Scientific Knowledge Group

Research Article

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Clinical Profile and Factors Associated with Early Adverse Outcome Following Surgery for Sigmoid Volvulus: A Multicenter Cohort

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ABSTRACT

Introduction: *In Uganda, one of the leading causes of intestinal obstruction is sigmoid volvulus. Due to unavailability of endoscopic services in some settings, most of the patients usually undergo emergency surgery. The aim of this study was to determine the clinical profile and factors associated with early adverse outcome following surgery for sigmoid volvulus at Jinja, Hoima and Fortportal regional referral hospitals (FRRH, HRRH and FRRH respectively).*

Methods: *This was an observational prospective cohort done at 3 regional referral hospitals in Uganda. Patients undergoing surgery for sigmoid volvulus were enrolled consecutively and followed up till the time of discharge or death to document the mortality, occurrence of complications and length of hospital stay. Data analysis was done using SPSS version 26 with Poisson regression done to determine the factors.*

Results: *In this study that enrolled 81 participants, majority were males 63(77.8%) with a mean age of 55.1(SD=14.2) years. Hemodynamic instability was seen in 27(33.3%), non-viable gut in 27(33.3%) with colostomies placed in 61(75.3%) of the participants. Death occurred in 10(12.3%) of the patients, while 37(45.7%) had at least one complication with the commonest complication being surgical site infection 21(25.9%). The median length of hospital stay (LOS) was 8(IQR=7-11) days. At multivariate level of analysis, hyperkalemia (aRR=2.210, CI=1.512-3.630, P=0.024) and presence of a sigmoid perforation (aRR=1.913, CI=1.015-3.962, P<0.001) were independently associated with mortality, hypertension (aRR=2.726, CI=1.206-6.158, P=0.016) and presence of hemodynamic instability (aRR=2.500, CI=1.561-4.004, P<0.001) associated with occurrence of complications, while duration of symptoms greater than 3 days (aRR=1.217, CI=1.016-1.458, P=0.033) and hemodynamic instability (aRR=1.165, CI=1.017-1.335, P=0.028) were independently associated with prolonged hospital stay.*

Conclusion: *A big proportion of the participant's presented with hemodynamic instability and non-viable gut resulting in placement of many colostomies. The mortality and morbidity were high as well as the length of hospital stay. More sensitization in relation to early presentation to hospital is still needed in order to reduce the number of patients that present with hemodynamic instability and non-viable or perforated sigmoid which in turn could improve the outcomes.*

Keywords: Sigmoid Volvulus, Clinical Profile, Adverse Outcomes, Uganda.

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List of Abbreviations

cRR=Crude Risk Ratio,
aRR=Adjusted Risk Ratio,
CI=Confidence Interval.

Background

A closed loop of bowel that is vulnerable to strangling, ischemia, gangrene, and perforation results from sigmoid volvulus, which happens when the sigmoid colon bends axially around a small base of mesentery [1]. Volvulus is frequently an emergency, and clinical and radiologic features help to determine its diagnosis [1]. Constipation, stomach pain, nausea,

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vomiting, and distention are among the typical presenting symptoms [2]. There may be symptoms of peritonitis (guarding and rebound tenderness) and bleeding per rectum, depending on how long the condition has been present. Traditionally, asymmetric gaseous abdominal distention and emptiness of the left iliac fossa serve as the pathognomonic signs of sigmoid volvulus [3].

The optimum therapeutic approach for treating volvulus is still up for debate and depends on the surgery selected, the patient's clinical state, the location of the problem, the possibility or confirmation of peritonitis, the viability of the intestine, and the surgical team's experience [1]. Patients should undergo urgent surgery if they have signs of intestinal perforation or ischemia when they first arrive [4]. In the absence of peritonitis, flexible sigmoidoscopy, which has an 80% success rate for colonic detorsion and decompression, is the first-line treatment of choice for sigmoid volvulus [4]. Elective sigmoid colectomy is the recommended course of treatment for instances of simple volvulus following detorsion. Due to their high failure rates, nonoperative treatment and non-resectional surgery, such as sigmoidopexy should only be used in weak patients who are unsuited for colectomy [5].

