SMOKING AND GASTRIC JUICE VOLUME IN OUTPATIENTS

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IT HAS BEEN FOUND that out-patients presenting for general anaesthesia have greater volumes of gastric juice than do in-patients, and several reasons have been suggested for this.¹ One factor which does not seem to have been examined is the effect that smoking cigarettes may have on gastric juice volume. We compared the volumes and pH of gastric juice in smokers and non-smokers presenting for dental surgery under general anaesthesia.

METHOD

Twenty-six out-patients having dental extractions were studied. They had previously been given instructions not to eat or drink after midnight on the day of operation but had had no instructions about smoking. No premedication was given. Informed consent was obtained to pass a nasogastric tube during anaesthesia to empty the stomach. The lungs were pre-oxygenated and anaesthesia was induced using thiopentone. Succinylcholine was given to facilitate tracheal intubation with a cuffed oral tube and anaesthesia was maintained with nitrous oxide and oxygen with halothane or enflurane. After tracheal intubation and inflation of the cuff, a 16-gauge nasogastric tube was introduced into the stomach so that injected air could be heard entering the stomach. Suction was applied gently with a 50 ml syringe and the stomach was emptied as completely as possible at this position, with the nasogastric tube advanced another 10 cm and with the tube pulled back 10 cm. The volume of gastric juice was measured and a sample taken for determination of pH.

The pH of the gastric juice was measured using a Fisher Acumet 140A pH meter except in three cases where less than 5 ml were aspirated and in these the pH was determined with Hydrion pH indicator paper. Over the range which included these three measurements (pH 1–2.5) there was agreement within pH 0.5 between indicator paper

and pH meter. The pH values were converted to hydrogen ion concentrations (cH^+) for the purpose of comparison.

These factors and the ages and weights of the patients were examined to see if there was any relationship between them and the various groups into which the patients could be divided. The different groups were compared one with another for each variable by means of the unpaired Student's *t* test.

RESULTS

The 26 patients were divided into two groups, Group A (non-smokers) and Group B (smokers) and Group B could be further sub-divided into those who had not smoked on the day of the operation (Group C) and those who had already smoked on the day of the operation (Group D) (Table I).

There was no significant difference in the weights or the times fasted of the different groups, nor was there a significant difference in the pH of the gastric juice found in the different groups. There was, however, a significant difference ($p < 0.05$) between the ages of the non-smoking group (Group A) with an average of 36 ± 16 years and the combined smoking groups (Group B) with an average of 25 ± 8 years. There was also a significant difference ($p < 0.05$) between the volume of gastric juice found in the non-smokers (average 8.6 ± 5.6 ml) and in those smokers who had smoked on the day of the operation (average 18.8 ± 10.8 ml). There was no significant difference between the volumes of gastric juice found in the two groups of smokers (Groups C and D) nor between the volumes found in the non-smokers (Group A) and in all the smokers (Group B).

DISCUSSION

Different methods of measuring gastric juice volume give different results. The simple aspiration method is open to several errors. The end of the nasogastric tube may not reach a dependent pool of juice and suction which is too powerful

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TABLE I
DETAILS OF PATIENTS AND RESULTS

	Group A (Non-smokers)		Group B (Smokers)		Group C (Those who had not smoked on the day)		Group D (Those who had already smoked on the day)	
	Mean $\pm$ SD	Range	Mean $\pm$ SD	Range	Mean $\pm$ SD	Range	Mean $\pm$ SD	Range
Numbers: Male	4		10		2		8	
Female	3		9		3		6	
Age (years)	36 $\pm$ 16	19-58	25 $\pm$ 8	17-50	25 $\pm$ 8	18-37	25 $\pm$ 9	17-50
Weight (Kg)	67 $\pm$ 9	57-82	63 $\pm$ 10	45-77	56 $\pm$ 9	48-68	65 $\pm$ 10	45-77
Time fasted (hours)	11 $\pm$ 1.5	9.5-14	11.5 $\pm$ 2.5	8.5-19	11 $\pm$ 0.7	10-11.5	11 $\pm$ 2.8	8.5-19
Gastric juice volume (mls)	8.6 $\pm$ 5.6	2-18	18.1 $\pm$ 14	2-55	16 $\pm$ 22	2-55	18.8 $\pm$ 10.8	2-44
pH	2.2 $\pm$ 1.4	1.5-5.7	2.6 $\pm$ 1.6	1.5-6.2	2.7 $\pm$ 1.2	1.5-4.6	2.5 $\pm$ 1.3	1.5-6.2

This compares Group A (non-smokers) and Group B (smokers). Group B may be split into Group C (those who had not yet smoked on the day of surgery) and Group D (those who had already smoked on the day of surgery).

There is a significant difference ($P < 0.05$) between the ages of Group A and Group B and between the volumes of gastric juice in Group A and Group D.

may collapse gastric mucosa on to the end of the tube preventing the removal of juice. We have attempted to reduce these errors by changing the position of the tube and by using gentle hand suction. Our measurements in out-patients are similar to those of Christensen and Skovsted² on in-patients (14 or 22 ml, depending on premedication) and those of Keating, Black and Watson³ on in-patients (20–23 ml depending on premedication). Both those studies, like ours, quote gastric juice volumes determined by simple aspiration from the stomach. The higher volumes in the study of Ong, *et al.*¹ of 69 ml in out-patients and 22 ml in in-patients reflect their method of measurement, which was by dilution of an inert indicator. While the simple aspiration method is perhaps less accurate and usually underestimates the volume of gastric juice, it is straightforward, does not add fluid to the stomach, not all of which may be removed⁴ and may be actually helpful in these patients, reducing the dangers of regurgitation and aspiration.

Smoking produces variable effects on gastric motility and on gastric secretions⁴ according to the circumstances of the investigation. A recent study, however, has shown that smoking increases the rate at which liquid contents leave the stomach.⁵

Smoking may not have been the cause of the increased gastric juice volumes in our patients. Perhaps young, anxious patients who produce more gastric juice than older, less anxious patients are also more likely to be smokers. Gastric secretion does decrease with age⁶ presumably because of a gradual loss of secretory cells. Gastric motility, however, seems to be unrelated to age.⁷

How significant are our findings clinically? The average volumes of gastric juice in smokers and non-smokers differed by only 10 ml and the pH was similar. It may be significant, however, that all five patients with more than 25 ml of gastric juice were smokers and that in four of these the pH was 2.0 or less. These four smokers are more at risk than the other patients if one accepts the statement of Roberts and Shirley⁸ who defined patients at risk from acid aspiration as those with more than 25 ml of gastric juice of pH less than 2.5. What is more, it has been shown that smoking relaxes the lower oesophageal sphincter and

thus gastro-oesophageal reflux is more likely in those patients.⁹

Thus, until more investigation is done, out-patients who smoke should perhaps be considered to be more at risk from aspiration of gastric contents and, therefore, likely to benefit from prophylaxis before anaesthesia by the use of such agents as oral antacids or metoclopramide.

SUMMARY

The volumes and pH of gastric juice in 26 out-patients presenting for dental surgery were measured by simple aspiration through a nasogastric tube introduced after the induction of anaesthesia. The average volume in these patients who were non-smokers was 9 ml and in those patients who had smoked on the day of the operation was 19 ml. Four of the smokers had more than 25 ml of gastric juice with a pH of 2.0 or less. It is suggested that out-patients who smoke would benefit from prophylaxis such as oral antacids or metoclopramide before anaesthesia.

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