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ABSTRACT:

Prediction of serious complications is an essential part of risk management in surgery. Knowing which patient to operate and those at high risk of dying contributes significantly to the quality of surgical care and cost reduction. The postoperative mortality of patients who underwent laparotomy in Mulago Hospital was studied using Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity (POSSUM). Consecutive patients who underwent laparotomy in Mulago Hospital were recruited and consent obtained. Patients operated were followed up to the 30th postoperative day. Postoperative deaths were promptly investigated and findings recorded. Follow-up of patients was conducted by phone and surgical review once a week in outpatient. Ethical approval was obtained from the Institutional Review Board (IRB) of Makerere University Medical School. Seventy-six patients participated and the observed mortality was 14.5% and the predictive value of POSSUM using Receiver Operative Characteristics (ROC) curve was 0.817 (95% Confidence Interval 0.711, 0.924) and the Hosmer and Lemeshow test predicted 18.2% of mortality and survival 100%. Postoperative mortality can be predicted in the modern management of surgery using POSSUM. It is markedly influenced by the preoperative, operative and postoperative conditions of the patients.

Key words: Postoperative mortality, POSSUM, Mulago Hospital, laparotomy, prediction
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INTRODUCTION:

Prediction of serious complications and mortality are essential part of risk management in surgery [1]. Knowing which patient is at risk of developing complications or dying contributes to the quality of surgical care and cost reduction in surgery [1]. Doctors are legally bound to inform their patients the potential risks involved with a particular treatment [1, 2, 3]. It is therefore essential to identify and make appropriate decision on those patients who are at high-risk of developing serious complications or die [1, 2, 4, 5]. Postoperative complications and death are sometimes determined by the surgical procedures conducted [1,2,4,6-9]. The Department of surgery in Mulago Hospital had no defined guideline for predicting the outcome of surgery. The department used crude rates of morbidity and mortality as measures of performance of surgeons and firms. Because of the above scenario, surgeons did not have a reproducible and predictive score, which could be used to assess and make appropriate decisions on certain categories of patients especially while teaching and preparing for laparotomy. This gap in knowledge among the surgeons was thought could be over-come by using a scientifically accepted risk-predictor. Review of several studies that were conducted in Uganda to determine postoperative mortality found non that used POSSUM scoring equation.

The purpose of this study was to use POSSUM scoring model to predict postoperative mortality in the patients who underwent laparotomy in Mulago National Referral Hospital (MNRH).

SUBJECTS AND METHODS:

This was a prospective observational study design conducted over a period of 6-months at MNRH.

The study population consisted of 76 patients aged 13 years and above admitted and consented/assented for elective and emergency surgeries. Day-care surgery and those who died before laparotomy were excluded. The patients were assessed preoperatively, operatively and postoperatively to determine their clinical status and suitability.

Each patient was scored with the physiological component of POSSUM just before the induction of general anesthesia [4, 9]. All the individual scores were computed and summed up to produce the POSSUM physiological score for each patient. The operative severity score was used on the patients who underwent laparotomy [4, 9].

The quality control was ensured by the principal investigator carrying-out all the pre-operative and postoperative assessment, clinical examinations and measurements of variables. Laboratory investigations particularly blood investigations were done by the same standard operating methods and reported in standard Units (SI units).

Using the POSSUM equation for predicting Mortality (R_2) the post operative mortality of each individual patient was calculated by [1]:

Log (R_2 /1-R_2) = -7.04 + (0.13 x Physiological Score) + (0.16 x Operative severity score).

The values obtained from these patients were subjected to a ROC curve and logistic regression analysis for prediction of mortality using the Hosmer and Lemeshow test [22].

Patients were followed up to the 30th postoperative day with a weekly review in surgical outpatient. Telephone contacts were used to follow-up some postoperative patients. In the event of postoperative death, postmortem examinations were conducted by a pathologist from Makerere University and findings summarized and recorded. Mortality was investigated and possible cause determined by autopsy examination and histology.

Statistical data analysis was conducted using the SPSS version 10.0software. A student t-test was used to compare significant differences and chi-square/Fisher's exact test was used in testing association of categorical variables. ROC curve and logistic regression analysis using Hosmer Lemeshow test was used to predict the risk of mortality using POSSUM equation.

Ethical approval was obtained from the Institutional Review Board (IRB) of Makerere University Medical School and each patient consented/or assented to the study.

