

Comparison between Preoperative Overnight Fasting versus Oral Rehydration Solution (ORS) Administration Until Two Hours before Abdominal Surgery under General Anaesthesia

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Abstract

Background: Preoperative fasting is a major concern to protect the gastric aspiration which is very dangerous. However overnight fasting is uncomfortable and has many deleterious effects on the human body. In many countries fasting until 2 to 3 hours before surgery has been practiced but in Bangladesh, overnight fasting is still being practiced in routine cases.

Objectives: The objective of this study was to compare the effectiveness between preoperative overnight fasting and oral rehydration solution administration until two hours before abdominal surgery under general anaesthesia.

Methods: A total of 100 patients of ASA (American Society of Anesthesiologist) class I and II, age above 18 years, and BMI <30 kg/m² were scheduled for abdominal surgery under GA (General Anaesthesia) were included in this study. Then all patients were randomized into two groups as patients who were on overnight fasting for 10 hours (Group A-Controlled, n=50), patients who were on ORS until 2 hours before abdominal surgery (Group B-ORS, n=50). All patients had their last meal at 11 PM before the day of surgery. Patients in group A will not take anything orally or via any route, except their ongoing vital medications if present. Patients in group B received 500 ml of standard ORS in the early morning on the day of surgery after waking up from bed (from 05 AM to 06 AM) and another 500 ml until 2 hour before the surgery (06 AM to 07 AM). As the primary outcome gastric residual volume and gastric fluid pH in both group was measured immediately after anaesthesia induction. Several physiological measures (thirst and hunger, nausea/vomiting, cognitive function) were measured with the help of a preformed questionnaire.

Results: Mean gastric residual volume immediately after induction was statistically significant ($p < 0.05$) between the two groups. However the mean gastric fluid pH was statistically insignificant ($p > 0.05$). The ORS group (Group B) became less thirsty before surgery ($P = 0.001$). Postoperative nausea/vomiting (PONV) was less in group B ($P = 0.029$) than in group A. The patient's recovery time was significantly less in the ORS group ($P = 0.003$). Postoperative cognitive performance was better in group B ($P = 0.001$).

Conclusions: Oral rehydration solution administration until two hours before surgery is effective and can be considered routinely before abdominal surgery conducted under general anaesthesia except for delayed gastric emptying.

Key Words:

Preoperative fasting, Oral Rehydration Solution, Gastric residual volume, Gastric fluid pH, PONV, Postoperative cognitive function

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Introduction

Aspiration of gastric contents is a major cause of morbidity and mortality during general anaesthesia.^{1,2} The risk of mortality is up to 5% and it is involved in over 9% of all deaths related to anaesthesia.³ The overall incidence in a mixed surgical population ranges between <0.1% and 19% depending on patient and surgical factors and it has not changed in the last few decades.⁴ The presence of acidic stomach contents during anaesthesia induction is an important risk factor for its occurrence. That's why for more than 100 years overnight fasting has been a widely recommended routine practice before elective surgery.

Although there is a controversy about the gastric residual volume which is considered critical, because this volume itself increases risk of aspiration. Studies have shown that healthy patients under fasting often have gastric residual volume near 1.5 ml kg⁻¹ without significantly increased risk for aspiration⁵. However this routine has been questioned lately, primarily because of fasting is uncomfortable for the patient, and strict fasting results in unnecessary problems with routine oral medication.^{6,7}

In several studies free intake of water was allowed within 2-3 hours before surgery in both children and adults, where preoperative thirst and anxiety were reduced as compared with traditional overnight fasting.⁸ Dehydration impairs working memory and increases anxiety, fatigability.⁹ In studies with elderly patients, clear fluid intake until 2 hour before surgery did not cause problem.¹⁰

In studies with obese patients (BMI > 30 kg m⁻²), the gastric fluid volume in patients who received clear fluid until 2 hours before surgery was similar to that in fasting patients¹¹. A study of obese pregnant women showed that the gastric fluid volume 1 hour after they drank 300 ml of water was the same as the volume when fasting before drinking water.¹²

Ingestion of clear fluids until 2 hours did not increase gastric contents or risk of aspiration before surgery.⁸ Moreover intravascular volume deficits may be a factor in postoperative nausea/vomiting and perioperative fluid administration may reduce the incidence of adverse outcome without the expense or potential for side effect seen with pharmacologic approaches to this problem.^{13,14}

