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Full Length Research Paper

An analysis of the short term outcomes of laparotomy among surgeons in Mulago Hospital using POSSUM scoring system

David Lagoro Kitara[1*], Ignatius Kakande[2] and Didas D. Mugisa[3]

[1]Gulu University, Faculty of Medicine, Department of Surgery, P.O Box 166 Gulu, Uganda.
[2]Uganda Martyrs University, Nsambya, Kampala, Uganda.
[3]Makerere University, College of Health Sciences, Faculty of Medicine, Department of Surgery, Uganda.

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More than 600 laparotomy operations are conducted in Mulago National Referral Hospital (MNRH) every year. However, there are no criteria for judging the outcomes (morbidity and mortality) and comparing the short-term outcomes of these operations among surgeons in the Department of Surgery. The Physiological Operative Severity Score for the enumeration of Morbidity and Mortality (POSSUM) was used to analyze the short-term outcomes of laparotomy among surgeons in MNRH. A cross-sectional study was conducted using 76 consecutively recruited patients who underwent emergency and elective laparotomy. POSSUM scoring system was used and patients followed-up to 30th post-operative day. Day-care surgeries, patients who died on table before induction of anesthesia, and patients below 13 years of age were excluded from the study. Informed consent and assent was obtained from each patient before surgery and ethical approval was obtained from the research and review committee of Makerere University Medical School. There were 51 emergencies (67.1%) and 25 (32.9%) electives. 13 patients (17.1%) were operated by consultants, 8 (10.5%) by registrars and 55 (72.4%) by senior residents. Short-term outcome (morbidity) among the surgeons was: consultants (t= -0.081, p=0.243), registrars (t= -0.039, p=0.368), and senior residents (t= -0.041, p=0.362). Mortality outcomes for surgeons were consultants (t= -0.012, p=0.460), registrar (t=.-0.012, p=0.460) and senior residents (t= 0.087, p=0.228). POSSUM successfully analyzed the short-term outcomes of laparotomy among surgeons in MNRH. All the surgeons were performing well within the predictive power of Possum.

Keywords: Possum scoring system, Mulago, surgeons, laparotomy.

INTRODUCTION

Continuous professional auditing is a requirement in modern surgical practice and patients increasingly want to know the results obtained by their surgeons (Neary, 2003). Monitoring crude death rates can mask the effects of case mix; surgeons who work in impoverished hospitals or tertiary referral centers may feel disadvantaged compared with their colleagues elected to treat fit patients or work in affluent areas (Neary, 2003). The idea behind POSSUM was to enable a fair comparison between the performance of individual surgeons and individual firms/ units/ hospitals (Neary, 2003). Most of the original POSSUM scoring system validation was done on general surgical procedures (Neary, 2003).

The first study on POSSUM was modeled on a general surgical population. It however excluded both pediatric and day-care surgeries because physiological parameters in children differ from those of adults and day-care surgery where there is a low incidence of morbidity and mortality (Copeland, 1991).

POSSUM has acknowledged its limitations in that the equation performed poorly in predicting mortality in procedures, which have low associated mortality rates e.g. in day-care surgery (Neary, 2003). Low-risk, high-volume operations are often better audited as process measures rather than outcomes. Similarly, it predicts

*Corresponding author. E-mail: klagoro@gmail.com.

mortality only within 30 days (Neary, 2003; Copeland, 1992; Copeland, 2000).

POSSUM scoring system produced consistent results when it was used to compare patients treated in different countries and in continents with health care systems different from that of the UK (Gotohdan, 1998; Bennett-Guerrero, 2003). Even where resources, facilities and pre-hospital care were different, POSSUM was found to be accurate at predicting post-operative outcomes (Yii, 2002).

The purpose of this study was therefore to use POSSUM scoring system to fairly analyze the short-term outcomes of laparotomy among surgeons in Mulago National Referral Hospital (MNRH). The patients were followed-up to the 30th postoperative day.