RESULTS:

Diagnoses for postoperative mortality: Eleven mortality with intestinal obstruction constituting 55%, abdominal trauma with generalized peritonitis (9%), perforated Peptic ulcer disease with generalized peritonitis (9%) and abdominal malignancy (18%) and surgical jaundice (9%) were the diagnosis of the patients. No statistical significant relationship was observed between diagnoses and mortality. However, Diabetes Mellitus (t=3.333, p=0.001), occupation (civil servants) was positively correlated and significant (t=2.720, p=0.008).

Nature of surgery had a statistically significant effect on the operative scores (t=4.375, p=0.000). On average, the emergency operations had higher operative scores (23.39) than the rest of the elective patients (16.68). Similarly emergency surgery had a higher average physiological score (25.63) than the rest of the electives (24.4) though the difference was not statistically significant (p=0.595). Overall, the risk of mortality was increased by emergency surgery (t=0.129, p=0.134) though not significantly.

Consultants and senior Residents were the surgeons. Consultants operated 2 of the patients and all had a fairly good physiological status (PS of 25 & 25) but had very high operative scores (OS of 26 & 30 respectively). There was a negative correlation and a statistically insignificant relationship between consultant surgeon and mortality (t=-1.643, p=0.105).

The majority of the patients who died were operated by the senior Residents (9/11). In general, the Senior Residents operated patients with higher physiological scores (poorer physical condition). There was a positive correlation (t=2.765) and a statistically significant relationship between physiological score and senior Residents (p=0.007).

A statistically insignificant correlation between senior Residents and mortality (t=0.087 and p=0.228) was observed. The average physiological score (PS) observed overall was 25.22 while for mortality cases it was 38.5. This score was positively correlated and statistically significant with mortality (t=2.228, p=0.029) and (χ^2 =15.862, p=0.003).

The average score (OS) for the study was 21.2 while for mortalities was 27.9. This figure was far higher compared to that of the overall population. There was a positive correlation and a statistically significant relationship between mortality and OS (t=3.280, p=0.000) and (χ^2=14.605, p=0.012).

The mean postoperative hospital stay for study population was 8.46 but for mortalities was 12.4 days. The postoperative hospital stay had a negative correlation (t= –2.894) to mortality but a statistically significant correlation (p=0.005).

The Predicted mortality using POSSUM Equation: The ROC curve showed that mortality formula had an area under the curve of 0.817 and the 95% confidence interval (CI) was ranging from 0.711 to 0.924. This means that prediction of mortality by this formula is good.

ROC curve for risk of Mortality (R_2) is presented in Figure 1.

The area under the curve is 0.817 (95% CI is 0.711, 0.924). The range was considered good enough for the present study.

Hosmer and Lemeshow test was used to assess the relationship between the observed and predicted mortalities. This statistical package showed that the mortality formula could with accuracy predict survival 100% (p=0.003) but only predicted death correctly in 18.2% (95% c.i. 1.014, 1.070). This meant that this test could adequately predict survival but not death. It therefore predicted death in only 2.6% as opposed to the observed 14.5%. This indicated that a number of patients could have had unexpected death due to perhaps other confounding factors such as poor postoperative management.

DISCUSSION:

Data obtained from the present study indicates that POSSUM can be used to predict the risk of mortality following laparotomy in MNRH.

Assessing the preoperative, operative and postoperative indices following laparotomy was very useful while using POSSUM scoring system [4,6,10,11].

The mean postoperative hospital stay for mortalities were comparable to most studies conducted in Uganda [12,13,14]and diagnoses

were also similar to previous studies conducted here[12-19]. All patients who died had a mortality risk which was greater than 50%. The highest mortality rate was among patients of bowel surgery. This was perhaps due to inadequate preparation and poor choice of patients for operation by surgeons. The physiological and operative scores, diabetes mellitus, hospital stay and civil servants significantly increased the risk of mortality. Our result showed a positive correlation and a statistically significant relationship between these variables and mortality.

Most mortality was due to surgery for intestinal obstruction. This was consistent with other previously conducted studies in Mulago Hospital [12, 14-16]. This in most cases occurred with emergency patients who were mainly operated by the senior Residents. Inadequate resuscitation and lack of experience by senior Residents may be the main reason for this unexpectedly high mortality. These patients had very high physiological and operative scores and these two factors were found to statistically (p=0.029, p=0.000 respectively) and significantly increased the risk of mortality.

The observed mortality rate in this study was comparable with other previous studies conducted here in Mulago [12,13,17-19]. All the emergency patients who died had very high physiological and operative scores. All the elective patients who died had very high operative scores and one of the patients had both carcinoma of the pancreas and diabetes mellitus. Diabetic status statistically (p=0.001) and significantly increased the risk of morality.

