INGESTION OF CLEAR FLUIDS IS SAFE FOR ADOLESCENTS UP TO 3 H BEFORE ANAESTHESIA

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SUMMARY
We have studied the effect of ingestion of unlimited clear fluids by adolescents up to 3 h before anaesthesia to determine the effect this fluid ingestion would have on thirst, hunger and gastric contents at induction of anaesthesia. We studied prospectively 152 adolescents (ages 13–19 yr) undergoing elective surgery. Fifty percent of the patients had nothing by mouth after midnight. The other 50% were instructed to ingest unlimited clear fluids up to 3 h before surgery. On arrival in the operating room, subjects were asked to assess thirst and hunger with a linear analogue scale of 0–10 (0 corresponding to no thirst or no hunger). After induction of anaesthesia, gastric contents were aspirated via a 16-French gauge orogastric tube. Gastric fluid volume (GV) was measured with a syringe and gastric pH (GpH) was assessed with Merck pH strips. GV, GpH and subject hunger were unaffected by ingestion of clear fluids. Subject thirst was reduced by clear fluids. It is concluded that unlimited clear fluid ingestion by healthy adolescents up to 3 h before operation decreases thirst and does not affect gastric contents.

KEY WORDS

The ingestion of clear fluids by patients on the day of surgery is being reviewed [1–8]. There is no physiological evidence to support the guidelines suggesting 4–6 h abstention from clear fluids by healthy patients before elective surgery. It has been shown that healthy adults may ingest limited volumes (only 150 ml) of clear fluids up to 2–3 h before anaesthesia [7, 8]. For adolescents, there is no evidence for or against the view that abstention from clear fluid is necessary on the day of surgery. Also, it has not been established if preoperative ingestion of clear fluids would benefit adolescents.

This study was designed to determine if adolescents could ingest unlimited volumes of clear fluids up to 3 h before surgery without affecting gastric contents, and to determine if this would decrease patient thirst and hunger. Also, we wished to examine if the gastric content of adolescents was influenced by gender, age, weight and inpatient/outpatient status.

PATIENTS AND METHODS
With Hospital Ethics Committee approval and with parental or patient informed consent, we studied 152 healthy adolescents, aged 13–19 yr, ASA physical status I or II allocated randomly to one of two groups. Patients were excluded if there was a history of gastrointestinal disease, if surgery was non-elective, or if their medication affected gastric contents.

It had been our usual practice to ask patients to fast after midnight of the evening before surgery. Fifty percent of the subjects (76) followed this standard procedure. The other 50% were instructed to have unlimited clear fluids until 3 h before operation. Clear fluids were defined as clear aqueous solutions which were liquid at 37 °C. Typical fluids ingested included apple juice, water, jelly (Jello in North America) and lemonade (soda pop in North America). Immediately before surgery, the patients completed...
PREOPERATIVE CLEAR FLUID INGESTION

Table 1. Patient data (mean (SD))

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Age (yr)</th>
<th>Weight (kg)</th>
<th>Percent inpatients</th>
<th>Volume ingested (ml)</th>
<th>Fast (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overnight fast</td>
<td>76</td>
<td>15 (2)</td>
<td>60 (16)</td>
<td>36</td>
<td>0</td>
<td>12.7 (2.5)</td>
</tr>
<tr>
<td>3-h fast</td>
<td>76</td>
<td>15 (2)</td>
<td>56 (11)</td>
<td>49</td>
<td>270 (190)</td>
<td>3.6 (0.8)</td>
</tr>
</tbody>
</table>

A questionnaire (LAS) on hunger and thirst using a 10-cm linear analogue scale on which 0 corresponded to no thirst or no hunger and 10 represented severe hunger and thirst.

Anaesthesia was induced by whatever technique the consultant anaesthetist deemed most appropriate. The trachea was intubated when indicated. After establishment of adequate anaesthesia, a 16-French gauge orogastric tube was passed into the stomach by an investigator who was unaware of the subject's fasting status. The position of the orogastric tube was confirmed by auscultation. Stomach contents were aspirated with the gastric tube in several positions and the patient tilted to the right, left, head-down and head-up positions. Gastric fluid volume (GV) was measured with a 20-ml syringe and gastric pH (GpH) was measured with pH paper (Merck pH 0–14 and pH 0–2.5). Gastric volumes of less than 1 ml were approximated to a value of 0.5 ml.

For the purpose of this investigation patients considered to be “at risk” of aspiration pneumonia had either GV > 1.0 ml kg⁻¹ or the combination of GV > 0.4 ml kg⁻¹ and GpH < 2.5 [9–11].

Normally distributed data were analysed using Student’s t test, non-parametric data were analysed with Mann–Whitney U test, chi-square test and Fisher’s exact test. Relationships between GV or GpH and gender, age, weight and length of

Fig. 1. Volumes of clear fluid ingested on the day of surgery (values represent midpoint of grouping). The number of patients in each grouping is given (total n = 76).