In Western nations, sigmoid volvulus causes 2-5% of intestinal blockage [6]. The incidence of sigmoid volvulus has been reported to be high in South America, Africa, Eastern Europe, Scandinavia, Russia, the Middle East, Pakistan, and India [7]. The anatomical, cultural, and nutritional variations may all contribute to this geographic diversity [8]. In the developing world, 50% of major bowel blockages are caused by sigmoid volvulus [9]. High-fiber diets and pre-existing redundant sigmoid colon have been cited as key factors in the multifactorial aetiology of this condition [10]. One of the staple foods in Uganda that has been connected to the aetiology of sigmoid volvulus is cassava, which has also been associated to rice, millet, porridge, peas, soya, beans, oranges, and mangoes [11]. A shorter intestinal transit time brought on by this high-fiber diet is hypothesized to result in a redundant sigmoid colon [10].

In Uganda, one of the leading causes of intestinal obstruction is sigmoid volvulus and can be a life-threatening emergency given that it is the most frequent reason for colon strangulation [12, 13, 1]. Due to unavailability of endoscopic services in some settings, most of the patients usually undergo surgery unless there is spontaneous resolution [10]. Whereas clinical patterns of presentation may influence the type of surgery and the surgery's results, nothing is known about these patterns in our setting.

More so, though there are some studies which have assessed sigmoid volvulus in northern Uganda and the central region, there is paucity of data on some aspects like length of hospital stay, clinical patterns and exhaustive assessment of the factors. The only study that assessed factors in northern Uganda, was a retrospective review of one hospital record which yielded low quality evidence [10]. There is need to have high quality evidence from the different regions of Uganda on clinical profiles, outcomes and factors associated with outcomes; the reason this multicenter prospective study was done. This study aimed to determine the clinical profile and factors associated with early adverse outcome following surgery for sigmoid volvulus at Jinja Regional Referral Hospital (JRRH), Hoima Regional Referral Hospital (HRRH) and Fortportal Regional Referral Hospital (FRRH). The clinical profile included the hemodynamic status at presentation, gut viability and type of surgical intervention done. The early outcomes were defined by death, complications and length of hospital stay. The factors assessed included both social demographic and clinical factors.

Methods

Study Design and Period

This was a multicenter prospective cohort done in the surgery departments of three regional referral hospitals; specifically, Hoima, Jinja, and Fortportal, over a period of 5 months.

Study Setting

The 3 hospitals are located in 3 different regions of Uganda and each hospital has general surgeons and senior house officers in the surgery departments. These doctors are responsible for the care of the patients with sigmoid volvulus. On average, each hospital receives 8 patients with sigmoid volvulus per month.

Study Population

All patients above the age of 18 years who underwent surgery for sigmoid volvulus at the selected study centres during the study period were included in the study if they consented.

Sample Size and Sampling

The sample size was determined using Daniel's formula. n_0=(z^2*p*(1-p))/e^2 . Using the findings by Chalya & Mabula in Tanzania where sigmoid volvulus accounted for 14.2% of the patients with intestinal obstruction, P=0.142, Where Z = 1.96, q = 1-p (85.8%) and e = 0.05 [14]. On substitution, n0= 187.2. Adjusting to a finite population of 120, using the formula n=n_0/(1+((n_0-1))/N) , n'=73.3. Adding 10% for those lost during follow up, 81 participants were needed. Since the approximate number of patients with sigmoid volvulus seen at these hospitals was approximately equal, 1/3 of the sample size was taken from each study centre (27 participants from each centre). Consecutive sampling was done till the sample size was reached.

Recruitment and Data Collection Procedure

Informed consent was obtained for legible participants. At admission, the vital signs were taken and the rest of social demographic and clinical information recorded. Resuscitation with fluids and electrolytes was done for all in accordance to the hemodynamic status at admission and the laboratory findings. Nasogastric tube and Foley catheter were inserted. A blood sample for serum electrolytes and complete blood count were taken. Antibiotics (ceftriaxone and metronidazole) were administered [15]. At surgery the gut viability was assessed and the type of surgery done noted. The patients were followed up till discharge to asses for early outcomes specifically morbidity (surgical site infection, burst abdomen and anastomotic leakage), length of hospital stays and mortality. Patients who were still admitted on the 30th day were considered to have been hospitalized for more than 30 days and considered not to have died.