The nature of surgery had a significant effect on the operative scores. Emergency operations observed far more deaths and complications compared to electives (9:2) although this observation was found to be statistically insignificant (t=0.129, p=0.134). This meant that although the emergency operations significantly increased the physiological and operative scores, the differences between the two was not significant, therefore we suspect there were other confounding factors, which may be responsible for the mortality. Inadequate resuscitation, poor surgical techniques by senior Residents and delayed surgical intervention in casualty theatres could perhaps be the reasons for these unexpected deaths. A study carried out in 168 hospitals in the state of Pennsylvania, USA involving 232,440 surgical patients indicated that a higher patient to nursing staff ratios was associated with higher risk-adjusted postoperative mortality rate [21]. This meant that nursing care alone could be an independent predictor of postoperative deaths [20,21]. 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) of patients [20,21,22].

Consultant surgeons and senior Residents conducted surgeries that resulted in mortalities.

In general, the senior Residents operated patients with higher physiological scores (poorer physical condition). There was a positive correlation but a statistically insignificant relationship (p=0.228) between mortality and senior Residents. This is not new since studies in other countries have shown that higher-risk surgery performed independently by physician in training was shown to be related to poor postoperative outcome [22]. The UK government report, have drawn attention to the dangers of leaving high-risk procedures to trainee surgeons without supervision [22] The average physiological (PS) and operative scores (OS) for the mortalities were far higher than those for the other patients. This finding was consistent with the findings observed in the USA and UK [22] and Malaysia [11].

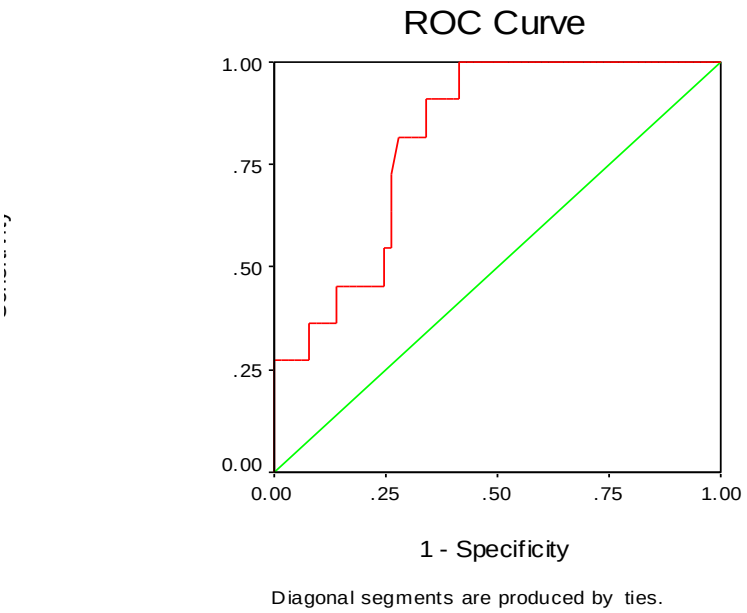

Figure 1: ROC curve for risk of mortality (R2)

The mean postoperative hospital stay for the mortality was comparable with the findings in UK and USA [22], Malaysia [11] and previous studies conducted in Mulago Hospital [12, 17-19]. The postoperative hospital stay had a negative correlation but a statistically significant relationship to mortality. This meant that the longer patients lived postoperatively, the less

likely they were to die. With regards to the occupation (Civil servants) of the patients increasing the risks of mortality, there was no clear explanation to advance. The ROC curve showed that mortality formula had an area under the curve of 0.817 and the 95% confidence interval of 0.711 - 0.924. This meant that prediction of mortality by this formula was good and could be used to predict mortality for patients who underwent laparotomy.

CONCLUSION:

The POSSUM scoring system equation was used to predict postoperative mortality among the patients of MNRH. Poor choice of patients for laparotomy markedly increased the risk of mortality. Apart from the physiological and operative scores, factors such as duration of postoperative hospital stay, diabetic status of the patient and occupation especially civil servants significantly increased the risk of mortality.

RECOMMENDATIONS:

The POSSUM scoring system equation can be used in the department of surgery to predict the outcome of surgery following laparotomy. Physiological and operative scores together with duration of hospital stay, and diabetic status of the patient should be used to assess the suitability of the patient and also to predict the outcome of the laparotomy. POSSUM scoring system can be used for research and clinical management of laparotomy.

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