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Original Research

Outcomes of Patients after Small Bowel Resection due to Superior Mesenteric Artery Occlusion

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ABSTRACT:

Small bowel resection is associated with major and minor complications. Short bowel syndrome (SBS) is a common consequence of small-bowel resection that is associated with severe malabsorption, malnutrition, imbalance of water electrolytes, and metabolic disorder. The aim of this study is to evaluate post operative complication after small bowel resection as a result of superior mesentric artery occlusion. A retrospective trial on 25 patients with mall bowel resection due to of superior mesentric artery occlusion aged 18 - 70 years old was performed. All patients were subjected to clinical examination (HR, BP), laboratory investigations (CBC, liver function, renal function, albumin and bilirubin, INR, PT, PTT, and electrolyte levels) and radiological assessment according to urgency to surgical intervention. Regarding operation outcomes of the

studied patients, 14(56%) patients had diarrhea, 24(96%) patients had pain, 4 (16%) patients had sepsis, 9 (36%) patients suffered weight loss, 7(28%) patients had hypokalemia, 6(24%) patients had hypoproteinaemia, 3 (12%) patients had wound infection, and 6 (24%) patients died. Small bowel resection is associated with minor and major complications so resection should be restricted of obvious gangrenous bowel. although Midgut resection due to complete superior mesentric artery occlusion results in intestinal failure reaction is still justifiable.

KEYWORDS: Small Bowel Resection, Superior Mesenteric Artery Occlusion, Short Bowel Syndrome, Diarrhea.

INTRODUCTION

Increased life expectancy along with technological and medical developments has resulted in an increasing number of patients undergoing multiple abdominal surgeries during their lifetime (Kruk et al., 2018). Adhesiolysis and intraoperative bowel injury during reoperations result in increased operative time, longer hospitalization, and higher postoperative morbidity (Di Saverio et al., 2018).

A frozen abdomen due to extensive adhesions from previous abdominal surgeries can limit future surgical treatment options. In addition, loss of bowel or enterocyte mass from surgical resection can potentially lead to short bowel syndrome (SBS) (Massironi et al., 2020).
Short bowel syndrome (SBS) is a common consequence of small-bowel resection that is associated with severe malabsorption, malnutrition, imbalance of water electrolytes, and metabolism disorder (Merritt et al., 2017; Bering & DiBaise 2020).

SBS reflects the most common cause for intestinal failure (IF), which is defined by the European Society for Clinical Nutrition and Metabolism (ESPEN) as “the reduction of gut function below the minimum necessary for the absorption of macronutrients and/or water and electrolytes, such that intravenous supplementation is required to maintain health and/or growth”. Other causes of IF include intestinal dysmotility, intestinal fistula, mechanical obstruction and extensive small bowel mucosal disease (Pironi, 2016).

SBS remains a clinical diagnosis. In adults, SBS has typically been diagnosed when a patient has a total functional small bowel length of less than 200 cm with requirement for nutritional and/or fluid substitution (Iyer et al., 2022). Patients with SBS always require long-term parenteral nutrition to support the transition and re-adaption of intestinal absorption for nutritional autonomy (Puoti & Köglmeier, 2022).

The prognosis of SBS also depends on the anatomical identity of the residual small intestine and the length of the residual colon. Salvage of the ileocecal valve is also considered critical whereas individual differences exist. Sustained surgical treatments intended to improve patient quality of life are challenging because repetitive bowel resections can lead to a combination of the above factors (Winkler & Tappenden, 2023).

In cases when small-bowel resection is inevitable, the selection of the surgical procedure and management of post-operative nutrition appear to be of cardinal importance. However, factors that influence outcome and can guide surgical and post-operative management remain obscure because of the limited number of cases presented in literature (Muff et al., 2022).

The aim of this study is to evaluate post operative complication associated with small

bowel resection.

MATERIALS AND METHODS

A retrospective trial on 25 patients with small bowel resection due to superior mesenteric artery occlusion aged 18 - 70 years old admitted to surgery department at Al-Wahda hospital.

An informed written consent was obtained from the patients. Patients refused to participate were excluded from the study.

All patients were subjected to demographic data (age, sex, BMI), history of comorbidities (HTN, diabetes, smoking, and dyslipidaemia), symptoms as chest pain and dyspnea and previous medication, clinical examination including HR, BP, Laboratory investigations: CBC (Hb, WBCs, Platelets), Liver function, renal function, Albumin and bilirubin, INR, PT, PTT, Electrolyte levels (Na, K, Ca, Mg). Enhanced abdominal computed tomography (CT) is done as needed.

