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Original Research Article

Short-term outcomes following massive small bowel resection: our experience of 23 cases

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ABSTRACT

Background: Short bowel syndrome (SBS) is a condition where a significant portion of the small intestine is lost/ absent, either congenitally or secondary to surgical resection. Complications arising due to the short length of the remnant bowel account for the high morbidity and mortality. In this case series, we describe our experience with 23 patients who underwent major intestinal resection.
Methods: Retrospective data were retrieved from departmental records from January 2017 to June 2024 of patients who underwent major small bowel resection at Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Puducherry with a remnant small bowel length of <200cm.
Results: After excluding patients with incomplete records, data from 23 patients were analyzed. Mesenteric ischemia due to thrombosis of the superior mesenteric artery or vein was the most common etiology behind massive bowel resection. Most of the patients required intensive care in the immediate postoperative period, with ventilator support. The wound related complications included superficial and deep surgical site infection (52.2%), wound dehiscence (21.7%), and stomal necrosis (26.1%). Dyselectrolytemia, in the form of hyponatremia, was common in Type I (90%) and Type II SBS (80%), whereas it had a lower incidence in Type III SBS (28.6%), p value = 0.023. Early postoperative mortality occurred in 5 patients.
Conclusions: The present case series shows the high morbidity and mortality associated with massive small bowel resection. Early initiation of enteral feeds, with or without parenteral supplementation, may help prevent dependence on parenteral nutrition and is associated with lower morbidity and mortality.

Keywords: Intestinal adaptation, Intestinal failure, Mesenteric ischemia, Parenteral nutrition, Short bowel syndrome, Teduglutide

INTRODUCTION

Short bowel syndrome (SBS) is a disease condition where a significant portion of the small intestine is lost/absent, either congenitally or secondary to surgical resection. The commonly accepted definition is a remnant small bowel length of less than 200 cm from the ligament of treitz.[1] In adults, usually encountered indications for massive small bowel resection include inflammatory bowel disease, mesenteric ischemia (secondary to arterial/venous occlusion), intra-abdominal trauma, radiation injury, and postoperative complications requiring repeated resections.[2] In the pediatric population, SBS is mainly due to intestinal volvulus, intestinal malformations, and necrotizing enterocolitis. Those with less than 60cm of remnant small intestine with a functional colon or less than 100cm of small intestine when the colon is absent mandate long-term, possibly life-long parenteral nutrition support. Complications associated with parenteral nutrition, as well

as those due to the short length of the remnant intestine, such as malabsorption and liver failure, account for the high morbidity and mortality associated with this condition.[3]

The epidemiology of short bowel syndrome is not well-established owing to its multi-factorial etiology. Furthermore, the data available on the epidemiology, etiology, and postoperative outcomes are mainly from foreign literature. In this case series, we describe the presentation and in-hospital management of 23 patients with short bowel syndrome managed at a tertiary care centre in southern India, admitted over eight years, from January 2017 to June 2024.

METHODS

Study design and period

This retrospective record-based study was initiated by screening the emergency operation theatre register for patients who had undergone emergent resection of the small bowel for various causes for the study duration from January 2017 to June 2024 at Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Puducherry. This study included 29 patients who had undergone emergent resection of the small bowel for various causes.

Ethical considerations

Ethics approval for this retrospective study was obtained from the Institutional Ethics Committee for Observational Studies (Jawaharlal Institute of Postgraduate Medical Education and Research) with an approval number: JIP/IEC-OS/2024/494 dated: 25.05.2025.

Inclusion criteria

Patients who have undergone massive resection of small bowel (defined as patients with a remnant/ functional small bowel of length <200 cm) from January 2017 to June 2024 in the Department of Surgery were included in this study.

Exclusion criteria

At the same time, those with missing medical records or information were excluded.