MATERIALS AND METHODS

Study design

We conducted a cross-sectional study in the surgical wards of MNRH. The sample size of 76 patients was found sufficient to analyze the short-term outcomes of laparotomy with a power of 80 to 95% confidence interval if the factors influencing short-term outcomes of laparotomy among the surgeons were between 10 and 90% in the study population.

Study site

The study was conducted in Mulago, the National Referral And Teaching Hospital for Makerere University Medical School and located in the Capital City, Kampala. Mulago was the study site for this research and it is the biggest hospital in Uganda with over 1500 beds. The department of surgery runs a casualty unit where all surgical emergencies were first presented. The emergency patients were then channeled to emergency wards, observed overnight or underwent emergency surgery before being sent to one of the three surgical firms (Green, Red, and Blue) for further management. The critically ill patients were sent to intensive care wards for critical care until they were fit enough to be managed in the surgical firms.

Selection of study participants

For the emergency patients, surgical care was provided by the casualty officer on duty who gave them first aid then transferred them to emergency ward - the next level of care for further management. The emergency wards were manned by senior residents (post-graduate students in third year of masters of medicine in surgery program) and their interns. The registrars and consultants of the admitting firms were called upon when senior residents deemed necessary. Senior residents were supervised and guided by the consultants of each of the three surgical firms.

The second category of patients who underwent elective laparotomy was recruited from the out-patient departments of the three firms. Once the surgical team decided to include a patient on their operation list, an informed consent/assent was obtained and the patients recruited for the study. They were assessed pre-operative, scored using POSSUM physiological scoring system, then transferred to the main theatre where surgery was undertaken.

Data collection procedures

The principal investigator collected data by use of questionnaires and direct observation of the laparotomy patients in the pre, operative and post-operative periods. The questionnaires were designed for the recruitment, investigations and follow-up of these patients.

Possum – physiological score

Each patient was scored with the physiological component of POSSUM just before the induction of general anesthesia. All the individual scores were computed and summed up to produce the POSSUM physiological score for each patient. The score therefore reflected the physiological indices at the time of surgery other than at admission.

Possum – operative score

Each patient was placed in a supine position on an operating table, general anesthesia administered, scrubbed with Hibitane 4% and draped with a sterile towel. Where necessary, shaving was done at this stage and the site was re-disinfected. A midline abdominal incision was made and deepened up to the peritoneal cavity. The cavity was inspected for evidence of soiling, the soiling agent and its quantity. Intra-operative blood loss was measured by the use of suction machine and weighing of mops, gauzes, and towels. In the latter cases, the weight difference of these materials before and after was used to determine the amount of blood lost during surgery. The assumption was that 1 g of weight difference =1 ml of blood lost (Neary, 2003; Kitara et al., 2007). The amount of blood lost on the floor was estimated on the basis that 1 liter of blood covered an equivalent of one square meter of floor surface area. The blood loss in tissues removed was estimated as follows:
Males (adult) = 70 ml of blood/kg of tissue removed.
Female (adult) = 65 ml of blood/kg of tissue removed

(Neary, 2003; Kitara et al., 2007).

Post-operative Care

The patients were managed by the general surgical wards of the three firms. Any post-operative complications were assessed by each firm and the principal investigator who reviewed the patients twice a day until the time of discharge from hospital. Patients' records were documented on questionnaires which consisted of seven parts: patient's identity, clinical evaluation, investigations, operative scores, duration of hospital stay, post-operative periods and outcomes. The investigations were carried out in hematology, clinical chemistry laboratories, hospital mortuary, and the pathology departments.

When patients were discharged, they were followed up to 30th post-operative day by history and physical examination at out-patient which were conducted once a week or by phone or email contacts. Post-operative mortality was reviewed and documented by a pathologist which was part of his routine work and a precondition for burial in Uganda.

Data analysis

SPSS statistical software package version 12.0 was used to analyze data. First, we carried out univariate analysis to generate frequencies and proportions and secondly bivariate analysis to test for association between independent and the outcome variables and a multivariate regression analysis to correlate the relationships between the dependent and independent variables.