Less attention has been paid to the fact that the preoperative fasting period also results in a marked alteration in body metabolism. Although strict fasting is usually set to begin at midnight, in clinical practice it often begins earlier resulting in more than 10 hours. It has long been known that even brief fasting results in a marked reduction in hepatic glycogen store and a change in metabolism.¹⁵ Although overnight fasting is a part of

human's normal diurnal rhythm, this change in the metabolic setting may not be ideal in preparing patient for surgical stress, especially who are diabetic or hypertensive.

Prolonged fasting may lead to several adverse effects including an increase in catabolic pathways, metabolic derangement and may aggravate insulin resistance.¹⁶ On the other hand, reduction of the period of preoperative fasting limited insulin resistance, organic response to trauma, overall stress, and hence thereby improving patient recovery.¹⁷

Preoperative carbohydrate supplementation given intravenously in the form of glucose infusion as 5 mg kg⁻¹ min⁻¹ overnight, instead of fasting resulted in 50% reduction in the development of postoperative insulin resistance in patients undergoing abdominal surgery.¹⁸ For routine administration of carbohydrates before surgery, oral administration has several advantages over the intravenous route which can be used only if shown to be safe.

Normally gastric emptying of clear fluid is almost completed within two hours of ingestion. Solid food follows a zero order emptying kinetic, that is at a constant speed according the number of calories (about 200 kcal/hr). Clear liquids follow a dramatically different path, emptying quickly from the stomach, following a first order kinetics. Some liquids such as water and 0.9% saline have a very short half-life of about 10 minutes, and effectively only have a flush through the stomach.^{19,20}

Various randomized controlled trials and meta-analysis have consistently documented that oral intake of water and other glucose or electrolytes rich clear fluids up to 2 hours before surgery does not increase gastric volume or acidity.¹¹ Even some studies have reported that gastric residual fluid volume was smaller in patients who received clear fluids until 2-3 hours before surgery.²¹ Maltby et al. (2004) noted that on average about 25 ml of acidic gastric juice remained in the stomach after an overnight fast, with a possibility of reaching 200 ml; because the stomach continuously secretes up to 50 ml/hr of acidic fluid even in fasting patients.¹¹ Saliva production occurs at a rate of 0.4-1.0 ml/kg/hr, with endogenous gastric secretion in a similar production rate²². That's why preoperative oral fluid administration until two hours before routine surgery is nowadays an emerging practice in the world.

Enhanced recovery after surgery (ERAS) protocols include changes in the conventional preoperative fasting practices and are supported by evidence-based medicine that preoperative carbohydrates reduce surgical trauma and stress, promote early eating and activity of patients, and shorten the recovery time.²³ Current preoperative

guidelines of American Society of Anaesthesiologist recommend oral intake of clear liquids with or without carbohydrate [water, fruit juice without pulp, carbonated beverages, clear tea, black coffee] up to 2 hours before induction of general anaesthesia to prevent complication of hunger and dehydration such as discomfort and stressful anaesthesia.^{24,25}

Interestingly these guidelines are not being followed in our hospital, because there are limited local evidence-based studies. All of these studies are on preoperative glucose administration, but no study was done on oral rehydration solution administration still now. Preoperative ORS administration may reduce all the negative effects of fasting. So in our hospital environment, this research work was designed to see the effectiveness and safety of oral rehydration solution administration until two hours before surgery.

Materials and methods

This randomized controlled trial was conducted in the General Surgery operation theatre under supervision of Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka from September 2018 to March 2021. The ethical permission of the study was obtained from the Institutional Review Board (IRB) of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh (Registration No. BSMMU/2020/9191). Informed written consent form was signed by all the participants before enrollment. The study recruited patients selected for abdominal surgery under general anaesthesia following inclusion and exclusion criteria. The estimated sample size was 50 patients in each group which included 10% attrition for this study and total sample size was 100.

