ESTIMATING GASTRIC RESIDUAL VOLUME (GRV) IN CRITICALLY ILL PATIENTS

Dr dr Luciana Sutanto MS SpGK - INDONESIA

GASTRIC VOLUME

- The cells of gastric gland secrete about 2,500 mL of gastric juice daily [Ganong W, 2001]

- In fasting patient, stomach can secrete up to 50 mL of gastric juice an hour [Guyton A, 1986, Greenfield S, et al. BMJ 1997]

- Empty gaster: 80 mL [Johnson & George, 1994]
# GASTRIC VOLUME

<table>
<thead>
<tr>
<th>NO</th>
<th>AUTHOR</th>
<th>INTAKE</th>
<th>Mean Fast</th>
<th>Mean Fast</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Miller et al (UK) 1983</td>
<td>toast + tea/coffee</td>
<td>3 ¼ h</td>
<td>9 h</td>
</tr>
<tr>
<td>2</td>
<td>Maltby et al (Canada) 1986</td>
<td>water 150ml</td>
<td>2 ½ h</td>
<td>16 ½ h</td>
</tr>
<tr>
<td>3</td>
<td>Sutherland et al (Canada) 1987</td>
<td>water 150ml</td>
<td>2 ½ h</td>
<td>13 ½ h</td>
</tr>
<tr>
<td>4</td>
<td>Hutchinson et al (Canada) 1988</td>
<td>coffee/juice 150ml</td>
<td>2 ½ h</td>
<td>14 ½ h</td>
</tr>
<tr>
<td>5</td>
<td>McGrady et al (UK) 1988</td>
<td>water 100ml</td>
<td>2 h</td>
<td>12 h</td>
</tr>
<tr>
<td>6</td>
<td>Agarwal et al (India) 1989</td>
<td>water 150ml</td>
<td>2 ½ h</td>
<td>12 h</td>
</tr>
<tr>
<td>7</td>
<td>Scarr et al (Canada) 1989</td>
<td>coffee/juice 150ml</td>
<td>2-3 h</td>
<td>&gt;8 h</td>
</tr>
<tr>
<td>8</td>
<td>Maltby et al (Canada) 1991</td>
<td>water 225ml</td>
<td>½ h</td>
<td>&gt;8 h</td>
</tr>
<tr>
<td>9</td>
<td>Ross et al (USA) 1991</td>
<td>clear liquid 1000ml</td>
<td>2 h</td>
<td>11 h</td>
</tr>
<tr>
<td>10</td>
<td>Mahiou et al (France) 1991</td>
<td>water 150ml</td>
<td>2-3 h</td>
<td>11 ½ h</td>
</tr>
<tr>
<td>11</td>
<td>Lam et al (Hong Kong) 1993</td>
<td>clear liquid, no limit</td>
<td>2 ¼ h</td>
<td>13 h</td>
</tr>
<tr>
<td>12</td>
<td>Phillips et al (UK) 1993</td>
<td>water 300-450ml</td>
<td>1 ½ h</td>
<td>13 h</td>
</tr>
</tbody>
</table>

# GASTROINTESTINAL WATER MOVEMENT

**Gastrointestinal Water Movement** (Ganong, 2005)

<table>
<thead>
<tr>
<th>Volume secreted/day</th>
<th>mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saliva</td>
<td>1500</td>
</tr>
<tr>
<td>Stomach</td>
<td>2500</td>
</tr>
<tr>
<td>Bile</td>
<td>500</td>
</tr>
<tr>
<td>Pancreas</td>
<td>1500</td>
</tr>
<tr>
<td>Intestine</td>
<td>1500</td>
</tr>
</tbody>
</table>

**Total** 7500 mL
GASTRIC EMPTYING OF 200 ML ORAL NUTRITIONAL SUPPLEMENTS (ONS)

SUTANTO, ET ALL, 2011, PHILSPEN ONLINE JOURNAL OF PARENTERAL AND ENTERAL NUTRITION

DEFINITION

Supplementary oral intake of dietary food for special medical purposes in addition to the normal food. ONS are usually liquid but they are also available in other forms like powder, dessert-style or bars. Synonyms used in literature: sip feeds.
• Take steps as needed to reduce risk of aspiration or improve tolerance to gastric feeding (use prokinetic agent, continuous infusion, chlorhexidine mouthwash, *elevate the head of bed*, and divert level of feeding in the gastrointestinal tract).

