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Abdominal re-operations: indications, early surgical outcomes and prognostic factors at Bugando Medical Centre, Mwanza Tanzania

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Abstract

Background: Abdominal re-operation is any repeated operation for an intra-abdominal procedure or wound complication on index admission or on a subsequent admission to the hospital within a post-operative period of sixty days. It is usually performed in case of post-operative complications either as a re-laparotomy, stoma or wound complications depending on the initial type of surgery. Incidence of abdominal re-operation differs according to the hospital's settings, patient's baseline clinical condition and type of primary abdominal surgery. Despite the increased number of surgical re-admissions, and post-operative complications, there is still a paucity of data describing burden, indications, outcomes and prognostic factors of abdominal re-operations at Bugando Medical Centre (BMC). This study was conducted to determine indications, early surgical outcomes and prognostic factors for abdominal re-operations at BMC.

Methods: This was an analytical cross-sectional study that was conducted at BMC from May 2017 to May 2018. Data were entered into a Microsoft Excel sheet and statistical analysis was done using STATA version 15.

Results: A total of 104 patients were enrolled, of whom 41(39.4%) were males and 63(60.6%) were females, giving a male-to-female ratio of 1: 1.5. Their ages at diagnosis ranged from 1 day to 76 years with a median age of 29 [IQR 17 – 46] years. The most common indications for abdominal re-operation were peritonitis 45 (43.3%), burst abdomen 29 (28.0%) and anastomotic leak 18 (17.3%). Stoma complications 7 (6.7%), haemorrhage 4 (3.9%) and post-operative paralytic ileus 1 (1.0%) were also recorded indications but at a lesser frequency. The mortality rate following abdominal re-operation was 28.9% (n=30). Older age and increasing number of abdominal re-operations were the main independent predictors of mortality following abdominal re-operations ($p < 0.001$).

Conclusion: Abdominal re-operation is associated with high mortality. The most common indications for abdominal re-operation were peritonitis, burst abdomen and anastomotic leak. Predictors of mortality were older age and an increasing number of abdominal re-operations. Hence it is recommended that patients with peritonitis, burst abdomen or anastomotic leak be managed in a timely and well-planned manner to minimize the number of unnecessary re-operations which may increase the risk for mortality.

Keywords: *Abdominal re-operations, indications, outcomes, prognostic factors, Tanzania*

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Introduction

Abdominal re-operation is any repeated operation for an intra-abdominal procedure or wound complication on the index admission or on a subsequent hospital admission within a post-operative period of 60 days (Girgor'ev *et al.*, 2003). Although surgeons generally take pride when there is no need for re-operation, there are circumstances where failure of one or multiple surgical requirement(s) necessitates abdominal re-operations. In addition, there are a number of other complications that occur after primary surgeries which may culminate in urgent abdominal re-explorations which may prove to be lifesaving (Girgor'ev *et al.*, 2003; Yovtchev *et al*., 2010).

Abdominal re-operations may be influenced by many factors including but not limited to the rank of the first attending surgeon, the indication for the primary surgery, the technique and skills of the attending surgeon, the patient's co-morbid conditions and sterility of the surgical environment and equipment (Holzheimer & Gathof., 2003; Yovtchev *et al*., 2010). Reoperation rates are classified according to the type of operation. These are divided into re-laparotomy (considered as a re-opening of the abdomen, abdominal washout, small bowel resection, further colorectal resection, open drainage of intra-abdominal abscess, division of adhesions, formation of stoma, stoma complications (considered as an operation on a stoma, excluding closure of stoma and stoma formation) and wound complications requiring re-operation (Zacharias *et al*., 1999; Burns *et al*., 2011).

Abdominal re-operation can be categorized as early or late; radical or palliative; urgent or elective; planned or unplanned depending on the performed period, its purpose, urgency and whether or not it is scheduled (Ching *et al*., 2003; Yovtchev *et al*., 2010). Urgent abdominal re-explorations following complicated abdominal surgeries are generally known as *'final choice'* operations, with high morbidity and mortality rates (Ching *et al*., 2003).

It is not necessary that all the abdominal re-operations are done due to failure of some requirements but there are a number of complications that occur after primary surgeries that may require urgent abdominal re-explorations, they are lifesaving and obligatory operations to be performed (Koirala *et al*., 2015). Redo laparotomies are called on demand if it has to be done because of the patients' condition and are called planned if the second laparotomy is decided upon during the course of the first surgery, for example: in case of severe intra-abdominal sepsis or post-damage control surgery(Wain & Sykes., 1987; Koirala *et al*., 2012).