In all patient we perform lapratomy through midline incision and we resected the obvious gangrenous bowel and hand sewan end to end anatomises. post operatively nutritional status of the patients maintains by intravenous fluid and total parental nutrition and allowed orally after passing flatus.

Determination of early complications including hypoproteinaemia, hypokalemia, diarrhea, deep vein thrombosis, malnutrition and weight loss.

Statistical Analysis

Statistical analysis was done by SPSS v28 (IBM Inc., Armonk, NY, USA). Quantitative variables were presented as mean ± standard deviation (SD), and range. Qualitative variables were presented as frequency and percentage (%).

RESULTS AND DISCUSSION

The mean age of patients was 38.7±11.67, 17 (68%) of them were males and the remaining 8 (32%) patients were females. The mean of BMI was 23.8 1.26 kg/m2, a mean temperature was 37.5 ± 0.35 °C, a mean heart rate was 82.6 ± 7.38 beats/min, a mean SBP was 134.8 ±14.18 mm Hg, a mean DBP was 84.4 ± 10.44 mm Hg. Twelve (48%) of the patients were smokers (**Table 1).**

Among the recent report, more individuals with SBS are women, are >45 years of age (Mundi, 2022).

Table 1: Demographic Data of Patients

Age (years)	**Mean ± SD**	38.7 ± 11.67
	Range	25 - 60
Sex	**Male**	17 (68%)
	Female	8 (32%)
BMI (kg/m^2)	**Mean ± SD**	23.8 ± 1.26
	Range	21.5 - 25.7
Temperature (°C)	**Mean ± SD**	37.5 ± 0.35
	Range	36.8 - 37.9
Heart rate (beats/min)	**Mean ± SD**	82.6 ± 7.38
	Range	72 - 100
SBP (mm Hg)	**Mean ± SD**	134.8 ± 14.18
	Range	110 - 160
DBP (mm Hg)	**Mean ± SD**	84.4 ± 10.44
	Range	70 - 100
Smoking	**Yes**	12 (48%)
	No	13 (52%)

Data are presented as mean ± SD, range, or frequency (%). BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure.Regarding comorbidities of the studied patients, 19 (76%) patients were hypertensive, 15 (60%) patients had diabetes mellitus, 10 (40%) patients had hyperlipidemia, 9 (36%) patients had

atrial fibrillation, and 14 (56%) patients had congestive heart failure (**Table 2).**

Table 2: Comorbidities of Patients (n =25)

Symptoms	Yes/No	N and (%)
Hypertension	Yes	19 (76%)
	No	6 (24%)
Diabetes Mellitus	Yes	15 (60%)
	No	10 (40%)
Hyperlipidaemia	Yes	10 (40%)
	No	15 (60%)
Atrial Fibrillation	Yes	9 (36%)
	No	16 (64%)
Congestive Heart Failure	Yes	14 (56%)
	No	11 (44%)

N: Numbers of patients.

The studied patients had a mean Hb of 11 ± 1.69 g/dL, a mean WBCs count of 6.9 ± 1.43 × 109/L, a mean PLT count of 260.2 ± 44.89 × 109/L, a mean INR of 1 ± 0.12, a mean ALT level of 48.1 ± 15.94 U/L, a mean AST level of 33.5 ± 6.78 U/L, a mean creatinine level of 1.2 ± 0.27 mg/dL, a mean urea level of 15.2 ± 6.57 mg/dL, a mean sodium level of 130.4 ± 2.2 mEq/L, and a mean potassium level of 4.6 ± 0.51 mmol/L (**Table 3).**

SBS can result from a single massive intestinal resection or repeated lesser resections. Mesenteric vascular disease, Crohn's disease, and treatment of malignancies are among the most frequent causes of intestinal failure (Mizushima et al., 2022). Unanticipated intestinal resection after surgical procedures is another potential cause of SBS, which results from a loss of blood supply to the intestine or a need for repeated resection to address complications, such as intestinal obstruction (Muff et al., 2022).

