Fasting, time for change?

Hannie Megens, anesthesiologist
BAPA – SKA January 2019
Disclosures

• Financial relationships: none.

• Non financial relationships: non-salaried member of the working group of the V&VN (Dutch professional organisation of nurses en caretakers) developing a quality indicator on preoperative fasting in children.
Let them drink!
Content

• Why fasting
• International guidelines
• Every day practice
• Drawbacks of fasting
• Gastric emptying
• New developments
• Near future?
Case report - preop

- M patiënt, 11 years, 38 Kilo
- 22 q 11 deletion
- Combined immune deficiency
- Chronic lung disease with recurrent pneumonia
- Many anesthetics

- Kidney dysfunction (Cr 76) unknown case
- Hematoma after kidney biopsy
- Removal of clot in bladder (PCM, oxybutinine)
- Last mael 8 hour ago
I have just one question for you...
Case report - anesthesia

- IV induction: lidocaine, propofol, sufentanil.
- Placement of LMA
- Aspiration of brown fluid – a lot
- Suxemethonium and intubation
- Suction through endotracheal tube

- Increasing oxygen and pressure needed
- Transfer to Pediatric Intensive Care Unit
Case report

Risk factors
• Emergency
• Pain
• Oxybutynine
• Lithotomy position
• ??
Case report - postop

• 25 days in PICU
• ARDS
• Pleural effusion, drainage
• Pneumonia – pseudomonas
• 20 days on ventilator
• Delirium

• Discharge from hospital 7 weeks after incident
• At home Oxygen 1 liter/min via nasal sprong
• FEV1 29%
Why fasting

Between 1932 and 1945, 66 cases of aspiration occurred during obstetrical anesthesia at New York Hospital.

Why fasting

- Obstetrician
- 1946
- 66 aspiration among 44016 pregnancies (0.15%)
- Aspiration of liquid: astma-like attack, full recovery
- 2 deaths due to airway obstruction by solid food.
- Injecting vomitus in respiratory tract of rabbits.

Mendelson's syndrome

- Chemical pneumonitis or aspiration pneumonitis caused by aspiration of gastric content during general anaesthesia due to abolition of laryngeal reflexes

Why fasting

- 1 Rhesus monkey, instillation of acid directly in bronchus
- 25 ml (0.4 ml/kg) of gastric fluid with a pH < 2.5


- **Relationship**: residual gastric volume and volume instilled into the lungs?
- **40 – 80% of fasted healthy patients gastric volumes > 25 ml and pH < 2.5.**

Maltby JR. Best Pract Res Clin Anaesthesiol 2006. Fasting from midnight - the history behind the dogma.
## Why fasting

<table>
<thead>
<tr>
<th>Study</th>
<th>Time period</th>
<th>Study design</th>
<th>Study size</th>
<th>Aspiration (per 10,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murat</td>
<td>2000-2002</td>
<td>Prospective, teaching hospital France</td>
<td>24.165</td>
<td>19 (8)</td>
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<tr>
<td>Walker</td>
<td>2010-2011</td>
<td>Prospective, multicentre UK</td>
<td>118.371</td>
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<td>Andersson</td>
<td>2008-2013</td>
<td>Retrospective, University hospital Sweden</td>
<td>10.015</td>
<td>3 (3)</td>
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<tr>
<td>Tan</td>
<td>2000-2013</td>
<td>Retrospective, Singapore</td>
<td>102.425</td>
<td>22 (2)</td>
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<tr>
<td>Eisler</td>
<td>2008-2014</td>
<td>Retrospective, tertiary care pediatric hospital, New York</td>
<td>47.472</td>
<td>20 (5.5)</td>
</tr>
<tr>
<td>Habré</td>
<td>2014-2015</td>
<td>Prospective, multicentre Europe</td>
<td>31.127</td>
<td>29 (9.3)</td>
</tr>
</tbody>
</table>
**Why fasting**

**Aspiration** the presence of any non-respiratory secretions in the airway as evidenced by laryngoscopy, suctioning, or bronchoscopy.

In a situation where there was suspicion of pulmonary aspiration but no positive aspiration of non-respiratory secretions, new clinical and/or chest X-ray signs consistent with aspiration are accepted as evidence for it (e.g., new wheeze or crackles in the chest after regurgitation or vomiting incident).