Study Variables

The dependent variables was early adverse outcome including complications (wound sepsis, wound dehiscence, anastomotic leak and others), prolonged hospital stay and mortality. Inde-

pendent variables included social-demographics like (age, sex, residence and smoking) and clinical factors like (Vital signs and gut viability and laboratory findings). The intervening variable was the type of surgery: Sigmoidectomy + Primary anastomosis, or Hartmans procedure.

Quality Control

The data collection tool was pretested for validity and reliability and adjustments made before starting data collection. The research protocol was explained to the research assistants during training. Every day, the principal investigator or his assistant double-checked the data to make sure it was accurate. A general surgeon supervised the research and all procedures were done by a qualified surgeon or a senior house officer under supervision of a general surgeon.

Data Analysis

Microsoft office excel was used to summarize data and then analysis was done by using SPSS version 26.0. Frequencies and percentages were used for the different elements of the clinical profile and early outcomes. For length of hospital stay, the median was reported since the length of stay was not normally distributed. Bivariate and multivariate analysis was done. Variables with P<0.2 were analysed at multivariate level. P values, risk ratios and confidence intervals obtained using Poisson regression were reported in tables with p<0.05 considered significant. This procedure was done for factors associated with mortality, occurrence of complications and prolonged hospital stay in order to report the specific factors for each of the 3 outcome categories.

Ethical Considerations and Consent

All methods were carried out in accordance with relevant guidelines and regulations. Ethical approval was granted by the Research and Ethics Committee of Mulago hospital (Ref No: **MHREC 2538**). All participants gave written informed consent as evidenced by the participants' signature.

Results

In this study that enrolled 81 participants that underwent surgery for sigmoid volvulus, majority of the study participants were males 63(77.8%) with a mean age of 55.1(SD=14.2) years. Majority were from rural areas 58(71.6%) and only 17(21.0%) reported a history of smoking (Table 1).

Table 1: Baseline Social Demographic Characteristics of Study Participants

Characteristic	Frequency	Percentage
Age (Years)	Mean=55.1, SD=14.2, Min=29, max=81	
29-45 (Middle aged adults)	22	27.2
46 - 65 (Older adults)	36	44.4
66-81(Elderly)	23	28.4
Sex		
Male	63	77.8
Female	18	22.2
Education		
None	6	7.4
Primary	30	37.0
Secondary	24	29.6
Tertiary	21	25.9
Religion		
Christian	61	75.3
Muslim	20	24.7
Residence		
Rural	58	71.6
Urban	23	28.4
Smoking		
No	64	79.0
Yes	17	21.0

Of the 81 study participants, 27(33.3%) had both a low systolic blood pressure and a high pulse rate and therefore classified as hemodynamically unstable. Non-viable gut was found in 27(33.3%) of the participants. Fifteen (18.5%) of the patients had a bowel perforation. Majority of the patients had a colostomy placed 61(75.3%) either due to the condition of the gut or the hemodynamic status (Table 2).

Table 2: Clinical profile of patients undergoing surgery for sigmoid volvulus at JRRH, HRRH and FRRH.

Characteristic	Frequency	Percentage
Hemodynamic stability		
Stable	54	66.7
Un stable (PR>100, SBP<90)	27	33.3
Gut Viability		
Viable	54	66.7
Non-viable	27	33.3
Bowel perforation		
No	66	81.5
Yes	15	18.5
Bowel procedure done		
Primary anastomosis	20	24.7
Colostomy	61	75.3

PR=Pulse rate, SBP=Systolic blood pressure.

In this study, 10 of the patients died representing a mortality of 12.3%. Thirty-seven (45.7%) of the participants had at least one complication with the commonest complication being surgical site infection seen in 21(25.9%) of the study participants. The median length of hospital stay was 8(IQR=7-11) days with 40(49.4) of the patients staying in hospital for a duration above the median (>8 days) (Table 3).

Table 3: Early Outcomes of Surgery Among Patients with Sigmoid Volvulus at JRRH, HRRH and FRRH.