Ethical consideration

The study was approved by the research and ethics committee of Makerere University Medical School. Informed consent and assent was obtained from each patient before a questionnaire interview and laparotomy were conducted.

RESULTS

Patients' ages ranged from 14-81years with a modal age-range of 20-29 years representing 26.3% of the study population. The relationship between age and physiological scores were (t= -0.019, p=0.873) and with operative score (t= -0.019, p=0.873).

Male to female ratio was 2:1. Most males presented with abdominal trauma with ruptured abdominal viscera. Males had though a positive correlation with morbidity (t=0.034, p=0.384).

Tribe

The majority of patients were Ganda (44/76) which constituted 57%. No observed significant correlation between tribe and physiological score (t=0.251, p=0.803), operative score (t=0.128, p=0.898); mortality (t=0.817, p=0.355); and morbidity (t=1.372, p=0.242).

Occupation

Most respondents were peasant farmers (52.6%), business people (27.6%), civil servants (13.2%) and students (6.6%). The occupations generally had no significant correlations with morbidity or mortality. However, civil servants had a positive correlation and a statistically significant relationship with mortality (Table 1).

Diagnosis

Commonest reasons for the laparotomy were intestinal obstruction (19.4%), acute appendicitis (13.3%), generalized peritonitis (18.5%), abdominal trauma with ruptured viscera (18.5%), abdominal malignancy (18.5%) and surgical jaundice (11.8%). Most diagnoses had a negative correlation to physiological scores. Diagnoses, however, affected the outcome morbidity (Table 1). Abdominal trauma with ruptured viscera, surgical jaundice and generalized peritonitis were subjected to the Pearson's correlation tests to determine further their roles in the development of complications and found to significantly cause more complications to occur than other diagnoses (t=2.654, p=0.01) and (t=2.1665, p=0.034) respectively. The analyses of diagnosis in relation with the operative scores (OS) are shown in Table 1.

Co-morbid conditions

Most patients 60/76 (78.9%) did not have any co-morbid condition. Hypertension constituted 11.8%, diabetes mellitus (1.65%), sickle cell disease (2%), peptic ulcer disease (2%), and tuberculosis (1.65%). Their relationships with PS, OS, morbidity and mortality are seen in Table 1.

Nature of surgery

Most patients 51 (67.1%) required emergency surgery. The average Operative Score (OS) for the emergency

Table 1. The correlations between variables with outcomes.

Conditions	Physiological score		Operative scores		Morbidity		Mortality	
Comorbidity	**t-value**	**p-value**	**t-value**	**p-value**	**t-value**	**p-value**	**t-value**	**p-value**
Diabetes mellitus	0.281	0.490	0.080	0.246	0.175	0.065	3.333	0.001
Sickle cell disease	0.217	0.030	-0.040	0.366	0.071	0.272	0.166	0.076
Hypertension	-0.009	0.470	0.078	0.251	-0.153	0.034	-0.151	0.097
Tuberculosis	0.146	0.104	-0.020	0.433	-0.076	0.257	-0.048	0.342
Peptic ulcer disease	-0.136	0.121	-0.073	0.264	0.308	0.003	-0.083	0.237
Diagnoses								
Abdominal trauma	0.193	0.047	2.751	0.007	0.130	0.131	-0.099	0.197
Generalized peritonitis	0.193	0.047	0.153	0.093	0.056	0.314	0.094	0.210
Abdominal malignancy	-0.121	0.149	-0.037	0.376	-0.091	0.216	-0.003	0.491
Intestinal obstruction	-0.023	0.423	0.167	0.074	-0.039	0.370	0.172	0.069
Surgical jaundice	-0.096	0.204	0.202	0.040	0.202	0.040	-0.035	0.382
Acute appendicitis	-0.185	0.055	-4.229	0.000	-0.256	0.013	-0.160	0.084
Nature of surgery								
Emergency surgery	2.560	0.595	4.375	0.000	0.034	0.029	0.129	0.134
Surgeons								
Consultants	-1.643	0.105	-2.062	0.043	-1.643	0.105	-0.012	0.460
Registrars	-0.216	0.061	-0.344	0.732	-0.039	0.368	-0.141	0.112
Senior Residents	0.306	0.007	1.974	0.052	-0.041	0.362	0.087	0.228
Possum Scores								
Physiological scores	1.000	0.000	0.320	0.001	-0.019	0.044	2.228	0.029
Operative scores	0.320	0.002	1.000	0.000	0.197	0.044	3.280	0.000
Duration of hospital stay	0.127	0.138	0.344	0.001	0.288	0.006	-2.894	0.005
Occupations								
Peasant farmer	-0.023	0.423	-0.043	0.356	-0.063	0.297	-0.134	0.124
Student	-0.058	0.423	-0.038	0.322	-0.059	0.305	-0.109	0.174
Business	0.137	0.119	0.195	0.046	-0.063	0.297	0.080	0.245
Civil servants	-0.106	0.182	-0.167	0.075	-0.087	0.228	2.720	0.008