## Why fasting

### Outcome

<table>
<thead>
<tr>
<th>Study</th>
<th>Time period</th>
<th>Study design</th>
<th>Aspiration per 10.000</th>
<th>Postoperative ventilation %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walker</td>
<td>2010-2011</td>
<td>Prospective, Multicentre UK</td>
<td>2</td>
<td>20.8</td>
</tr>
<tr>
<td>Tan</td>
<td>2000-2013</td>
<td>Retrospective, Singapore</td>
<td>2</td>
<td>9.1</td>
</tr>
<tr>
<td>Andersson</td>
<td>2008-2013</td>
<td>Retrospective, university hospital Sweden</td>
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<td>0</td>
</tr>
<tr>
<td>Habré</td>
<td>2014-2015</td>
<td>Prospective, multicentre Europe</td>
<td>9.3</td>
<td>0</td>
</tr>
</tbody>
</table>
Why fasting

Risk factors
• Non-elective surgical procedure
• Inadequate anaesthesia
• Abdominal pathology
• Obesity
• Opioid medication
• Neurological disease
• Lithotomoy
• Difficult intubation / airway
• Reflux
• Hiatus hernia

Kluger MT. Anesthesia 1999. Aspiration during anaesthesia: a review of 133 cases from the Australian anaesthetic Incident Monitoring Study.
Why fasting

- Gastric content
- Exceed lower oesophageal sphincter barrier pressure
- Regurgitate through the upper oesophageal sphincter
- Loss of protective airway reflexes

- What can we influence .... Gastric content

Why fasting, summary

To prevent pulmonary aspiration

Rare event

Consequences of fluid aspiration are not catastrophic (?)

No clear relationship: gastric content – volume aspiration

What can be modified: gastric content!
International guidelines

Pre-operative fasting guidelines: un update.

Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: application to healthy patients undergoing elective procedures.

Richtlijn Anesthesie bij kinderen.
International guidelines

8 – 6 – 4 – 2
International guidelines

- 8 Fried or fatty foods, meat
- 6 Light meal
- 4 Milk
- 2 Clear fluids
I have just one question for you...
International guidelines

• 6 Light meal, non human-milk, formula (all)
• 4 Breast milk (all)
  – neonates or infants (< 1 year) (ASA)
  – or ≤ 6 months (Scand)
  – also formula (Scand)
• 2 Clear fluids, no alcohol
  – Coffee / tea with 1/5 of total volume milk
• 1 hour 75 ml of water with preoperative oral medication
  – Children > 1 year (Scand)
large coffee

1940  1960  1980  2000  TODAY

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Every day practice

Fasting instructions: Who – What – Clear?
I have just one question for you...
Every day practice

Pediatric Anesthesia

ORIGINAL ARTICLE

Parents’ understanding of and compliance with fasting instruction for pediatric day case surgery

Steve Cantellow, Jonathan Lightfoot, Helen Bould & Richard Beringer
Bristol Royal Hospital for Children, University Hospitals Bristol NHS Foundation Trust, Bristol, UK

Table 1 Method by which parents received fasting instructions

<table>
<thead>
<tr>
<th>Method</th>
<th>Number of parents (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter</td>
<td>75 (72%)</td>
</tr>
<tr>
<td>Leaflet</td>
<td>21 (20%)</td>
</tr>
<tr>
<td>Anesthetist</td>
<td>11 (10%)</td>
</tr>
<tr>
<td>Pre operative assessment clinic</td>
<td>9 (9%)</td>
</tr>
<tr>
<td>Surgeon</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>Internet</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>Other</td>
<td>2 (2%)</td>
</tr>
</tbody>
</table>

doi:10.1111/j.1460-9592.2012.03903.x
Accepted for publication 22 May 2012
Email: cantellow@mac.com
Every day practice

Table 2  Parents’ understanding of the reason to fast

<table>
<thead>
<tr>
<th>Reason</th>
<th>Count (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspiration</td>
<td>9 (9%)</td>
</tr>
<tr>
<td>Nausea or vomiting</td>
<td>53 (51%)</td>
</tr>
<tr>
<td>Efficacy of anesthesia being altered</td>
<td>13 (12.5%)</td>
</tr>
<tr>
<td>Other</td>
<td>18 (17%)</td>
</tr>
</tbody>
</table>

4.9% would allow:
Every day practice

<table>
<thead>
<tr>
<th>Study</th>
<th>Year of publication</th>
<th>Fasting solids range</th>
<th>Fasting clear range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engelhardt 2011</td>
<td>2011</td>
<td>12:05 00:45-21:50</td>
<td>7:57 00:05-20:50</td>
</tr>
<tr>
<td>Arun* 2013</td>
<td>2013</td>
<td>11:25</td>
<td>9:25</td>
</tr>
<tr>
<td>Buller 2016</td>
<td>2016</td>
<td>10.0</td>
<td>6.3</td>
</tr>
<tr>
<td>Cantellow 2012</td>
<td>2012</td>
<td>9.53 - 40</td>
<td>5 0.5 – 24</td>
</tr>
</tbody>
</table>

*Change in surgical schedule is major cause (30%)*!

Every day practice

• 97% written NPO order: noncompliant with ASA guidelines for clear liquids
• NPO from midnight

Every day practice

• Children on morning list fast longer than children on afternoon list.
Buller Y. Anawsth Int Care 2016. Prolonged fasting of children before anaesthsia is common in private practice.

