INTRODUCTION

Colorectal cancer has steadily increased in sub-Saharan Africa over the last 20 years\(^1\)\(^-\)\(^4\), with about two—fifth of patients presenting with late stage disease\(^5\)\(^-\)\(^6\). One of the commonest modes of presentation of advanced disease are symptoms of large bowel obstruction necessitating emergency treatment, which often leads to an increased morbidity and mortality\(^6\). The epidemiology of benign colonic pathologies has not changed significantly over time in our region; except for the noted reduction in colonic intussusception and sigmoid volvulus which hitherto accounted for a large volume of emergency colon surgeries\(^7\)\(^-\)\(^11\). The outcomes following emergency and elective colorectal surgeries have been well studied with documented morbidity and mortality rates of between 1-30%\(^12\)\(^-\)\(^15\). We prospectively reviewed all colon and proximal rectal surgical cases done since 2008 with the aims of auditing our outcomes with regards to perioperative morbidity and mortality. We also identified risk factors for perioperative (in-hospital) mortality following colon and proximal rectal surgery in our practice.

METHODS

The study was undertaken at the Department of Surgery, University College Hospital, Ibadan between January 2008 and January 2018. Consecutive patients who had emergency or elective surgical intervention for lower gastrointestinal tract (caecum and proximal rectum) symptoms during the study period were included. Ethical approval was obtained from the state ethical review committee (AD 13/479/745) and conduct followed the guidelines of the Helsinki declaration on biomedical research in human subjects. Confidentiality of the identity of patients and personal health information was maintained.

Data regarding elective or emergency presentation, peri-operative findings, operative details and post-operative course were recorded prospectively.
obstetrics and gynaecological consults that had surgical intervention without the standard peri-operative work-up while elective colon surgical patients were reviewed and admitted via the surgical out-patients clinic. Resection was either segmental (anatomic) or partial (removal of the lesion-bearing segment). Primary anastomosis is defined as immediate restoration of bowel continuity and colostomy was either completely or partially defunctioning. Peri-operative short-term outcome was any sequelae attributable to surgical intervention which occurred in the first 30 days post-operatively.

**Pre-operative care**
All the patients had necessary clinical and radiopathologic diagnosis made. Routine cardiorespiratory, hematologic and biochemical investigations were done on admission. All emergency cases had fluid and electrolyte, blood and antibiotic and bowel decompression as part of initial resuscitation before contemplating surgery. Cardiology, endocrinology and pulmonology consults were sought as required for identified comorbidities while pre-operative anaesthesia review was mandatory before surgical intervention. Left-sided colonic surgery entailed bowel preparation in the elective setting only. A consent for a colostomy was obtained in all cases before surgery especially in the emergency setting.

**Operative procedure**
All the patients had an exploratory laparotomy under general anaesthesia except for extremis cases which necessitated mini-laparotomy for decompression under regional or local anaesthesia.

**Post-operative care**
This entailed care in either the ward, high dependency unit (HDU) or the intensive care unit (ICU). Deep venous thrombosis prophylaxis was discontinued after ambulation was established. Parenteral medications were only changed to oral when bowel function returned, indicated by the passage of flatus or faeces. Empirical antibiotics were given prophylactically or until features of sepsis resolved. Hospital discharge occurred between a week and ten days after laparotomy and was variable for the emergency surgical cases.

Out-patient care was at 2 weeks (histology or stoma/wound review); 4 weeks (ascertain full recuperation or commencement of adjuvant treatment for malignancy) and at 8 weeks (discharge or work up for closure of stoma).

**Statistical Analysis**
All information was recorded in Microsoft excel spread sheet. Data analysis was done using the SPSS version 20.0. Descriptive data were summarized using percentages, ratios and proportions for categorical data and measures of central tendency for continuous variable. Mann-Whitney U test was used to assess differences between proportions when appropriate. Univariate analysis was done with the Pearson chi-square test and Fischer’s exact test. Multivariate analysis was performed using logistic regression. Relationships and differences was considered statistically significant when the P value was ≤ 0.05.