Outcome	Frequency	Percentage
Mortality		
No	71	87.7
Yes	10	12.3
Complications		

No complication	44	54.3
One or more complications	37	45.7
Surgical site infection	21	25.9
Burst abdomen	3	3.7
Leakage	2	2.5
Superficial wound dehiscence	9	11.1
Other complication (DVT=3, respiratory complications=5)	8	9.9
Length of stay (Days)	Median=8, IQR= 7-11, Min=3, Max=18	
≤ Median (8)	41	50.6
> median	40	49.4

IQR= Interquartile range,

Hyperkalemia (aRR=2.210, CI=1.512-3.630, P=0.024) and presence of a sigmoid perforation (aRR=1.913, CI=1.015-3.962, P<0.001) independently predicted mortality in multivariate analysis. The risk of mortality was increased by 2.210 times among patients that had hyperkalemia, while it was increased by 1.913 times among patients that had a sigmoid perforation (Table 4). Detailed bivariate analysis is shown in supplementary file 1 as table S1.

Table 4: Multivariate Analysis of Factors Associated with Mortality

Characteristic	Bivariate analysis			Multivariate analysis		
	cRR	95% CI	P value	aRR	95% CI	P value
Sex						
Male	Ref					
Female	2.714	0.674-10.938	0.160	1.014	0.674-6.938	0.321
Residence						
Rural	4.041	0.482-33.879	0.198	2.041	0.652-11.879	0.693
Urban	Ref					
Diabetes						
No	Ref					
Yes	3.918	0.822-18.674	0.086	2.918	0.672-8.674	0.481
Symptom duration						
≤3 (Median)	Ref					
4+	2.184	1.352-6.724	0.024	1.134	0.512-7.324	0.121
Anemia						
No	Ref					
Yes	2.452	1.464-8.435	0.014	1.312	0.464-5.035	0.116
Sodium						
Normal	Ref					
Low	1.706	0.850-5.921	0.071	1.306	0.850-6.921	0.271
High	2.667	1.485-8.023	0.020	1.157	0.485-6.023	0.120
Potassium						
Normal	Ref					
Low	1.857	1.305-4.307	0.024	2.0547	0.557-7.578	0.101
High	**2.684**	**1.913-9.426**	**0.005**	**2.210**	**1.512-3.630**	**0.024**
Perforation						
No	Ref					
Yes	**3.600**	**5.421-28.250**	**<0.001**	**1.913**	**1.015-3.962**	**<0.001**

A history of hypertension (aRR=2.726, CI=1.206-6.158, P=0.016) and presence of hemodynamic instability (aRR=2.500, CI=1.561-4.004, P<0.001) independently predicted occurrence of complications in multivariate analysis. The risk of complications was increased by 2.726 times in hypertensive patients while it was increased by 2.500 times among patients that had hemodynamic instability (Table 5). Detailed bivariate analysis is shown in supplementary file 1 as table S2.

Table 5: Multivariate Analysis of Factors Associated with Occurrence of Complications

Characteristic	Bivariate analysis			Multivariate analysis		
	cRR	95% CI	P value	aRR	95% CI	P value
Age						
29-45 (Middle aged adults)	Ref					
46 - 65 (Older adults)	1.400	0.471-4.161	0.545	0.112	0.011-1.174	0.068
66+(Elderly)	2.275	0.687-7.535	0.179	0.141	0.007-3.033	0.211
Hypertension						
No	Ref					
Yes	2.932	1.183-7.267	0.020	2.726	1.206-6.158	0.016
Instability						
No	Ref					
Yes	2.625	1.661-4.149	<0.001	2.500	1.561-4.004	<0.001
Symptom duration						
≤3 (Median)	Ref					
4+	2.567	1.045-6.306	0.040	5.129	0.909-28.938	0.064
Anemia						
No	Ref					
Yes	1.821	0.736-4.506	0.194	1.621	0.341-7.714	0.544
Sodium						
Normal	Ref					
Low	1.942	0.760-4.966	0.166	0.686	0.178-2.645	0.584
High	0.767	0.166-3.544	0.734	0.121	0.010-1.437	0.094
Perforation						
No	Ref					
Yes	**4.231**	**1.217-14.713**	**0.023**	**1.133**	**0.150-8.546**	**0.904**
Procedure						
Anastomosis	Ref					
Colostomy	**2.411**	**0.819-7.101**	**0.110**	**1.042**	**0.261-4.160**	**0.953**

