Predictors of morbidity and mortality among elderly patients undergoing emergency exploratory laparotomy at regional referral hospitals in Uganda: a multi-centre prospective study.

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ABSTRACT

Background: Elderly patients commonly pose a significant challenge, mainly in emergency settings where the time to optimize the high-risk patient with other associated co-morbidities is inadequate, which predisposes these patients to a number of complications postoperatively. There is paucity of data on predictors of morbidity and mortality among elderly surgical patients in Uganda. This study assessed the predictors of morbidity and mortality among elderly patients undergoing emergency exploratory laparotomy at Jinja, Lira, Hoima, and Fort Portal Regional Referral Hospitals.

Methods: This was a prospective observational cohort in which elderly patients (≥65 years) that underwent emergency exploratory laparotomy from 15th November 2024 to 14th February 2025 were enrolled and followed up until 30 days post-operatively to assess for the occurrence morbidity and mortality. The complications assessed included hemorrhage, surgical site infection, deep venous thrombosis, respiratory complications. SPSS version 26 was used for analysis, with Poisson regression done to determine the significant predictors. $P<0.05$ was considered significant.

Results: Of the 86 participants, 29.1% were above 80 years of age. Majority were male (74.4%). Complications were seen in 25.6% of the participants. The commonest complication was surgical site infection. Mortality occurred in 10.5%. In the multivariable analysis, being older than 80 years, having DM or hypertension and having a perforation were associated with complications;

delayed presentation to hospital and blood transfusion associated with mortality (P<0.05 for all).

Conclusion: The rates of morbidity were high. More attention is required among the elderly undergoing surgery in order to reduce the rate at which they get morbidity and mortality with emphasis on wound care. Health education and sensitization in communities should be strengthened, advocating for timely seeking of medical attention by the elderly group.

Keywords: Elderly surgery; emergency laparotomy; morbidity; Mortality; Uganda.

Background

Postoperative complications have been reported to be more common among the elderly compared to the non-elderly patients undergoing surgery seen in 65.8% compared to 37.4% respectively (Chua & Chan, 2020). Because of this relatively high postoperative complication rate in the elderly, significant mortality rates have been reported (Onen et al., 2022; Endeshaw et al., 2023). It is observed that the majority of the elderly patients who present to surgical care units usually have one or more associated co-morbidities that significantly compromise postoperative healing, the common ones being diabetes and hypertension (Fan et al., 2020; Ogbuanya et al., 2023; Endeshaw et al., 2023).

The bottom-line factor that creates the marked presentation of postoperative abdominal complications is frailty, which leads to poor physiological reserve

among elderly patients (Tian et al., 2023). Emergency abdominal surgeries have been associated with unfavorable surgical care outcomes because of the marked toxicity that such patients present with, which is even worse due to patient delays to present to a surgical care unit or other in-hospital delays and scarcity of resources (Aakre et al., 2020; Ogwal et al., 2020; Ogbuanya et al., 2023).

Among the elderly surgical patients, the poor physiological reserve is more pronounced than that present in other emergency patients that are not elderly, which impede post-operative recovery (McCann et al., 2020; Sudlow et al., 2018). Geriatric patients commonly pose a significant challenge, mainly in emergency settings where the time to optimize the high-risk patient with other associated co-morbidities is inadequate, which predisposes these patients to a number of complications postoperatively (Halle-Smith et al., 2021; McCann et al., 2020; Menegozzo et al., 2019).

According to the hospital records at Jinja, Lira, Hoima, and Fort Portal Regional Referral Hospitals in the months of October to December 2023, 87 elderly patients underwent laparotomy procedures; some of whom sustained post-operative complications, according to the staff opinion; however, these outcomes were not well documented in the hospital records, nor were the predictors of complications assessed. There is an absence of data about outcomes from emergency laparotomy among the elderly in Uganda; the reason this study was done.

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Methods

Study design and period

This study was a prospective observational cohort that covered a period of three months (from 15th November 2024 to 14th February 2025) in which elderly patients (>65 years) that underwent emergency exploratory laparotomy were enrolled and followed up until 30 days post-operatively to assess for the occurrence of mortality and morbidity.

Study setting

The study sites were Jinja, Lira, Hoima, and Fort Portal Regional Referral Hospitals, wherein the study participants were recruited. These hospitals were selected because they could represent the different regions of Uganda, but also because they were accessible since they work as set lite teaching hospitals for Kampala international university.

Hoima and Fort Portal Regional Referral Hospitals are located in western Uganda in Hoima and Fort Portal cities, respectively, while Lira Regional Referral Hospital is located in northern Uganda in Lira City. Jinja Regional Referral Hospital is located in Eastern Uganda in Jinja City. The bed capacities for Jinja, Lira, Hoima, and Fort Portal Regional Referral Hospitals are 600, 401, 317 and 333 respectively. All these hospitals are government funded and have consultant surgeons, senior house officers, medical officers and other health workers attached to surgical wards. The departmental patient flow per day varies linearly and continuously from one hospital to

another due to the different dynamics of each city and the population demographics. All these hospitals receive a sizeable number of elderly patients that undergo laparotomies, which was the target of this study.