All patients who underwent elective abdominal surgery under general anaesthesia aging above 18 years, irrespective of gender with ASA class I & II and BMI (Body mass index) under 30 kg/m² were included in this study. Patients with history of gastrointestinal disease which impair gastric motility, history of earlier gastric surgery, diabetes mellitus or any disease involving the autonomic nervous system, gastroprokinetics (medications known to increase gastric emptying) users, patients who were on antiemetics & were receiving intravenous fluid, patients with bloody aspirate during suctioning via nasogastric tube and patients who refused to participate were excluded from this study.

The study was conducted in the general surgery unit of operation theatre in BSMMU under the department of

Anaesthesia, Analgesia and Intensive Care Medicine. Following approval of the Institute of Review Board (IRB) and obtaining informed consent from the patients who fulfilling the inclusion and exclusion criteria, data was collected up to 6 months after IRB clearance. Total 100 patients were scheduled for abdominal surgery under general anaesthesia. Patients were divided randomly into two groups: Overnight fasting for 10 hours (Group A-Controlled, n=50), ORS until 2 hours before surgery (Group B-ORS, n=50). Randomization was done by a computer generated list. Patients in group B received 500 ml of standard ORS solution in the early morning after waking up from bed on the day of surgery (from 5 AM to 6 AM) and another 500 ml until two hour before surgery (6 AM to 7 AM). No pharmacologic premedication was given to any patient. Thirst and hunger were measured by questions in both group before induction of general anaesthesia.

A standard general anaesthesia was given to all patients of both group. Fentanyl was used as 1.5 mg/kg for analgesia, propofol was used as 2 mg/kg for intravenous induction of anaesthesia, and intubating dose of suxamethonium chloride was used as 2 mg/kg for short term muscle relaxation. Loading dose of vecuronium bromide as 0.1 mg/kg, then one fifth of the loading dose as intermittent doses for maintenance were used for further muscle relaxation. After induction of anaesthesia a multi-orifice 16-18 Fr nasogastric tube were introduced carefully via oral route into the stomach approximately about 45 to 65 cm from the level of the upper incisor tooth to umbilicus. Confirmation done by any aspiration of gastric content or by listening of noisy sound over the anterior abdomen while giving air into stomach.

Any failed or bloody aspirate was excluded from the study. Gastric aspirate was obtained by application of gentle negative pressure to the tube using 50 cc syringe. During aspiration, tube is manipulated in different positions (Semi supine and Semi right lateral position) and upper abdominal massage was given to maximize the volume of aspirate. The volume was measured using the gradual markings of the syringe, and gastric fluid pH was measured by using special universal pH measuring strip. Patients developing intra operative hypovolemia were resuscitated accordingly and were discarded from the study. Any extended surgery which was more than 3 hours was excluded from the study. At the end of surgery all patients were infiltrated of their abdominal incision with 10-20 ml of 0.25% bupivacaine and diclofenac suppository 50-100 mg

per rectally as analgesic. No antiemetic or no opioid was given to anyone. All anaesthetic vapour and gas were stopped. Patients started to breath in 100% oxygen. Muscle relaxation was antagonized with proper dose of neostigmine and atropine. Patients were extubated upon resumption of full spontaneous ventilation. Then all patients were asked for eye opening, mouth opening, tongue protrusion, head raising, hand gripping, deglutition and coughing to check the time needed for recovery from general anaesthesia. Patients were moved to post anaesthesia care unit where they were checked for cognitive performance with the help of digit span forward and backward test. Postoperative nausea/vomiting was found out by questions in recovery room up to 4 hours after surgery.

The primary outcome of this study was to measure GRV (gastric residual volume) and gastric fluid pH just after induction of anesthesia. Preoperative thirst and hunger just before induction of general anesthesia and postoperative nausea/vomiting, patient's cognitive

performance and patient's recovery time were the secondary outcome.

Statistical analyses were carried out by using the Statistical Package for Social Sciences version 23.0 for Windows (SPSS Inc., Chicago, Illinois, USA). The mean values were calculated for continuous variables. The quantitative observations were indicated by frequencies and percentages. Chi-Square test was used to analyze the categorical variables like sex, ASA status. P values <0.05 was considered as statistically significant.

Results:

Total 100 patients were eligible and involved in the study. Eleven patients were excluded (11% dropout) from the study due to intraoperative hypovolemia (3 patients), extended surgical procedure (2 patients) and unable to confirm the nasogastric tube placement orally (4 patients) or bleeding during tube placement (2 patients). So, 46 patients in fasting group and 43 patients in ORS group were the remaining number of patients for analysis.