Staged abdominal re-operation (STAR) for abdominal trauma is a damage control surgery where there are modified sequence using rapid life saving techniques delaying the definitive resection and reconstructive surgery until when the patient can be adequately resuscitated and stabilized in the surgical intensive care unit (Johnson *et al*., 2001; Taviloglu., 2003; Koirala *et al*., 2012). The technique of abdominal packing with planned abdominal re-operation was first described in the beginning of 20th century as peri-hepatic packing, at that time liver lacerations were frequently packed with absorbable or non-absorbable material sutured in place (Taviloglu., 2003).

Staged abdominal re-operation is a technique of serial operations, planned either before or during the index operation and performed within 24 to 48 hours, with temporary closure of the abdomen often culminating into a final aponeurosis to aponeurosis abdominal closure (Lonasoff *et al*., 2002; Taviloglu., 2003; Koirala *et al*., 2012). Success of a surgeon would be proportionate to his correct responses to such questions as "to whom, when, under what conditions, why and how the surgery should be conducted" when urgent abdominal reoperations is required (Unalp *et al.*, 2006).

A large number of patients undergo various operative procedures every day and laparotomy forms a large proportion. At times, laparotomies have to be re-done due to complications like biliary peritonitis, faecal fistula, burst abdomen or anastomotic leak (Billing *et al*., 1991; Koirala *et al*., 2012). Incidence of abdominal re-operation is also found to be higher in hospital setup with training facility and it has contributed to morbidity and mortality (Patel *et al.*, 2016). This study aimed to explore on

abdominal re-operations, their indications, outcomes and prognostic factors at Bugando Medical Centre so that we may be able to explore potential interventions that will halt the associated morbidity and mortality.

Methods and patients

Study design

It was an analytical cross sectional study where all patients with indications to undergo abdominal re-operation in general surgical, urological and gynecological wards at Bugando Medical Centre between May 2017 and May 2018 were evaluated and considered for enrollment.

Study setting

This hospital-based study was conducted at the Emergency department (EMD), intensive care unit (ICU), general surgical, urological and gynecological wards of BMC for all patients who underwent abdominal re-operation were included in the study if they consented. BMC is one of the four zonal and tertiary referral hospitals in Tanzania; it is situated along the shores of Lake Victoria in Mwanza City in the Northwestern part of Tanzania. The hospital has 960 beds and serves as a referral center for tertiary specialized care for a catchment population of approximately 18 million people from neighboring regions (Mara, Kagera, Shinyanga, Simiyu and Geita). It is a consultant and teaching hospital to Catholic University of Health and allied sciences – Bugando (CUHAS- Bugando) and other health training institutes.

The hospital has well designed and equipped EMD where by all surgical emergencies are reviewed in consultation with surgical departments where by all patients with emergency surgical conditions are stabilized before sending to the operating room. Also the hospital has modern and equipped: Adult, Pediatric and Neonatal Intensive care unit (ICU) with a bed capacity of 12 for the adults and 10 for pediatrics. It is through the ICU where by those patients with emergency surgical conditions that underwent damage control abdominal surgeries and necessitated re-exploration as staged abdominal re-explorations were admitted.

Majority of patients who underwent damage control surgeries in operating theatre are transferred to ICU for stabilization before the definitive surgery, Patients with long duration of surgery and those who underwent abdominal re-explorations, ICU remains the safe place post-operatively. The hospital has specialized and super specialized departments, general surgery, obstetrics and gynecology, urology are among the specialized departments where by a number of abdominal surgical operations are conducted, most of the patient with planned and un planned abdominal re-explorations are found admitted here. In a year, from January 2016 to December 2016 a total of 120 number of surgical re admission were intervened.

Study Population

The study included patients of all age group and gender with planned and unplanned abdominal re-operations done at BMC, in ICU, general surgery, obstetrics and gynecology and urology departments, all referred cases that need abdominal re-exploration presenting at EMD. This study included patients of all age groups and sex who underwent abdominal re-operation under general anesthesia at BMC. Patients referred to BMC with indications for abdominal re-operation and those who gave consent to participate in the study were also included in the study.

Patients who underwent first abdominal surgery more than 60 days, patients with initial primary laparoscopic procedure, superficial abdominal operation that did not require general anesthesia and patients with insufficient details on the primary surgery were excluded from the study.

The minimum sample size required for this study was calculated using Yamane Taro (1967). Patients who met the inclusion criteria were enrolled serially until required sample size was reached.

Recruitment of patients to participate in the study was done at the A & E, ICU, gynecological, urological and general surgical departments. All patients who underwent abdominal re-operations and meet the inclusion criteria were offered information and explanations about the study and requested for his/her informed written consent before being enrolled in the study. The diagnosis and need to re-operate was established based on clinical findings (symptoms and signs), laboratory and radiological findings at admission. Patients with emergency abdominal trauma who were not clinically stable, a staged abdominal re-operation were done after the first damage control surgery was performed. These patients were then sent to ICU for hemodynamic stabilization and re-operation performed within 48 hours.