Data collection

After obtaining the names and hospital numbers of patients from the initial screening of the emergency operation theatre register, retrospective data were retrieved from departmental records (Medical Records Department (MRD), Hospital Information System (HIS), and Picture Archiving and Communication System (PACS)). The demographic details, etiology and indication for surgery, anatomical type of resection, and the patient's postoperative course following bowel resection, including postoperative complications, ICU admissions, total parenteral nutrition (TPN) requirement, in-hospital mortality, and cause of death, were noted. In patients with an ostomy, the time to restoration of bowel continuity was also noted. Anatomically, short bowel syndrome was classified into three types: Type I or end jejunostomy, Type II or jejuno-colic anastomosis, and Type III or jejuno-ileo-colic anastomosis.[3]

Statistical analysis

Statistical analysis was performed using the R program version 4.5.0. The Shapiro-Wilk normality test assessed the Gaussian or non-Gaussian distribution of quantitative data. Quantitative variables that followed a normal distribution (p value ≥ 0.05) were defined using mean and standard deviation, while for non-Gaussian variables (p value <0.05), median and range were used. Qualitative variables (like sex, comorbidities, postoperative complications, and mortality) were defined using percentages. Quantitative variables were compared between the anatomical types of short-bowel syndrome using the one-way ANOVA test. Due to the small sample size, qualitative variables were compared using Fisher's exact test. The results were evaluated with a 95% confidence interval, and significance was set at p values <0.05.

RESULTS

Demographics

We identified 29 patients during the given study period who had undergone major small bowel resection in an emergency. Six patients had incomplete data or missing records and were excluded from our study. The age of the patients varied from 22 to 75 years, with the median age being 52 years. Fifteen of the 23 patients were male, and the rest were female (Table 1). The various etiologies warranting bowel resection in these patients included mesenteric ischemia due to arterial or venous occlusion, which were secondary to atherosclerosis/arterial emboli/secondary antiphospholipid syndrome/other thrombophilia, traumatic mesenteric injuries, mesenteric volvulus or other unidentified causes (Table 2).

The majority (13, 56.5%) of them associated comorbid illnesses such as diabetes, hypertension, heart disease, or malignancy. Two (40%) of the patients who suffered gut gangrene secondary to superior mesenteric vein thrombosis without other risk factors were noted to have concurrent SARS-CoV-2 illness. About 21.7% (n=5) of the patients had high-risk behavior for thrombotic incidents, such as smoking or chronic alcohol use (Table 3).

Surgery details

All patients underwent an exploratory laparotomy in the emergency setting with resection of the gangrenous bowel

and reconstruction as deemed appropriate (Table 4). All these patients had a remnant functioning small bowel length being less than 200 cm in all cases. Two of the patients also underwent a retrograde arterial thrombectomy during the primary surgery, and one of them underwent a planned re-look after 48 hours with no further bowel resection. Three of the 23 patients had a remnant jejunal length of <40 cm.

Table 1: Demographic data of patients who had a massive small bowel resection.

Variables	Type I SBS (n=11)	Type II SBS (n=5)	Type III SBS (n=7)	P value[a]
Age (years)				
Mean±SD	54.27±12.47	55.60±16.01	51±16.71	0.845[b]
Sex, N (%)				
Male	6 (54.55)	3 (60)	6 (85.71)	0.454[c]
Female	5 (45.45)	2 (40)	1 (14.29)	
Co-morbidities/high-risk behaviour, N (%)				
Yes	8 (72.73)	4 (80)	7 (100)	0.391[c]
No	3 (27.27)	1 (20)	0 (0)	

[a]: p value<0.05 considered significant; [b]: Statistical analysis performed using one way ANOVA (Analysis of variance); [c]: Statistical analysis performed using Fisher's exact test

Table 2: Etiology for massive small bowel resection in the study group.

Etiology		Number of patients (n=23), N (%)
Mesenteric ischemia	Arterial occlusion	9 (39.1)
	Venous occlusion	5 (21.7)
	Non-occlusive	1 (4.3)
Midgut volvulus		2 (8.7)
Trauma		1 (4.3)
Radiation enteritis		1 (4.3)
Other/unknown[a]		4 (17.4)

[a]: Cases of gut gangrene with or without perforation with an unknown etiology

Table 3: Co-morbidities and high-risk behaviour of patients.

Co-morbidities/high-risk behaviour	Number of patients (n=23), N (%)
Diabetes	6 (26.1)
Hypertension	3 (13)
Coronary artery disease	4 (17.4)
SARS-COVID	2 (8.7)
COPD	3 (13)
Deep vein thrombosis (DVT)	1 (4.3)
Rheumatic Heart Disease (RHD)	1 (4.3)
HIV	1 (4.3)
HBV	1 (4.3)
Systemic Lupus Erythematosus (SLE)	1 (4.3)
Carcinoma Cervix	1 (4.3)
Hypothyroidism	1 (4.3)
Alcohol	5 (21.7)
Smoking	3 (13)

SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2, COPD: Chronic Obstructive Pulmonary Disease

Table 4: Surgery details of the patients: resection of bowel and anastomosis performed.