Study population

We targeted patients aged 65 years and older with emergency abdominal pathology that needed to be addressed by an emergency exploratory laparotomy.

Inclusion criteria

All patients aged 65 years and above undergoing emergency exploratory laparotomy that gave permission to take part in the research were included. The participants who were not sure of their age were requested to avail their national identity card. The underlying diagnoses included intestinal obstruction, gut perforation, splenic injury, gastric outlet obstruction, appendicitis, splenic abscess and peritoneal abscess.

Exclusion criteria

Patients with mental illness, involved in poly-trauma or confirmed metastatic abdominal malignancy were excluded. The study centres were not currying out any laparoscopic procedures at the time. It’s those patients with endoscopy confirmed malignancy that had features suggestive of metastasis that were not included in the study because we anticipated that these patients

could experience complications due to advanced malignancy that could bias our findings.

Sample size and sampling.

Modified Daniel through field formula was utilized to determine the sample size.

$n_o = \frac{(z_{\alpha+}z_{\beta})^2 * p(1-p)}{d^2}$; in which p indicated the proportion of elderly patients that sustained complications following emergency laparotomy estimated to be 50% (P = 0.50), z_{α}= standard normal variate at $\alpha = 0.05$; $z_{0.05}$= 1.96; z_{β} = standard normal variate at $\beta = 0.2$ (statistical power =80%); $z_{0.2} = 0.84$ (One sided); d = precision, Took 5% (arbitrarily).

$$n_o = \frac{(1.96_{+}0.84)^2 * 0.50(1 - 0.50)}{0.05^2} = 784$$

According to Fort Portal, Lira, Hoima, Jinja Regional Referral Hospitals record (surgical theater book), a total of 87 elderly patients had laparotomies done between October and December 2023 (unpublished data of the hospital); adjustment for accessible population was as follows using.

$$n^1 = \frac{n_o}{1+\frac{n_o - 1}{N}} = \frac{784}{1+\frac{784-1}{87}} = 78 \text{ participants.}$$

Adding 10% for lost to follow-up, the final sample size required was 86 participants.

The sampling procedure was consecutive recruitment of study participants.

Recruitment and data collection procedure

Any patient aged 65 years and older sanctioned for laparotomy by the attending surgeon was approached and explained the objective of the study and why his or her participation was required. Any participant who accepted to participate and fulfilled the eligibility criteria signed an informed consent document. All patients were approached for consent. The hospital staffs were aware about the ongoing study and the study assistants were informed whenever a potential participant presented to hospital. All patients that presented during the study period were approached and none declined to participate since the study was observational in nature and carried a low risk. All age was confirmed. It is currently recommended in Uganda for all patients to present with identification card; which was used to confirm age. The consent for participation in the study was done by study assistants who were not directly involved in the care of the patient. However, the staff informed the study assistants wherever there was a potential participant. The baseline characteristics of the patients were assessed and documented in the data collection form. After consent, the patient underwent the surgery as recommended by the attending surgeon, and the attending surgeon documented the intraoperative findings during the course of the operation. Follow-up was done for 30 days; if the patient was discharged prior, review dates were appointed accordingly.

Following surgery, the patient was evaluated daily by the research team for the occurrence of any complications. Postoperative hemorrhage was

assessed by examining the surgical site for any bleeding and checking the vital signs. If the blood pressure fell or the pulse rate increased, ultrasonography was done to confirm the presence of hemorrhage. Surgical site infection (SSI) was diagnosed by examination of the wound for induration and pus discharge. Ultrasonography was done if there were features suggestive of an organ-space infection. If there were findings suggestive of DVT, Doppler sonography was done to confirm it. Respiratory complications were assessed clinically using history-taking and examination, including auscultation and percussion of the chest.

The evaluation was done daily for each patient until the patient was discharged. At discharge, the information relating to the occurrence of complications and the complications that occurred was documented in the data collection form. Upon discharge, the participants were followed up in the outpatient department at 2 weeks and 30 days. However, in case of any sustained complaint, the participants were encouraged to come to the facility for an adequate evaluation.

Study variables

The study variables included independent variables like socioeconomic characteristics of elderly patients, such as sex, age, alcohol consumption, and cigarette smoking. Clinical characteristics of elderly patients included: body mass index, mid upper arm circumference, time to presentation (defined as time from onset of symptoms to when the patient reached the hospital where

operation was done), time from presentation to surgery, duration of surgery, ASA class, wound class, blood transfusion, intraoperative findings, cadre of the patient's operator, hemoglobin levels, WBCs, and platelets. The study dependent variables included both primary morbidity (hemorrhage, SSI, DVT, respiratory complications) and mortality occurring with in 30 days of surgery.