Fig. 2. Duration of clear fluid fast (values represent midpoint of grouping). The number of patients in each grouping is given (total n = 76).
fast were analysed using linear regression analysis. Values were considered to be significantly different if $P < 0.05$. Sample size was determined to test for equivalence of interventions; alpha was set at 0.05 and beta set at 0.10.

**RESULTS**

The groups were similar with respect to age, weight, gender, ASA physical status, and inpatient/outpatient status (table I). Adolescents who were allowed clear fluids ingested 10–1000 ml (mean 270 (SD 190) ml) on the day of surgery (fig. 1). The clear fluid fast was of 2.2–6.0 h (3.6 (0.8) h) among the adolescents permitted fluids on the day of their operation (fig. 2).

Gastric fluid volumes and gastric pH were similar in the two groups (table II, figs 3, 4). Gastric fluid volume and gastric pH of the 28 patients who ingested clear fluid 3 h or less before anaesthesia was similar to that of those who abstained from food and drink on the day of surgery; this subgroup had a gastric fluid volume of 0.40 (range 0.02–1.13) ml kg$^{-1}$ and a gastric pH of 1.7 (1.3–4.0).

Adolescents who ingested clear fluids on the day of surgery did not have an increased incidence of “at risk” gastric contents (table III). Gastric fluid volume and pH were unaffected by patient age, weight, gender, inpatient/outpatient status, duration of fast and volume ingested. Inpatients ingested more clear fluids than outpatients ($P < 0.02, 95\%$ confidence limits 22–187 ml).

The adolescents permitted clear fluid had decreased thirst on the day of surgery. Patient hunger at the time of surgery was unaffected by ingestion of clear fluid (table IV).

**DISCUSSION**

The ingestion of unlimited volumes of clear fluids by healthy adolescents up to 3 h before elective

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**TABLE II. Volume of gastric contents (mean (SD) [range])**

<table>
<thead>
<tr>
<th>Group</th>
<th>Volume (ml kg$^{-1}$)</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overnight fast</td>
<td>0.48 (0.40) [0.02–2.11]</td>
<td>1.6 (0.4) [1.2–3.0]</td>
</tr>
<tr>
<td>3-h fast</td>
<td>0.46 (0.39) [0.02–1.47]</td>
<td>1.8 (1.0) [1.2–6.5]</td>
</tr>
</tbody>
</table>

**TABLE III. Number of patients with large volume gastric contents**

<table>
<thead>
<tr>
<th>Group</th>
<th>Volume &gt; 0.4 ml kg$^{-1}$ and pH &lt; 2.5</th>
<th>Volume &gt; 1.0 ml kg$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overnight fast</td>
<td>76</td>
<td>9</td>
</tr>
<tr>
<td>3-h fast</td>
<td>76</td>
<td>11</td>
</tr>
</tbody>
</table>
surgery decreased thirst and did not affect gastric fluid volume and pH measured at the onset of anaesthesia. Gastric volumes and pH were similar to those observed in adults and children [1–8].

The methods used to measure gastric contents are not exact. Gastric aspiration underestimates gastric fluid volume, but it correlates well with true GV [12], removing 60–90% of gastric fluid volume. Each patient's GV was measured in a similar fashion, thus any underestimation would be observed in both groups. On the other hand gastric pH may be measured accurately with Merck pH sticks [13, 14].

No patient variable studied (age, weight, gender, inpatient/outpatient status) was found to affect gastric contents. Subject age has been shown to affect gastric volume and pH, but this was not observed over the narrow age range of this study [15]. Ong [16] observed larger residual gastric volumes among adult outpatients. Outpatient/inpatient status does not appear to affect adolescents’ gastric fluid volume. Further study is required to determine if outpatients have increased gastric volumes.

The subjects in this study ingested variable amounts of clear fluids. This may reflect the variable eating habits typically observed in adolescents. A few teenagers may have ingested less than normal because of their awareness of past fasting guidelines. Inpatients ingested more fluid than outpatients, possibly because of greater availability of clear fluids; for example, they were offered a clear fluid breakfast.

Ingestion of clear fluids decreased thirst, but had no effect on hunger. Several subjects told us their hunger increased after ingesting fluids.

Clear fluids, such as water, clear fruit juices and jelly, rapidly empty from the stomach because gastric emptying of clear fluids follow first-order kinetics. The ingestion of solid food and non-clear fluids on the day of surgery is not recommended, as they empty according to zero-order kinetics.

TABLE IV. Patient thirst and hunger (median (range)).

<table>
<thead>
<tr>
<th>Group</th>
<th>Thirst</th>
<th>Hunger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overnight</td>
<td>4.0 (0–10)</td>
<td>6.0 (0–10)</td>
</tr>
<tr>
<td>3-h fast</td>
<td>5.0 (0–10)*</td>
<td>5.5 (0–10)</td>
</tr>
</tbody>
</table>

*P < 0.05, Mann-Whitney U test

REFERENCES