Anatomical type of SBS	Number of patients (n=23), N (%)
Type I-Bowel resection and end jejunostomy	11 (47.8)
Type II-Bowel resection and Jejuno-colic anastomosis	5 (21.7)
Type III-Bowel resection and Jejuno-ileo-colic anastomosis	7 (30.4)

SBS - Short bowel syndrome

Postoperative outcomes

Most of the patients required intensive care in the immediate postoperative period, with ventilator support. Five patients were started on parenteral nutrition, which they received for a duration ranging from 3 days to 2 weeks. Only one patient developed dyselectrolytemia, after which TPN was stopped (Table 5).

Dyselectrolytemia in the form of hyponatremia was common in patients with Type I and II SBS. Around 90% (10) of the Type I patients had high-output stomas, and all these patients had hyponatremia. The incidence of dyselectrolytemia was 80% (4) in Type II SBS patients, despite diarrhea being 100%. The incidence of diarrhea and dyselectrolytemia was 28.6% (2) in Type III patients, p value = 0.023 using Fisher's exact test. The wound-related complications following surgery included superficial and deep surgical site infection (52.2%, n=5) and wound dehiscence (21.7%, n=5). SSIs were more common in anatomical Type III SBS (85%, n=6), and wound dehiscence was common in Type I SBS (36.4%, n=4) patients, p value = 0.439 using Fisher's exact test. Stomal necrosis occurred in 54.5% (6) of the Type I

patients and required refashioning of the stoma in all the cases. One patient, each in Type II (20%) and Type III (14.3%), developed an anastomotic leak in the postoperative period, which was managed conservatively without any surgical intervention. Manifestations of the acute phase of short bowel syndrome were noted in the form of diarrhea and high stoma output, causing pre-renal acute kidney injury, which was managed with IV fluids, proton pump inhibitors, injectable Octreotide and bulk-forming agents such as Ispaghula husk. The incidence of acute kidney injury was highest in Type I (36.4%, n=4), followed by Type II (20%, n=1), and Type III (14.3%, n=1), p value = 0.828 using Fisher's exact test (Table 5).

Enteral feeding, either orally or via Ryle's tube, was initiated in 16 patients (69.6%) within the first week following surgery; however, it had to be subsequently stopped in half due to complications such as wound dehiscence or stomal necrosis, which required re-exploration. Early postoperative mortality (within one week) occurred in 4 patients. It was highest in Type I (27.3%, n=3), followed by Type II (20%, n=1) and Type III, where there were no deaths within 7 days of surgery, p value = 0.391 using Fisher's exact test. The occurrence of major postoperative complications (Clavien-Dindo ≥III) was higher in patients with Type I (81.8%, n=9), followed by Type II (60%, n=3), and Type III (14.3%, n=1), p value = 0.025 using Fisher's exact test (Table 5).

Table 5: Postoperative outcomes in different types of short bowel syndrome.

Postoperative Outcomes	Number (%)			P value[a]
	Type I (n=11), N (%)	Type 2 (n=5), N (%)	Type 3 (n=7), N (%)	
SSI	5 (45.5)	1 (20)	6 (85.7)	0.087
Wound dehiscence	4 (36.4)	0 (0)	1 (14.3)	0.439
Stoma necrosis	6 (54.5)	-	-	-
Anastomotic leak	-	1 (20)	1 (14.3)	1
Acute kidney injury	4 (36.4)	1 (20)	1 (14.3)	0.828
High output stoma/diarrhoea	10 (90.1)	5 (100)	2 (28.6)	0.424
Dyselectrolytemia	10 (90.1)	4 (80)	2 (28.6)	0.023
Requirement of intensive care	10 (91)	4 (80)	6 (85)	1
Requirement of total parenteral nutrition	1 (9)	2 (40)	2 (28.5)	0.439
Severity of complications				
Minor (Clavien-Dindo I-II)	2 (18.2)	2 (40)	6 (85.7)	0.025
Major (Clavien-Dindo ≥ III)	9 (81.8)	3 (60)	1 (14.3)	
Early mortality (7 days)	3 (27)	1 (20)	-	0.391

[a]: Statistical analysis performed using Fisher's exact test, p value<0.05 considered significant

Table 6: Hospital stay and initiation of enteral feeds.