Duration of symptoms greater than 3 days (aRR=1.217, CI=1.016-1.458, P=0.033) and having hemodynamic instability (aRR=1.165, CI=1.017-1.335, P=0.028) independently predicted prolonged hospital stay in multivariate analysis. A patient who presented after 3 days of symptoms was 1.217 times more likely to have prolonged hospital stay, while one who had hemodynamic instability was 1.165 times more likely to have prolonged hospital stay (Table 6). Detailed bivariate analysis is shown in supplementary file 1 as table S3.

Table 6: Multivariate Analysis of Factors Associated with Prolonged Hospital Stay

Characteristic	Bivariate analysis			Multivariate analysis		
	cRR	95% CI	P value	aRR	95% CI	P value

Age						
29-45 (Middle aged adults)	Ref					
46 - 65 (Older adults)	1.917	0.632-5.820	0.251	0.382	0.046-3.185	0.374
66+(Elderly)	4.898	1.386-17.310	0.014	1.102	0.071-17.203	0.945
Residence						
Rural	3.017	1.078-8.443	0.035	0.946	0.797-1.122	0.521
Urban	Ref					
Hypertension						
No	Ref					
Yes	2.118	0.873-5.140	0.097	1.013	0.833-1.231	0.899
Diabetes						
No	Ref					
Yes	2.687	0.643-11.235	0.176	1.064	0.882-1.284	0.518
HIV						
No	Ref					
Yes	3.677	0.916-14.765	0.066	1.102	0.949-1.280	0.203
Instability						
No	Ref					
Yes	**4.857**	**1.747-13.506**	**0.002**	**1.165**	**1.017-1.335**	**0.028**
Symptom duration						
≤3 (Median)	Ref					
4+	**1.358**	**1.190-1.550**	**<0.001**	**1.217**	**1.016-1.458**	**0.033**
R/tenderness						
No	Ref					
Yes	1.929	0.788-4.719	0.150	0.995	0.825-1.200	0.961
Sodium						
Normal	Ref					
Low	4.021	1.505-10.741	0.006	1.455	0.306-6.922	0.637
High	1.538	0.352-6.730	0.567	0.111	0.004-2.886	0.186
Perforation						
No	Ref					
Yes	1.325	1.169-1.501	<0.001	5.346	0.572-49.948	0.142
Viability						
Viable	Ref					
Non-viable	2.909	1.106-7.650	0.030	1.911	0.429-8.505	0.395
Procedure						
Anastomosis	Ref					
Colostomy	4.038	1.302-12.529	0.016	1.726	0.373-7.985	0.485

Discussion

Clinical Profile

This study enrolled 81 participants that underwent surgery for sigmoid volvulus, majority of whom were males 63(77.8%) with a mean age of 55.1(SD=14.2) years. This is because sigmoid volvulus is known to be common among males in the older age groups (40-50) years in third world countries [16]. Majority were from rural areas 58(71.6%) probably due to the catchment area of the hospitals being rural settings.

We noted that 27(33.3%) of the study participants had both a low systolic blood pressure and a high pulse rate and therefore classified as hemodynamically unstable. This percentage was higher than that reported in Turkey where hemodynamic instability was seen among 102 (24.3%) of the patients presenting with sigmoid volvulus [17]. The difference could be because in this study a big number of patients had bowel gangrene or sigmoid perforation which both worsen the condition of the patient resulting in hypotension and tachycardia which constituted hemodynamic instability in this study.

Non-viable gut was found in 27(33.3%) of the participants while 15 (18.5%) of the patients had a bowel perforation. Percentage of non-viable gut in this study was higher than that reported by Mulugeta & Awlachew in Ethiopia where 26% had non-viable bowel but was lower than the percentage reported by Selçuk Atamanalp in Turkey (63.1%) and Emna in Tunisia (40%) [17-19]. The high percentage of non-viable bowel seen in our study is mainly because of delayed presentation where 46.9% of the study participants presented after 3 days of symptoms. Delay was probably due to inaccessibility of hospital from the rural areas.