Since these patients were in critical clinical condition their next of kin gave consent. However, when their clinical condition improved, they were informed about the study and asked for their willingness to continue participating in the study. Before being subjected to abdominal re-operation, all patients were resuscitated with intravenous fluids to correct electrolytes deficits, nasogastric tube and urethral catheterization were inserted. Broad spectrum antibiotics were administered and relevant pre-operative investigations were performed. Every patient was followed up from time of admission until time of discharge/death.

Data Management

Data collection

Both Swahili and English version questionnaire was used to collect information on the socio-demographic data (i.e. age and sex), referral details, indications for abdominal re-operation, co-morbid conditions, details of primary surgery (indications for the first surgery and Rank of the surgeon who performed the procedure and intra-operative duration of the first surgery). Information on interval to abdominal re-operation, number of subsequent abdominal re-operations was recorded. Post-operative data including: length of hospital stay, development of complications and mortality were collected. Mobile phone communication was used to obtain referral details.

Statistical data analysis

Statistical data analysis was done using STATA version 15. Categorical variables were summarized into proportions and frequency distributions. Continuous variables were summarized into mean (standard deviation) and median (interquantile range). Data were further displayed using histograms and pie chart. Categories for different predictor variables were made based on literature findings and clinical experience. Univariate analysis using logistic regression was done between each predictor variable and outcome variable to obtain crude odds ratios (cOR) with their respective 95% CI and p-values. All predictor variables with a p-value ≤ 0.10 were considered for the final multivariate analysis model where adjusted odds ratios (aOR) with their respective 95% CI and p-values were obtained. All variables with p-value ≤ 0.05 in the final logistic multivariate analysis model were considered to be independent predictors of the outcome variable (mortality from abdominal re-operation).

Ethical considerations

The approval to carry out the study was sought from the Joint CUHAS/BMC Research, Ethics and Committee (CREC/224/2017) before the commencement of the study. Also, permission was sought from BMC authority. A written informed consent was requested from each participant and/or close relative after explaining the aim and importance of the study as well as the study procedures. For patients < 18 years of age and those who were critically ill, parents/guardians or next of kin were

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requested to give consent on their behalf. Patient's refusal to give consent or withdraw from the study did not alter or jeopardize their access to medical care at BMC. Confidentiality was strictly maintained during data collection and thereafter.

Results

From May 2017 to May 2018 a total of 115 patients who underwent abdominal re-operations at BMC. Participants were screened for eligibility of being recruited into the study. Of those 104 (90.4%) patients fulfilled the inclusion criteria and were enrolled into the study, whereas 11 (9.6%) patients were excluded from the study due to failure to meet the inclusion criteria as shown in Figure 1 below.

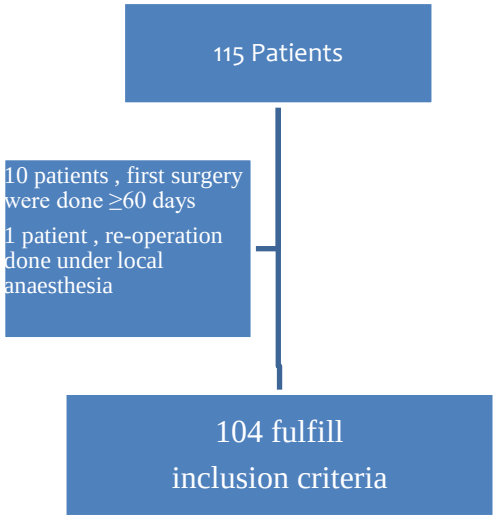

Figure 1: Flow chart showing recruitment of patients who underwent abdominal re-operation at BMC

Demographic and clinical characteristics of the patients enrolled into study

Of the 104 patients enrolled, 41 (39.4 %) were male and 63 (60.6%) were females, giving a male to female ratio of 1: 1.5. Their age at diagnosis ranged from 1 day to 76 years with the median age of 29 [IQR 17 – 46] years. The majority of patients, 69 (66.4%) were in the age <40 years. 95 (91.4%) of patients had no premorbid illness and 9 (8.6%) had premorbid illness. Most of the abdominal re-operation was done as emergency surgeries 90 (86.5%) and few as elective surgeries 14 (13.5%). Majority of patients had one abdominal re-operation 81 (77.9%) and the interval from the first abdominal surgery to the re-operation was 4 to 6 days in majority of them 55 (52.9%). Table 1 below summarizes the distribution of demographic and clinical characteristics of enrolled patients.

