

# Epidemiology and Outcomes of Small Bowel Volvulus at a Tertiary Referral Hospital in Rwanda

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## Research Article

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# Abstract

## Background

Small bowel volvulus is a rare surgical condition that presents with features of intestinal obstruction. The aim of the study was to define the epidemiology, clinical characteristics, and outcomes of small bowel volvulus at a tertiary referral hospital in Rwanda.

## Methods

We conducted an observational study of patients with small bowel volvulus from January 2013 – July 2020. Data were searched from the operative database, logbooks, and the electronic medical record.

## Results

A total of 75 patients were enrolled. Patients were predominantly male (n=63, 85%) and in the lowest income category (n=51, 85%). Median duration of symptoms was 3 days (interquartile range: 2, 5). Tachypnea and tachycardia were observed in 68 (91%) and 46 (61%) patients, respectively. Most patients (n=46, 67%) presented with features of peritonitis. The most commonly involved segment of bowel was ileum in 36 (49%) patients and 49 (67%) patients had gangrenous bowel. Small bowel resection was performed in 46 (64%) patients and stoma was performed in 27 (36%) patients. Overall, 39 (52%) patients had a complication. Surgical site infections were observed in 12 (16%) patients. In-hospital mortality was 21%. Median length of hospital stay was 7 days (interquartile range: 4, 10)

## Conclusion

Small bowel volvulus is an important consideration in patients with intestinal obstruction. The underlying etiologies are not clear but there is a significant association in being a male and having a low socio-economic status. It is important to recognize and identify small bowel volvulus to facilitate timely management and improve patient outcomes.

# Introduction

Small bowel volvulus (SBV) is a rare, potentially life-threatening surgical condition that presents with features of intestinal obstruction (IO). Overall, the incidence of SBV is unknown, but reports suggest a higher incidence in middle Eastern, Asian, and central African countries (1). In Ethiopia and Kenya, single institution studies report SBV accounts for 8.5–36% of IO (2)(3). In contrast, SBV accounts for 1% of IO in the adult US population (4).

SBV involves at least 180° rotation of a segment of the small bowel on its mesenteric axis (2)(5). Emergency presentation is the hallmark of the condition and operative management is the mainstay of care (1). In some situations, spontaneous detorsion prior to surgery may warrant non-operative treatment (4). If this condition is not treated early, the involved segment of bowel may become ischemic and

gangrenous which contributes to the severity of the disease (3)(6)(7). In Kenyan and Ethiopian studies, the mortality rate was 3–5% and morbidity was 5–15% (2)(3).

In Rwandan district hospitals, acute abdominal conditions comprise 14.3% of all general surgery emergencies (8). However, data on SBV are lacking in Rwanda. The objective of this study was to describe the presentation and outcomes of SBV at a tertiary referral hospital in Rwanda.

## Materials And Methods

This study was conducted at University Teaching Hospital of Kigali (CHUK). CHUK is a tertiary referral hospital in Rwanda located in the capital city of Kigali and has an acute care surgery (ACS) firm that treats emergency trauma and non-trauma surgical conditions (9).

From January 2013 to July 2020, we enrolled all patients who were treated at CHUK with an operative diagnosis of SBV. Patients enrolled from 2013 through July 2019 were enrolled retrospectively. Beginning August 2019 through July 2020, data were collected prospectively. We included all etiologies of SBV during the study period, including ileo-sigmoid knotting. We identified all patients with SBV from the operative database, ward and operative logbooks. The diagnosis of SBV was based on the assessment of the primary surgeon at time of operation. From August 1, 2019 – July 31, 2020, prospective participants were identified intraoperatively, enrolled into the study, and followed up through their hospital stay and at 30-day post-operatively.

For all participants we analyzed demographic characteristics, clinical history, diagnosis, operative details, postoperative course, and outcomes. Variables included age, gender, referral hospital, presence of insurance, income category (10), chief complaint, duration of symptoms, and presence of medical comorbidities. We collected data on specific comorbidities including diabetes mellitus, hypertension, alcohol consumption, gastritis, and human immunodeficiency virus status.

