Surgical Management of Intestinal Failure

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Definition

- Reduction in the functioning gut mass below the minimal amount necessary for adequate digestion and absorption of food.
  

- Failure of the intestinal tract to maintain adequate hydration and electrolyte balance in the absence of artificial fluid and electrolyte support.
  
  Nightingale JMD. Intestinal failure; 2001
Intestinal Failure (IF) may have various degrees of severity and duration:

- According to the duration:
  - Acute (reversible within 6 months)
  - Chronic (longer than 6 months, and even permanent)
Types of Intestinal Failure

Type 1: Short Term
Self-limiting intestinal failure

Type 2: Medium Term
Significant & prolonged PN support (>28 days)

Type 3: Long Term
Chronic IF (long term PN support)

Lal et al. AP&T 2006:24;19-31
Type I Intestinal Failure

- Postoperative I Obstruction

**Mechanical obstruction**
- after open surgery
- Adhesions
- Managed conservatively, using
  Nasogastric drainage and intravenous feeding. (within the first 7 days)
- after laparoscopic surgery
- port-site herniation
- Laparotomy should be considered
Postoperative I Obstruction

- Patients who require re-laparotomy can be extremely challenging
  - abdominal cavity can be hostile
  - inadvertent intestinal injury, even if recognized is associated with a high incidence of abdominal sepsis, intestinal fistulation → type II intestinal failure
Type I Intestinal Failure

- Postoperative ileus

- The average duration of ileus after major abdominal surgery varies depending on what part of the digestive system affected
  - Small Intestine 0 to 24 hours
  - The stomach 24 to 48 hours
  - The colon 48 to 72 hours
Pathogenesis of POI is multifactorial

- Sympathetic Nervous System
  - Inhibitory neural reflexes

- Disorganized electrical activity

- Multiple Pathways

- Excessive IV fluids
  - Intestinal edema

- Proinflammatory Mediators
  - Macrophage and neutrophil infiltration, IL-1, tumor necrosis factor, IL-6

- Pharmacologic
  - Exogenous opioids

IL = interleukin
There Are Numerous Risk Factors for POI

- Surgical Site
- Extent of Bowel Manipulation
- Operation Time
- Patient Health
- Systemic Infections
- Amount of Opioids
- Patient Factors

POI Is Expected to Affect Almost Every Patient Who Undergoes Abdominal Surgery

Senagore AJ. Am J Health-Syst Pharm. 2007;64(suppl 13):S3-S7.
# Management Options for POI

<table>
<thead>
<tr>
<th>Nonpharmacologic Options</th>
<th>Potential Mechanism</th>
<th>Impact on Bowel Function, Length of Stay</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NG tube</strong></td>
<td>Gastric/small bowel decompression</td>
<td>Removal of NG tube associated with earlier return of bowel function, reduction in pulmonary complications, shorter length of stay</td>
</tr>
<tr>
<td><strong>Early feeding (including sham feeding)</strong></td>
<td>Stimulates GI motility by eliciting reflex response and stimulating release of hormonal factors</td>
<td>Some studies report a reduction in POI with early feeding, meta-analyses suggest a modest (non-significant) reduction in length of stay</td>
</tr>
<tr>
<td><strong>Early ambulation</strong></td>
<td>Possible mechanical stimulation; possible stimulation of intestinal function</td>
<td>No effect on duration of POI; beneficial for prevention of lower extremity thromboembolism</td>
</tr>
<tr>
<td><strong>Laparoscopic surgery</strong></td>
<td>Decreased opiate requirements, decreased pain, less abdominal wall trauma, less intestinal manipulation</td>
<td>Earlier passage of flatus, earlier bowel movement, shortened length of stay</td>
</tr>
</tbody>
</table>
# Management Options for POI

<table>
<thead>
<tr>
<th>Treatment or Prevention</th>
<th>Potential Mechanism</th>
<th>Impact on Bowel Function, Length of Stay</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Epidural (thoracic) anesthesia/analgia</strong></td>
<td>Inhibits sympathetic reflex at cord level; opioid-sparing analgesia</td>
<td>Earlier bowel movement, reduced duration of POI compared with systemic analgesic regimens</td>
</tr>
<tr>
<td><strong>NSAIDs</strong></td>
<td>Opiate-sparing analgesia, inhibits COX-mediated prostaglandin synthesis</td>
<td>Earlier bowel movement, earlier ambulation, no change in length of stay compared with morphine PCA</td>
</tr>
<tr>
<td><strong>Metoclopramide</strong></td>
<td>Dopamine antagonist, cholinergic agonist, prokinetic agent</td>
<td>No benefit on the duration of POI</td>
</tr>
<tr>
<td><strong>Erythromycin</strong></td>
<td>Motilin receptor agonist, prokinetic effect</td>
<td>No benefit on the duration of POI</td>
</tr>
<tr>
<td><strong>Laxatives</strong></td>
<td>Help to induce bowel movement</td>
<td>Limited data from small nonrandomized study suggests benefit; additional study required</td>
</tr>
<tr>
<td><strong>Peripherally selective mu-receptor antagonists</strong></td>
<td>Block enteric mu-receptors and minimize opioid effects on GI function, without impacting CNS-mediated analgesia</td>
<td>Clinical trials with alvimopan demonstrated reduced time to recovery of GI function, reduced time to discharge order written compared with placebo</td>
</tr>
</tbody>
</table>
Prevention and treatment for POI