Majority of the patients had a colostomy placed 61(75.3%) either due to the condition of the gut or the hemodynamic status. This percentage was comparable to the one reported by Lee in Korea (74.3%) but higher than that reported by Chalya & Mabula in Tanzania and Okello in Uganda at Mulago national referral hospital [14, 20, 21]. The studies in Tanzania and Mulago had both emergency procedures and some elective procedure in which the volvulus was de-rotated endoscopically and then surgery done later. All the patients operated in our study underwent an emergency laparotomy and this could explain the difference in percentage of patients that had a stoma placed since emergency surgery increases possibility of stoma placement [22]. The other explanations for having a big number of patients undergoing stoma placement could be because of the significant number of patients with bowel gangrene, hemodynamic instability and perforation with gross contamination which conditions increase the risk for anastomotic leakage making stoma placement the safer option.

Early Outcomes

In this study, 10 of the patients died representing a mortality of 12.3%. Our findings were in agreement with findings of a systematic review by Selvaraj & Palaniswamy who reported that mortality following sigmoid volvulus ranged from 10-50% [23]. Also, the mortality found in this study was comparable though slightly lower than that reported in Mulago (15.9%) and Tanzania (17%) [14, 21].

The mortality we found was higher than that reported by Awedew in Ethiopia (6.45%), Jumbi & Kuremu in Kenya (3.3%) and Wismayer in northern Uganda (7.7%) [10, 24, 25]. The differences seen in mortality could be because these studies that reported lower mortality had some patients operated electively after derotation yet in our study there were no facilities for endoscopic derotation, yet emergency procedures are associated with a higher mortality [15]. Also, the high percentage of patients with perforated sigmoid (18.5%) could have contributed to the high mortality.

Thirty-seven (45.7%) of the participants had at least one complication with the commonest complication being surgical site infection seen in 21(25.9%) of the study participants. The per-

centage of patients with complications was comparable to that reported by Lee where 40.0% of the patients that had emergency surgery for sigmoid volvulus got complications [20]. Also, our findings were in agreement with studies by Emna in Tunisia, Mulugeta & Awlachew in Ethiopia, Chalya & Mabula in Tanzania and Wismayer in northern Uganda who reported surgical site infection as the commonest complication [10, 14, 18, 19]. This is possibly because these surgeries would be classified as contaminated or even dirty if there is perforation which classifications are associated with a high risk of surgical site infection.

The percentage of complications reported in our study was higher than that reported by Jumbi & Kuremu in Kenya (21.7%), Chalya & Mabula in Tanzania (20.5%) and Wismayer in northern Uganda (17.5%) [10, 14, 25]. The high percentage of complications in this study could be attribute to the fact that a high percentage of the patients had perforated sigmoid (18.5%) which resulted in peritonitis. Given that surgical site infection was the commonest complication, the peritonitis could partly explain the high percentage of complications. The occurrence of sigmoid perforation can again be attributed to late presentation seen among most of the patients in our study since the median duration of symptoms at presentation was 3 days.

The median length of hospital stay was 8(IQR=7-11) days with 40(49.4) of the patients staying in hospital for a duration above the median (>8 days). This LOS was comparable to that reported by Awedew in Ethiopia (median=8 days) but slightly lower than that reported by Lee in Korea (Median =11 days), Jumbi & Kuremu in Kenya (average 11.8 days) and Chalya & Mabula in Tanzania (Median=14 days) [14, 20, 24, 25]. The High length of hospital stay could be attributed to the high occurrence of complications which are known to increase length of hospital stay.

Factors Associated with Early Adverse Outcomes

The variables that were independently and significantly associated with mortality were hyperkalemia and presence of a sigmoid perforation. Our findings were in agreement with what was reported by Lee in Korea who noted that mortality was significantly associated with presence of sigmoid colon gangrene or perforation (P=0.001), Chalya & Mabula in Tanzania who reported that bowel gangrene or perforation predicted adverse outcomes and Wismayer in northern Uganda who reported that electrolyte imbalances were associated with unfavorable outcomes [10, 14, 20]. Presence of hyperkalemia may be an indicator of acute kidney injury which has a potential to increase mortality while sigmoid perforation results in generalized peritonitis which significantly increases mortality.