Quality control

A continuous medical education session was held at the start of the study and in between the study period to refresh the research assistants about the special category of elderly surgical patients and how best these patients could be managed in the respective local settings. We employed coded patient numbers for proper patient identification to prevent participant duplication. Data collection tools were well re-checked to confirm the adequate completeness of study participant data prior to their discharge. Case files and other relevant documents of the patients were referred to so as to gather any additional relevant information.

Data analysis plan

Microsoft office excel was used to create excel sheets with a summary of the collected data. The Statistical Package for Social Sciences (SPSS Inc., Chicago, USA, version 26.0 for Windows) was used for data cleaning and later data analysis. The percentages and frequencies of patients with any early post-operative complication (complication occurring within 30 days following

surgery) was computed, and data was represented in a table. Poisson regression with a 95% confidence interval and a P value of ≤ 0.05 was used at levels of bivariate and multivariate analysis. Variables with P ≤ 0.05 were considered significant predictors for morbidity and mortality among elderly patients who underwent emergency laparotomies.

Ethical considerations and consent:

All methods were carried out in accordance with relevant guidelines and regulations. The study adhered to the Declaration of Helsinki. Ethical approval was granted by **Kampala International University western campus Research Ethics Committee** (**KIU-2024 492)**. All participants gave written informed consent as evidenced by the participant's signature.

Results

In this study, we enrolled 86 participants (Figure 1), of whom, 29.1% were above 80 years of age. Majority were male (74.4%). Over one-third of participants (33.7%) reported a history of smoking. No known comorbidity was present in 70.9% of the participants. Blood transfusion was done in 27.9% of the participants.

Morbidity and mortality among elderly patients undergoing emergency exploratory laparotomies.

Of the 86 participants enrolled, complications were seen in 25.6% of the participants. The commonest complication was surgical site infection, seen in 14/22 patients that had complications. Mortality occurred in 9 of the study

participants, representing a mortality rate of 10.5%. The details on morbidity and mortality are shown in table 1 below.

Table 1: Early complications among elderly patients undergoing emergency exploratory laparotomies.

Outcome category	Frequency	percentage	95% CI
Complications (N=86)			
No	64	74.4	65.1-83.7
Yes	22	25.6	16.3-34.9
Specific complications (N=22)			
SSI alone	6	27.3	9.1-45.5
DVT alone	2	9.1	0.0-22.7
Respiratory comp alone	6	27.3	9.1-45.5
SSI + Bleeding + Respiratory	6	27.3	9.1-45.5
SSI + DVT	2	9.1	0.0-22.7
Mortality (N=86)			
No	77	89.5	82.6-95.3
Yes	9	10.5	4.7-17.4

SSI=Surgical site infection, DVT=Deep Venus thrombosis, Bleeding= Any bleeding following surgery that required a surgical intervention or resulted in transfusion of at least two units of packed cells 24 hours after surgery.

Predictors complications among elderly patients undergoing emergency exploratory laparotomy.

The variables considered for multivariate analysis (P<0.2) were: age, comorbidity, high blood pressure, white cell count category, American association of anaesthesiology class, Transfusion, duration of procedure,

WHO wound class and presence of a perforation. Details are shown in table 2 below.

Table 2: Bivariable analysis of predictors for complications among elderly patients undergoing emergency exploratory laparotomy.

Characteristic	No Complications, N=64	Complications, N=22	Bivariable analysis		
			cIRR	95% CI	P value
Age (years)					
65-79	50(78.1)	11(50.0)	1		
80-100	14(21.9)	11(50.0)	1.29	1.043	**0.019**
Sex					
Male	49(76.6)	15(68.2)	1		
Female	15(23.4)	7(31.8)	1.08	0.872	0.456
Smoking					
No	40(62.5)	17(77.3)	1		
Yes	24(37.5)	5(22.7)	0.88	0.735	0.275
Alcohol					
No	33(51.6)	9(40.9)	1		
Yes	31(48.4)	13(59.1)	1.08	0.903	0.385
Comorbidity					
None	54(84.4)	7(31.8)	1		
HTN	6(9.4)	10(45.5)	1.66	1.297	**<0.00**
DM	0(0.0)	5(22.7)	2.42	2.237	**<0.00**
HIV	2(3.1)	0(0.0)	0.89	0.823	0.205
Malignancy	2(3.1)	0(0.0)	0.89	0.823	0.205
BMI					
Normal	42(65.6)	19(86.4)	1		
Underweight	12(18.8)	0(0.0)	0.92	0.714	0.538
overweight	10(15.6)	3(13.6)	0.73	0.652	0.201
High BP					
No	49(76.6)	12(54.5)	1		
Yes	15(23.4)	10(45.5)	1.22	0.987	**0.066**
Pyrexia					
No	51(79.7)	18(81.8)	1		
Yes	13(20.3)	4(18.2)	0.97	0.777	0.825
Low Spo2					
No	57(89.1)	19(86.4)	1		
Yes	7(10.9)	3(13.6)	1.05	0.779	0.744
Tachypnea					
No	48(75.0)	14(63.6)	1		
Yes	16(25.0)	8(36.4)	1.11	0.898	0.328