Table 1: Distribution of demographic and clinical characteristics of enrolled patients (N=104)

Patient's variables	Number (n)	Percent (%)
Age group		
<40 years	69	66.4
≥40 years	35	33.6
Sex		
Male	41	39.4
Female	63	60.6
Premorbid illness		
No	95	91.4
Yes	9	8.6
Interval for abdominal re-operation(from the first surgery)		
48 hours	13	12.5

3 days	15	14.4
4–6 days	55	52.9
>6 days	21	20.2
Number of abdominal re-operation(s)		
Single abdominal re-operation	81	78.0
Multiple abdominal re-operations	23	22.0
Admission pattern		
Obstetrics and gynecology	21	20.2
ICU	30	28.8
Surgical wards	53	51.0
Hospital stay		
≤ 14 days	53	51.0
>14 days	51	49.0
Urgency of surgery		
Elective surgery	14	13.5
Emergency surgery	90	86.5

Indications and details of the primary surgery

The most common indications for the primary surgery were intestinal obstruction 30 (28.8%) as shown in Figure 2 below.

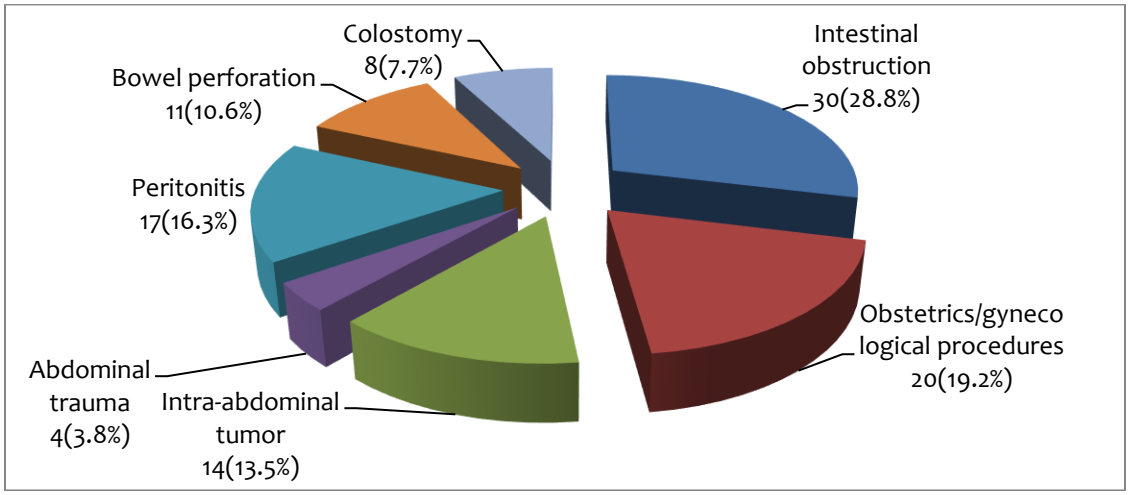

Figure 2: Indications for primary abdominal surgery among patients who had abdominal re-operations at BMC

Table 2: Indications and details of the first/primary surgery (N=104)

Patient variables	Number (n)	Percent (%)
First surgeon's rank		
Junior (registrar/residents)	95	91.3
Senior(specialist)	9	8.7
Duration of the first/primary surgery		
1 –2 hours	24	23.1
≥ 3 hours	80	76.9
Health facility for the first/primary surgery		
District hospital	24	23.1
Regional hospital	39	37.5
Tertiary hospital	41	39.4
Contamination status of first/primary surgery		
Clean-contaminated surgery	100	96.0

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Dirty surgery	4	4.0

Indications for abdominal re-operation

Of the 104 patients who underwent abdominal re-operation, the most common indications were peritonitis 45 (43.3%) followed by burst abdomen 29 (28.0%), anastomotic leak 18 (17.3%) as shown in Figure 3 below.

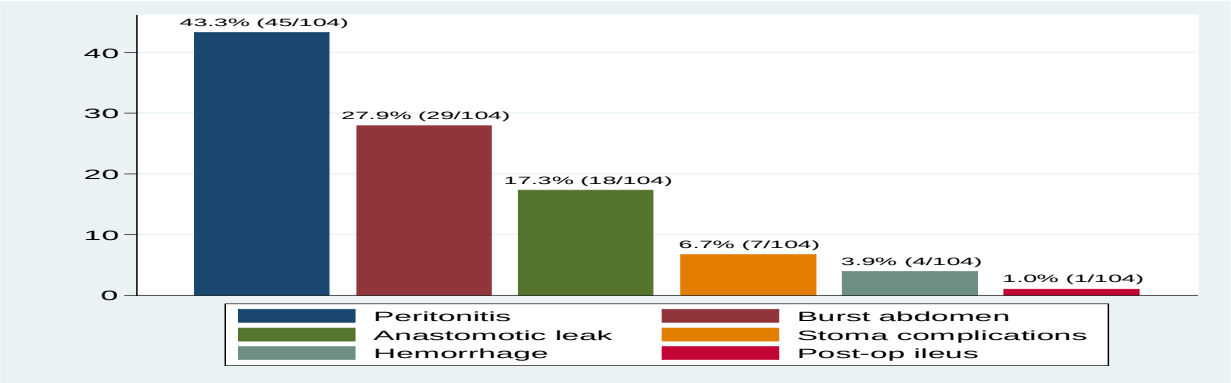

Figure 3: Indications for abdominal re-operations

Complications of abdominal re-operations

Of the 104 patients who underwent abdominal re-operation, 35(33.7%) developed complications. Of these, surgical site infection was the most common post-operative complications following abdominal re-operations as shown in Figure 4 below.