The variables that were independently and significantly associated with occurrence of complications were a history of hypertension and presence of hemodynamic instability. Our findings are in agreement with what was reported by Lee in Korea who noted that patients who had a concomitant disease like hypertension (P=0.001) and those who had hemodynamic instability or shock (P=0.001) had an increased risk of getting complications [20]. Also in agreement are the findings by Okello at mulago who reported that patients who had comorbid diseases like, hypertension had increased risk [21]. Hemodynamic instability increases the risk of complications since it impairs healing and hence increasing risk of wound complications and even anastomotic leakage. Presence of hypertension more so if poorly controlled impairs perfusion of the tissues due to the associated arteriosclerosis impairing the healing of tissues and hence the occurrence of wound complications.

The variables that were independently and significantly associated with prolonged hospital stay were duration of symptoms greater than 3 days and having hemodynamic instability. Though many studies have reported about length of stay among patients undergoing sigmoid volvulus surgery, this is the first study that has reported on the factors associated with length of stay following surgery for sigmoid volvulus to best of our knowledge. Delayed presentation increases the risk of bowel ischemia, gangrene and perforation. These in turn increase the risk of post-operative complications as was reported by Chalya & Mabula, which complications eventually results in prolonged hospital stay [14]. The presence of hemodynamic instability also results in complications which in turn increase the length of hospital stay.

Strength and Limitations of the Study

This was a multicenter prospective cohort study that increases the generalizability of the findings. However, our findings are limited by the fact that the centres did not have endoscopic services which can be used to de-rotate volvulus and do the surgeries electively; which procedure has been associated with a better outcome. Therefore, our fining may not be generalizable to the centres where endoscopic derotation is practiced.

Conclusion and Recommendations

A big proportion of the participant's presented with hemodynamic instability and non-viable gut resulting in placement of many colostomies. The mortality and morbidity were high as well as the length of hospital stay. Hyperkalemia and presence of a sigmoid perforation independently predicted mortality. Hypertension and presence of hemodynamic instability predicted occurrence of complications. Duration of symptoms greater than 3 days and hemodynamic instability independently predicted prolonged hospital stay.

More sensitization in relation to early presentation to hospital is still needed in order to reduce the number of patients that present with hemodynamic instability and non-viable or perforated sigmoid which in turn will improve the outcomes. All hospitals should be equipped with colonoscopy towers to enable derotation of some of the patients with sigmoid volvulus in whom derotation is indicated. Another multicenter prospective cohort should be done in hospitals that are able to do endoscopic derotation to assess the outcomes.

Ethical Considerations and Consent

All methods were carried out in accordance with relevant guidelines and regulations. Ethical approval was granted by the Research and Ethics Committee of Mulago hospital (Ref No: MHREC 2538). All participants gave written informed consent as evidenced by the participants' signature.

Consent for Publication

Not applicable

Availability of Data and Materials

Data is available upon request. Requests should be sent to **skhadolwa@yahoo.com (SAK)**

Competing Interests

The authors declare that they have no conflict of interest

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Author Contribution

SAK was the principal investigator, conceived and designed the study, collected data, analysed data and wrote the draft of the manuscript.

JM participated in data analysis, discussion of results and revised the manuscript.

DA and RM supervised the work and revised the manuscript.

MDO, UK, JIK and SG participated in data collection, revised the manuscript and all authors approved the final paper.