	Mean±SD			F value	P value[a]
	Type I	Type 2	Type 3		
Hospital stay	14.83±4.07	12.67±3.05	20.33±7.31	2.42	0.131
Initiation of enteral feeds	4.33±2.07	3±0.82	3.17±0.75	1.434	0.274

[a]: Statistical analysis performed using Fisher's exact test, p value<0.05 considered significant

The mean hospital stay of the remaining patients was 16.6 days, with a standard error of 6.1 days. Length of hospital stay was highest for Type III (20.33±7.31 days), followed by Type I (14.83±4.07 days), and Type II (12.67±3.05 days), F value = 2.42, p value = 0.131, using one-way analysis of variance (ANOVA) test. The day of initiation of enteral feeds was similar in all the anatomical types of SBS, F value = 1.434, p v= 0.274, using a one-way ANOVA test. None of the patients had early restoration of bowel continuity. Of the data available, 3 of the 11 patients with an end jejunostomy underwent surgery for reinstatement of bowel continuity 2-3 months postoperatively (Table 6).

DISCUSSION

Intestinal failure (IF) is the "reduction of gut function below the minimum required for the absorption of macronutrients and water and electrolytes, necessitating IV supplementation to maintain health and/or growth". Short bowel syndrome has been reported to be the leading cause of chronic intestinal failure. Surgical complications, mesenteric ischemia, malignancy with or without irradiation, inflammatory bowel disease and a few other benign conditions, as well as trauma, have been noted to be the major conditions warranting a significant resection of the small bowel.[4] In our patient population, mesenteric ischemia was the most common etiological factor, with arterial occlusion (thrombosis/embolism) being more common than venous thrombosis. Anatomically, short

bowel syndrome has been classified into three types: Type I or end jejunostomy, Type II or jejuno-colic anastomosis, and Type III or jejuno-ileo-colic anastomosis (Figure 1).[3]

Those with type III SBS have generally been noted to have a faster nutritional recovery, with 80% of non-malignant patients developing spontaneous adaptation.[5] There has been significant progress in the management of SBS over the last few decades since the development of the technique for intravenous feeding to support patients with IF. The incidence of IF requiring parenteral nutrition is higher in females, which has been attributed to the short bowel length in women.[6] In our study population, the majority (83.3%) were male.

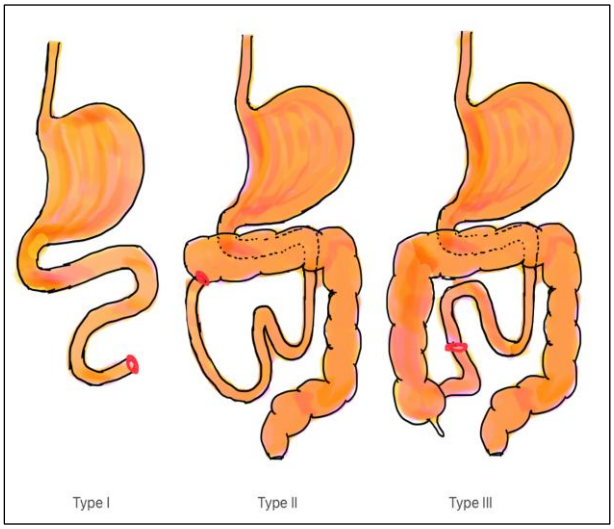

Figure 1: Pictorial depiction of the different types of short bowel syndrome.

Anatomical Classification of Short Bowel Syndrome: Type I or end jejunostomy, Type II or jejuno-colic anastomosis, and Type III or jejuno-ileo-colic anastomosis

The prevalence of patients with SBS requiring home-based parenteral nutrition (HPN) has increased considerably over the last few decades. This finding is likely due to the growing knowledge among clinicians on SBS-associated IF and their awareness of various management options that are particularly available in developed countries, one of which is HPN.[7] None of our patients required HPN, while previous studies have shown that up to 47% of patients with SBS require HPN.[5] This could have been due to poor feasibility due to resource limitations or faster intestinal adaptation in our cases with antimotility medications and dietary modifications, the former being more likely and responsible for longer in-hospital stay (median length 15.5 days). HPN is not considered to be the final option for patients with IF following massive small bowel resection. There has also been a substantial increase in the knowledge of complications due to IF and parenteral nutrition.[8-10] Apart from medical advancements, surgeries like serial transverse enteroplasty and intestinal transplants are also employed to manage IF.[11] In our case series, none of the patients underwent any such surgeries. Management following any major small bowel resection in our department included intravenous fluids, bulk-forming agents, antimotility drugs, fat-soluble vitamin supplements, and TPN whenever the caloric requirement of the patient couldn't be met with enteral feeds.

