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Full Length Research Paper

Determinants of mortality outcome of laparotomy in Mulago Hospital using POSSUM scoring system: a cohort study design

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Patients' care is the responsibility of individual surgeon but outcomes often depend on large multidisciplinary team and all of whom may affect morbidity and mortality. Adequate knowledge about a patient for operation and those at high risk of dying contributes significantly to the quality of care and cost reduction in surgery. Physiological Operative Severity Score for the Enumeration of Morbidity and Mortality (POSSUM) was used to find out the determinants of mortality following Laparotomy in MNRH. A cohort study was conducted using 76 consecutively recruited patients who underwent emergency and elective laparotomy. POSSUM scoring system was used and patients followed-up to the 30th post-operative day. Day-care surgeries, death on table before induction of anesthesia, and patients below 13 years were excluded. Ethical approval was obtained from research and ethics committee of Makerere University medical school. The determinants of mortality were: Physiological score (PS) (t=2.228, p=0.029; χ^2 =15.862, p=0.003); Diabetes Mellitus (t=3.331, p=0.001); Operative Score (OS) (t=3.280, p=0.002; χ^2 = 14.605, p=0.012); Occupation (Civil service) (t=2.720, p=0.008) and Hospital stay (t= -2.894, p=0.005). POSSUM successfully assessed the determinants of mortality of laparotomy in Mulago National Referral Hospital (MNRH) in a 30 day cohort.

Keywords: POSSUM scoring system, Mulago hospital, mortality determinants, laparotomy.

INTRODUCTION

Risk management is an important health care issue. Prediction of complications is an essential part of risk management in surgery (Neary, 2003). Knowing which patient is at risk of developing complications or dying contributes to the quality of care and cost reduction in surgery (Neary, 2003). Doctors are legally bound to inform their patients the potential risks involved with a particular treatment (Neary, 2003). It is essential to identify and make appropriate decisions on those patients who are at high risk of developing serious complications or dying (Neary, 2003; Copeland et al., 1991).

Currently, the Department of surgery in MNRH has no clearly defined guideline for predicting outcomes of surgery. Physiological and Operative severity score for the enumeration of Mortality and Morbidity (POSSUM) has been used to produce numerical estimate of expected mortality and morbidity after variety of surgical procedures (Neary, 2003; Copeland et al., 1991). POSSUM has been found easy to use and applicable for both emergency and elective settings (Copeland et al., 1991). It has been used in Hospital setting to provide clinical information (Copeland, 1992).

POSSUM equation performed poorly in predicting mortality in procedures, which had a low mortality rates e.g. Day-care surgery (Neary, 2003) and similarly, it predicted mortality only within 30 days (Neary, 2003; Copeland et al., 1991; Copeland, 2000).

The purpose of this study was to use POSSUM scoring system to fairly analyze the determinants of mortality following laparotomy in Mulago National Referral Hospital (MNRH) when the patients were followed to 30th postoperative day.

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MATERIALS AND METHODS

Study site

This study was conducted in Mulago National Referral and Teaching Hospital for Makerere University Medical School which is located in the capital city, Kampala, Uganda. The department of surgery runs a Casualty unit where all surgical emergencies were first presented. The emergency patients were channeled to emergency wards, observed overnight or underwent emergency surgery before being transferred to one of the three surgical firms for further management. The critically ill patients were transferred to Intensive care unit (ICU) for critical care until they were fit enough to be managed in surgical wards.

Participants' selection

Seventy six (76) patients were consecutively selected on the basis of the decision of the admitting firm to undertake laparotomy. Surgical care for patients was provided by casualty officer on duty who gave first aid and transferred them to emergency wards. The emergency wards were manned by senior residents (surgery postgraduate students in third year) and their interns who were supervised and guided by their consultants.

Those who underwent elective laparotomy were recruited from out-patient departments. They were assessed pre-operatively; scored using POSSUM physiological score, and then transferred to theatre where surgery was undertaken.