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References

1. Sarfaraz M, Hasan SR, Lateef S (2017) Sigmoid volvulus in young patients: A new twist on an old diagnosis. Intractable Rare Dis Res 6: 219-223.
2. Naveed M, Jamil L, Fujii-Lau L (2020) American Society for Gastrointestinal Endoscopy guideline on the role of endoscopy in the management of acute colonic pseudo-obstruction and colonic volvulus. Gastrointest Endosc 91: 228-235.
3. Assenza M, Ciccarone F, Iannone I, Bracchetti G, de Meis E, et al. (2020) Elective treatment of large-bowel obstruction in asymptomatic sigmoid volvulus. Clin Ter 171: E466-470.
4. Seow-En I, Chang SC, Ke TW, Shen MY, Chen HC, et al. (2021) Uncomplicated Sigmoid Volvulus Is Ideal for Laparoscopic Sigmoidectomy with Transrectal Natural Orifice Specimen Extraction. Dis Colon Rectum 5: E90-93.
5. Perrot L, Fohlen A, Alves A, Lubrano J (2016) Management of the colonic volvulus in 2016. J Visc Surg 153: 183-192.
6. Halabi W, Jafari M, Kang C (2014) Colonic volvulus in the United States: trends, outcomes, and predictors of mortality. Ann Surg 259: 293-301.
7. Raveenthiran V, Madiba T, Atamanalp S, De U (2010) Volvulus of the sigmoid colon. Color Dis 12: e1-17.
8. Toh JWT, Collins GP, Ridley LJ, Chan M, Schofield R (2022) A tale of two twists: mesentero-axial and organo-axial sigmoid volvulus. J Med Imaging Radiat Oncol 67: 252-259.
9. Ali M, Hashmi Z, Zafar A (2009) Management of acute sigmoid volvulus, using one stage resection and anastomosis, without colonic lavage. J Med Sci 7: 101-104.
10. Wismayer R (2021) Incidence and Factors Influencing the Outcome of Sigmoid Volvulus in Northern Uganda. A Prospective Observational Study. In: Highlights on Medicine and Medical Science 5: 8-34.
11. Tumusiime G, Kakande I, Masira N (2009) Factors associated with redundant sigmoid colon at Mulago Hospital, Kampala. East Centr Afr J Surg 14: 65-68.
12. Okeny PK, Hwang TG, Ogwang DM (2011) Acute Bowel Obstruction in a Rural Hospital in Northern in Northern Uganda. East Cent Afr j surg 16.
13. Saba M, Rosenberg J, Wu G, Hinika G (2021) A case of sigmoid volvulus in an unexpected demographic. Surg Case Reports 7: 3–7.
14. Chalya PL, Mabula JB (2015) Sigmoid volvulus and ileo-sigmoid knotting: A five-year experience at a tertiary care hospital in Tanzania. World J Emerg Surg 10: 4-11.
15. Kazem shahmoradi M, khoshdani farahani P, Sharifian M (2021) Evaluating outcomes of primary anastomosis versus Hartmann's procedure in sigmoid volvulus: A retrospective-cohort study. Ann Med Surg 62: 160-163.
16. David N, Bimston M, Steven J, Stryker M (2005) Volvlus of the colon. Second. Current therapy in colon and rectal surgery 557–612.
17. Atamanalp SS, Aydinli B, Öztürk G, Başoğlu M, Yildirgan MI, et al. (2008) Classification of sigmoid volvulus. Turkish J Med Sci 38: 425-429.
18. Mulugeta GA, Awlachew S (2019) Retrospective study on pattern and outcome of management of sigmoid volvulus at district hospital in Ethiopia. BMC Surg 19: 1-5.
19. Emna T, Atef M, Sarra S (2022) Management of acute sigmoid volvulus: A Tunisian experience. Asian J Surg 45: 148-153.
20. Lee K, Oh HK, Cho JR, Kim M, Kim DW, et al. (2020) Surgical management of sigmoid volvulus: A multicenter observational study. Ann Coloproctol 36: 403-408.
21. Okello T, Ogwang D, Kisa P, Komagum P (2009) Sigmoid Volvulus and Ileosigmoid Knotting at St. Mary's Hospital Lacor in Gulu, Uganda. T.R. Okello , D.M. Ogwang, P. Kisa, P. Komagum. St. Mary's Hospital Lacor, Gulu, Northern Uganda. East Cent Afr j surg 14: 58-64.
22. Kim EM, Kang BM, Kim BC, Kim JY, Park JH, et al. (2020) Clinical outcomes of sigmoid volvulus and risk factors for its recurrence: a multicenter study in Korea. Int J Colorectal Dis 35: 1841-1847.
23. Selvaraj DR, Palaniswamy C (2010) Sigmoid volvulus. J Hosp Med 5: 9-11.
24. Awedew AF (2020) Magnitude and Clinical characteristics of Sigmoid Volvulus. Reserch squire 1-10.
25. Jumbi G, Kuremu RT (2008) Emergency resection of sigmoid volvulus. East Afr Med J 85: 398-405.