Gastric emptying of novel protein- and carbohydrate-rich clear liquids

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Introduction

To ensure safety for elective anesthesia, standard practice requires pre-operative fasting, so there will be very little material to regurgitate into the pharynx and hence risk aspiration when reflexes are depressed at induction. Beyond the magnitude of the gastric volume, the presence of solid matter and low pH are associated with worse outcome in cases of aspiration.

A disadvantage of pre-operative fasting is distress from hunger and thirst. Some younger, malnourished or chronically ill children develop frank hypoglycemia. Thus established fasting guidelines aim to balance thirst. Some younger, malnourished or chronically ill children develop

Methods

With IRB approval we enrolled 48 ASA I or II children, 8 to 14 years of age, fasted overnight and without risk factors for abnormal gastointestinal motility. Exclusions included BMI>50kg/m2, known prior gastrointestinal surgery or disorders; medications except oral contraceptives; allergy or intolerance to milk, apple juice or Ensure Clear (Abbott Laboratories). Demographic characteristics were compared between groups by the Kruskal-Wallis rank sum (for continuous variables) or χ 2 (for categorical tests).

16 subjects each were randomized to ingest 300ml of either apple juice, 2% milk or Ensure Clear. The gastric antrum was visualized in the right lateral decubitus position at baseline, within 5 minutes following ingestion of 300 ml of drink at 4 degrees Celsius, then every 30 minutes thereafter until return to baseline or 6 hours (whichever sooner). Qualified sonography technologists, blinded to group assignment, saved images for later analysis. Two independent anesthesiologists, also blinded to group assignment, measured the gastric antral cross-sectional area (CSA) from each saved image using Merge PACS software (Merge Healthcare, Chicago, IL.) to determine the perpendicular diameters then calculate CSA using the formula for the area of an ellipse.

Results

The three groups of 16 children each drank apple juice, 2% milk or Ensure Clear after fasting overnight. The groups were similar in demographics (age, p=0.10; weight, p=0.47; body mass index, p=0.17; sex, p=0.72; ethnicity, p=0.25). While there is inter-observer variation in CSA measurements, this predominantly affects time points soon after ingestion, notably for milk (Figure 1). Differences at lower gastric volumes are small, supporting conclusions related to near-empty state.

The time course of gastric emptying is depicted in Figure 2 and differs between drinks (p=0.03). There is a suggestion that gastric volume declines most rapidly in the first hour after ingestion of milk, as compared to the other liquids studied. Of note, the stomach volume returned to baseline by 240 min for all drinks with little difference between drinks in the terminal phase of gastric emptying.

Discussion

Despite significant differences in the early phase, clearance of the stomach of apple juice, milk and a novel protein- and carbohydrate-rich clear liquid (Ensure Clear) is similar during the terminal phase. The differentiation between liquids in current pre-operative fasting guidelines is not supported by our ultrasound gastric emptying study. The stomach is essentially clear by 3/4 hours for all three drinks studied.

Our observations suggest that milk empties from the stomach faster in the first hour than apple juice or Ensure Clear. We suspect that this may relate to a curdling effect. Inter-observer variation in measurement is most marked after ingestion of milk, which casts a “slimy” appearance on ultrasound images.

This pilot study establishes an experimental paradigm to investigate gastric emptying after ingestion of various drinks and foods. This will facilitate a scientific approach to pre-operative fasting (“NPO”) instructions.

References


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