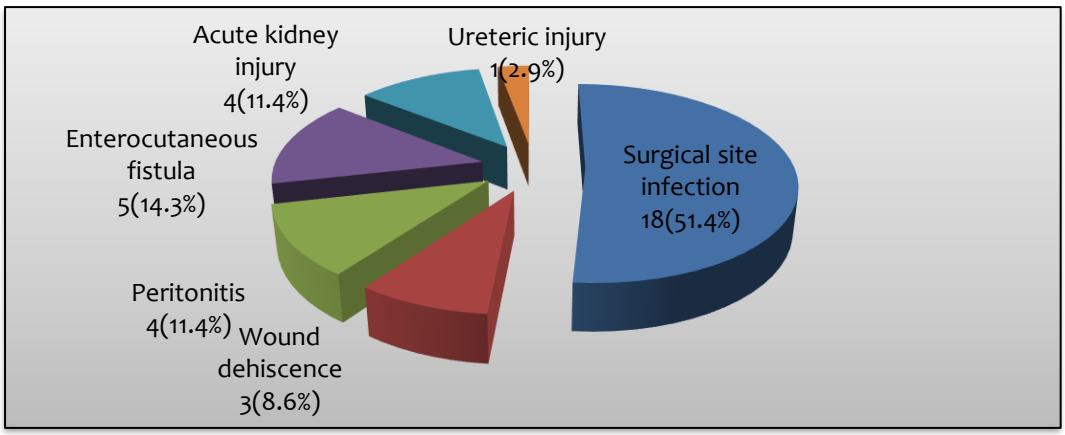

Figure 4: Post-operative complications following abdominal re-operations

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Mortality among abdominal re-operated patients

Out of 104 patients, 30 patients died giving a mortality rate of 28.9%. Figure 4 summarizes the proportion of patients who died following abdominal re-operation