• Postoperative NPO time in complex surgery
• The story continues: 30 hours
Brunet-Wood K. J Ped Surg. Surgical fasting guidelines in children: are we putting them into practice.

• Small feedings may actually stimulate the gastrointestinal tract and shorten the period of ileus.
Every day practice

- Kwaliteitswet Zorginstellingen (Law on Quality in Health Care Institutions)
- Set of quality indicators

- Pediatric nurses (V&VN)
- Working group
- Unnecessary – long fasting in children
- Improve care by means of a quality indicator
Every day practice

- Quality indicator
- 2020 (?)
- Percentage of children no clear fluids > 2 h (= 120 min)
- Information child and parents
- Agreement on what to do
Every day practice, summary

*We don’t tell 6 – 4 – 2*

*We don’t explain*

*We are unable to plan*

*Patients – parents – nurses – ..*
Case report

- M patiënt, 2 year + 3 months old
- Achrondoplasia
- Lunghypoplasia
- Previously admitted gastro-enteritis with hypoglycaemia

- Set up for non invasive ventilation
- Hypertrofia of adenoid and tonsils
- On the emergency list, starting at 12:00
Case report

- Fasting from 6:00 a.m.
- Refused clear fluids
- No intravenous line

- 21:00 surgery started
- Dronk well after surgery, mostly water
- IV no glucose added
- Next morning ...... difficult to wake up
- Glucose level < 1
Case report

- Glucose IV
- Intubation, respiratory insufficiency
- PICU
- Accidental detubation
Drawbacks of fasting

Thirsty, hungry, behaviour, uncomfortable


Hungry or starving 56%
Thirsty 27%

Drawbacks of fasting

Blood glucose level, ketone body concentration
- (low) normal glucose level
- Ketone bodies ↑
- BE / Anion gap ↓

- Dennhardt N. Eur J Anaesth 2015. Impat of preoperative fasting times on blood glucose concentration, ketone bodies and acid-base balance in children younger than 36 months.
Drawbacks of fasting

Hemodynamics in optimized preop fasting
- Incidence of hypotension ↓
- MAP after induction ↑

Drawbacks of fasting

- Insulin resistance \( \uparrow \) in standard fasting versus Pre Op (= lemon flavoured carbohydrate beverage)


- Insulin resistance \( \downarrow \) preop oral carbohydrates

Drawbacks of fasting, summary

*Thirst, oncomfortable, negative behaviour*

*Glucose / ketone bodies*

*Instability at induction ... (IV placement?)*

*Insulin resistance*
# Gastric emptying

<table>
<thead>
<tr>
<th>Factors increasing emptying</th>
<th>Factors decreasing emptying</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physiological factors</strong></td>
<td></td>
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<tr>
<td>Large gastric volume</td>
<td>Large duodenal volume</td>
</tr>
<tr>
<td>Liquid gastric contents</td>
<td>High-calorie chyme</td>
</tr>
<tr>
<td>Solids &lt;2 mm</td>
<td>Acidic chyme</td>
</tr>
<tr>
<td>Parasympathetic stimulation</td>
<td>Hypo-/hyper-osmolar chyme</td>
</tr>
<tr>
<td>Secretion of motilin and gastrin</td>
<td>Fatty and amino acid-rich chyme</td>
</tr>
<tr>
<td>Sitting position (for non-caloric liquids)</td>
<td>Hot and cold chyme</td>
</tr>
<tr>
<td><strong>Pharmacological factors</strong></td>
<td></td>
</tr>
<tr>
<td>Anticholinergics</td>
<td>Secretion of cholecystokinin, secretin, somatostatin, vasoactive intestinal peptide, and gastric inhibitory peptide</td>
</tr>
<tr>
<td>Metoclopramide</td>
<td>Antimuscarinics</td>
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<tr>
<td>Domperidone</td>
<td>Opioids</td>
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<tr>
<td>Erythromycin</td>
<td></td>
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<tr>
<td><strong>Patient factors</strong></td>
<td></td>
</tr>
<tr>
<td>Hyperthyroidism</td>
<td>Pain</td>
</tr>
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<td></td>
<td>Anxiety and stress</td>
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<tr>
<td></td>
<td>Trauma</td>
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<td></td>
<td>Pregnancy</td>
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<td></td>
<td>Alcohol ingestion</td>
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<td></td>
<td>Hypothyroidism</td>
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<td></td>
<td>Diabetes</td>
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<td></td>
<td>Pyloric stenosis</td>
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<td></td>
<td>Intestinal obstruction</td>
</tr>
<tr>
<td></td>
<td>Vagotomy</td>
</tr>
</tbody>
</table>

