Clinical Nutrition ESPEN xxx (2017) e1–e4

Contents lists available at ScienceDirect

Clinical Nutrition ESPEN

journal homepage: http://www.clinicalnutritionespen.com

Original article

Gastric fluid volume and acidity 2 h after intake of clear fluids in patients undergoing upper GI, lower GI, and non-GI surgery

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ARTICLE INFO

Article history:
Received 23 October 2016
Accepted 26 January 2017

Keywords:
Gastric fluid volume
Liberal preoperative fasting
Gastrointestinal surgery

SUMMARY

Background: In recent years, liberal preoperative fasting has been widely practiced. However, the safety of applying liberal preoperative fasting to patients suffering from gastrointestinal diseases is unclear. We therefore compared the gastric volume and pH of patients who underwent upper and lower gastrointestinal surgery and non-gastrointestinal surgery.

Methods: Patients scheduled for surgery at 08:45 on a given day were forbidden solid foods from 21:00 hours the day before surgery and allowed to drink only clear fluids (e.g. water, green tea, sports drinks, and clear juices) freely until 07:00 hours on the day of the surgery. After induction of anesthesia, gastric juice was obtained by inserting a 14 French gastric tube into the stomach to ascertain gastric volume and pH. In the present study, the patients were divided into three groups according to type of surgery: non-gastrointestinal (Group N), upper gastrointestinal (Group U), and lower gastrointestinal (Group L) surgery. The gastric volume and pH of the three groups were then compared.

Results: Gastric fluid volume of the patients in Groups N, U, and L was 8 (0, 20) ml, 4 (0, 12) ml and 13 (0, 20) ml, respectively. Patients in Group L had significantly greater gastric volume compared with those in Groups N ($p = 0.0156$) and U ($p = 0.0003$). The gastric pH in Groups N, U, and L was 1.6 (1.3, 3.7), 3 (1.6, 5.65) and 1.9 (1.4, 5.6), respectively. Gastric pH was significantly higher in Group U than in Group N ($p = 0.0061$).

Conclusion: Although gastric volume and pH differed among patients who underwent upper, lower, and non-gastrointestinal surgery after liberal preoperative fasting, the values remained within the safety parameters (UMIN000010802).

1. Introduction

Normally, preoperative fasting is started on the day before surgery to guard against aspiration pneumonia during the induction of general anesthesia. However, the supporting scientific evidence on prevention of aspiration pneumonia has been questioned [1]. The guidelines in the West for preoperative fasting recommend that patients drink clear fluids up to 2 h prior to general or regional anesthesia [2–5]. On the other hand, in Europe the enhanced recovery after surgery (ERAS) protocol was introduced for colonic surgery in the 2000s and has subsequently been adopted for other forms of surgery as well. In the ERAS protocol, patients are required to drink clear fluids up to 2 h prior to initiation of anesthesia and to receive preoperative oral carbohydrate loading [6]. However, the presence of a gastrointestinal obstruction of any form or a carcinoma in the upper gastrointestinal tract precludes the application of liberal fasting guidelines [2,3]. Furthermore, these guidelines may not apply to, or may require modification for, patients with comorbidities or conditions that can affect gastric volume [3,4].

Because most patients who undergo gastrointestinal surgery experience abdominal symptoms, application of ERAS guidelines to such patients may appear to be of dubious merit. We followed the liberal fasting guidelines for all patients undergoing elective surgery without obstructive gastrointestinal disorders such as pyloric stenosis or ileus from September 2008 to the present. To verify the safety of this procedure, gastric fluid was collected after the

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http://dx.doi.org/10.1016/j.clnesp.2017.01.013
2405-4577/

induction of general anesthesia. Then the gastric volume and pH of patients who underwent upper, lower, and non-gastrointestinal surgery were compared postoperatively.

2. Materials and methods

We enrolled patients undergoing elective surgery under general anesthesia with physical status classification I–III of the American Society of Anesthesiologists (ASA) at random between January 2010 and April 2011. We excluded patients with obstructive gastrointestinal disorders such as pyloric stenosis or ileus from the study. The ethics committee of Tokyo Metropolitan Tama Medical Center approved this study (ref: 17 2012-0817), which has been registered in the UMIN Clinical Trial Registry (UMIN000010802).

Our preoperative fasting regimen was as follows: patients were forbidden solid foods from 21:00 hours on the day before surgery and allowed to drink only clear fluids (e.g. water, green tea, sports drinks, and clear juices) freely until 07:00 hours on the day of the surgery. Gastric acid reducing agents were not prescribed on the day of surgery.