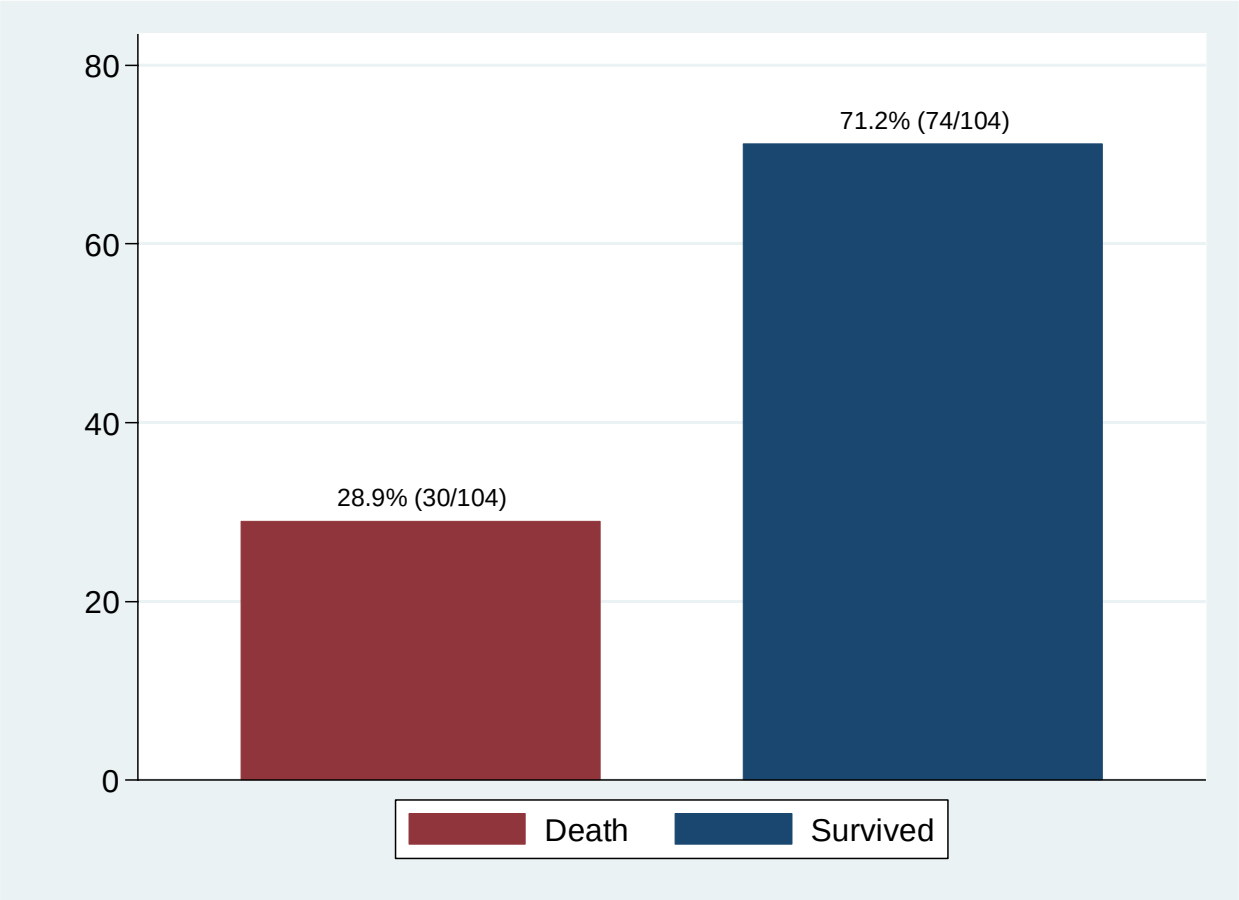

Figure 5: Proportion of patients who died following abdominal re-operation at BMC

Predictors of mortality among patients undergoing abdominal re-operation at BMC

Table 3 below summarizes predictors of mortality among patients who underwent abdominal re-operations according to univariate and multivariate logistic regression analysis.

Table 3: Predictors of mortality among patients who underwent abdominal re-operations according to univariate and multivariate logistic regression analysis

Patient	Survival		Univariate		Multivariate analysis	
	Died	Alive	OR[95% CI]	p-value	OR[95% CI]	p- value
Characteristics	n (%)	n (%)				
Age group						
<40	10 (33.3)	59 (79.7)	1.0			
≥40	20 (66.7)	15 (20.3)	7.9 [3.1 –20.3]	<0.001	9.3 [2.5 –34.1]	0.001
Sex						
Male	15 (20.3)	7 (23.3)	1.0			
Female	59 (79.7)	23 (76.7)	0.8 [0.3 –2.3]	0.729		
Primary Surgery						
Intestinal obstruction	11 (36.7)	19 (25.7)	1.0			
Obstetrics/gynecology	0 (0.0)	20 (27.0)	.			

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Intra-abdominal tumor	5 (16.7)	9 (12.2)	0.9 [0.3 –3.6]	0.951		
Abdominal trauma	2 (6.7)	2 (2.7)	1.7 [0.2 –14.0]	0.609		
Peritonitis	10 (33.3)	7 (9.4)	2.5 [0.7 –8.3]	0.146		
Bowel perforation	2 (6.7)	9 (12.2)	0.4 [0.1 –2.1]	0.270		
Colostomy	0 (0.0)	8 (10.8)	.	.		
Indications for re-operation						
Stomal complications	0 (0.0)	7 (9.5)	1.0			
Peritonitis	17 (57.7)	28 (37.8)	1.6 [0.5 –5.2]	0.454		
Burst abdomen	7 (23.3)	22 (29.7)	0.8 [0.2 –3.1]	0.781		
Post operative ileus	0 (0.0)	1 (1.35)	.	1.0		
Hemorrhage	1 (3.3)	3 (4.1)	0.9 [0.1 –10.4]	0.910		
Interval for re-operation						
48 hours	4 (13.3)	9 (12.2)	1.0			
3 days	5 (16.7)	10 (13.5)	1.1 [0.2 –5.5]	0.885		
4-6 days	16 (53.3)	39 (52.7)	0.9 [0.2 –3.4]	0.905		
>6 days	5 (16.7)	16 (21.6)	0.7 [0.1 –3.3]	0.656		
Diagnostic modality						
Lab findings	1 (3.3)	0 (0.0)	1.0			
Imaging	1 (3.3)	4 (5.4)	0.7 [0.1 –6.8]	0.732		
Clinical and lab	3 (10.0)	23 (31.1)	0.3 [0.1 –1.4]	0.147		
Clinical, lab and Imaging	16 (53.3)	23 (31.1)	1.9 [0.7 –5.0]	0.224		
Rank of a surgeon						
Junior (registrar/residents)	29 (96.7)	66 (89.2)	1.0			
Senior (Specialists)	1 (3.3)	8 (10.8)	0.3 [0.0 –2.3]	0.246		
Duration of the first surgery						
1-2 hours	3 (10.0)	21 (28.4)	1.0			
≥3 hours	27 (90.0)	53 (71.6)	3.6 [1 –13]	0.054		
Facility for the primary surgery						
District hospital	7 (23.3)	17 (22.9)	1.0			
Regional hospital	13 (43.3)	26 (35.1)	1.2 [0.4 –3.7]	0.730		
Tertiary hospital	10 (33.3)	31 (41.9)	0.8 [0.3 –2.4]	0.673		
Admission						
Obstetrics and Gynecology	0(0.0)	21 (28.4)	1.0			
ICU	17 (56.7)	13 (17.5)	10.8 [2.1 – 54.1]	0.004		
Surgical wards	13 (43.3)	40 (54.1)	2.6 [0.5 –13.0]	0.240		
Number of abdominal re-operation						
One surgery	14 (46.7)	67 (90.5)	1.0			
More than one surgery	16 (53.3)	7 (9.5)	10.9 [3.7 –31.5]	<0.001	5.3[1.2 –23.0]	0.024
Complications						
No	18 (60.0)	51 (68.9)	1.0			
Yes	12 (40.0)	23 (31.1)	1.5 [0.6 –3.6]	0.384		
Hospital stay						
≤ 14 days	14 (46.7)	39 (52.7)	1.0			
>14 days	16 (53.3)	35 (47.3)	1.3 [0.5 –3.0]	0.577		