She et al. (2016) in their case report found that the SBS-associated mortality is high, particularly after total small-bowel resection, and survival depends largely on appropriate post-operative parenteral nutrition support. In addition, strategies chosen for digestive tract reconstruction and manipulation to prevent complications are also critical to patient survival. Unfortunately, no clear guidelines, especially with regard to surgery, have been defined although successful digestive tract reconstruction through duodenal colostomy, stomach transverse anastomosis, and duodenal transverse anastomosis has been described. Given this life-threatening condition, resection of the midgut, including the whole small bowel and right colon, was decided upon. The team then was confronted with two surgical options, to perform duodenal colostomy or to perform digestive tract reconstruction. The first is to close the end of the residual transverse colon but needs a second reconstructive operation. They thought that closing the residual end of the duodenum might result in the formation of an artificial blind loop. Jejunum resection at the Treitz ligament of the duodenum would also make it difficult to exteriorize sufficient duodenum outside the abdominal wall for fistulation. In addition, as energy scavenging and fluid absorption critically depend on absorption in the colon, duodenum fistulation may cause severe loss of digestive juice, resulting in unmanageable water and electrolyte problems. The possible reflux of bile and other pancreatic secretions into the stomach and subsequent re-entry into the colon may also bring obvious post-operative discomfort (She et al.(2016).

In addition to SBS need for parenteral nutrition, and failure to restore bowel continuity in the patient resulted in the inability to resume oral nutrition with continuous PEG decompression (Stamopoulos et al., 2018).

In the current study, regarding the symptoms before operation of the studied patients, 20 (80%) patients had pain, 13 (52%) patients had fever, 19 (76%) patients had nausea and vomiting, and 16 (64%) patients had rigid abdomen (**Table 4).** Regarding the operation

outcomes of the studied patients, 14 (56%) patients had diarrhea, 24 (96%) patients had pain, 4 (16%) patients had sepsis, 9 (36%) patients suffered weight loss, 7 (28%) patients had hypokalemia, 6 (24%) patients had hypoproteinaemia and 6 (24%) patients had irreversible bowel damage (**Table 5).**

Diarrhea is a leading symptom and a significant detrimental factor that affects quality of life in patients with SBS (Parrish & DiBaise, 2017). Fast transit of hyperosmotic fluids into the colon through a duodenocolostomy may worsen this bothersome symptom. Indeed, all patients with SBS experience a degree of diarrhea (Lakkasani et al., 2022). The patient, after resuming consumption of normal food, experienced 3–4 loose bowel movements, which were well tolerated without antidiarrheal medications. The harmful long-term effects of gastric and duodenal fluids on the colic epithelium should also be assessed (Cojocari et al., 2022). Six (24%) patients died during the study period. Other studies have reported a mortality rate of 12.8–50% (Massironiet al., 2020; Wu et al., 2017); however, these rates may not be directly comparable because of the differences in study designs. The frequency of liver disorders was higher in patients who died than in the overall study population. Given the design of the present study, it is probable that the patients who died during the follow-up period had severe underlying comorbidities such as hepatic dysfunction before the index PN hospitalization. However, a previous report also suggested that liver complications in patients with SBS might not be linked to HPN but may instead result from the underlying IF (Massironiet al., 2020). A recent review analyzed 28 patients who underwent total small bowel resection in the last 70 years (Huerta et al., 2015). Establishment of bowel continuity by means of a duodenocolic anastomosis was shown to be a viable option in hemodynamically stable patients (Stamopoulos et al., 2018). Cruz et al., (2017) reported on 13 patients who underwent near total enterectomy and duodenocolostomy was performed in 5 cases. This small case series concluded that reestablishment of GI tract continuity after total enterectomy seems to be the best option for postoperative fluid and electrolyte management. Digestive tract restoration can facilitate electrolyte control and dietary support of the patient and can serve as a bridge to newer drug or surgical treatments, including small bowel transplantation (Garcia-Roca et al., 2016; Shirafkan et al., 2016). In a review of 43 patients undergoing open mesenteric revascularization, the authors noted that 11 of the 23 patients undergoing a second-look operation required bowel resection (Lim et al., 2019). The bowel in these patients is often very swollen and at high risk for anastomotic leak. Recent studies suggest that careful hand sewn techniques are preferable to the use of staples in this group (Espin et al., 2020; Enomoto et al., 2022).