Clinical variables included vital signs on admission, presence of peritonitis, laboratory investigations, date and time of surgery, operating surgeon, operative procedure and characteristics, anatomical location of affected bowel (ileum, jejunum, or both), and American Society of Anesthesia (ASA) score. Leukocytosis was defined as a white blood cell count of > 11000/cu mm. Tachycardia was defined as a pulse rate of > 100/min. Tachypnea was defined as respiratory rate of > 20 cycles/min.

Postoperative variables included intensive care unit (ICU) length of stay, hospital length of stay, and complications. Specific in-hospital complications included reoperation, surgical site infection (SSI), mortality, postoperative malnutrition, and postoperative short gut syndrome. These complications were measured based on clinical assessment of the treating physician as documented in the patient file.

For patients enrolled prospectively, we contacted patients at 30 days postoperatively to assess outcomes through phone calls by trained data collectors. Specific outcomes assessed at 30 days included survival, SSI, hospital readmission, and home activities. Surgical site infection was defined as pus discharge from

the wound or a wound requiring a dressing for more than 10 days. Postoperative hospital readmission was verified from the file. Resumption of home activities was defined based on whether the patient had returned to work.

The primary outcome of the study was in-hospital mortality. Secondary outcomes were ICU length of stay, overall hospital length of stay, reoperation, surgical site infection, postoperative malnutrition, and postoperative short-gut syndrome.

The data collection tool was developed and validated in a reliable way in that information were collected from the files of the patients. All collected data were entered into Research Electronic Data Capture (REDCap) which uses an open-source MySQL (Oracle Corporation, Cupertino, CA) database via a secure web interface, with data checks to ensure data quality (11). The database and web server were housed on secure servers that provide a stable, secure, well-maintained, high-capacity data storage environment. Access to study data in REDCap was restricted to the members of the study team.

To analyze data, we used Stata statistical software (version 13.0, StataCorp, College Station, TX). For our descriptive analysis, we reported frequencies and percentages for categorical variables; medians and interquartile ranges (IQR) for continuous variables.

The study was approved by University of Rwanda institutional review board and University Teaching Hospital of Kigali (CHUK) research ethics committee.

## Results

A total of 75 patients were enrolled. Sixty-seven patients were evaluated retrospectively and 8 were enrolled prospectively. Patients were predominantly male (n = 63, 85%) and in the lowest income category (n = 51, 85%) (Table 1). The majority (n = 53, 71%) did not have comorbidities and the mean duration of symptoms at presentation was 3 days (IQR: 2, 5). Tachypnea and tachycardia were observed in 68 (91%) and 46 (61%), respectively. Most patients (n = 46, 67%) presented with features of peritonitis and 40 (53%) had leukocytosis.

Table 1  
Patient characteristics

		<b>N (%)</b>
Collection method	Prospective	8 (11)
	Retrospective	67 (89)
Age, years (median, IQR*)		40 (28, 55)
Gender	Male	63 (85)
	Female	11 (15)
Referred from another hospital (N = 67)		65 (97)
Province	Kigali	13 (20)
	East	14 (22)
	North	28 (43)
	South	4 (6)
	West	6 (9)
Insurance (N = 72)		66 (92)
Income category	1	51 (85)
	2	2 (3)
	3	5 (8)
	4	2 (3)
Comorbidities	Diabetes mellitus	0
	Hypertension	2 (3)
	HIV	5 (7)
	Tuberculosis	0
	Gastritis	6 (8)
	Smoking	8 (11)
	None	53 (71)
Symptom duration, days (median, IQR*) (n = 65)		3 (2, 5)

\* IQR = interquartile range

		N (%)
Vitals	Fever	13 (17)
	Tachycardia	46 (61)
	Tachypnea	68 (91)
	Hypotension	4 (5)
	Hypoxia	8 (11)
	Altered mental status	8 (12)
Peritonitis		46 (67)
White blood cell count > 11000/cu mm		40 (53)
* IQR = interquartile range		

ASA II and III were most commonly seen in 30 (40%) and 16 (21%) patients, respectively. Intraoperatively, almost all patients had volvulized bowel with ileum involved in 36 (49%) patients, jejunum alone in 4 (5%) patients, and both segments involved in 13 (18%) patients (Table 2). Most (n = 49, 67%) patients had gangrenous bowel. Small bowel resection was performed in 46 (64%) patients and stoma was performed in 27 (36%) patients.