A nasogastric or orogastric tube (Salem Sump 14Fr, Covidien Japan, Shizuoka, Japan) was placed after induction of anesthesia and tracheal intubation. Correct tube placement was confirmed by auscultation. A 65 cm tube was inserted while the patient was in a supine position. Then the tube was slowly withdrawn with constant suction applied by a catheter syringe until the appropriate length for catheter fixation (45 cm) in the Trendelenburg position was achieved. The gastric contents were aspirated into a 50-ml catheter syringe slowly over more than 5 min. The gastric volume and pH of the specimen were measured using a calibrated catheter syringe and a pH meter (waterproof pocket-sized pH meter, S2K712; Toyorika, Tokyo, Japan), respectively. If the gastric fluid could not be aspirated in spite of correct tube placement, the amount of gastric fluid was regarded as 0 ml. The patients were divided into three groups according to the type of surgery they underwent: non-gastrointestinal surgery (Group N), upper gastrointestinal surgery (Group U), or lower gastrointestinal surgery (Group L).

Data with a normal distribution were analyzed statistically by analysis of variance techniques followed by Tukey's honestly significant difference test. If the data had a non-normal distribution, they were analyzed statistically using the Kruskal–Wallis test followed by the Steel–Dwass test. The results were presented as the median (interquartile range) or mean ± standard deviation. Statistical calculations were performed using JMP 10 software (SAS institute Japan, Tokyo, Japan). A difference was considered statistically significant if $p < 0.05$ on the two-tailed test. Assuming that the effect size d was 0.5 and the allocation rate N2/N1 was 1, a sample size of at least 67 patients per group was calculated to have a power of 80% and a significance level of 5% using G*power3.1 [7].

3. Results

3.1. Demographics data of patients (Tables 1–3)

Specimens were collected from 392 patients between January 2010 and December 2012. Two-hundred fifty-six patients underwent non-gastrointestinal surgery (Group N), 73 patients underwent upper gastrointestinal surgery (Group U), and 63 patients underwent lower gastrointestinal surgery (Group L). Patient profiles and the numbers are listed in Table 1. Women outnumbered men in Group N because this group included gynecological surgery. Patients in Group N were younger than those in the other groups. The diagnoses of the patients requiring surgery are shown in Table 2. The patients in Group U underwent surgery for gastric cancer, liver cancer, gallbladder stone, etc. Most of the patients in Group L underwent surgery for colon cancer. Patients who received proton pump inhibitors or histamine H2-receptor antagonists before surgery are shown in Table 3. Patients who received proton

Table 1
Patient demographics.

	Group N ($n = 256$)	Group U ($n = 73$)	Group L ($n = 63$)
Age (year)	58.2 ± 16.2*	67.0 ± 12.6	65.3 ± 11.6
Sex (M/F)	60/196**	45/28	39/24
%	23.4/76.6	61.6/38.4	61.9/38.1
Body length (cm)	158 ± 8***	161 ± 9	161 ± 9
Body weight (kg)	57.1 ± 11.1	58.5 ± 11.2	59.3 ± 10.1
Body mass index	22.9 ± 3.6	22.7 ± 4.0	23.0 ± 3.6
ASA (I/II/III)	66/171/17	13/54/5	16/40/6
%	26.0/67.3/6.7	18.1/75.0/9.7	25.8/64.5/9.7

*: $p = 0.0002$ compared to Group U, $p = 0.0088$ compared to Group L Kruskal–Wallis test.
**: $p < 0.0001$; χ^2 test.
***: $p = 0.0195$ compared to Group U, $p = 0.0538$ compared to Group L Kruskal–Wallis test.

Table 2
Diagnosis of the patients.

Groups	Diagnosis		
N	Brain		90
		Cerebral aneurysm	43
		Internal carotid artery stenosis	22
		Middle cerebral artery occlusion	4
		Brain tumor	15
		Others	6
	Gynecological		82
		Ovarian cancer	17
		Uterine cancer	31
		Vulvar cancer	3
		Others	31
	Bone and soft tissue		21
		Fracture	6
		Rheumatism	5
		Hip osteoarthritis	3
		Soft tissue tumor	4
		Others	3
	Urinary tract		16
		Cancer	13
		Others	3
	Body surface		12
		Breast cancer	10
		Hernia	2
	Oral cavity		12
		Oral cancer	9
		Jaw deformity	3
	Cervicofacial		9
		Thyroid tumor	5
		Otitis media	2
		Others	2
	Vascular		5
		Arteriosclerosis obliterans	3
		Varicose vein	2
	Dermatological		5
	Thoracic		4
U	Gastric cancer		32
	Liver cancer		15
	Gallbladder cancer		1
	Pancreatic cancer		6
	Duodenal cancer		1
	Intrahepatic stone		1
	Gallbladder stone		17
L	Sigmoid colon cancer		25
	Rectal cancer		13
	Other colon cancer		21
	Others		4

Please cite this article in press as: Sasuga M, et al., Gastric fluid volume and acidity 2 h after intake of clear fluids in patients undergoing upper GI, lower GI, and non-GI surgery, Clinical Nutrition ESPEN (2017), http://dx.doi.org/10.1016/j.clnesp.2017.01.013