

# Hospital Readmissions After Intestinal and Multivisceral Transplantation

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## ABSTRACT

**Background.** Intestinal transplant recipients require frequent hospital readmission after a successful transplantation, but the reasons for readmission have not been characterized in detail.

**Methods.** We reviewed our single-center experience to characterize the patterns of readmissions and to identify preventable causes. Among 87 adult patients who received an intestinal or multivisceral transplant, 65 patients (35 males, 30 females; median age, 42 years [range, 19–66]) with a follow-up of at least 1 year were included in this study. Readmissions were defined as any unplanned inpatient hospital stay of 24 hours or longer occurring within 1 year after discharge from the transplantation admission and were classified as early (<1 month) and late (months 2–12) readmissions.

**Results.** Forty-four (68%) patients required early, and 59 (91%) patients required late readmission. A total of 333 readmissions (median, 4 readmissions/patient [0–20]) occurred within the first year post-transplantation; 69 were early (21%) and 264 were late (79%), resulting in a total of 4089 days of hospital stay (median, 7 days/readmission [2–136]). The three most frequent causes of readmission were dehydration, infection, and surgical complications.

**Conclusions.** These findings suggest that the rate of hospital readmission after intestinal transplantation could potentially be reduced by optimizing fluid balance and hydration status after discharge.

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**I**N AN attempt to cut costs, readmission rates have recently been adopted by regulatory agencies and payers as a surrogate parameter of quality of healthcare delivery with important impact on reimbursements. Although currently not applicable to transplantation, it is reasonable to expect that readmission rates will soon come under scrutiny given the high costs associated with transplants. Recent studies have reported on readmission rates at 30 days and 1 year after liver [1–5] and kidney [6,7] transplantation, but such analysis has not yet been done in intestinal and multivisceral transplantation (ITx). Although nationally the number of ITx being performed is much smaller than kidney and liver transplantations, nevertheless, it is a very expensive procedure. In addition, the threshold for readmission after ITx may be different from other transplantations and has not been evaluated before. In particular, it remains unclear to what extent the high readmission rate observed after ITx is due to the significant pretransplantation comorbidity associated with intestinal

failure or to the inherent complexity of post-transplantation care, including the treatment of intervening complications. We hypothesized that such high readmission rates are related to the inherent complexity of care required by these recipients and that readmission rates could potentially be reduced if preventable causes could be identified and managed accordingly. In this retrospective study we aimed to determine the incidence and causes of hospital readmission after ITx at our program as a first step toward the development of strategies to reduce readmissions.

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## MATERIAL AND METHODS

Since 2003, our program performed 208 intestinal and multivisceral transplantations in 102 pediatric (age younger than 18 years) and 101 adult recipients. For the purposes of this study, pediatric recipients were excluded from this analysis given the different patterns of comorbidity (prematurity, congenital anomalies, feeding disorders) compared with adults, with significant impact on threshold for readmission. Among 101 adult recipients, we excluded 16 patients who lost the graft or died within the first year after transplantation, 13 who are alive with functioning graft with a follow-up shorter than 1 year, and 7 patients who underwent retransplantation. The remaining 65 patients form the final cohort of this study, which was approved by the Institutional Review Board (Table 1). We reviewed the electronic medical records of the above patients and recorded date, cause, duration, and outcome of all hospital readmissions occurring within the first year after transplantation. According to current criteria, hospital readmissions were defined as any unplanned inpatient hospital stay for 24 hours or longer after discharge from the initial intestinal transplantation (primary admission). Planned readmissions for ileostomy take-down, usually 3 months post-transplantation, were excluded. To better characterize the causes of readmission at different time points post-transplantation, hospital readmissions were subclassified as early (within 30 days from discharge after transplantation) and late (between 2 and 12 months post-discharge) in accordance with current criteria. The causes of readmission were categorized as “infections” (documented culture-positive bacterial and/or viral infections such as pneumonia, urinary tract infections, cytomegalovirus, adenovirus, *Clostridium difficile* colitis, wound infections, intra-abdominal abscess, and others), or “fever/infection work-up” when the source of infection could not be determined. Other causes of readmission were categorized as “surgical complications” (incisional and para-stomal hernia, wound dehiscence, intestinal obstruction, dislodgement or malfunctioning of feeding tube, and others) and “abdominal pain/nausea” including all non-obstructive functional gastro-intestinal symptoms. The remaining causes of readmission were categorized as “others” and included