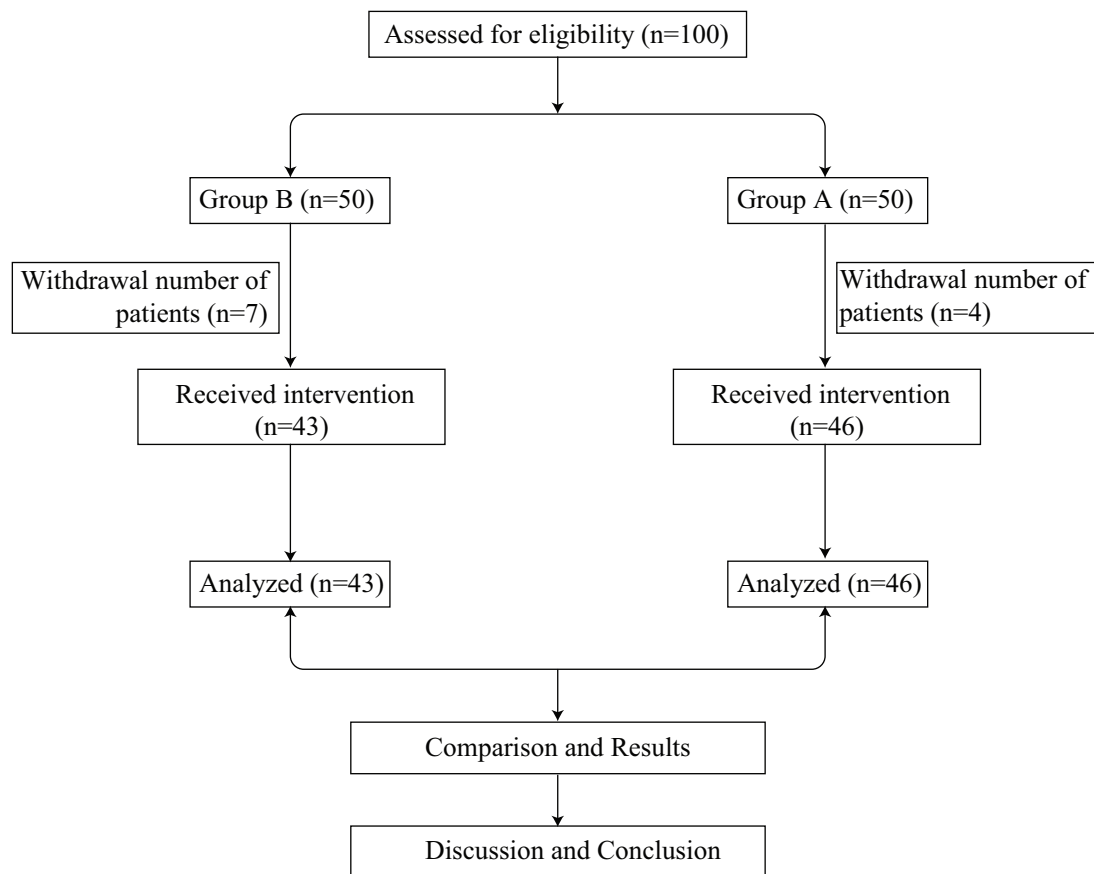


Figure 1: CONSORT patient flow diagram

Table I

<i>Comparison between the patient groups by demographic data and baseline characteristics</i>					
Variable	Group-A (n=46)		Group-B (n=43)		P value
	Mean±SD		Mean±SD		
Age (in years)	42.9±11.8		45.6±13.2		^a 0.309 ^{ns}
BMI (kg/m ²)	23.6±0.4		23.8±0.6		^a 0.354 ^{ns}
	n	%	N	%	
Gender					
Male	13	(28.26)	14	(32.55)	^b 0.641 ^{ns}
Female	33	(71.73)	29	(67.44)	
ASA status					
Class I	29	(63.04)	28	(65.11)	^b 0.505 ^{ns}
Class II	17	(36.95)	15	(34.88)	

ns= not significant, ^ap value reached from unpaired t-test, ^bp reached from chi square test

Table I shows Comparison between the patient groups by demographic data and baseline characteristics, it was observed that mean age was found 42.9±11.8 years in group A and 45.6±13.2 years in group B. Mean BMI was found 23.6±0.4 kg/m² in group A and 23.8±0.6 kg/m² in group B. Almost three fourth 33 (71.73%) were female in group A and 29 (67.44%) were group B. Almost two third 29 (63.04%) ASA status were class I in group A and 28 (65.11%) were in group B. The difference were statistically not significant (>0.005) between two groups.