surgery was 23.39 as opposed to 16.68 for elective cases (Table 3). It also had a physiological score of 25.63 compared to 24.4 for the rest of study population. Emergency operations were observed far more mortality and complications compared to the electives. Most mortality (81.8%) was observed in emergency laparotomy and the relationship with operative scores was statistically significant; however, its relationship with physiological score was statistically insignificant (Table 1).

POSSUM physiological scores (PS) (Copeland, 1992)

This score ranges from 12 to 96 points and in this study we had a minimum of 12 and a maximum of 53 with an average of 25.22 and a modal PS score was 20-29. Physiological score was negatively and insignificantly correlated with morbidity but positively and significantly correlated with mortality. Furthermore, the Chi-square tests result showed a positive association and a statistically significant relationship between mortality with the physiological score (Table 2b).

POSSUM operative score (OS) (Copeland, 1992)

This score ranges from 6 to 48 points and in this study we had a minimum score of 8 and the maximum of 33 with an average of 21.2. Operative scores statistically and significantly correlated with morbidity and mortality (Table 1). Furthermore, the Chi-square tests result showed a positive association and a statistically significant relationship between mortality with operative

Table 2a. Outcome versus operative score of patients' crosstabulation.

Outcome	6-10	11-15	16-20	21-25	26-30	31-35	Total
Dead	0	1	0	2	5	3	11
Alive	7	11	17	13	15	2	65
Total	7	12	17	15	20	5	76

Table 2a. continues: Chi-square tests.

	Value	df	Asymp.Sig.(2-sided)
Pearson chi-square	14.605a	5	0.012
Likelihood Ratio	14.960	5	0.011

Table 2b. Outcome of surgery versus physiological scores.

Outcome	10-19	20-29	30-39	40-49	50-59	Total
Dead	2	3	2	2	2	11
Alive	22	29	11	3	0	65
Total	24	32	13	5	2	76

Table 2b continue. Chi-square tests.

	value	df	Asymp. sig(2-sided)
Pearson chi-square	15.862[a]	4	0.003
likelihood ratio	11.275	4	0.024

Table 3. The distribution of procedures conducted by surgeons.

Surgeon	Emergency	Elective	Percentage (%)
Consultant	2.0	11.0	17.1
Registrar	5.0	3.0	10.5
Senior residents	44.0	11.0	72.4
Total	51.0	25.0	100.0

score (Table 2a).

Duration of hospital stay

Patients were followed to 30th post-operative day with a mean of 8.46±6.039 days. The duration of hospital stay had a significant correlation with morbidity but negatively and statistically significantly correlated with mortality. The duration of hospital stay had a negative and an insignificant correlation with physiological scores but it a significantly and positively correlated with OS and mortality (OS).

Surgeons

Consultants conducted 13 laparotomy. All the patients operated had very good physiological status. The mean physiological score for those patients was 21.38 as compared to 26.03 for others in the study population. There was a negative correlation and a statistically insignificant correlation between the consultants and morbidity. Similarly, the mean operative scores for patients they operated was lower (17.62) compared to 21.92 for the others. There was a negative correlation and a statistically insignificant correlation between the consultants and morbidity and mortality.