Symptom duration (hrs)					
<6	6(9.4)	2(9.1)	1		
6-12	18(28.1)	4(18.2)	0.93	0.664	0.695
12-24	14(21.9)	3(13.6)	0.98	0.673	0.920
24-48	7(10.9)	3(13.6)	1.05	0.695	0.813
>48	19(28.7)	10(45.5)	1.09	0.778	0.592
Time to					
1-2	7(10.9)	2(9.1)	1		
3-6	15(23.4)	4(18.2)	0.98	0.712	0.944
7-12	17(26.6)	6(27.3)	1.03	0.751	0.816
>12	25(39.1)	10(45.5)	1.06	0.781	0.688
Cadre of					
Surgeon	31(48.4)	13(59.1)	1		
Resident	28(43.8)	9(40.9)	0.94	0.782	0.596
Medical officer	5(7.8)	0(0.0)			
White cell					
Normal	34(53.1)	7(31.8)	1		
leukocytosis	30(46.9)	15(68.2)	1.17	0.983	**0.076**
Platelets					
Normal	47(73.4)	12(54.5)	1		
Low	14(21.9)	10(45.5)	1.23	0.991	0.260
High	3(4.7)	0(0.0)	0.81	0.736	0.201
ASA class					
I	15(23.4)	0(0.0)	1		
II	30(46.9)	7(31.8)	1.20	1.065	**0.003**
III	19(29.7)	15(68.2)	1.55	1.316	**<0.00**
Anemia					
No	29(45.3)	9(40.9)	1		
Yes	35(54.7)	13(59.1)	1.03	0.860	0.718
Transfusion					
No	52(81.3)	10(45.5)	1		
Yes	12(18.8)	12(54.5)	1.40	1.126	**0.003**
Pre-op fluid					
≤2	34(53.1)	14(63.6)	1.08	0.904	0.384
3+	30(46.9)	8(36.4)	1		
Procedure					
1	10(15.6)	2(9.1)	1		
1-2	42(65.6)	14(63.6)	1.08	0.855	0.495
2-3	12(18.8)	0(0.0)	0.84	0.686	**0.121**
>3	0(0.0)	6(27.3)	2.30	1.864	**<0.00**
WHO wound					
1	8(12.5)	0(0.0)	1		
2	29(45.3)	6(27.3)	1.18	1.048	**0.007**
3	21(32.8)	16(72.7)	1.54	1.314	**<0.00**

4	6(9.4)	0(0.0)	1.00	1.000	1.000
IO					
No	26(40.6)	12(54.5)	1		
Yes	38(59.4)	10(45.5)	0.89	0.745	0.261
Perforation					
No	50(778.1)	10(45.5)	1		
Yes	14(21.9)	12(54.5)	1.34	1.085	**0.007**

cIRR= Crude incidence rate ratio, CI= Confidence interval, HTN=Hypertension, DM=Diabates mellitus, HIV=Human immunodeficiency virus, BMI=Body mass index, ASA=American association of anesthesiology class, Anemia=hemoglobin <13g/dl in males and <12g/dl in females, Transfusion= Receiving blood products during surgery or after the completion of surgery, Hypertension= A patient with known hypertensive disease on treatment or one with hypertensive urgency or emergency at presentation.

In the multivariable analysis, the independent predictors for complications were: being older than 80 years, having DM or hypertension and having a perforation. The incidence rate ratio for complications was increased by 9.7% for those older than 80 years (aIRR=1.097, CI=1.003-1.611, P=0.049), by 66.4% among those with diabetes mellitus (aIRR=1.664, CI=1.392-1.990, P<0.001), by 61.0% for those with hypertension ((aIRR=1.610, CI=1.200-2.160, P=0.002) and by 39.7% among those with a gut perforation (aIRR=1.397, CI=1.118-1.745, P=0.003). The details are shown in table 3 below.

Table 3: Multivariable analysis of predictors for complications among elderly patients undergoing emergency exploratory laparotomy.