Study design

We conducted a cohort study design in the surgical wards of MNRH. The 76 patients were enough to analyze the determinants of mortality as a short-term outcome of laparotomy with a power of 80% at 95% confidence interval.

Data collection

The principal investigator collected data using a questionnaire and direct observation of the laparotomy patients pre- and postoperatively.

POSSUM – Physiological score

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

POSSUM – Operative score

Each patient was placed in a supine position on operating table, general anesthesia administered, scrubbed with hibitane 4% and draped with a sterile towel. Midline abdominal incision was made and deepened up to 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, drapes 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 (Neary, 2003; Kitara et al., 2007). The assumption was that 1g 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 assumption that 1 liter of blood covered an equivalent of one square meter of floor surface area (Kitara et al., 2007). The blood loss in tissues removed was estimated as follows: Males (adult) = 70ml of blood/kg of tissue removed. Female (adult) = 65ml of blood/kg of tissue removed (Kitara et al., 2007).

Post-operative care

The patients were managed by surgical wards and post-operative complications were assessed by the surgical team and the principal investigator who reviewed the patients twice a day until the time of discharge. The patients' records were documented on a questionnaire which consisted of six parts: i.e. patient's identity, clinical evaluation, investigations, operative scores, duration of hospital stay, and post-operative outcomes. The investigations were carried out in hematology, clinical chemistry laboratories, the hospital mortuary, and the pathology departments. Patients discharged were followed up to the 30^{th} postoperative day by physical examination which was conducted once a week in the surgical outpatient. Post-operative mortality were reviewed and documented by a pathologist.

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 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

The socio-demographic characteristics of the patients

Patients ranged from 14-81 years of age with a modal age range of 20-29 years representing 26.3% of study population. Male to female ratio was 2:1. Most males presented with abdominal trauma with ruptured abdominal viscera. There was also no relationship between sex and outcomes (morbidity and mortality).

The majority of the patients were Ganda (44/76) which constituted 57% of the patients. No observed significant correlation between tribe and mortality (t=0.817, p=0.355).

Most respondents were peasant farmers (52.6%); business (27.6%), civil servants (13.2%), students (6.6%). Only Civil servants had a positive correlation and a statistically significant relationship with mortality (t=2.720, p=0.008).

Commonest reason for the laparotomy was intestinal obstruction (19.4%), acute appendicitis (13.3%), and generalized peritonitis (18.5%), abdominal trauma with ruptured viscera (18.5%), abdominal malignancy (18.5%) and surgical jaundice (11.8%).

Sixty patients (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%). However Diabetes mellitus had a positive and a statistically significant correlation with mortality (t=3.333, p=0.001).

Fifty one (67.1%) patients required emergency surgery. The average Operative Score (OS) for the emergency surgery was 23.39 as compared to 16.68 for the elective cases. It also had a physiological score of 25.63 compared to 24.4 of the rest of the study population. Emergency operations (81.8%) observed far more deaths and complications compared to the elective cases and there was a positive correlation (t=4.375) and a statistically significant correlation (p=0.000) between emergency operation and operative scores. More still, emergency procedure had a positive correlation but a statistically insignificant relationship to physiological score (t=2.56, p=0.595). Emergency surgery observed more complications (t=0.034, p=0.029) and death (t=0.129, p=0.134) compared to the elective surgeries as shown by the statistical correlations and significance.

POSSUM physiological scores (PS) (Copeland, 1992)

This score ranges from 12 to 96 points and in our study we had a minimum of 12 and a maximum of 53 points with an average of 25.22 and a modal PS score was 20-29. The average physiological score for the patients who died was 29.6. Physiological score was positively correlated and significantly correlated with mortality (t= 2.228, p=0.029).

POSSUM Operative scores (OS) (Copeland, 1992)

This score ranges from 6 to 48 points and in our study we had a minimum of 8 and the maximum of 33 with an average of 21.2. The mean operative score for the patients who died was 27.0 compared to 21.2 for the rest of the patients. Operative score significantly correlated with morbidity (t=0.197, p=0.044) and with mortality (t=3.280, p=0.000).