**Preoperative management strategies**
- Avoid prolonged preoperative fasting
  - Consider carbohydrate loading
  - Consider probiotic supplements
- Avoid mechanical bowel preparation
- Pain management
  - Consider preoperative COX-2 inhibitors
  - Continuous epidural anesthesia with local anesthesia administration

**Intraoperative management strategies**
- Minimally invasive surgery when feasible
- IV fluid restriction when appropriate

**Postoperative management strategies**
- Avoid routine NGT and drain placement
- Early ambulation
- Pain management
- Early oral feeding
  - Limit opioid use
  - Consider opioid antagonists
  - Consider prokinetic agents
Type II intestinal failure

Type II failure may be self-limiting, (simple intestinal fistulation, spontaneous healing with effective nutritional and metabolic support)

- Complications of abdominal surgery, (severe abdominal sepsis)
- A patient malnourished following intestinal resection
- IF result from a short bowel secondary to resection and fistula formation and/or indirect effect of sepsis on gastro-intestinal function
Prevention of intestinal failure

- Anastomosis avoided in the malnourished patient, adjacent to sepsis, haemodynamically unstable patient, or ischemic bowel

- In cases of significant resection/fistula formation, accurate intra-operative measurement of the length of the remaining bowel should be attempted to aid subsequent planning (Level 5)
Prevention of intestinal failure

- IF surgery, should be discouraged within 12 weeks, and preferably postponed until 24 weeks.
- Open abdomen should not have planned reconstructive surgery until the abdomen has softened and re-epithelialized.
- Re-laparotomy should be taken with the involvement of a second specialized consultant not involved with the case at the time of the original operation (Level 4).
Management of acute intestinal failure: A position paper from the European Society for Clinical Nutrition and Metabolism (ESPEN) Special Interest Group

Stanislaw Klek a,⁎, Alastair Forbes b, Simon Gabe c, Mette Holst d, Geert Wanten e, Øivind Irtun f,g, Steven Olde Damink h, Marina Panisic-Sekeljic i, Rosa Burgos Pelaez j, Loris Pironi k, Annika Reintam Blaser l,d, Henrik Højgaard Rasmussen d, Stéphane M. Schneider m, Ronan Thibault n, Ruben G.J. Visschers h, Jonathan Shaffer o

![Multidisciplinary management of type II AIE](image-url)
Adult Conditions Causing Type 3 Intestinal Failure

- Short bowel syndrome following extensive surgeries secondary to mesenteric ischemia
- IBD such as Crohn's disease
- Small bowel tumors such as Gardner's syndrome (familial colorectal polyposis)
- Tumors of the mesenteric root and retroperitoneum (desmoid tumor)
IF in inflammatory bowel disease

- Rare in MUC
- IF in patients with CD
  - Complications of surgery for intra-abdominal sepsis,
  - Extensive primary small bowel disease impairing nutrient absorption
  - Uncomplicated sequential resection leading to a shortened small bowel
IF in inflammatory bowel disease

- IF in patients with CD 20 years after first resection is 8.5%
- Predisposing factors to type 3 IF in CD
  - Younger age at diagnosis and (at first operation)
  - Strictureing disease
  - Family history of IBD
  - CD susceptibility gene nucleotide containing protein 2 (NOD2) is associated with IF
Strategies for managing Type 3 IF

- Growth hormone to enhance intestinal adaptation and absorption and reducing PN requirements
  - Effects not sustained and patients revert to pretreatment states relatively quickly

- Glucagon-like peptide-1 (GLP-1) and GLP-2 agonists
  - Study demonstrated enhanced absorption with combination GLP-1 and GLP-2 analogues
  - Madsen KB, et al. Regul Pept. 2013
Strategies for managing Type 3 IF in CCF

Antidiarrheals
Histamine$_2$-blockers
Proton pump inhibitors

Pancreatic enzymes
Antimicrobials

Bile acid therapies
Somatostatin analogues

Probiotics
$\alpha_2$-Adrenergic receptor antagonists

Growth hormones
Glucagonlike peptide 2 hormones
Twenty adult patients
- Bianchi (n=6)
- Serial transverse enteroplasty (STEP) (n=15)

