

Anesthesia for Intestinal Transplantation

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KEYWORDS

• Intestinal transplant • Intestinal failure • Multivisceral transplant • Anesthesia

KEY POINTS

- Intestinal transplant is an established treatment for patients with irreversible intestinal failure.
- Intestinal failure leads to systemic manifestations requiring multidisciplinary evaluation at a transplant center.
- Intestinal transplantation is a complex operation with potential for hemodynamic and metabolic instability.
- Patient outcomes for intestinal transplant are improving.

Intestinal transplantation merits attention from the transplant anesthesiologist owing to the complexity of the operation and the unique medical comorbidities associated with intestinal failure. Intestinal transplantation is relatively uncommon compared with other types of solid organ transplants; 2796 were completed in the United States from 1988 to 2016. There were 138 intestinal transplants overall in 2016, down from a peak of 198 in 2007.¹ In 2015, nearly equal numbers of intestinal transplantation patients in the United States received combined liver–intestine grafts versus intestine alone, and more than 40% of intestinal transplantation recipients were younger than 18 years of age.²

INTESTINAL FAILURE AND PARENTERAL NUTRITION DEPENDENCY

Patients who cannot meet their protein and caloric needs, obtain essential micronutrients, and maintain electrolyte and fluid balance by their oral intake have intestinal failure. Intestinal failure may result from a number of conditions that affect gut function, but are typically classified as anatomic/surgical (short bowel syndrome),

Disclosures: None.

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Anesthesiology Clin ■ (2017) ■–■
<http://dx.doi.org/10.1016/j.anclin.2017.04.007>

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functional/motility, or mucosal disorders. In infants, the most common etiologies are gastroschisis, volvulus, and necrotizing enterocolitis; in adults, intestinal failure most often arises after an extensive resection for acute mesenteric ischemia, Crohn's disease, or trauma^{3,4} (Table 1). Although the threshold intestinal length necessary for nutritional autonomy varies, less than 200 cm of small bowel in an adult, or less than 20 cm in a child, raises the concern of intestinal failure.⁵ The syndrome of intestinal failure encompasses large-volume enteral outputs from stoma, fistula, or diarrhea/steatorrhea; electrolyte disturbances (hypokalemia, hypomagnesemia); chronic dehydration leading to renal insufficiency; D-lactic acidosis; gastric hyperacidity and hypergastrinemia; vitamin D deficiency with osteoporosis; micronutrient deficiencies (especially thiamine, vitamin B₁₂, zinc) and toxicities (manganese, copper); cholestasis; hepatic steatosis; and nephrolithiasis.⁵

Rehabilitation after the onset of intestinal failure begins with autoadaptation, both physiologic and behavioral. Adaptive changes include delayed gastric emptying, intestinal dilation and hypomotility, and increased absorptive surface area.⁵ Dietary modifications to enhance nutrient absorption include increasing oral intake, choosing low-fat foods with complex carbohydrates, and avoiding caffeine. Medications that slow transit (eg, codeine, loperamide, diphenoxylate/atropine) allow more time for absorption. Teduglutide, a glucagon-like peptide-2 analogue, increases intestinal villi height and crypt depth by 50%, and fluid and macronutrient absorption.⁵ Nonetheless, many patients require long-term supplementation with parenteral nutrition (PN) or intravenous fluids and electrolytes. In adults, need for PN beyond 2 years, typically in the setting of 60 to 80 cm of small intestine without an ileocecal valve, constitutes PN dependence; in children, thresholds for PN dependency are less than 30 cm of small intestine and 36 to 48 months on PN.⁴⁻⁶

The advent of PN transformed intestinal failure from a catastrophe with nearly uniform mortality, into a chronic condition with a 5-year survival of 75%.⁵ Key to this sea change was the commercialization of PN, whereby patients can self-administer infusions at home. But the cost of PN dependency remains high: US\$150,000 of

Table 1
Etiologies of intestinal failure

Infants and Children	Adults
<ul style="list-style-type: none"> • Gastroschisis • Volvulus • Necrotizing enterocolitis • Intestinal atresia • Pseudo-obstruction • Hirschsprung disease • Microvillous inclusion disease • Tufting enteropathy 	<ul style="list-style-type: none"> • Acute mesenteric ischemia <ul style="list-style-type: none"> ◦ Arterial thromboembolism ◦ Venous thrombosis ◦ Nonocclusive mesenteric ischemia • Crohn's disease • Trauma • Desmoid tumor • Carcinoid tumor • Pseudoobstruction • Volvulus • Gardner's syndrome • Radiation enteritis • Adhesive obstruction or internal hernia not amenable to lysis

Adapted from Bathla L, Langnas A. Intestinal and multivisceral transplantation. In: Busuttill RW, Klintmalm G, editors. Transplantation of the liver. 3rd edition. Philadelphia: Elsevier; 2015. p. 818-34; and Rege A, Sudan D. Intestinal transplantation. *Best Pract Res Clin Gastroenterol* 2016;30(2):320; with permission.

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