Duration of Hospital stay (days)

This was described as that period after surgery when the patient spent days in hospital before discharge. The minimum duration observed in our study was 1 day and maximum of 30 days. The mean postoperative hospital stay was 8.46 days. The postoperative hospital stay had a negative correlation (t= –2.894) but a statistically significant correlation (p= 0.005) with mortality. For patients who died, the average duration of the hospital stay was 9.5 days.

The Observed Mortality

A mortality rate of 14.5% was observed in the study. The laparotomy related to intestinal obstruction was the commonest cause of death (45.4%). 18.2% of these intestinal obstructions were caused by carcinoma of the colon. There was no statistically significant relationship with mortality.

DISCUSSION

POSSUM scoring system was used to find out the short-term determinants of mortality. This study was a short term cohort to follow-up laparotomy cases partly as an important audit process in the department of surgery. The determinants were: Physiological score (PS), Diabetes mellitus, Operative score (OS), Occupation (Civil service) and duration of Hospital stay.

The socio-demographics of the study population was similar to the previous studies conducted in Mulago Hos-

Table 1. Outcome of surgery versus physiological scores – cross-tabulations (The 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**

The Chi-square tests result shows a positive association and a statistically significant relationship between outcome (mortality) with the physiological score ($\chi^2 = 15.862$, p=0.003).

Table 2. Outcome versus operative score of patients - cross-tabulation (Operative Scores)

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**

The Chi-square tests result shows a positive association and a statistically significant relationship between outcome (mortality) with the operative score ($\chi^2 = 14.605$, p=0.012).

pital (Mugisa, 1988; Birabwa-male, 1989; Yiga, 1979) and the findings were comparable to most studies that used POSSUM scoring system for analyzing the short-term outcomes of surgical interventions (Copeland, 1992; Bennett-Guerrera et al., 2003).

Civil servant (Occupation)

Civil servants as an occupation increased the risk of mortality and morbidity. Civil servants had a positive correlation and a statistically significant correlation with mortality. The factor that was responsible for this finding was not obvious because this phenomenon could not be explained in terms of POSSUM physiological and operative scores. The need to investigate further the confounding factors, which significantly contributed to the above observation, is required. A factor such as HIV status (immune status) of civil servants, we suspect could perhaps be the confounder in the study.

Diabetes mellitus

Diabetes mellitus, a co morbid condition was found to have a positive correlation and statistically significant correlation with mortality. This finding was consistent with the fact that Diabetes mellitus greatly elevated the physiological scores of the patients. The higher the POSSUM scores, the greater the risk of morbidity and mortality (Neary, 2003). This implies that diabetic patients should be rigorously prepared by surgeons to ensure that they achieve better outcome e.g. normalization of the blood sugar level etc. A recent study in the USA observed that POSSUM eighteen variables were not adequate enough to differentiate any population characteristics. They proposed that other factors such as surgical disease state, co-morbidities, genetic and socio-economic factors should be taken into consideration because they affect the outcome of surgery (Bennett-Guerrera et al., 2003).

The physiological score

The physiological score however, was found to have a positive correlation and a statistically significant relationship with mortality (table 1). This was consistent with the findings observed in the USA and UK (Bennett-Guerrera et al., 2003). The need to resuscitate our patients adequately and investigate them thoroughly is an important component of surgery before the patients are subjected to surgery. Several of the patients who died had already poor physiological indices and they should have not been taken to theatre in the first place.