Indications were
- To increase the enteral caloric intake thereby reduce or wean parenteral nutrition (PN) (n=14)
- For bacterial overgrowth (n=6)
<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Procedure</th>
<th>Bowel anatomy</th>
<th>Length of SB remnant</th>
<th>Additional SB length gained</th>
<th>Final SB length</th>
<th>% of SB length gained</th>
<th>Colon anatomy</th>
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</thead>
<tbody>
<tr>
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<td>To increase enteral calorie intake</td>
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<tr>
<td>1</td>
<td>Bianchi and STEP</td>
<td></td>
<td>80</td>
<td>60</td>
<td>140</td>
<td>75</td>
<td>TC and LC</td>
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<tr>
<td>2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>STEP</td>
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<td>150</td>
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<td>LC</td>
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<td>172</td>
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<td>5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Bianchi</td>
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<td>48</td>
<td>36</td>
<td>84</td>
<td>75</td>
<td>All</td>
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<tr>
<td>6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Bianchi</td>
<td></td>
<td>150</td>
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<td>160</td>
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<td>TC and LC</td>
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<tr>
<td>8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>STEP</td>
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<td>65</td>
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<td>Rectum</td>
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<td>TC and LC</td>
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<tr>
<td>11&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>Bacterial overgrowth</td>
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<td>TC and LC</td>
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</tbody>
</table>
Conclusions: Bowel lengthening is technically feasible and effectively leads to weaning from PN in more than half of the adult patients.

Lengthening procedures may be an underutilized treatment for adults with short bowel syndrome.
Conclusions: (STEP) significantly increases intestinal length without any evidence of obstruction. It may be a safe and facile alternative for intestinal lengthening in children with short bowel syndrome.
The First Clinical Application of the Spiral Intestinal Lengthening and Tailoring (SILT) in Extreme Short Bowel Syndrome


Fig. 1 Contrast studies demonstrating the small bowel size before bowel expansion (a) after bowel expansion (b) and after SILT (c). White arrows (marking the plough used for catheter fixation in the stoma) are used to equalize magnification between image a and b. They are the same size on both a and b images. The black arrows are representing the bowel diameter before bowel expansion on a and b images. Dilatation and some lengthening after bowel expansion can be observed in image b. Image c shows the tailored and lengthened segment anastomosed end to side into the ascending colon.
IF Surgery
A 3-year-old girl had remaining 15 cm jejunum after midgut volvulus.

The length of the jejunum increased from the initial 15 to 22 cm during 12 months of PN and bowel expansion.

11 cm of distended bowel was further lengthened up by SILT giving a total small bowel length of 33 cm.

**Conclusion** SILT procedure is a safe and feasible technique for human intestinal lengthening and tailoring.
# Intestinal transplantation

<table>
<thead>
<tr>
<th>North American</th>
<th>European</th>
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</thead>
<tbody>
<tr>
<td><strong>Indications</strong></td>
<td><strong>Indication</strong></td>
</tr>
<tr>
<td>Failure of home parenteral nutrition (HPN)</td>
<td>Irreversible, benign, chronic</td>
</tr>
<tr>
<td>Impending or overt liver failure</td>
<td>intestinal failure with no</td>
</tr>
<tr>
<td>Central venous thrombosis of ≥ 2 central veins</td>
<td>possibility of bowel rehabilitation associated with life</td>
</tr>
<tr>
<td>Frequent and severe central venous catheter-related sepsis</td>
<td>threatening complications of HPN</td>
</tr>
<tr>
<td>Frequent episodes of severe dehydration despite intravenous fluids in addition to HPN</td>
<td>Individual case-by-case decision for all patients</td>
</tr>
<tr>
<td>High risk of death attributable to the underlying disease</td>
<td>Non-indications</td>
</tr>
<tr>
<td>Intra-abdominal invasive desmoids tumour</td>
<td>High risk of death due to underlying disease</td>
</tr>
<tr>
<td>Congenital mucosal disorders</td>
<td>Chronic dehydration</td>
</tr>
<tr>
<td>Ultra-short bowel syndrome</td>
<td>Significantly impaired quality of life</td>
</tr>
<tr>
<td>Intestinal failure with high morbidity and low acceptance of HPN</td>
<td></td>
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<tr>
<td>Need for frequent hospitalisation, narcotic addiction or inability to function</td>
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<tr>
<td>Patient’s unwillingness to accept long-term HPN</td>
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</tbody>
</table>
Intestinal transplantation

- The grafts include **liver-containing grafts** (liver-small bowel or multivisceral) or **liver-free grafts** (isolated small bowel including small bowel and colon or modified multivisceral including stomach, pancreas, small bowel, and colon).

- **Patient survival** rates continue to improve, the last international registry data reported 1-, 5-, and 10-year survival as 76%, 56%, and 43%.

- **Complications**
  - Rejection, graft-versus-host disease, post-transplant lymphoproliferative disorder, and infection.
Conclusions

- IF is an uncommon condition, but the impact on the individual is enormous.
- Prevention is the most important.
- The MDT approach to ensuring longevity in these complex patients.
- As growth factors develop, opportunities to wean patients off PN become closer to reality.
Conclusions

- In the absence of relatively cheap hormonal treatments to facilitate intestinal adaption, surgical rescue procedures are vital to maintain functioning gut.
- Intestinal lengthening and transplant are important options.
Thank you