Discussion

Abdominal re-operation remains frustrating for surgeons worldwide and it is performed due to the complications observed following the initial operation and is associated with high morbidity and mortality (Harbrecht *et al*., 1984; Richards *et al., 2012*). In this study, the majorities of patients who underwent abdominal re-operations were in the second and third decade of life which is in keeping with other studies in African countries (Scriba *et al.,* 2015; Ugumba *et al.,* 2018). However, this is contrary to studies in developed countries which showed that the age at presentation is about a decade or two later compared to what is reported in African reports (Ching *et al*., 2003; Martínez-Casas *et al*., 2010). The high life expectancy and disease pattern, more malignant condition in the western world which tends to occur in older age, may contribute to this discrepancy.

The female predominance demonstrated in this study is in keeping with previous observations reported in studies performed elsewhere (Burns *et al*., 2011; Uysal *et al*., 2017). Many studies done elsewhere among patients who underwent abdominal re-operations demonstrated male predominance (Ching *et al*., 2003; Unalp *et al*., 2006; Martínez-Casas *et al*., 2010; Koirala *et al*., 2015; Patel *et al*., 2016). However, equal gender distribution was reported in a previous study from Ethiopia (Kirubel *et al*., 2020). The female predominance in this study may be contributed by the high number of obstetrics and gynecological patients which are exclusively females.

In the current study, the most common indications for abdominal re-operation were peritonitis, burst abdomen and anastomotic leak. This finding is in keeping with other studies which demonstrated similar indication patterns (Hinsdale *et al*., 1984; Krivitskiĭ *et al*., 1984; Zavernyi *et al.*, 1992; Lojpur *et al*., 2005; Unalp *et al*., 2006; Uysal *et al*., 2017; Zala *et al* ., 2022). This observation could be explained by the fact that septic abdomen following peritonitis or intra-abdominal collection like abscess, anastomotic leaks are associated with diffuse contamination and inflammation. Therefore, this necessitates abdominal re-operation for repeating peritoneal lavage in-order to achieve control of infection. On the other hand burst abdomen could be explained by the experience of the operating surgeon. In addition to this, the type of primary surgery could influence the occurrence of burst abdomen specifically for those dirty primary surgeries. In contrast to our study, studies done by Koirala *et al* (2015) and Ching *et al* (2003) revealed hemorrhage being the commonest indication which is very low in our patients. This discrepancy can be explained by the complexity and type of the first surgery. In these two studies, there is high burden of liver and pancreatic surgery which were usually complicated by bleeding.

In line with other studies (Mamchich *et al*., 1992; Koperna & Schulz., 2000; Ching *et al*., 2003; Mushaya *et al*., 2005; Unalp *et al*., 2006; Koirala *et al*., 2015; Patel *et al*., 2016), most primary abdominal operations requiring re-operations in our study were done for emergency surgeries than elective and most of them were performed by junior doctors. The high rate of emergency abdominal surgeries requiring re-operations in this study can be explained by the fact that there are inadequate patient preparations during emergency surgical procedures and this can predispose them to complications that may require re-operations. In addition, the majority of emergency primary surgeries in the present study were performed by junior doctors (registras and residents) who may have little experiences in forming these surgeries. This calls for direct supervision of junior doctors in order to reduce the incidence of complications that follow emergency abdominal operations. On the other hand, in elective surgery, there is time to plan and optimize the patient before the operation and therefore these surgeries are less likely to develop complications requiring reoperations.

In this study and many other studies (Leshchenko *et al*., 1991; Unalp *et al*., 2006; Koirala *et al*., 2015; Scriba *et al*., 2015; Ugumba *et al*., 2018), surgeries for bowel obstructions, gynaecology/obstetrics conditions, bowel perforation and peritonitis were the top most primary abdominal operations that complicated and required reoperations. On the contrary, studies from developed nations

demonstrated GI malignancies as the most common index surgery (Billing *et al*., 1991; Girgor'ev *et al*., 2003). This may reflect the difference in disease incidence.