Table II

<i>Comparison between the patient groups by GRV and pH</i>			
Variable	Group-A	Group-B	P value
	(n=46)	(n=43)	
	Mean±SD	Mean±SD	
GRV(ml)	54.6±21.9	31.4±13.9	0.001 ^s
Range (min-max)	16-98	8-53	
pH	2.1±1.1	2.0±0.9	0.138 ^{ns}
Range (min-max)	1.5-3.5	1.0-3.0	

s= significant, p value reached from unpaired t-test

Table II shows mean GRV was found 54.6±21.9 ml in group A and 31.4±13.9 ml in group B with a range from 16-98 ml and 8-53 ml respectively. Mean pH was found 2.1±1.1 in group A and 2.0±0.9 in group B with a range from 1.5-3.5 and 1.0-3.0 respectively. Mean GRV was statistically significant (p<0.005) between two groups.

Table III

<i>Comparison between the patient groups by thirst and hunger</i>					
Thirst and Hunger	Group-A (n=46)		Group-B (n=43)		P value
	N	(%)	N	(%)	
Thirst					
Yes	33	(71.73)	8	(18.60)	0.001 ^s
No	13	(28.26)	35	(81.39)	
Hunger					
Yes	29	(63.04)	23	(53.48)	0.128 ^{ns}
No	17	(36.95)	20	(46.51)	

s= significant, p value reached from chi square test

Table III shows comparison between the patient groups by thirst and hunger, it was observed that 33 (71.73%) patients had thirst in group A and 8 (18.60%) had in group B. 29 (63.04%) had hunger in group A and 23(53.48%) had in group B. The Thirst was statistically significant (p<0.005) between two groups.

Table IV

<i>Comparison between the patient groups by post-operative nausea/vomiting</i>					
Nausea/Vomiting	Group-A (n=46)		Group-B (n=43)		P value
	N	(%)	N	(%)	
Yes	17	(36.95)	7	(16.27)	0.029 ^s
No	29	(63.04)	36	(83.72)	

s= significant, p value reached from chi square test

Table IV shows comparison between the patient groups by nausea/vomiting, it was observed that 17 (36.95%) patients had nausea/vomiting in group A and 7 (16.27%) had in group B. The difference was statistically significant ($p < 0.05$) between two groups.

Table V

Comparison between the groups by patient recovery time from general anesthesia

Patient recovery time (min)	Group-A (n=46)		Group-B (n=43)		P value
	N	(%)	N	(%)	
<10	09	(19.56)	16	(37.20)	
10-20	21	(45.65)	25	(58.13)	0.003 ^s
>20	16	(34.78)	02	(4.65)	

s= significant, p value reached from chi square test

Table V shows comparison between the groups by patient recovery time from general anaesthesia, it was observed that majority 21 (45.65%) patients had 10-20 min in group A and 25 (58.13%) in group B. The difference was statistically significant ($p < 0.05$) between two groups.

Table VI

Comparison between the groups by digit span forward and backward test

Variable	Group-A (n=46)	Group-B (n=43)	P value
	Mean±SD	Mean±SD	
Forward test score	3.7±1.3	4.6±0.4	0.001 ^s
Backward test score	2.7±2.3	3.8±1.2	0.001 ^s
Total score	6.4±3.6	8.4±1.6	0.001 ^s

s= significant, p value reached from unpaired t-test

Mean forward test score was found 3.7±1.3 in group A and 4.6±0.4 in group B. Mean backward test score was found 2.7±2.3 in group A and 3.8±1.2 was in group B. Mean total score was found 6.4±3.6 in group A and 8.4±1.6 in group B. The difference was statistically significant ($p < 0.05$) between two groups.