Operative score

There was a positive correlation and a statistically significant relationship between operative score and mortality **(**table 2). This observation was consistent with the findings in USA, UK (Bennett-Guerrera et al., 2003) and Malaysia (Yii, 2002). The higher the overall POSSUM operative score, the greater the risk of mortality and morbidity (Neary, 2003). The patients who died had average operative score of 27.0 which were far higher than those for the rest of the patients. These were mainly

Table 3. Observed mortality

Patients	Diagnosis	Cause of death	PS	OS	Date
1st	Pancreatic tumor	Multiple organ failure (MOF)	25	26	18
2nd	Right colonic tumor	Septicemia with MOF	25	30	7
3rd	Gastric outlet obstruction	Septic shock	40	13	3
4th	Sigmoid Volvulus	Septic shock	29	22	19
5th	Sigmoid Volvulus	Peritonitis with septic shock	25	29	2
6th	Sigmoid Volvulus	Septic shock with metastasis	16	28	6
7th	Generalized peritonitis	Septic shock in SCD	52	29	1
8th	Cancer of the colon with IO	Septicemia with MOF	13	33	30
9th	Perforated PUD +Peritonitis	septic shock with peritonitis	35	22	1
10th	Gunshot wound +Peritonitis	Multiple organ failure	46	33	1
11th	Surgical Jaundice	Septicemia with septic shock	30	33	17

IO = intestinal obstruction, SCD=sickle cell disease; MOF = Multiple organ failure; OS=operative score; PS = Physiological score; Date = Duration of the hospital stay

emergency patients operated by junior surgeons and they lost large volumes of blood during surgery. This could perhaps mean that if the operative scores were kept low by meticulous control of bleeding and auto-transfusion etc, the patients could have probably lived.

Duration of hospital stay

The minimum duration observed in the study was 1 day and maximum of 30 days. The mean postoperative hospital stay was 8.46 days and for the postoperative death, the mean was 9.5 days. This value was comparable with the findings in UK, USA (Bennett-Guerrera et al., 2003), Malaysia (Yii, 2002) and Uganda (Olaro, 1999). The postoperative hospital stay had a negative correlation and a statistically significant correlation to mortality. This means that the longer one stayed in hospital the more it became less likely for one to die.

Perhaps an improved postoperative care, a state of art intensive care for the very sick and proper resuscitations could be a factor that could have improved the chances of survival in the study population.

The observed mortality (table 3)

This mortality rate of 14.5% was comparable with other previous studies conducted in Mulago National Referral Hospital (MNRH) (Birabwa-male, 1989; Mugisa, 1988; Kazibwe, 1987; Olaro, 1999). All the emergency patients who died had very high physiological scores that were greater than 25. All the elective patients who died had very high operative scores that were greater than 22. This can partly explain the cause of death in this study - high physiological and operative scores. One of the patients who died had both carcinoma of the pancreas and Diabetes mellitus. The patient with Diabetes mellitus had very high physiological score and this co morbid condition was found to statistically and significantly increase the risk of morality. The higher the values for the physiological and operative score the greater the risk of death (Copeland, 1992). The postoperative duration of hospital stay however had a negative correlation with outcome - death. This means it was less likely for one to die if one stayed longer postoperatively in hospital. Good nursing care in the postoperative period could be a robust mechanism for the improvement of quality of life and prevention of mortality.

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 et al., 2000). Another study involving 232,440 surgical patients at 168 hospitals in the state of Pennsylvania, USA indicated that, higher patients to nursing staff ratios are associated with higher risk-adjusted postoperative mortality rate (Aiken et al., 2002). This means that nursing care alone can be shown to be a robust independent predictor of postoperative deaths (silber et al., 2000; Aiken et al., 2002). These results indicate that factors such as hospital resources, the availability and training of medical staffs have a significant impact on the postoperative outcome (mortality and morbidity) (Bennett-Guerrero et al., 2003; silber et al., 2000; Aiken et al., 2002).

CONCLUSION

POSSUM scoring system assessed successfully the determinants of mortality in laparotomy patients in a 30

day cohort. Physiological and Operative scores, Diabetes mellitus, civil servants and duration of hospital stay were key determinants of mortality. We would wish to adoptand use POSSUM scoring system as an instrument for auditing, predicting short term outcomes and follow-up of patients after laparotomy in a 30 day postoperative period.

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