The interval from the first surgery to the repeated one was analyzed and found that the interval of 4-6 days was mostly practiced at Bugando Medical Centre. In the study of Unalp *et al* (2006), the mean re-dolaparatomy interval was 4 days, whereas it was 12.7 days in the study of Koirala *et al* (2015). Longer interval time could be explained by the fact that usually surgeons were optimizing patient's condition and selecting a more conservative approach before sending patients for abdominal re-operations.

Complications are not totally avoidable in surgery, in some cases surgeon may have to perform repeated operations which may consequently be associated with increased morbidity and mortality of the patient. In the current study it was found that 33.7% patients experienced complications following abdominal re-operations. Our proportion of postoperative complications was relatively lower compared to 66.4% that was reported by Koirala *et al* (2015). In this study, surgical site infection was the most common complication following abdominal re-operation accounting for 51.4% of cases. This figure is higher than 39.1% that was reported by Pérez-Guerra *et al* (2017). High rate of surgical site infection in the present may be attributed to contamination of the laparotomy wound during the surgical procedure. Surgical site infections contribute significantly in increasing health care cost, both for patients and hospitals. Ensuring proper sterilization and aseptic precautions is a major remedial factor in preventing post-operative surgical site infections.

The overall mortality rate following abdominal re-operations has been reported in literature to range from 20-40% (Ching *et al*., 2003; Unalp *et al*., 2006; Gedik *et al*., 2009; Martínez-Casas *et al*., 2010; Patel *et al*., 2016; Prabhu *et al*., 2017). In this study the mortality following abdominal re-operation was 28.9% which is within the range in literature. This finding agrees with the overall mortality of 29.7% that was reported by another study following abdominal re-operation (Hutchins *et al.,* 2004). Higher mortality rates of 37.0% and 61.5% were reported by Unalp *et al* (2006) and Koirala *et al* (2015) respectively.

Several factors have been reported in the literature to be associated with mortality following abdominal reoperations (Martínez-Casas *et al*., 2010; Patel *et al*., 2016). Most studies have reported that age is associated with mortality following abdominal reoperations (Ching *et al*., 2003; Unalp *et al*., 2006; Martínez-Casas *et al*., 2010; Patel *et al*., 2016). In this study, age 40 years and above was significantly associated with mortality which is consistent with reports of other studies (Ching *et al*., 2003; Unalp *et al*., 2006; Martínez-Casas *et al*., 2010; Patel *et al*., 2016). Ching *et al* (2003) reported that mortality rate increases with advancing age, rising from 23% in younger patients below 50 to 75% in those over 80 years. Other studies done in India and Europe have also revealed association between older age and mortality (Martínez-Casas *et al*., 2010; Patel *et al*., 2016). High mortality rate in older age group could be due to instability to the surgical stress for the older populations, also multiple organ failure which affects many of the older population, though in this study multiple organ failure was not dealt with, creating a room for further studies that will explore the contribution of multiple organ failure to mortality among older patients who underwent abdominal re-operation.

The association between the number of abdominal re-operations and mortality among patients undergoing abdominal reoperations has been largely studied (Rygachev *et al*., 1997; Srivastava *et al*., 2016). It has been reported in the study of Rygachev *et al* (1997) that the mortality rates were significantly higher in multiple abdominal re-operations compared to single abdominal re-operations. In the study of Koirala *et al* (2015), the mortality rates were reported to be 23.6% in single abdominal reoperations and 61.2% in multiple abdominal re-operations. In this study, the number of abdominal re-operations was found to be significantly associated with mortality in multivariate logistic analysis whereby patients who underwent multiple abdominal re-operations had a significant higher mortality

than those who had single abdominal re-operation. Multiple abdominal re-operations are associated with prolonged exposure to risks of anesthesia as well as fluid and electrolytes derangement and multiple organ failure. The interaction of these factors may explain the elevated mortality in patients with multiple abdominal re-operations.

The major limitation in this study was insufficient information about primary surgery for patients referred to BMC. However, despite this limitation, the study has provided local data that can guide health care providers in the management of these patients.

In conclusion, the most common indications for abdominal re-operation at BMC were peritonitis, burst abdomen and anastomotic leak. The mortality and complication rates following abdominal re-operation at BMC were 28.9% and 33.7% respectively. Advanced age (40 years and above) and multiple abdominal re-operation were the main predictors of mortality in patients undergoing abdominal re-operation. It is therefore recommended that timely and planned abdominal re-operation for patients with peritonitis should be advocated in order to lower mortality rate. Watchful waiting or re-laparotomy on demand should be practiced particularly for relatively old patients. Surgeons should make urgent abdominal re-operation decision without delay. Since multiple abdominal re-operations are associated with mortality, the first re-operation is very crucial.

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