Characteristic	**Bivariable analysis**			**Multivariable analysis**		
	cIRR	**95% CI**	**P value**	**aIRR**	**95% CI**	**P value**
Age (years)						
65-79	1					
80-100	**1.29**	**1.043-**	**0.019**	**1.09**	**1.003-**	**0.04**
Comorbidity						

None	1					
HTN	**1.66**	**1.297-**	**<0.00**	**1.66**	**1.392-**	**<0.0**
DM	**2.42**	**2.237-**	**<0.00**	**1.61**	**1.200-**	**0.00**
HIV	0.892	0.823-	0.205	1.29	1.010-	0.051
Malignancy	0.892	0.823-	0.205	1.08	0.897-	0.394
High BP						
No	1					
Yes	1.225	0.987-	0.066	1.17	0.976-	0.089
White cell						
Normal	1					
Leukocytosis	1.177	0.983-	0.076	0.98	0.835-	0.887
ASA class						
I	1					
II	1.208	1.065-	0.003	1.29	0.964-	0.086
III	1.555	1.316-	<0.00	1.26	0.951-	0.106
Transfusion						
No	1					
Yes	1.403	1.126-	0.003	1.56	0.320-	0.061
Procedure time						
1	1					
1-2	1.087	0.855-	0.495	0.93	0.797-	0.426
2-3	0.846	0.686-	0.121	0.58	0.479-	0.053
>3	2.301	1.864-	<0.00	1.10	0.850-	0.450
WHO wound						
1	1					
2	1.187	1.048-	0.007	1.26	0.885-	0.197
3	1.541	1.314-	<0.00	1.10	0.740-	0.620
4	1.000	1.000-	1.000	1.03	0.647-	0.879
Perforation						
No	1					
Yes	**1.34**	**1.085-**	**0.007**	**1.39**	**1.118-**	**0.00**

cIRR= Crude incidence rate ratio, aIRR= adjusted incidence rate ratio, CI= Confidence interval.

Predictors for mortality among elderly patients undergoing emergency exploratory laparotomy.

The variables considered for multivariate analysis (P<0.2) were: Age, comorbidity, blood pressure, duration of symptoms, time from admission to surgery, platelet count, ASA class, and blood transfusion. The details are shown in table 4 below.

Table 4: Bivariable analysis predictors for mortality among elderly patients undergoing emergency exploratory laparotomy.

Characteristic	No mortality, N=77	Mortality, N=9	Bivariable analysis		
			cIRR	95% CI	P value
Age (years)					
65-79	58(75.3)	3(33.3)	1		
80-100	19(24.7)	6(66.7)	1.210	1.015-1.443	**0.034**
Sex					
Male	58(75.3)	6(66.7)	1		
Female	19(24.7)	3(33.3)	1.044	0.889-1.225	0.602
Smoking					
No	51(66.2)	6(66.7)	1		
Yes	26(33.8)	3(33.3)	0.998	0.871-1.144	0.979
Alcohol					
No	39(50.6)	3(33.3)	1		
Yes	38(49.4)	6(66.7)	1.067	0.939-1.213	0.320
Comorbidity					
None	58(75.3)	3(33.3)	1		
HTN	10(13.0)	6(66.7)	1.385	1.086-1.767	**0.009**
DM	5(6.5)	0(0.0)	0.952	0.902-1.005	**0.076**
HIV	2(2.6)	0(0.0)	0.952	0.902-1.005	**0.076**
Malignancy	2(2.6)	0(0.0)	0.952	0.902-1.005	**0.076**
BMI					
Normal	55(71.4)	6(66.7)	1		
Underweight	12(15.6)	0(0.0)	0.906	0.841-1.977	0.210
overweight	10(13.0)	3(3.3)	1.142	0.897-1.453	0.281
High BP					
No	58(75.3)	3(33.3)	1		
Yes	19(24.7)	6(66.7)	1.210	1.015-1.443	**0.034**

Low Spo2					
No	70(90.9)	6(66.7)	1		
Yes	7(9.1)	3(33.3)	1.247	0.933-1.668	0.236
Tachypnea					
No	56(72.7)	6(66.7)	1		
Yes	21(27.3)	3(33.3)	1.029	0.884-1.197	0.715
Symptom					
<6	8(10.4)	0(0.0)	1		
6-12	22(28.6)	0(0.0)	1.000	1.000-1.000	1.000
12-24	17(22.1)	0(0.0)	1.000	1.000-1.000	1.000
24-48	7(9.1)	3(33.3)	1.350	1.016-1.793	**0.038**
>48	23(29.9)	6(66.7)	1.230	1.061-1.425	**0.006**
Time to					
1-2	9(11.7)	0(0.0)	1		
3-6	19(24.7)	0(0.0)	1.000	1.000-1.000	1.000
7-12	20(26.0)	3(33.3)	1.139	0.993-1.307	**0.063**
>12	29(37.7)	6(66.7)	1.187	1.048-1.345	**0.007**
White cell					
Normal	38(49.4)	3(33.3)	1		
leukocytosis	39(50.6)	6(66.7)	1.062	0.935-1.206	0.354
Platelets					
Normal	56(72.7)	3(33.3)	1		
Low	18(23.4)	6(66.7)	1.220	1.017-1.464	**0.032**
High	3(3.9)	0(0.0)	0.950	0.899-1.005	**0.075**
ASA class					
I	15(19.5)	0(0.0)	1		
II	34(44.2)	3(33.3)	1.084	0.993-1.184	**0.071**
III	28(36.4)	6(66.7)	1.193	1.050-1.356	**0.007**
Anemia					
No	35(45.5)	3(33.3)	1		
Yes	42(54.5)	6(66.7)	1.047	0.922-1.189	0.477
Transfusion					
No	62(80.5)	0(0.0)	1		
Yes	15(19.5)	9(100.0)	1.455	1.199-1.766	**<0.001**
Pre-op fluid					
≤2	42(54.5)	6(66.7)	1.047	0.922-1.189	0.477
3+	35(45.5)	3(33.3)	1		
IO					
No	35(45.5)	3(33.3)	1		
Yes	42(54.5)	6(66.7)	1.047	0.922-1.189	0.477
Perforation					
No	54(70.1)	6(66.7)	1		
Yes	23(29.9)	3(33.3)	1.016	0.879-1.173	0.835