Discussion

In this study, the demographic characteristics of the patients in group A (controlled) and group B (ORS) were statistically indifferent in the context of age, gender, BMI, ASA status ($P > 0.05$). So demographic variables didn't significantly alter the outcome of the study. Demographic characteristics of a similar study by Itou et al (2012) found

BMI was significantly different between the groups, which was not clinically important; and others didn't differ significantly.²⁷

The present study revealed, mean (SD) GRV immediately after anesthesia induction was 31.4 (13.9) ml in ORS group and 54.6 (21.9) ml in the fasting group ($P = 0.001$). Mean (SD) gastric fluid pH was 2.0 (0.9) in ORS group and 2.1 (1.1) in fasting group ($P = 0.138$). Carbohydrate rich clear drinks are known to increase gastric emptying, because their osmolality is low²⁸. That's why GRV was less in ORS group than in fasting group. On the other hand, gastric fluid pH was not statistically significant between the groups although pH in the ORS group was slightly decreased, as glucose and electrolytes containing solution also stimulate gastric secretion. The observations were similar in other studies.²⁷

If the gastric residual fluid volume is larger than 200 ml when anaesthesia is induced, the patient is at increased risk of vomiting and aspiration²⁹. However in the present study no patient had a gastric volume more than 200 ml: the maximum volume was 53 ml in ORS group and 98 ml in the fasting group. Similar study by Itou et al. (2012) revealed maximum 60 ml in the ORS group and 155 ml in the fasting group.²⁷

In the present study, we have found preoperative thirst among 18.60% patients in ORS group and 71.73% patients in fasting group ($P = 0.001$). On the other hand, hunger was 53.48% in ORS group and 63.04% in the fasting group. Thirst was significantly lower in ORS group and hunger was also lower in ORS group but it was not statistically significant ($P = 0.128$), because oral rehydration solution contain only 13.5 g/l glucose. A similar study on 252 elective surgery patients was done between carbohydrate drink and placebo groups, where they found the incidence of thirst and hunger were lower in carbohydrate drink than the placebo group.³⁰ Some authors say administration of higher concentration of glucose without electrolytes may exaggerate the dehydration via glucose induced diuresis, although during perioperative period a little electrolytes retention may occurs in the body due to stress.

This study revealed postoperative nausea/vomiting was 16.27% in ORS group and 36.95% in fasting group ($P = 0.029$), which was statistically significant. Another study was done to see the effect of routine preoperative fasting in patients undergoing myomectomy. They have found that postoperative nausea/vomiting was lower in carbohydrate and placebo group than fasting group ($P = 0.01$)³¹. Another randomized study found that the incidence of PONV was lower in the carbohydrate rich clear drink group than in the fasting group ($P < 0.05$)³⁰.

They also demonstrated that allowing oral intake of clear fluids had some protective influence on postoperative nausea/vomiting (PONV), as dehydration is one of the major cause.

In this study, we observed patient's recovery time after general anesthesia which was shorter in ORS group than in fasting group. Most of the patients recovered within 10-20 minutes, ($P=0.003$). A single center cohort study done by Javier et al (2018) found more patients in the non-ERAS group than in the ERAS group developed delayed recovery (31.9% vs. 22.26%, $p=0.009$).³²

In addition we also observed patient's postoperative cognitive performance which was better in ORS group than in fasting group. P values were 0.001, 0.001, 0.001 in case of digit span forward, backward and total scores between the groups. No such related study during perioperative period was done previously, although there are some study to compare between dehydration and rehydration group. Most studies revealed that dehydration can impair cognitive performance ($P<0.05$).²⁶

Total ORS intake in each patient was 1000 ml in this study and 812 ml in average in a similar study done by Itou et al.(2012)²⁷, which was more than it was expected (because empty stomach may initiate nausea during consumption of plane water) and indicates that oral rehydration solution is well tolerated. So, the present study demonstrates that oral rehydration solution until two hours before surgery is feasible and effective.

Limitation of the study

The study was conducted in a single center, so that the results may not reflect the entire population of the country.

Conclusion

The administration of oral rehydration solution until two hours before routine surgery is safe and effective. Preoperative ORS intake rather than overnight fasting reduces preoperative thirst/hunger, PONV and improves postoperative cognitive performance.

Conflict of interest: The authors declare that they have no competing interests

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