• Implement enteral feeding protocols with institution-specific strategies to promote delivery of EN.

• Do not use gastric residual volumes as part of routine care to monitor ICU patients on EN.

• Start parenteral nutrition early when EN is not feasible or sufficient in high-risk or poorly nourished patients.

---

**MCCLAVE, ET ALL. J PARENTER ENTERAL NUTR 2009 33: 277–316.**

• **Holding** EN for gastric residual volumes < 500 mL in the absence of other signs of intolerance should be avoided. (Grade: B)

• In all intubated ICU patients receiving EN, the head of the bed should be elevated 30° - 45°. (Grade: C)

• For high-risk patients or those shown to be intolerant to gastric feeding, delivery of EN should be switched to continuous infusion. (Grade: D)

• Agents to promote motility such as pro kinetic drugs (*metoclopramide* and erythromycin) or narcotic antagonists (naloxone and alvimopan) should be initiated where clinically feasible. (Grade: C)

• Diverting the level of feeding by post-pyloric tube placement should be considered. (Grade: C)
FACTORS REGULATING GASTRIC MOTILITY & EMPTYING IN ICU PATIENTS

- medications (opioid agonists, dopamine),
- hyperglycemia
- electrolyte disturbances
- ischemia/hypoxia
- burns, trauma, surgery, sepsis, increased intracranial pressure
- the administration of calorically dense or hyperosmolar formulas.


GASTRIC RESIDUAL VOLUME STATUS ICU PATIENT IN 24 HOURS

- Josefina Junizar, Luciana B.Sutanto, Dita Aditianingsih
- Poster presentation in MDA-AODA meeting, Malaysia, 2016
- ICU Ciptomangunkusumo Hospital, Jakarta

![Pie chart showing 77% Normal Residue and 23% High Residue]
GASTRIC RESIDUAL VOLUME STATUS ICU PATIENT IN 48 HOURS

- Pittara Pansawira, Luciana B. Sutanto, Dita Aditianingsih
- Poster presentation in AICNU meeting, Colombo, 2016
- ICU Ciptomangunkusumo Hospital, Jakarta

The paracetamol absorption test: a useful addition to the enteral nutrition algorithm?

J. COHEN, A. AHARON, P. SINGER

General Intensive Care Unit, Rabin Medical Center, Beilinson Campus, Petah Tiqwa, and the Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel (Correspondence to: Dr P Singer Director, General Intensive Care Unit Rabin Medical Center, Beilinson Campus Petah Tiqwa, 49100 Israel)

Abstract—Background: Enteral nutrition in critically ill patients given via the nasogastric route is often decreased or stopped because of large gastric residual volumes. Aim: To assess the effect of continuing enteral nutrition in patients

Conclusion: The paracetamol absorption test may be normal in patients with relatively high gastric residual volumes. These patients may continue to receive enteral nutrition.

The subgroup had to be stopped because of persistently elevated residual volumes. Conclusion: The paracetamol absorption test may be normal in patients with relatively high gastric residual volumes. These patients may continue to receive enteral nutrition. © 2000 Harcourt Publishers Ltd.
FACTOR REGULATING GASTRIC MOTILITY & EMPTYING IN ICU PATIENTS

HYPERGLYCAEMIA

- Increases ROS production
- Stimulates vagal afferent pathways
- Causes osmotic diuresis
- Cel apoptosis
- Gastric smooth muscle contraction disorder

GASTRIC DYSMOTILITY

HYPOPERFUSION

- The inflammatory response in the intestinal muscularis externa
- Local activation of transcription factors, regulatory cytokines & chemokines

DYSMOTILITY
MUCOSAL DAMAGE INDEX IN GUT FOLLOWING RESUSCITATION AFTER HEMORRHAGIC SHOCK. CHANG, ET ALL. WORLD J GASTROENTEROL 2005

As compared to the control group, the mucosal thickness at 24 h diminished by 25.2%, 23.6%, 23.4% and 24.5% respectively, namely from 547±23 µm to 418±28 µm in jejunum, 483±45 µm to 364±35 µm in ileum. The mucosal thickness of colon was not markedly changed in each time point group (F = 0.296, P = 0.936, Table 1).