cIRR= Crude incidence rate ratio, CI= Confidence interval, HTN=Hypertension, DM=Diabates mellitus, HIV=Human immunodeficiency virus, BMI=Body mass index, ASA=American association of anesthesiology class, Anemia=hemoglobin <13g/dl in males and <12g/dl in females, Transfusion= Receiving blood products during surgery or after the completion of surgery, Hypertension= A patient with known hypertensive disease on treatment or one with hypertensive urgency or emergency at presentation.

In the multivariable analysis, the independent predictors for mortality were: delayed presentation to hospital (presenting after 24 hours of symptoms), and blood transfusion. The incidence rate ratio for mortality was increased by 56.3% among those who presented between 24-48 hours (aIRR=1.563, CI=1.267-1.928, P<0.001), by 84.6% for those who presented after 48 hours (aIRR=1.846, CI=1.270-2.182, P<0.001) and by 122.6% for those who had blood transfusion (aIRR=2.226, CI=2.011-2.465, P<0.001). The details are shown in table 5.

Table 5: Multivariable analysis of predictors for mortality among elderly patients undergoing emergency exploratory laparotomy.

Characteristic	Bivariable analysis			Multivariable analysis		
	cIRR	95% CI	P value	aIRR	95% CI	P value
Age (years)						
65-79	1			1		
80-100	1.210	1.015-	0.034	1.11	0.005-	0.054
Comorbidity						
None	1					
HTN	1.385	1.086-	0.009	1.28	0.086-	0.059
DM	0.952	0.902-	0.076	0.85	0.702-	0.086
HIV	0.952	0.902-	0.076	0.75	0.602-	0.056
Malignancy	0.952	0.902-	0.076	0.85	0.402-	0.066
High BP						

No	1					
Yes	1.210	1.015-	0.034	1.21	0.015-	0.134
Symptom						
<6	1					
6-12	1.000	1.000-	1.000	0.98	0.945-	0.527
12-24	1.000	1.000-	1.000	1.51	0.228-	0.210
24-48	**1.35**	**1.016-**	**0.038**	**1.56**	**1.267-**	**<0.0**
>48	**1.23**	**1.061-**	**0.006**	**1.84**	**1.270-**	**<0.0**
Time to surgery						
1-2	1					
3-6	1.000	1.000-	1.000	1.05	0.050-	0.080
7-12	1.139	0.993-	0.063	1.03	0.993-	0.063
>12	1.187	1.048-	0.007	1.08	0.048-	0.067
Platelets						
Normal	1					
Low	1.220	1.017-	0.032	1.12	0.017-	0.132
High	0.950	0.899-	0.075	0.98	0.899-	0.085
ASA class						
I	1					
II	1.084	0.993-	0.071	1.00	0.993-	0.081
III	1.193	1.050-	0.007	1.03	0.050-	0.097
Transfusion						
No	1					
Yes	**1.45**	**1.199-**	**<0.00**	**2.22**	**2.011-**	**<0.0**

cIRR= Crude incidence rate ratio, aIRR= adjusted incidence rate ratio, CI= Confidence interval.

Discussion.

In this study of older people undergoing emergency abdominal surgery in Uganda we have observed a high rate of morbidity (over 25%) and mortality (over 10%). The most common post operative complication was surgical site infection. This rate is comparable to that seen in similar populations in other parts of the world, including China where, the postoperative complications among elderly surgical patients were estimated at 20.5% following the open-operative method (Zhang et al., 2021). Since the 20.5% reported in China lies in the confidence interval found in this study (16.3-34.9), these rates of complications can be considered not to be significantly different. The possible explanation could be because in both studies, the patients under went open surgery and hence reporting comparable findings.

In Tanzania, in a prospective hospital-based study, surgical site infection was noted in 9% (Mbembati & Melkizedeck, 2024) also in a cross-sectional retrospective study in Rwanda, surgical site infections occurred in about 8.2% of the elderly patients (Mukamuhirwa et al., 2021), which was lower than that in this study where surgical site infection was seen in 27.3%. This can be explained by the fact that a big proportion of the participants in our study had bowel perforation which significantly increase the risk of surgical site infection.

