with patients who have smoked before arriving in the operating room. Indeed, 4% of hospitalized smokers may not abstain from tobacco during their hospital stay,[5] while 15% of regular smokers may continue to smoke within an h of surgery.[6]

Cigarette smoking may be associated with increased cardiac and pulmonary morbidity and with increased incidence of complicated postoperative healing.[7–9] However, these complications are efficiently reduced by refraining from cigarette smoking at least eight weeks before general anaesthesia.[7 10 11] In healthy patients (i.e. in patients without any history of cardiac or pulmonary disease), the main feared complication related to acute cigarette smoking immediately before general anaesthesia, remains pulmonary aspiration of gastric contents. In regular smokers, acute cigarette smoking may lead to either unchanged, decreased, or accelerated gastric emptying of solids or liquids.[12–14] Acute cigarette smoking may also briefly make the gastro-oesophageal sphincter incompetent, and back to normal within eight min after the end of smoking.[15–17] However, there is a lack in clear data as concerns the effect of acute cigarette smoking on the gastric volume in fasted regular smokers.

This non-inferiority prospective randomized cross-over trial aimed to assess the effect of acute smoking on gastric contents in healthy fasted habitual smokers, through using real-time ultrasonographic measurement of the antral area, a well-described non invasive technique, allowing reliable assessment of gastric contents during the preoperative period.[18 19] The primary endpoint was the variation in antral area during the 120 min study period, whether healthy volunteers had smoked two cigarettes or not. We hypothesized that the variation in antral area would be <2% and would be equivalent during the 120-min period in both study sessions.

Methods

This prospective randomized trial was registered at the French National Agency for Medicines and Health Products Safety (ANSM, N° 2014-A00127-40) on January 22, 2014, and in the public registry ClinicalTrials.gov No NCT 02080598. It was approved by an Institutional Ethics Committee (Comité de Protection des Personnes Sud-Est IV, N°L14-12, Lyon, France). All volunteers provided written informed consent before enrolment.

Regular adult smokers (i.e. volunteers smoking more than five cigarettes a day for more than one year), were included in this cross-over single blind study. The criteria for exclusion from the study were upper gastrointestinal tract diseases, previous gastrointestinal surgery, history of diabetes mellitus, pregnancy and use of medication affecting gastric motility. Volunteers attended two separate study sessions, each at least two weeks apart. In this study, volunteers were randomly allocated by coded envelopes to the following study sessions: control (no cigarette smoked during the study period) or Smoking (two cigarettes smoked over 15 min after the first ultrasound measurement of antral area). Randomization was performed using a computer-generated list. Allocation concealment was ensured by the use of coded, sealed opaque envelopes.

All tests were carried out after an overnight fast and after the volunteers had abstained from smoking for a 12-h period.

The study period started with an initial ultrasound measurement of antral area for each volunteer laying down in a semi-upright position, with the head of the bed elevated to 45°. Then, volunteers had to go outside for 30 min. During this time, according to their session, volunteers had to smoke two cigarettes from their usual consumption over 15 min (Smoking session) followed by 15 min waiting, or they had to wait 30 min without smoking (Control session). At the end of this first period of 30 min, volunteers had to wear a surgical mask during the study period in order to obscure the smell of recent cigarette consumption and thereby ensure blinding. They were again asked to lay down in a semi-upright position, with the head of the bed elevated to 45° throughout the test, and a second ultrasonographic measurement of antral area was performed, followed by three other measurements, each at 30-min intervals, for a total study period of 120 min.

All measurements of the antral area were performed by a physician (LB) blinded to the session (also wearing a surgical mask), using real-time ultrasonography (SonoSite, Inc., Bothell, WA, S-Nerve™, fitted with a 2–5.5 MHz probe), as previously described.[18 20] Longitudinal (D_1) and anteroposterior (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. The measurements of the gastric antrum were performed from serosa to serosa, between antral contractions to provide a measure of the relaxed width of the antrum. These longitudinal and anteroposterior diameters were given verbally to a second physician (SL), who calculated the cross-section antral area at each time using the following formula:

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

The physician performing the ultrasound measurements of longitudinal and anteroposterior diameters could not access the document containing the values of antral area until the end of the whole study.

The corresponding gastric volume to the measured antral area was estimated at each time by using the equation that we previously described,[18] which applies to antral area measured in supine position with the head of the bed elevated to 45°:

Volume (ml)=−215+57×log (antral area)–0.78×age–0.16×height –0.25×weight–0.8×American Society of Anesthesiologists physical status classification. The adjusted R^2 value for this model was 0.570.[18]

These repeated measurements of antral area allowed for the calculation of the variation rates in antral area ($VRaa_{0\text{-}n}$) between the initial measurement and the measurements performed n=30, 60, 90 and 120 min later, using the equation:

$$VRaa_{0-n} = [(A_{area}^{Tn}/A_{area}^{initial}) - 1] \times 100.$$