Table 3: Laboratory Data of Patients (n= 25)

Hb (g/dL)	**Mean ± SD**	11 ± 1.69
	Range	8 - 13.5
WBCs (× 10^9/L)	**Mean ± SD**	6.9 ± 1.43
	Range	4.7 - 9.3
PLT (× 10^9/L)	**Mean ± SD**	260.2 ± 44.89
	Range	204 - 334
INR	**Mean ± SD**	1 ± 0.12
	Range	0.8 - 1.1
ALT (U/L)	**Mean ± SD**	48.1 ± 15.94
	Range	21 - 72
AST (U/L)	**Mean ± SD**	33.5 ± 6.78
	Range	21 - 42
Creatinine (mg/dL)	**Mean ± SD**	1.2 ± 0.27
	Range	0.9 - 1.7
Urea (mg/dL)	**Mean ± SD**	15.2 ± 6.57
	Range	6 - 35
Sodium (mEq/L)	**Mean ± SD**	130.4 ± 2.2
	Range	127 - 134
Potassium (mmol/L)	**Mean ± SD**	4.6 ± 0.51
	Range	3.8 - 5.4

Data are presented as mean ± SD and range. Hb: Hemoglobin, WBCs: White blood cells, PLT: Platelets, INR: International normalized ratio, ALT: Alanine transaminase, AST: Aspartate aminotransferase.

Table 4: Symptoms before Operation of the Studied Patients

Symptoms before Operation	Numbers and Percentage (%)
Pain	20 (80%)
Fever	13 (52%)
Nausea and vomiting	19 (76%)
Rigid abdomen	16 (64%)

Table 5: Operation Outcomes in the Studied Patients

Symptoms	Yes/No	N and (%)
Diarrhea	Yes	14 (56%)
	No	11 (44%)
Pain	Yes	24 (96%)
	No	1 (4%)
Sepsis	Yes	4 (16%)
	No	21 (84%)
Weight loss	Yes	9 (36%)
	No	16 (64%)
Hypokalaemia	Yes	7 (28%)
	No	18 (72%)
Hypoproteinemia	Yes	6 (24%)
	No	19 (76%)
Wound infection	Yes	3 (12%)
	No	22 (88%)
Mortality	Yes	6 (24%)
	No	19 (76%)

N: Numbers of patients.

CONCLUSION

Small bowel resection due to superior mesenteric artery occlusion is associated with high morbidity and mortality so resection should be restricted to obvious gangrenous bowel. In case of superior mesenteric artery occlusion and massive bowel gangrene, bowel resection is justifiable especially in young patient as there is a hope for bowel transplantation. Further larger multicentre studies are required to validate our findings.

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ETHICS

The study was done after approval from the Ethical surgical department and medical affair of Al wahada teaching hospital.

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الملخص

يرتبط استئصال الأمعاء الدقيقة بمضاعفات رئيسية وثانوية. تُعد متلازمة الأمعاء القصيرة (SBS) من المضاعفات الشائعة لاستئصال الأمعاء الدقيقة، وتترافق مع سوء امتصاص حاد، وسوء تغذية، واختلال توازن الماء والكهارل، واضطرابات أيضية. تهدف هذه الدراسة إلى تقييم المضاعفات ما بعد الجراحة لاستئصال الأمعاء الدقيقة نتيجة انسداد الشريان المساريقي العلوي. أُجريت دراسة استرجاعية على 25 مريضًا خضعوا لاستئصال الأمعاء الدقيقة بسبب انسداد الشريان المساريقي العلوي، وتراوحت أعمارهم بين 18 و70 عامًا. خضع جميع المرضى لفحص سريري (معدل ضربات القلب، ضغط الدم)، وفحوصات مخبرية (صورة الدم الكاملة، وظائف الكبد، وظائف الكلى، الألبومين والبيليروبين، نسبة INR، زمن البروثرومبين، زمن الثرومبوبلاستين الجزئي، ومستويات الكهارل)، وتقييم شعاعي وفقًا لمدى إلحاح التدخل الجراحي. فيما يتعلق بنتائج العمليات الجراحية للمرضى الذين شملتهم الدراسة، عانى 14 مريضًا (56%) من الإسهال، و24 مريضًا (96%) من الألم، و4 مرضى (16%) من الإنتان، و9 مرضى (36%) من فقدان الوزن، و7 مرضى (28%) من نقص بوتاسيوم الدم، و6 مرضى (24%) من نقص بروتينات الدم، و3 مرضى (12%) من التهاب الجرح، وتوفي 6 مرضى (24%). يرتبط استئصال الأمعاء الدقيقة بمضاعفات طفيفة وكبيرة، لذا ينبغي حصر الاستئصال في حالات الأمعاء المصابة بالغرغرينا الواضحة. على الرغم من أن استئصال الجزء الأوسط من الأمعاء نتيجة انسداد كامل للشريان المساريقي العلوي يؤدي إلى فشل معوي، إلا أن الاستئصال يظل مبررًا.

الكلمات المفتاحية: استئصال الأمعاء الدقيقة، انسداد الشريان المساريقي العلوي، متلازمة الأمعاء القصيرة، الإسهال.