**RESULTS**
Out of a total of 1618 patient seen with colorectal disease-related complaints, a total of 817 patients were operated on during the study period. Of these 38.1% presented as emergencies while 61.9% were managed as elective surgical cases. The cases that required

| Characteristic          | Number | Percentage |
|-------------------------|--------|------------|
| Sex                     |        |            |
| Male                    | 466    | 57.0       |
| Female                  | 351    | 43.0       |
| Age                     |        |            |
| 16 – 40                 | 92     | 11.3       |
| 41 – 65                 | 542    | 66.3       |
| > 65                    | 183    | 22.4       |
| Co-morbidity            |        |            |
| Hypertension            | 110    | 13.5       |
| Diabetes                | 33     | 4.0        |
| Asthma                  | 4      | 0.5        |
| COPD                    | 13     | 1.6        |
| Heart failure           | 36     | 4.4        |
| Renal (AKI)             | 42     | 5.1        |
| ASA                     |        |            |
| I                       | 90     | 11.0       |
| II                      | 188    | 23.0       |
| III                     | 261    | 32.0       |
| IV                      | 237    | 29.0       |
| V                       | 41     | 5.0        |
| Cadre of Surgeon/Anaesthetist |      |            |
| SR                      | 364/590| 44.6/55.4  |
| Consultant              | 453/227| 55.4/45.6  |
| Diagnosis               |        |            |
| Benign                  | 503    | 61.6       |
| Diverticular disease    | 94     | 11.5       |
| Adhesions               | 29     | 3.5        |
| Appendiceal pathology   | 41     | 5.0        |
| Enterocutaneous fistula | 25     | 3.0        |
| Intussusception         | 14     | 1.8        |
| Volvulus                | 74     | 9.0        |
| Hernia                  | 33     | 4.0        |
| Iatrogenic/Ob/Gyn/Others| 193    | 23.8       |
| Malignancy              | 314    | 38.4       |
| Caecum                  | 50     | 16.0       |
| Ascending               | 31     | 9.8        |
| Hepatic flexure         | 27     | 8.6        |
| Transverse              | 29     | 9.2        |
| Splenic flexure         | 17     | 5.4        |
| Descending              | 13     | 4.1        |
| Sigmoid                 | 49     | 15.6       |
| Proximal Rectum         | 98     | 31.2       |

COPD – Chronic Obstructive Pulmonary disease AKI – Acute Kidney Injury ASA – American Society of Anaesthesiologists SR – Senior Registrar HDU – High Dependency Unit ICU – Intensive Care Unit Ob/Gyn – Obstetric/Gynaecology
emergency surgery included obstruction (68%), perforation (13%), diverticular disease (bleeding/perforation – 11.5%), gynaecology related conditions (9%) and terminal ileal or appendiceal disease that necessitated a limited hemicolectomy (5%). The distribution of the surgical cases is highlighted in Table 1. Colon cancer, diverticular disease, iatrogenic Obstetrics/Gynaecology bowel injuries and volvulus were the most frequent cases done electively in descending order (Table 1).

Figure 1 shows the flow chart of patients treated during the study period. The mean age was 54 ± 9 years. Half of the patients were above 55 years of age. The prevalent co-morbidities were hypertension (110; 13.5%) and diabetes (33; 4%). The median age of patients who had emergency surgery was 56 (33–81) compared to 59 (27–87) for the elective group. Patients who underwent emergency or elective surgery were predominantly male (466; 57%) with no statistical significance. Table 1 highlights the clinico-pathologic and peri-operative profile of the patients who underwent surgery.

Table 1 also shows that the most frequent surgical intervention was a right hemicolectomy, followed by anterior resection and then colostomies. The commonest benign indication was an inflammatory mass or phlegmon involving the terminal ileum, caecum and ascending colon from an appendiceal pathology.

The post-operative morbidity and mortality in the elective and emergency patients were compared in Table 2. A significantly higher mortality and morbidity was seen in emergency surgeries than in elective cases. The overall morbidity was 13.7% (elective 4.2%; emergency 9.5%), while mortality was 6.8% (elective 2.1%; emergency 4.7%).