Globally, complications among elderly patients following emergency abdominal surgeries are diverse, with a notable prolonged hospital stay of

13.5 days (Tian et al., 2023; Mercer et al., 2022) which is higher than in this study (8.57 days). This can be explained by the fact that the global results are compiled from across the world where there are a variety of risk factors and different patient characteristics and varying complexities of surgery which factors could all have come into play.

In elderly patients above 80 years, the mortality rate following abdominal surgery is approximated at about 5.16–6.2% (Endeshaw et al., 2023). Globally the mortality of 9.2% was seen (Tian et al., 2023). In China, elderly patients above the age of 75 years had a mortality of about 9.2% (Mercer et al., 2022) which was comparable to the mortality rate in our study since they fall within the confidence interval range of our study (4.7 to 17.4%). This can be explained by the similarities in the characteristics of the study participants.

Frailty significantly compromises the physiological reserve, thus making the elderly patients susceptible to postoperative complications (Chua & Chan, 2020), which explains the high mortality rate.

Predictors for morbidity and mortality among elderly patients undergoing emergency exploratory laparotomy

In the multivariable analysis, the independent predictors for complications were: having a perforation, being older than 80 years and having DM or hypertension, for mortality were: delayed presentations to hospital (presenting after 24 hours of symptoms), and undergoing blood transfusion.

A gut perforation greatly increases the danger of complications and death because it allows intestinal contents into the abdominal space, which can lead to a severe inflammatory response, resulting in peritonitis, sepsis, and multi-organ failure, with death occurring in severe instances. In agreement, a study conducted by (Busch & Gutzwiller, 2011) revealed that perforation was associated with a higher reintervention rate.

Although unavoidable at times in major surgery, blood transfusion has been associated with the development of numerous post-operative complications due to its dose-dependent effects on wound healing, fluid balance, and host immunity. In agreement with our findings, a study conducted by (Vlot et al., 2019) revealed that Intra-operative transfusion was associated with a more than three-fold increased risk of 30-day mortality.

In Nigeria, delayed patient presentation to a surgical care centre, was associated with complications following abdominal surgeries (Ogbuanya et al., 2023) which is in agreement with our study where it was an independent predictor for mortality. A study conducted by (Franklin et al., 2024) revealed that late operation significantly increased risk for 30-day mortality, which is in agreement with this study. As the patients delay at home, the diseases progress. For example, for patients with intestinal obstruction, as they delay at home or in small health facilities, the bowel may get gangrene or perforate, resulting in hemodynamic instability that increase the risk of early complications.

In Rwanda and Tanzania, co-morbidities were associated with complications following emergency laparotomies in elderly patients (Mukamuhirwa et al., 2022; Mbembati & Melkizedeck, 2024). In Uganda, the factors that are associated with complications following emergency laparotomy included co-morbidities, and old age (Ssenyonjo & Kwikiriza, 2024). This is in agreement with our study where comorbidities like diabetes Mellitus or hypertension were a risk factor for post operative complications. Diabates has been known to reduce the body immunity, increasing the risk of wound complications such as surgical site infection, which complication was the commonest in our study. Also, hypertension is associated with heart disease that may increase the risk of cardiovascular events

Okot and others from Gulu Regional Hospital have noted that old age is also associated with surgical complications following emergency laparotomy (Amone et al., 2020) which is in agreement with our findings where age greater than 80 years was and independent risk factor for complications. Older age increases the risk of post-surgical complications due to the inherent physiological decline associated with aging, e.g., decreased organ function (e.g., heart, lungs, and kidneys), impaired immune system, decreased wound healing, and increased likelihood of underlying medical issues (comorbidities) that can further complicate recovery from surgery; this can lead to a higher risk of complications such as infections, blood clots, delirium, and longer recovery times compared to younger patients.

Based on these findings, it is clear that the mortality and morbidity rates among the elderly still need a closer attention. Given that wound complications were the commonest, it can be suggested that improving wound care and optimization would go far in preventing these complications. Give that a long duration of symptoms played a role in the outcomes of these elderly patients, the measures that encourage early presentation should be considered including sensitization of the communities.

Study limitations

The study was limited to government funded regional referral hospitals, yet the care for elderly patients undergoing surgery may differ significantly if the patients are in a private hospital, or a lower-level health facility; which limits the generalizability of our findings. The data collection was also limited to a period of 3 months and follow up limited to 30 days. The measure of severity of the complications was not done. Different surgeries with different risks of complications have been included which may limit generalizability of findings. Diabetes and hypertension were assessed as binary presence/ absence and data on severity and control was not collected.