Table 2  
Operative characteristics

		N (%)
Time of surgery (N = 64)	Day	45 (70)
	Night/weekend	19 (30)
Primary surgeon	Consultant/faculty surgeon	25 (35)
	Resident	47 (65)
Consultant involved	Not	36 (48)
	Present, not scrubbed	11 (15)
	Scrubbed	28 (37)
Bowel affected	Ileum	36 (49)
	Jejunum	4 (5)
	Jejunum and ileum	13 (18)
	Ileosigmoid knotting	10 (14)
	Not reported	11 (15)
Gangrenous bowel (n = 73)	49 (67)	
Perforation	6 (8)	
Operation	Resected	46 (64)
	Anastomosis	20 (27)
	Stoma	27 (36)
American Society of Anesthesiologist score	I	6 (8)
	II	30 (40)
	III	16 (21)
	IV	2 (3)

At least 12 (16%) patients required ICU admissions with the mean length of ICU stay of 3 days (IQR: 2, 4) (Table 3). Overall, 39 (52%) patients had complications. SSI were observed in 12 (16%) patients. In-hospital mortality was 21%. Median length of hospital stay was 7 days (IQR: 4, 10) (Table 3).

Table 3  
Postoperative course and outcomes

		<b>N (%)</b>
<b>Intensive care unit</b>	No	52 (69)
	Unknown	11 (15)
	Yes	12 (16)
<b>Length of intensive care unit stay, days (median, IQR*)</b>		3 (2, 4)
<b>Complications (in-hospital)</b>	Dead**	16 (21)
	Reoperation	12 (16)
	SSI	12 (16)
	Malnutrition	6 (8)
	Short gut	2 (3)
	Other	4 (5)
	None	36 (48)
	<b>Any complication</b>	39 (52)
<b>Length of hospital, days (median, IQR*) (n=71)</b>		7 (4, 10)
<b>30-day outcome</b>	Readmitted	1 (1)
	Alive	44 (59)
	Dead**	14 (19)
	Missing	17 (23)
* IQR = interquartile range		
** 2 patients died in hospital at > 30 days postoperatively		

## Discussion

This study provides a review of SBV at a single institution. SBV is relatively rare with most reports of SBV coming from case studies or case series. In the US, SBV accounts for 1% of cases of IO. In contrast, in some regions of Africa, SBV accounts for 21–36% of all cases of IO (2)(3). The underlying etiology of primary SBV is poorly defined (5)(12)(13) and secondary SBV may be due to numerous risk factors ranging from malrotation, adhesions, pregnancy, and tumors (6)(14)(15)(16).

Higher rates of SBV are noted in regions commonly associated with higher rates of sigmoid volvulus (3). Similar to risk factors for sigmoid volvulus, it is thought that a long mesentery with a narrow root may



lead to a mesenteric twisting in primary SBV (7)(17). SBV has been associated with farmers working long, hard hours and eating a single large meal in the afternoon (18). Other contributing factors include unusual mobility of small bowel, laxity of abdominal wall, physical exercise, absence of mesenteric fat, constipation or diarrhea, sudden filling of an empty intestine, and the unusual length of small bowel segment (2)(6)(18). In Ethiopia, a high incidence was also recorded during the rainy season and spring when the farmers are occupied with heavy field works which raises a suspicion of seasonal association (18).

SBV occurred most commonly in young male patients. This is similar to the demographics of patients presenting to the ACS service at CHUK with other acute general surgery emergencies. This is also consistent with other studies on SBV in sub-Saharan Africa (2)(9).

Patients from the low-income category were disproportionately represented in this population. In 2015, the government of Rwanda launched a new economic classification of its citizens into four economic categories based on the familial level of income. Low levels (Category I and II) included the poorest population, unemployed, and who have difficulties to afford at least one meal per day (10). Category III and IV are comprised of citizens with relatively high economic class among others. Overall, 14% of the Rwandan population is categorized as "category 1" (19). This study found that 85% of patients presenting with SBV were category 1. This suggests that certain risk factors such as lifestyle, occupation, or dietary patterns are likely present within this population, predisposing patients to SBV, and this warrants further study.