There was a tendency to a diverting stoma as the only procedure during an emergency procedure than elective (p-0.06). A bypass surgery had a poorer outcome than a resection in either the emergency or elective arm (p-0.03). Uncomplicated large bowel obstruction (LBO) did not contribute significantly to morbidity or mortality (p-0.16); however, LBO complicated with either perforation or gangrene predicted mortality significantly (p-0.01).

Morbidity associated with right-sided resection was higher than with left-sided resection (p-0.02) in both
the emergency and elective surgery groups. The American Society of Anaesthesiologist (ASA) score was expectedly higher in the emergency surgery group and overall but only significant when higher than ASA III in the emergency setting (p=0.002) while the noted comorbidities did not determine outcome significantly.

Left-sided faecal diversion surgeries resulted in more surgical site infections than left-sided resection and anastomosis (p=0.01).

Table 3 shows the surgical procedure and mode of admission. The cadre of surgeon (trainee vs Consultant) and time of surgery (day vs night) were also significant in determining the procedure being done, and a stoma was fashioned more by a trainee surgeon during the call hours mostly.

Approximately 7% of all patients requiring surgery could not be operated on due to unavailability of intensive care unit (ICU) beds.

Almost all patients (99.7%) of our patients had hand-sewn anastomosis. Only 0.3% of our patients had anastomosis done with a stapling device.

**DISCUSSION**

The present study represents a large heterogeneous cohort of patients managed over a 10 year period in a typical surgical unit in sub-Saharan Africa with its inherent structural and technical challenges. The post-operative morbidity and mortality of colon and rectal surgery have been reported extensively with wide variability noted. The total perioperative morbidity and mortality of 13.7% and 6.8% found in our study is slightly higher when comparing with the review by Masoomi et al who analysed the Nationwide Inpatient Sample (NIS) in the United States of America. In this study by Masoomi et al, the overall rate of in-hospital mortality was 4.5%.

In comparing with other reviews, the findings of an older patient-set with colorectal tumours
presenting with LBO as emergencies was similar to our findings. Of note is the fact that our study consisted of a heterogenous population with varied diagnosis as opposed to the homogenous cohort of the patients noted reviewed by other authors.\textsuperscript{6,20,21,22,23}

There is a higher morbidity and mortality related incidences in the emergency group irrespective of what type of procedure was carried out as highlighted in Table 2. In the emergency circumstances, the response time is important, and there is a need to optimise the patients' physiological state while also not unnecessarily prolonging the duration of perioperative sepsis. This leads to an abridged resuscitation period where-in the thorough review, medical management of comorbidities along with a comprehensive risk assessment which are completed in the elective setting are aborted at the expense of the much-needed surgical intervention. This may explain the increase in the post-operative morbidity and mortality noted in this group. Co-morbidities were present in a quarter of patients operated on and it is an established fact that end-organ damage in patients undergoing colon/rectal surgery results in a higher morbidity and mortality.\textsuperscript{15} Allied to this is the age of the patients which was mainly between the fifth and seventh decade of life in our study. Most studies assessing age and outcome agree that advanced age is a significant risk factor to be considered in pre-operative assessment.\textsuperscript{24,25}

Overall the commonest procedure in our series was a right hemicolectomy, either a formal hemicolectomy for lesions in the proximal colon or a limited hemicolectomy for a terminal ileal or appendicular pathology. There was a preponderance of by-pass/stoma surgeries in the emergency than the elective surgical groups and this may be a reflection of the emergency and unstable hemodynamic state of the patients in the perioperative period with little or no bowel preparation. More so the expertise available during the emergency hours may not be adept at attempting resection in this group of unstable patients. The incidence of perforation in malignancies is within the quoted range in other reports.\textsuperscript{17,20,22} We confirm that bowel perforation/gangrene is the most significant predictor of mortality in large bowel pathologies as opposed to the finding by Sjo et al\textsuperscript{16} who found no significant difference in morbidity and mortality when comparing bowel obstruction and perforation in their own series. The variation in patient demography may have contributed to this.