Gastric emptying

- Scintigraphy using radiolabelled meals
- Magnetic Resonance Imaging
- Endoscopy
- Ultrasound
- Paracetamol absorption test
- Wireless motility capsules
Gastric emptying begins instantly, solid emptying begins after the lag phase. Hellström PM. Best Pract Res Clin Anaesthes. 2006. The physiology of gastric emptying.
Gastric emptying

MRI
• 18 healthy volunteers (aged 9 years)
• Breakfast (cereal flakes and milk) 4 of 6 h
• Clear liquids 2 h
• Half hourly MRI
• No anesthesia

Schmitz A. Acta Anaesth Scand 2012. Residual gastric contents volume does not differ following 4 or 6 h fasting after a light breakfast – a magnetic resonance imaging investigation in healthy non-anaesthetised school-age children.
Gastric emptying

MRI

- Clear liquids gone within 1 h (T1/2 30 min)
  - Also Okabe. BJA 2015. Liquid gastric emptying.
- Regardless of breakfast at 4 or 6 h prior
**Gastric emptying**

Endoscopy
- 120 children
- Clear fluids water / tea or Pre-Op 5 ml per kg
- Endoscopy under anesthesia
- Stomach contents aspirated for volume & pH

- **Volume of gastric content lower in Pre Op children**
- Less postop nausea in Pre Op children

Tudor-Drobyewski BA. BJA 2018. Randomised controlled trial comparing preoperative carbohydrate loading with standard fasting in paediatric anaesthesia.
Gastric emptying

Ultrasound

• Preoperative bedside test
• Right lateral decubital (RLD)
• Gastric cross-sectional area (CSA)
• CSA in RLD correlates well with MRI volume (Schmitz)

Mean gastric emptying time < 4 h after breakfast (Beck)

Gastric emptying

Ultrasound

Gastric emptying time < 4 h after breakfast.


No difference in pH / volume fasting 1 or 2 h clear fluids.

- Schmidt. BJA 2015. Gastric pH and residual volume
Gastric emptying

Solid: lag phase followed by linear manner
Cow milk: intitial fast phase followed by linear manner
Liquids: first order kinetics half-life of 10 – 26 min

Andersson H. CO-anesth 2018. Preoperative fasting guidelines in pediatric anesthesia: are we ready for a change?
Gastric emptying, summary

*Is influenced by many factors*

*Can be measured in various ways*

*Breakfast safe – 4 h*

*Clear fluids gone very fast*

*Ad glucose to speed up the process*
New developments
New developments
New developments

• Hanna Andersson & Prof Frykholm
• Restrospective
• 10.015 children
• Elective surgery
• Intake of clear fluids until called

• Aspiration 3 in 10,000
• No intensive care or ventilation support
Low incidence of pulmonary aspiration in children allowed intake of clear fluids until called to the operating suite

Hanna Andersson, Björn Zarén & Peter Frykholm

Department of Surgical Sciences, Anesthesia and Intensive Care, Uppsala University Hospital, Uppsala, Sweden

What is already known

- Today most departments apply the 6-4-2 fasting regime. Previous studies have shown incidence of pulmonary aspiration in pediatric anesthesia to be 1–10 in 10,000.

What this article adds

- With a regimen allowing free clear fluids until called to the operating suite the incidence of pulmonary aspiration was 3 in 10,000.

Implications for translation

- Shortened fasting times may improve the perioperative experience for parents and children and reduce dehydration and hypoglycemia.
New developments

Meanwhile at the Wilhelmina Children’s Hospital

“We tend to favour more traditional anaesthetic techniques here.”
New developments

- Poster (2014) and publication (2015)
- Questions for the investigators
- PICO by resident
- Staff meeting

- Nurses on board
- Pediatricians on board
- Surgeons
New developments

Meanwhile at the Wilhelmina Children’s Hospital

March 2016

6 – 4 – 0

10 ml per kg per hour

Max 100 ml per hour

Clear liquids or rocket waterice
Statement ESPA

April 30, 2018

*Based on the current convincing evidence base, unless there is a clear contraindication, it is safe and recommended for all children able to take clear fluids, to be allowed and encouraged to have them up to 1 hour before elective general anesthesia.*
Statement SKA

January 10th, 2019

• Solids / milk: Guideline Anesthesie in Children, NVA
• Clear fluids: 6 – 4 – 0
• Short turnover time: 6 – 4 – 1
• Clear fluids are water, water with sugar, tea, appeljuice, syrup or waterice. Volume: about 3 ml per hour, preference glucose containing drinks!!
Near future?

Quality indicator fasting in children

Multicentre trail drink untill called for anesthesia
• Prof Frykhom, Uppsala University, Sweden
• Sufficient power
• Establish non inferiority – just as save
• Andersson H. CO Anesth 2018. Preoperative fasting guidelines in pediatric anesthesia: are we ready for a change?

Breakfast 4 h prior to anesthesia?
Let them drink sweet

OR