Conclusion

Complications were common with over one quarter having complications and over 10% dying. The independent predictors for complications were: having a perforation, being older than 80 years and having DM or hypertension. The independent predictors for mortality were: delayed presentations to hospital

and blood transfusion. More attention is required among the elderly undergoing surgery in order to reduce the rate at which they get complications with emphasis on wound care to minimize surgical site infection, since it was the commonest complication. Healthy education and sensitization in communities should be strengthened, advocating for timely seeking of medical attentions by the elderly group. We recommend that future work in this direction should look at the group presenting as acute surgical admissions and review those who are offered surgery versus those who are not offered surgery in addition to bridging the other limitations identified in this study.

List of abbreviations: DVT= Deep Venous Thrombosis, ASA=American Society of Anesthesiologists, JRRH=Jinja Regional Referral Hospital, HRRH=Hoima Regional Referral Hospital, LRRH=Lira Regional Referral Hospital, FRRH=Fort portal Regional Referral Hospital.

Declarations

Clinical trial number: not applicable

Human Ethics and Consent to Participate: All methods were carried out in accordance with relevant guidelines and regulations. The study adhered to the Declaration of Helsinki. Ethical approval was granted by **Kampala International University western campus Research Ethics Committee (KIU-2024 492)**. All participants gave written informed consent as evidenced by the participant's signature.

Funding: This study did not receive any specific grant from funding agencies in public, commercial, or not for profit sectors.

Consent for publication: Not applicable

Availability of data and materials: Data is available upon request. Requests should be sent to kagimuanthony@gmail.com (AK).

Competing interests: The authors declare that they have no conflict of interest

Author contribution: AK was the principal investigator, conceived and designed the study, collected data, analysed data and wrote the draft of the manuscript. **OEN, YSB and IE** supervised the work and revised the manuscript. **GRI**, **TH** and **JM** contributed to data collection, discussion of results and revised the manuscript. All authors approved the final manuscript.

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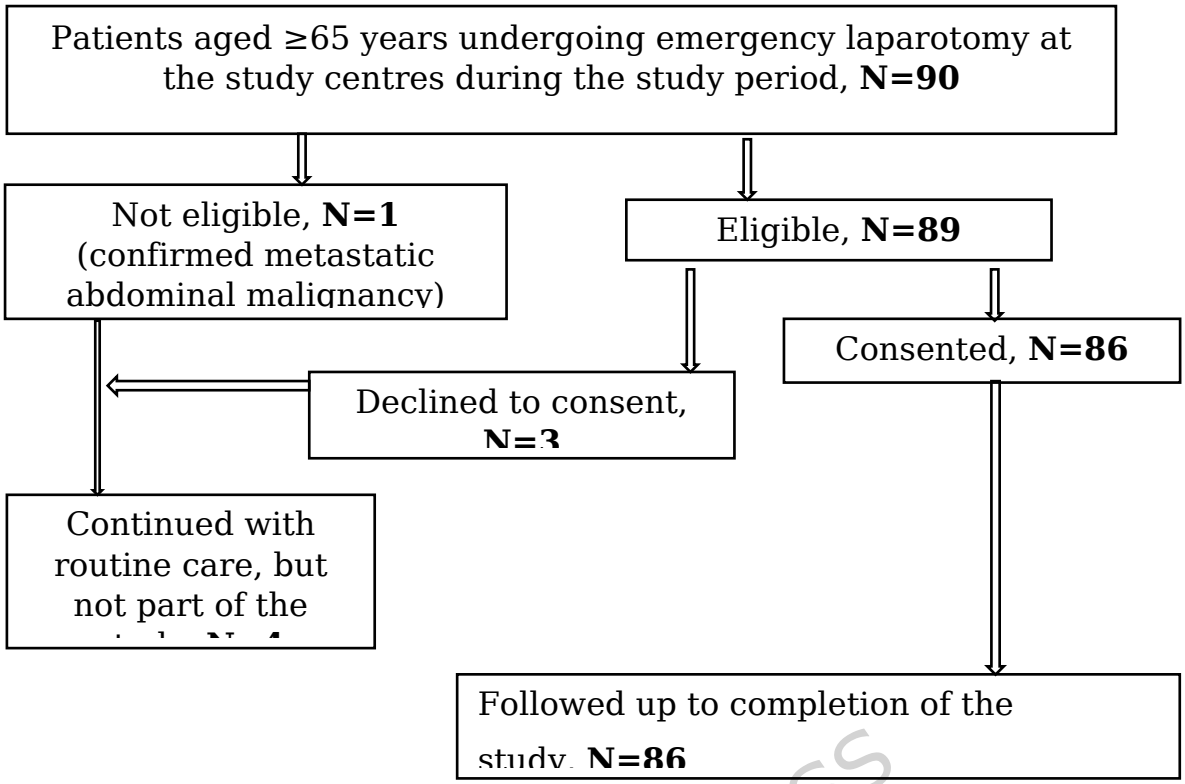

Figure 1: Flowchart