In this study, geographic evaluations are critical as a significant number of participants were from the Northern province of Rwanda. Previously, Mpirimbanyi et al reported that 21% of all general surgery emergencies at CHUK were referred from the Northern province (20). In contrast, 43% of SBV were referred from the Northern province. This finding may be for multiple reasons. There may be variations in referral patterns based on staffing issues at the district hospitals during this time period accounting for a higher referral rate. Alternatively, there may be environmental or cultural influences such as diet, soil, or behavioral patterns. There are many farmers involved in field work in the region. In Ethiopia, SBV occurred mainly in male farmers who perform prolonged hard work in erect position and ingest a single voluminous meal in the afternoon (18).

Most patients presented to the referral hospital with 3 days of symptoms. This is similar to other emergency general surgery patients at this hospital as well as other hospitals in sub-Saharan Africa (8) (21). This delayed presentation suggests delays in the referral patterns and opportunities for improvement in the healthcare system. Despite a high rate of gangrenous bowel in this population (67%), there were relatively low percentage of patients with fever or leukocytosis. In addition to the typical signs of peritonitis, tachypnea and tachycardia were predominant. Fever or leukocytosis are not necessarily present in SBV but they may be early signs of an impending bowel ischemia (6)(12). In our study, 67% had gangrenous small bowel and 64% required bowel resection which is slightly different from the report of Li et al (6). We estimated that the degree of mesenteric torsion, and the duration of symptoms have

contributed to the high rate of bowel resection. Clinicians should maintain a high index of suspicion for bowel ischemia in these patients, despite a lack of fever or leukocytosis.

The mortality rate for SBV in this study was 20% which is similar to worldwide reports on SBV mortality (10–35%) (1). However this is higher than prior studies at this hospital where the mortality rate for emergency general surgery patients was found to be 11% (9). This is despite similar comorbidities, ASA scores, and symptom duration. This suggests that these patients are more critically ill than other emergency general surgery patients. Given the high morbidity and mortality rate for these patients, clinicians need to have a high index of suspicion, manage early and aggressively, and counsel patients and family members accordingly.

The study had several limitations. The study only included patients with an operative diagnosis of SBV. Therefore, patients who had spontaneous mesenteric de-torsion could not be evaluated. This study was conducted at a single institution, therefore does not account for patients who never arrived at the referral hospital, either de-torsing prior to arrival or dying prior to operation. This was a small study with most data collected retrospectively. As such it is potentially subjected to missing information that can affect the results. Where possible, we collected data on the etiology of SBV as well as the degree of rotation. However, this was not always recorded in the operative notes. There has been a suggestion of possible seasonal variation with SBV presentation. We collected data over a multiple year time frame which should allow for seasonal variation. However, we did not specifically analyze data for seasonal variability. We did not collect data on occupation or dietary patterns therefore, we cannot determine if these factors are associated with SBV.

## Conclusion

Small bowel volvulus is a life-threatening condition at CHUK. The underlying etiologies are not well understood but the relationship of being a male, living in the Northern province and being in the low-income category was important. We recommend a large prospective multi-center observational study for proper analysis of this relationship.

## Abbreviations

### ACS

Acute Care Surgery

### ASA

American Society of Anesthesiology

### CHUK

Centre Hospitalier Universitaire de Kigali/University Teaching Hospital of Kigali

### Cu

Cubic

### HIV

Human Immunodeficiency Virus

**ICU**

Intensive Care Unit

**IO**

Intestinal Obstruction

**IQR**

Interquartile ratio

**n/N**

number

**REDCap**

Research Data capture

**SBV**

Small Bowel Volvulus

**SSI**

Surgical site infection

**US**

United States

## **Declarations**

### **Ethical Approval and Consent to participate**

Both the University of Rwanda Institutional Review Board and research ethics committee of CHUK approved the study. For prospective part of the study, all participants signed informed consent forms before enrollment into the study.

### **Consent for publication**

Not applicable

### **Availability of data and materials**

The dataset supporting the conclusions of this article is available by request.

### **Competing interests**

None

### **Funding**

None

### **Authors' contributions**

Constantine Saclarides conceived and presented the idea. Jean Marie Niyonkuru and Jennifer Rickard developed the theory and performed computations. Emmanuel Mutabazi and Jean Christian Urimubabo verified the analytical methods. Jean Marie Niyonkuru and Jennifer Rickard supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

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