For the registrars, 8 operations were conducted. The mean physiological scores of these patients were lower (19.38) compared to 25.91 for the others. This difference was however found to be statistically insignificant. Similarly, the mean operative scores of these 8 patients were lower (20.38) compared to 21.28 which was for the others. There was a negative correlation between registrar and operative score though this was statistically insignificant. With regards to registrars and the short term morbidity and mortality, a linear regression analysis showed a negative correlation with morbidity and mortality.

The majority of the patients were operated by the senior residents 55(72.4%) of study population. There

were 51 emergency laparotomy performed in the study population. Most of the emergency operations 44 (86.3%) were conducted by senior residents. In general, the senior residents operated patients with higher physiological scores than the others. The mean physiological scores of these patients were 26.98 compared to 20.62 for the others.

A linear regression analysis showed a negative correlation and a statistically insignificant relation between senior residents and morbidity but a positive and statistically insignificant correlation with mortality (Table 1).

Distribution of patients by wards

The patients were nearly uniformly distributed among the three surgical firms 3C (32%), 2B (34%), and 2A (34%). No correlation was observed between the surgical wards with the outcomes.

Determinants of mortality

A linear regression analysis of the variables showed determinants of mortality: Physiological scores, operative scores, diabetes mellitus, civil servant and duration of Hospital stay.

DISCUSSION

POSSUM scoring system was used to analyze the short-term post-operative complications and mortality following laparotomy among surgeons of the hospital as an important audit process in the department of Surgery. It was used to assess the performances of surgeons as an important tool to determine the short-term outcome of laparotomy in MNRH. This study showed that the socio-demographics of the study population was similar to the previous studies conducted in Mulago Hospital (Mugisa, 1988; Birabwa-Male, 1989; Olaro, 1999) and the findings were comparable to most studies that used POSSUM scoring system for analysis of short-term outcomes of surgical interventions (Benneth-Guerrero, 2003; Copeland, 2002).

Civil servants had a positive correlation and a statistically significant correlation to mortality (Table 1). The reason for this occurrence was not really well understood. However, there is probably an underlying pathology among civil servants that increased their risks to mortality. We suspect it could probably be due to immunosuppressive disease such as HIV/AIDS or some other factors that are yet to be investigated (Kitara et al., 2007).

There were three categories of surgeons who conducted laparotomy in the study: consultants, registrars, and senior residents. Consultants conducted fewer laparotomy (13). All their patients had very good physiological status. The mean physiological score for those patients was much lower than those for the rest of the patients. There was a negative correlation and a statistically insignificant relationship between the consultant surgeons and outcome morbidity. This indicated that the consultants chose patients who were better prepared for laparotomy than the other surgeons and second reason could be that consultants have better skills and more experienced in handling laparotomy procedures (Kitara et al., 2007).

Similarly, the mean operative scores for the patients they operated were lower compared to those patients operated by the other surgeons. There was a negative correlation and a statistically significant correlation between consultants and operative scores (Table 1). Again this showed that the wealth of surgical experience among the consultants in carrying out surgical procedures in MNRH was clearly better in this study group. This was proven by lower operative and physiological scores among patients they operated leading to lower mortality and morbidity.

There was a positive correlation and a statistically significant relationship between physiological score and senior residents (Table 1). This is no surprise because most of emergency procedures were conducted by senior residents and most had poorer physiological and operative scores (Kitara et al., 2007). This finding is no surprise because higher-risk surgery performed independently by physician in training was shown to be related to poor postoperative outcome (Benneth-Guerrero, 2003). The UK Government report has drawn attention to the dangers of leaving high-risk procedures to trainee surgeons without supervision (Benneth-Guerrero, 2003).

The mean operative score for patients operated by senior residents was higher compared to the others. There was a positive correlation but a statistically insignificant relationship between the operative score and senior residents (Table 1).

