Fluid management in short bowel & intestinal failure

Dr Simon Gabe
Consultant Gastroenterologist
St Mark’s Hospital
# Variability of intestinal length

<table>
<thead>
<tr>
<th>Technique</th>
<th>Author</th>
<th>n</th>
<th>Small intestinal length, m</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autopsy</td>
<td>Bryant, 1924</td>
<td></td>
<td></td>
<td></td>
<td>3.0–8.5</td>
</tr>
<tr>
<td>Laparotomy</td>
<td>Backman, 1974</td>
<td>32</td>
<td></td>
<td>660</td>
<td>4.0–8.5</td>
</tr>
<tr>
<td></td>
<td>Slater, 1991</td>
<td>38</td>
<td></td>
<td>500</td>
<td>3.0–7.8</td>
</tr>
</tbody>
</table>

Short bowel

What is the critical length of bowel that you need?
## Length matters: critical lengths

<table>
<thead>
<tr>
<th>SBS type</th>
<th>Critical SB length</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jejunostomy or EC fistula</td>
<td>100 cm</td>
<td>More needed if diseased bowel</td>
</tr>
<tr>
<td>Jejunocolic anastomosis</td>
<td>Around 50 cm</td>
<td>Depends on amount of residual colon</td>
</tr>
</tbody>
</table>
Intestinal balance (kg/d) vs. Jejunal length (m)

- IV nutrition
- IV fluid
- Oral supplements

Nightingale, 1990

$r = 0.96$
$p < 0.001$
Citrulline


95% positive predictive value in distinguishing transient from permanent IF

Permanent IF
O Transient IF

$r = 0.83, P<0.0001$
Short bowel

How much fluid does a patient need?
Salt & water losses

Patients with short bowel have a high output

The higher the output the higher the sodium losses

These losses need replacing otherwise the patient will become both salt & water deplete

![Graph showing correlation between intestinal output and sodium output](Nightingale, 1990)
Jejunum

Hypotonic fluids
Water, tea, coffee, fizzy drinks

Jejunal mucosa
Unable to maintain a Na gradient >30-40mmol/L

[Na]=100mmol/L
Jejunum
Decreasing fluid losses & increasing absorption

Electrolyte Mix
100mmol/l Na

Na$^+$ + H$_2$O

Na
Oral rehydration solutions

Water & sodium solutions <90mmol/L
- Negative Na balance\(^1\)

Sodium solutions >90mmol/L
- Greater Na absorption
- But palatability an issue\(^2\)

**Treatment: High Output**

Drink little hypotonic fluid | Maximum 1L/day
--- | ---
Drink a glucose-saline solution | Maximum 1L/day

<table>
<thead>
<tr>
<th></th>
<th>Na mmol/l</th>
<th>K mmol/l</th>
<th>Glucose mmol/l</th>
<th>Volume ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHO</td>
<td>90</td>
<td>20</td>
<td>111</td>
<td>1000</td>
</tr>
<tr>
<td>Electrolyte mix</td>
<td>90</td>
<td>0</td>
<td>111</td>
<td>1000</td>
</tr>
<tr>
<td>Dioralyte</td>
<td>60</td>
<td>20</td>
<td>90</td>
<td>200</td>
</tr>
<tr>
<td>Gastrolyte ORS</td>
<td>60</td>
<td>20</td>
<td>90</td>
<td>200</td>
</tr>
<tr>
<td>Powerade isotonic</td>
<td>12</td>
<td>4</td>
<td>0 (214) sucrose &amp; maltodextrin</td>
<td>600</td>
</tr>
<tr>
<td>Powerade isotonic + ½teaspoon NaCl</td>
<td>85</td>
<td>4</td>
<td>0 (214) sucrose &amp; maltodextrin</td>
<td>600</td>
</tr>
</tbody>
</table>
### E-mix recipe

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose</td>
<td>20g</td>
<td>6 teaspoons</td>
</tr>
<tr>
<td>Salt</td>
<td>3.5g</td>
<td>1 level 5ml teaspoon</td>
</tr>
<tr>
<td>Sodium bicarbonate</td>
<td>2.5g</td>
<td>1 heaped 2.5ml teaspoon</td>
</tr>
</tbody>
</table>

Stir into 1L water & chill overnight: enjoy the next day!
## Treatment: high output

<table>
<thead>
<tr>
<th>Drug therapy</th>
<th>Antimotility</th>
<th>Antisecretory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Loperamide (up to 32mg QDS)</td>
<td>Omeprazole (40mg BD)</td>
</tr>
<tr>
<td></td>
<td>Codeine phosphate (up to 60mg QDS)</td>
<td>?Octreotide (50µg BD)</td>
</tr>
<tr>
<td>Drink little hypotonic fluid</td>
<td>Maximum 1L/day</td>
<td>?Clonidine patch</td>
</tr>
<tr>
<td>Drink a glucose-saline solution</td>
<td>Maximum 1L/day</td>
<td>?Racecadotril</td>
</tr>
</tbody>
</table>
Sodium balance
Patient with jejunostomy at 100 cm

Potassium & magnesium

**Potassium**
- Negative K balance when jejunum <50 cm
- Hyperaldosteronism in chronic Na deficiency

**Magnesium**
- Deficiency is common
  - 40% jejunum-colon pts
  - 70% jejunostomy pts
- No correlation between Mg balance & jejunal length
## Fluid & nutritional balance

<table>
<thead>
<tr>
<th>Fluid</th>
<th>Nutrition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure losses</td>
<td>Assess current nutritional status</td>
</tr>
<tr>
<td>IV fluid replacement</td>
<td>Dietary history</td>
</tr>
<tr>
<td>Accurate fluid balance charts essential</td>
<td>Losses</td>
</tr>
<tr>
<td>Urine Na best gauge of hydration status</td>
<td>Albumin NOT a good marker</td>
</tr>
</tbody>
</table>
High output stoma

1.5-2L/24h

Hypomagnesemia

Water & sodium depletion
Stomal output & jejunal length

50 cm  100 cm  200 cm
High output stoma

- **Thirst & cramps**: Output 1.5-2L/day → Water & sodium loss → Hypomagnesemia
- **Stomal problems**: Frequent emptying of bag → Leakage / difficult skin care
- **Tremor**: Magnesium depletion
- **Undernutrition**: Dehydration → Decreased absorption

Undernutrition, dehydration, and decreased absorption can lead to undernutrition, which is common in high output stomas. Additionally, magnesium depletion can cause tremors. Fluid and sodium loss can lead to hypomagnesemia, which can further exacerbate the tremors and other symptoms.
What NOT to do ...

Drink more water
## Summary

| **Critical SB length** | 1m without colon  
| 50cm with whole colon |
|-----------------------|--------------------------------------------------|
| **Stomal sodium loss** | 90-100mmol/L |
| **Decreasing output** | Drink less, use oral rehydration solution  
| Antimotility & antisecretory agents  
| Consistent message to the patient |
| **High output stoma** | Surprisingly common (13-16% ileostomists)*  
| Look at the colour of the output  
| Look for the symptoms and signs |

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