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Jejunum</th>
<th>Ileum</th>
<th>Jejunum</th>
<th>Ileum</th>
<th>Colon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>310±30</td>
<td>270±22</td>
<td>545±13</td>
<td>482±19</td>
<td>633±58</td>
</tr>
<tr>
<td>Exp(h) 0</td>
<td>309±24</td>
<td>271±31</td>
<td>547±23</td>
<td>483±45</td>
<td>651±65</td>
</tr>
<tr>
<td>12</td>
<td>297±29</td>
<td>244±25</td>
<td>523±18</td>
<td>445±26</td>
<td>639±60</td>
</tr>
<tr>
<td>7</td>
<td>278±24</td>
<td>210±27</td>
<td>501±27</td>
<td>420±31</td>
<td>674±71</td>
</tr>
<tr>
<td>6</td>
<td>270±23</td>
<td>220±18</td>
<td>433±19</td>
<td>380±33</td>
<td>652±69</td>
</tr>
<tr>
<td>24</td>
<td>268±23</td>
<td>220±18</td>
<td>433±19</td>
<td>380±33</td>
<td>652±69</td>
</tr>
</tbody>
</table>

Values are mean±SE; n = 5 rats in control group, n = 7 in each experiment group.

*P <0.05 vs control group.

Mucosal damage index in small intestine and colon:
Control samples taken from small intestine and colon exhibited a minor grade of damage at each time point group. In the experimental group, the 0th hour after shock resuscitation showed moderate damage with the values of the mucosal damage index being 1.4 in jejunum, 1.6 in ileum and 0.6 in colon. The value was significantly elevated in the 1st group and the 3rd group with their damage grade being 2.6 in jejunum, 2.8 in ileum and 1.2 in colon, then it dropped gradually at the 6th hour (0.8, 1.0, and 0.6, respectively in the above three areas). In the 12th, all mucosal damage and degradation were nearly closer to that in the control group.

For the mucosal thickness change, the damage in colon was significantly less (Figure 3).

**COLOR OF GASTRIC RESIDUE**

<table>
<thead>
<tr>
<th>COLOR</th>
<th>INTERPRETATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemorrhagic</td>
<td>Blood</td>
</tr>
<tr>
<td>Bloodstained/coffee-ground type</td>
<td>Blood</td>
</tr>
<tr>
<td>Green</td>
<td>Bile</td>
</tr>
<tr>
<td>Light yellow</td>
<td>Normal color</td>
</tr>
<tr>
<td>Clear</td>
<td>Normal color</td>
</tr>
</tbody>
</table>

Figure 3

Mucosal damage index in small intestine and colon following resuscitation after hemorrhagic shock. Bars are mucosal damage index, the color represented different sites.

Effect of L/M and the LPS test
Intestinal permeability to macromolecules, as measured by the urinary concentration of L and M, was significantly increased in experimental group rats. The value of L/M was elevated following the time, and reached the peak from 3 to 6 h (0.063±0.012, 0.098±0.011 respectively, P <0.001),
CONCLUSION

➤ Measure gastric residue before starting enteral nutrition and every four hour, for the first 5 days (ICU)

➤ Measure gastric residue every 12 hours on days 6–20

➤ High gastric residue: ≥150 mL /single aspirate

➤ IV administration of metoclopramide or erythromycin should be considered in patients with intolerance to enteral feeding e.g. with high gastric residue

CONCLUSION

➤ Maintain blood glucose level 70 - 180 mg/dL

➤ Maintain blood Potassium level 4 mEq/L

➤ Maintain hemodynamic: MAP >65
GASTRIC RESIDUAL VOLUME 510 ML IN 24 HR

Volume
mL 300

0 4 8 12 16 20 24/0 HOUR

TERIMA KASIH
AICNU 2016, Colombo