Our study observed that operative score directly determined both outcomes -mortality and morbidity (Benneth-Guerrero, 2003; Kitara et al., 2007). It was observed that those patients who had poor operative scores (>21.2) developed complications or died. This means that the quality of surgery significantly affected the outcomes-complications and death. There was a positive correlation between senior residents and mortality but the relationship was statistically insignificant. This means that although the emergency operations significantly increased the physiological and operative scores among senior residents, their performances did not lead to increased mortality and morbidity. There were probably other confounding factors, which could be responsible for mortality of these patients e.g. inadequate resuscitation, and delayed intervention in the wards and casualty

theatres.

In a study of 3,006 general surgical cases by five surgeons from a hospital, crude mortality rates were compared with risk-adjusted outcomes (calculated from POSSUM observed: expected ratio) (Bann, 2001). It was found out that Individual surgeons had mortality rates that varied 5 folds from 1.0 to 4.9 percent. But once adjusted with POSSUM scoring system, there was no significant difference in observed versus expected mortality ratios, which ranged from 0.86 to 1.06 (Bann, 2001).

In another one-year study, surgeons from district general hospitals were compared with those of a teaching hospital. The mortality rates were observed to be 6 and 9% in the 2 hospitals but the morbidity rates were 9 and 26% respectively, with the teaching hospital performing much better (Bennett-Guerrero, 2003). The POSSUM predicted mortality rates for the 2 centers were however 5.2 and 9.8%, whereas the predicted morbidity rates were 11.2 and 23.9% respectively. It was therefore concluded that both hospitals were performing as expected and that reporting crude hospital mortality and morbidity rates only may be misleading (Bennett-Guerrero, 2003).

Furthermore, in a study of 217,440 surgical patients in USA, it was observed that a significant variation in the outcome of surgery depended on the level of nurse staffing level. Those with a low patient to nurse ratio had fewer postoperative deaths (Silber, 2000). Another study involving 232,440 surgical patients at 168 hospitals in the State of Pennsylvania, USA found that higher patients to nursing staff ratios were associated with higher risk-adjusted postoperative mortality rate (Aiken, 2002). This meant that nursing care alone could be shown to be a robust independent predictor of postoperative deaths (Silber, 2000; Aiken, 2002). These results indicated that factors such as hospital resources, the availability and training of medical staffs had a significant impact on the postoperative outcome (mortality and morbidity) (Benneth-Guerrero, 2003; Silber, 2000; Aiken, 2002).

In general, our study found that there was a negative correlation between surgeons and outcome morbidity; a negative and a statistically insignificant correlation to mortality for the consultants and registrars; while for the senior residents, they had a positive correlation with mortality but the relationship was statistically insignificant. The senior residents were perhaps less experienced and were usually under pressure to conduct surgical procedures and probably had little choice to make on the patients for surgery since most of the patients they operated were emergency surgical cases.

Secondly, perhaps their skills and inexperience in surgery could explain the outcomes compared to their senior colleagues; the registrar and consultants. The overall finding of the study meant that all the different surgeons were performing well within acceptable predictive analysis of POSSUM scoring system (Bann, 2001).

Diabetes mellitus had a positive correlation and a statistically significant relationship with mortality but a statistically insignificant correlation with morbidity. Co morbidities increased both the physiological and operative scores of the patients and thus explained the increased risk of morbidity and mortality.

Most mortality (81.8%) was observed in emergency laparotomy and its correlations with operative scores were statistically significant. Emergency surgery had a positive correlation with physiological score but the relationship was statistically insignificant. Emergency surgery observed statistically significant relationship with complications but not with mortality.

The chi-square tests showed a significant association between physiological score and operative score with (outcomes) mortality and morbidity (Table 2a and b). This means that factors that lead to increased PS and OS could very likely increase the risk of mortality and morbidity.

CONCLUSION

Possum scoring system successfully analyzed the short term outcomes of laparotomy among surgeons in Mulago hospital. All surgeons were performing well within acceptable predictive analysis of POSSUM scoring system and their performances did not significantly increase the risks of mortality and morbidity. Possum can be used successfully as an auditing tool in the measure of outcomes in the department of surgery.

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