Many American and European studies have found the mean age of the patients hospitalized for SBS to be 50 - 55 years. Data from the Japanese literature found the mean age to be older (59.2 years). It was 69.2 years when SBS developed in patients due to malignancy, while it was lower (51.5 years) in patients without malignancy.[12] In our series, there were no cases of massive small bowel resection due to malignancy, and the median age was 52 years. Patients with jejuno-colic anastomosis have usually been reported to have more severe symptoms due to the disruption of Vitamin B12 and entero-hepatic bile salt systems. Refractory diarrhea is the most enervating symptom affecting the quality of life of patients with SBS.[4] Of the five patients with Type II SBS in our population, all were noted to develop severe fluid deficit secondary to diarrhea, and hyponatremia occurred in 80% of these patients. One patient was noted to develop acute kidney injury with acute liver failure, followed by early postoperative mortality on POD-5. Intestinal failure-associated liver disease (IFALD), however, is an entity that is noted in patients on long-term parenteral nutrition for chronic intestinal failure, occurring due to increased gut permeability, alteration of gut microbiome, and altered enterohepatic bile acid circulation.[13] None of the patients in our study population developed IFALD. Other metabolic complications reported secondary to SBS include cholelithiasis, bone disease, and iron deficiency anemia.

After a major bowel resection, the remaining small bowel undergoes a process known as intestinal adaptation to recover from ongoing malabsorption. These adaptive changes depend on enteric neurohormonal stimuli and gut microbiota changes. Thus, early enteral feeding significantly enhances recovery and weaning from parenteral nutrition.[14] Enteral nutrition was established in 16 out of 23 patients in our cohort within the first week postoperatively, with or without parenteral support. Only one patient with early enteral feeding had early postoperative mortality (within one month). Using novel drugs such as teduglutide (GLP-2 analogues) and somatropin-glutamine combinations has shown promising results in patients with poor intestinal adaptation and those dependent on parenteral nutrition in meta-analyses.[15] However, secondary to cost and resource constraints, no such regimens were utilized in our setting.

The European and American studies have shown a downward trend in mortality over the last few decades despite the increasing severity of illness and associated co-morbidities.[7] We encountered a mortality rate of 26.1%. In prior published case series, the factors associated with higher mortality included an age of >60 years, arterial mesenteric ischemia, the presence of an end ostomy, and a

history of cancer.[16] Similar trends were noted in our patient population; the mortality rate was 50% in patients with arterial mesenteric ischemia, 44.4% in patients aged >60 years, and 33.3% in patients with an end stoma. Mortality in the short term is primarily due to the underlying disease, while it has been attributed to Chronic IF and PN-related complications in those who had a longer survival.[5,7,17-19]

Limitations

This is the first study of patients with massive small bowel resection in a tertiary care hospital in southern India. It has limitations like a retrospective, small data-based study of discharge-level medical records of inpatient hospitalizations. Therefore, the validity of this study depends on the accuracy of the diagnosis, findings, and procedures documented in the case sheet/ discharge certificate. The sample was small, and no concrete risk factors or postoperative outcomes could be attributed to the different types of short bowel syndrome.

CONCLUSION

The present case series provides an idea about the spectrum of presentations and common etiologies leading to massive bowel resection and short bowel syndrome in the Indian subcontinent. It also gives an insight into the postoperative outcomes following massive small bowel resections. The seriousness of the condition following massive small bowel resection can be felt from the high morbidity and mortality, as seen in this case series. The severity of complications is lower in Type II and III when compared to Type I short bowel syndrome. Early initiation of enteral feeds with or without parenteral supplementation might help prevent dependence on parenteral nutrition and is associated with lower morbidity and mortality.

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Ethical approval: The study was approved by the Institutional Ethics Committee of Jawaharlal Institute of Postgraduate Medical Education and Research (approval number: JIP/IEC-OS/2024/494 dated: 25.05.2025)

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