All complications noted in the emergency group were also observed in the elective population. However post-operative sepsis was significantly higher in the emergency surgical cases because of the factors inherent in the manner of presentation. This may include peritoneal soilage from bowel perforation and strangulation leading to severe sepsis. Closely allied to this is the ASA classification of patients for surgery.

The commonest morbidities noted were superficial surgical site infection (SSSI) and wound dehiscence which closely mirrored the findings by Sjo et al.\textsuperscript{16} The procedures associated with the highest incidence of morbidity were sigmoidectomy and anterior resection. Our findings mirrored that of Core et al\textsuperscript{25} who also showed a higher rate of mortality in left sided colon surgeries. In the emergency setting, performing a resection surgery had the worst outcome; closely followed by performing a diverting stoma or an ileo-transverse anastomosis. We found the Hartmann's procedure to be a versatile tool in managing left sided colonic pathologies, particularly in the emergency setting when avoiding the risk of an anastomotic leak after surgical resection of a rectosigmoid lesion. Other authors\textsuperscript{16,21,27,28} opined differently with a >10% morbidity/mortality rate associated with the use of the procedure. These authors preferred an on-table lavage with primary anastomosis after a left sided resection. A randomized trial comparing Hartmann's procedure and left hemicolectomy in a comparable group of patients will assist in making a firm conclusion on the better of the two options. We however agree to the technicality associated with a stoma closure and fashioning of a colorectal anastomosis thereafter as a second stage procedure.

Peritoneal sepsis occurring after a primary resection and anastomosis was seen in 4.1% of patients, this necessitated a re-exploration and fashioning a stoma, this is comparable to the reports from other high volume centres.\textsuperscript{26} It is trite knowledge that restoring bowel continuity after resection in emergency circumstance has a greater propensity to an anastomotic leak.\textsuperscript{26,32,33,34} The subset analysis show that a greater percentage had the anastomotic leak in the emergency setting in our review, this was however not statistically significant and is akin to the findings by Choi et al.\textsuperscript{35} An important guide that we imbibe is the operative time and intra-operative blood loss which are known surrogate markers of a difficult procedure.\textsuperscript{26,36,37} If at the point of restoring bowel continuity, the operative time, blood loss or need for transfusion is high; we usually accompany our primary anastomosis with a proximal protective defunctioning stoma or use adjuncts like a pelvic drain.

In the face of faecal peritonitis and shock in the emergency setting, most patients only get a stoma in
our practise, this may on one hand increase the volume of patients requiring a second procedure; it however increases the chances of survival overall. The category of very ill and emergency patients requiring surgical intervention as a part of their resuscitation will be better served if a comprehensive intensive care unit, high dependency unit are available for the post-operative care. Indeed, up to 7% of emergency patients in this series could not be operated on clearly because of lack of ICU beds.

Only 0.3% of our patients had a stapler device employed for their surgery with no case being done laparoscopically during the review period. This highlights the gulf in surgical practice between the LMIC and the high-income countries (HIC) where most procedures are done through minimal access with staplers being the norm rather than the exception. Large bowel obstruction from a malignancy followed by sigmoid volvulus and adhesions were the commonest indication for an emergency procedure in this series while colon and rectal malignancy was the predominant indication for an elective colon or rectal surgery. In observing the trend in frequency of volvulus in the preceding 5 decades, where-in 50% of large bowel obstruction was attributed to volvulus to our present finding of 9%, that tallies with the rates of 8% seen in other parts of Africa and 9.2% in the Middle East, but clearly higher than the North American rates of 4%. In either the emergency or elective colon/rectal surgeries, colon and rectal cancer presentation was mainly stages III and II respectively, thus confirming that where colorectal cancer screening is scarce, patients present with late stage disease.

In conclusion, like other reports large bowel obstruction due to malignancy is the leading cause of emergency colon surgery. LBO complicated with perforation and gangrene is a major risk factor for morbidity and mortality in colorectal surgery in our setting. Hand sewn anastomosis is still the predominant method of restoring bowel continuity after resection of colon or rectum.

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