Fluid Restriction in Post-Operative GI Surgical Patients: Valuable

R Dawn Fevurly, MD
History of Fluid Administration
(Srinivasa and Hill, 2012)

• **1830s**: IVFs used on cholera victims
• **1880s**: IVFs for hemorrhage and shock
• **Early 1900s**: use in surgical patients – administered via rectum or subq
• **1924**: “Drip” developed
• **1950s**: improvement of injured soldiers with IVFs in the Korean War and increased understanding of water and electrolyte changes post operatively
• **Early 21st century**: renewed interest in perioperative care and fluid status

Matas’ Intravenous “Drip” 1924
### Pathophysiology of Fluid Excess
(Holte et al, 2002)

<table>
<thead>
<tr>
<th>Effect</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased demands on cardiac function</td>
<td>Shift to right on Starling curve</td>
</tr>
<tr>
<td>Fluid accumulation in lungs</td>
<td>Post-op pneumonia, respiratory failure</td>
</tr>
<tr>
<td>Increased excretory demand on kidneys</td>
<td>May lead to urinary retention</td>
</tr>
<tr>
<td>Inhibition of gastrointestinal motility</td>
<td>Prolonged ileus</td>
</tr>
<tr>
<td>Decrease tissue oxygenation</td>
<td>Poor wound healing</td>
</tr>
<tr>
<td>Coagulation enhanced with crystalloids</td>
<td>Predispose to post-op thrombosis</td>
</tr>
</tbody>
</table>
Pathophysiology of Fluid Excess
(Holte et al, 2002)

Cardiac output

Fluid administration improves myocardial performance

Fluid volume administered

Fluid administration impairs myocardial performance
Volume Overload and Intestinal Anastomotic Stability
(Marjanovic et al, 2009)

- Small bowel anastomosis studies in rats exposed to increased volumes of crystalloid (36 ml/kg/hr) vs fluid restricted group (3 ml/kg/hr)
  - Bursting pressure of anastomosis lower in high volume group
  - Structural stability (measured via hydroxyproline levels) decreased in high volume group
Fluid Restriction
(Brandstrup et al, 2003)

• Randomized assessor-blinded multicenter trial (8 Danish hospitals)
• 172 patients undergoing colorectal resection (69 restricted group, 72 standard group)
Fewer Post-Op Complications
(Brandstrup et al, 2003)

• Complications included: anastomotic leakage, bleeding, sepsis, wound dehiscence, intestinal obstruction, pulmonary edema, wound infection, ileus, pneumonia, cardiac arrhythmias, etc
Support for fewer post-op complications
(Abraham-Nordling et al, 2012)

- Randomized clinical trial (161 patients)
  - Fluid restricted on day of surgery (median 3050 ml) vs standard group (median 5775 ml)
  - Lower complications in restricted group (31 of 79 vs 47 of 82, p=0.027)
  - No change in length of stay

<table>
<thead>
<tr>
<th></th>
<th>Restricted fluid</th>
<th>Standard fluid</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients with major surgical complication</td>
<td>4 (5)</td>
<td>12 (15)</td>
<td>0.063</td>
</tr>
<tr>
<td>No. of major surgical complications</td>
<td>5</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Anastomotic leakage ± reoperation</td>
<td>1</td>
<td>6</td>
<td>0.117</td>
</tr>
<tr>
<td>Peritonitis without leakage ± reoperation</td>
<td>1</td>
<td>1</td>
<td>1.000</td>
</tr>
<tr>
<td>Bleeding ± reoperation</td>
<td>0</td>
<td>2</td>
<td>0.497</td>
</tr>
<tr>
<td>Sepsis/shock</td>
<td>1</td>
<td>4</td>
<td>0.368</td>
</tr>
<tr>
<td>Total No. of patients</td>
<td>19 (24)</td>
<td>31 (38)</td>
<td>0.064</td>
</tr>
<tr>
<td>No. of patients with minor surgical complication</td>
<td>22</td>
<td>37</td>
<td>0.061†</td>
</tr>
<tr>
<td>No. of minor surgical complications</td>
<td>23</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Periop. or postop. blood transfusion without reoperation</td>
<td>6</td>
<td>16</td>
<td>0.038</td>
</tr>
<tr>
<td>Wound infection, haematoma, dehiscence</td>
<td>10</td>
<td>11</td>
<td>1.000</td>
</tr>
<tr>
<td>Total No. of patients</td>
<td>17 (22)</td>
<td>24 (29)</td>
<td>0.282</td>
</tr>
<tr>
<td>No. of organ-specific complications</td>
<td>23</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Cognitive disorder</td>
<td>2</td>
<td>6</td>
<td>0.277</td>
</tr>
<tr>
<td>Cardiac complication</td>
<td>5</td>
<td>0</td>
<td>0.027</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>0</td>
<td>1</td>
<td>1.000</td>
</tr>
<tr>
<td>Renal dysfunction</td>
<td>2</td>
<td>0</td>
<td>0.239</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>3</td>
<td>8</td>
<td>0.211</td>
</tr>
<tr>
<td>Total no. of postoperative complications</td>
<td>50</td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>Total no. of patients with complications</td>
<td>31 (39)</td>
<td>47 (57)</td>
<td>0.027</td>
</tr>
</tbody>
</table>
Improved gastric emptying
(Lobo et al, 2002)

- Post-op fluid restriction (< 2 L water per day) in patients (N=20) who underwent elective colonic resection for colon cancer had decreased gastric emptying times compared with standard (> 3 L water per day) group.
Immunologic Response
(Gao et al, 2012)

- Prospective randomized controlled trial of elderly patients (> age 65) with abdominal cancer (N=179)
  - Fluid restriction resulted in less reduction of T cells post-op and enhanced recovery of T cells
  - Higher CD4$^+$/CD8$^+$ ratio in fluid restriction
    - Better preserved immunologic function
Independent of ASA Class
(Srinivasa et al, 2012)

- Retrospective analysis (N=227) – greater fluid volumes associated with adverse outcomes regardless of ASA class (Class 1-3)
  - Elective colectomy
  - Complications with those receiving 5000 ml post op vs 2000 ml (p<0.01)
Arguments Against

• Excessive fluid restriction intraoperatively increases level of hypovolemia, leading to increased post-op complications (N=70) (Futier et al, 2010)
  – Tissue hypoperfusion, increased anastomotic leak, and post-op sepsis

• No change in times to flatus or bowel motion between fluid restrictive (< 2 L per day) and standard groups (> 3 L per day) (N=80) (MacKay 2006)
  – No change in hematocrit between groups, invalidates argument that hemoconcentration occurred in restrictive group (Morera 2007)
Conclusions Regarding Fluid Restriction

- Fewer post-operative complications
- Improved gastric emptying times
- Less harmful immunologic response
- Safe across a variety of patients
References