deep vein thrombosis, trauma, seizure, failure to thrive, anemia, chest pain, immunologic complications other than rejection such as thrombocytopenia, and others.

The pretransplantation work-up and the post-transplantation management were conducted according to our protocol [8]. At the time of transplantation, all patients received induction immunosuppression with high-dose methylprednisolone bolus and either basiliximab or thymoglobulin, depending on the degree of sensitization. Maintenance immunosuppression consisted of tacrolimus (target trough level, 20–25 ng/mL) and steroids. Sirolimus was added within the first month post-transplantation, unless contraindicated. Acute allograft rejection was diagnosed histologically according to established criteria [9] and treated, depending on severity, with increased immunosuppression consisting of a combination of steroid bolus, augmented doses of tacrolimus, and thymoglobulin. All patients received bacterial, fungal, and viral prophylaxis. Patients with hypercoagulable conditions received perioperative intravenous heparin followed by low-molecular weight heparin subcutaneously adjusted according to renal function for the first year and oral anticoagulation thereafter. As for stomal output and central line management, patients were started on diphenoxylate and atropine and/or loperamide, and the doses were gradually titrated up to the maximum dose. If the output was still high, fiber supplement was added, followed by tincture of opium. In patients with fluid balance persistently negative despite all the above measures free water boluses via gastro-jejunal tube were administered supplemented in selected cases by boluses of intravenous fluids. Patients living in the region were discharged home whereas patients from out-of-state were housed locally for the first 3 months or more until deemed stable to return home. After returning home, patients were followed up locally with periodic blood tests and monthly in our clinic for the first year. No patient was discharged or transferred to another health care facility after the transplantation admission. All patients were followed up in our outpatient transplantation clinic with surveillance endoscopy and mucosal biopsy thru the ileostomy constructed at the time of transplantation (either end-ileostomy or loop ileostomy) twice a week during the first 6 weeks, weekly for the following 6 weeks, and then monthly thereafter.

Table 1. Patient Demographics

Gender (n)	
Male/female	35/30
Age (y)	
Median (range)	42 (19–66)
Ethnicity	
White	43 (66%)
African American	14 (22%)
Others	8 (12%)
Hypercoagulable condition	
Yes	23 (35%)
No	42 (64%)
Prior abdominal surgeries (n)	
Median (range)	6 (1–40)
Indication for transplantation	
Short gut syndrome	50 (77%)
Dysmotility	11 (17%)
Mesenteric tumor	4 (6%)
Type of graft	
Isolated small intestine	51 (78%)
Multi-visceral/modified*	14 (22%)

\*Combination of small intestine and one or more other abdominal organs (stomach, liver, pancreas, colon).

## RESULTS

In our series, 44/65 (68%) patients required early and 59/65 (91%) patients required late readmission after discharge from ITx. Overall, by the end of the first year post-transplantation, 63/65 (97%) patients required a total of 333 readmissions to the hospital with a median number of 4 readmissions/patient (range, 0–20). The total combined hospital days of these 333 readmissions was 4064 days with a median hospital stay of 7 days per readmission, ranging from 2 to 136 days (Table 2). Thirty-four planned readmissions for ileostomy take-down, which occurred at median postoperative day (POD) 152 from the transplantation date (range, 81–394), were excluded in this study. The most common reason for readmission was dehydration with/without acute kidney injury requiring aggressive intravenous fluid resuscitation. The other causes of early and late readmission are listed in Table 2. Of note, as mentioned in our Methods section, our “infections” category included documented culture-positive bacterial and/or viral

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