Research Article

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Morbidity and Mortality in the Surgical ICU: A Retrospective Audit in a Tertiary Care Center of a Developing Country

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Abstract

Introduction: *Patients admitted to the surgical intensive care units (SICUs) pose a significant burden on both the health care services and the economy. In our institution and moreover in our part of the world, data concerning the morbidity and mortality in these patients is unknown. With an increasing number of patients admitted to the service, figures need to be calculated to establish guidelines and quality indicators.*

Objectives: *This study aims to calculate the risk of infectious complications in the SICU, and to calculate the mortality rate and ratio.*

Materials and methods: *This is a retrospective review of patients admitted to the SICU at the Aga Khan University Hospital from January 2010 to December 2014. Only adult general surgery and trauma patients were included. Data was collected about the types of morbidities, the mortality rate and different factors that affect this rate. The standardized mortality ratio (SMR) was also calculated.*

Results: *A total of 243 patients were included. The mean age was 49 ± 18 years. ER admissions comprised of 89% of patients with 67% having planned ICU admission. The average length of ICU stay was 5.57 days. The mean APACHE II score was 19.59. Hospital/ventilator-associated pneumonia was seen in 33%, blood stream infections in 27%, central line infections in 4% and catheter-associated urinary tract infections in 13%. The mortality rate was 45.3%. Age, unplanned ICU admissions and non-trauma admissions were found to be significantly associated with mortality (P <0.05). The SMR was 1.81 for operative cases and 1.36 for non-operative cases.*

Conclusion: *Our mortality rate and SMR is high when compared to international institutions – this could be due to the paucity of regional data for comparison. Our study highlights the benefit of a planned ICU admission and set criteria should be established to define which patients need critical care.*

Keywords: Surgical Intensive Care Unit (Sicu), Intensive Care Unit (Icu), Apache Ii, Mortality Rate, Standardized Mortality Ratio, Morbidity, Infections.

Introduction

Patients admitted to the surgical intensive care unit (ICU) have a variable disease process and an extensive range of severity of illness. It is a challenge to care for these patients; not just for the doctors but also for the nurses, physiotherapists, nutritionists and the whole team that is involved in the caregiving process. These patients pose a significant burden on both our healthcare services and the economy.

A new distinct surgical entity which is recently emerging is that of acute care surgery, which includes trauma surgery, non-trauma emergency general surgery and surgical critical care. To cope with these new developments, we need to develop quality indicators, along with monitoring, auditing and improving of these parameters to ensure proper delivery of care to this group of patients [1].

In our part of the world, we do not have figures to estimate the burden posed by such patients in our hospitals. Moreover, and particularly in our set-up, healthcare needs often outweigh the available resources. Quality indicators are not properly defined, so we are not able to judge the quality of care being provided to these patients and we are not able to compare ourselves to international standards [1].

A recent study was undertaken in our institution by our colleagues

in department of General Surgery – they compared emergency laparotomies with the National Emergency Laparotomy Audit (NELA) being conducted by the NHS in UK. They found that there was a mortality rate of 24% in emergency laparotomies [2]. One of the key factors identified in the improvement of this figure was postoperative ICU care, which further propelled us to perform our study.

In our institution data concerning the morbidity and mortality of patients in the surgical ICU is not known. With the increasing number of patients admitted to this service, the figures need to be calculated so that recommendations and guidelines can be established. Factors that influence mortality need to be investigated to see the trend in our set-up and how these factors can be improved.

Objectives

We sought to calculate the risk of infectious complications in the surgical ICU, to calculate the mortality rate and the standardized mortality ratio (SMR). And furthermore, to compare the mortality rate and SMR of our center with those of international critical care units around the world.

Materials and Methods

This was a retrospective audit done in the surgical ICU at the Aga Khan University Hospital, Karachi from the period of January 2010 to December 2014. The audit was conducted after seeking approval from the hospital Ethical Review Committee. The hospital registry was used to identify the medical record numbers of patients admitted to the surgical ICU during this period - a total of 243 patients were included in our study. The data was entered on a specifically designed Performa and analyzed using SPSS version 19.

We included all adult patients aged 16 years and above who were admitted to the surgical ICU and only looked at general surgery and trauma patients. We excluded other surgical specialties and those patients with incomplete records or missing data.

Results

For the 243 patients, the mean age was 49 +/- 18.7 years. 68% of the patients were male and 32% female. Out of these, 49% (n = 119) had no co-morbids, 23% (n = 56) had one co-morbid and 28% (n = 68)had more than one co-morbid.

We broadly classified the diagnosis into four categories – peritonitis/abdominal sepsis, trauma, non-abdominal causes and elective surgeries (Table 1). The most number of admissions were seen in patients with peritonitis/abdominal sepsis comprising 39.5% of admissions. This included conditions such as pancreatitis, bowel perforation, mesenteric ischemic, intestinal obstruction, etc. 28.4% were trauma patients, which included RTAs, gunshots and bomb blast victims. 17.2% were non-abdominal causes such as necrotizing fasciitis, carbuncles and other skin infections, and dry/wet gangrene of the limbs. 7.4% were patients who were admitted for elective surgery but required post-operative ICU care secondary to the complicated nature of the surgery or due to postoperative complications. 89% of patients were admitted to the SICU via the emergency room (ER) while the remaining 11% were elective admissions. 67% (n = 172) patients were planned to be sent to the ICU on admission - these were patients who were already sick at admission and were anticipated to need critical care. The remaining 33% (n = 71).

Diagnosis at admission	
Peritonitis/abdominal sepsis	39.5% (n=96)
Trauma	28.4% (n=69)
Non-abdominal causes	17.2% (n=42)
Elective cases	7.4% (n=18)
Others	7.4% (n=18)

Table 1: Diagnosis at admission

Were not planned for ICU on admission and were shifted to the ICU later on during their hospital course of the 33% who were not planned for ICU admission, the main reasons for shifting to the ICU were looked into (Table 2). The most common cause identified was respiratory distress in 27 patients (requiring ventilatory support), septic shock in 14 and difficult extubation in the operating room (OR) in 9 patients. The exact reasons for difficult extubation were not clearly documented in the medical records. Other common reasons included hemorrhagic shock (n = 7), encephalopathy (n = 4), aspiration (n = 2), and cardiac arrest (n = 2).

	No. of patients
Respiratory distress	27
Septic shock	14
Difficult extubation	9
Hemorrhagic shock	7
Encephalopathy	4
Aspiration	2
Cardiac arrest	2
Others	6

Table 2: Causes of unplanned ICU admission

The average length of hospital stay was 12.7 +/- 9.2 days and the average length of ICU stay was 5.57 +/- 4.84 days. 79.4% patients underwent surgery, while the remaining were non-operative cases such as pancreatitis and cholangitis. Of those who underwent surgery, majority of the patients fell into the ASA level IV category (**Chart 1**).

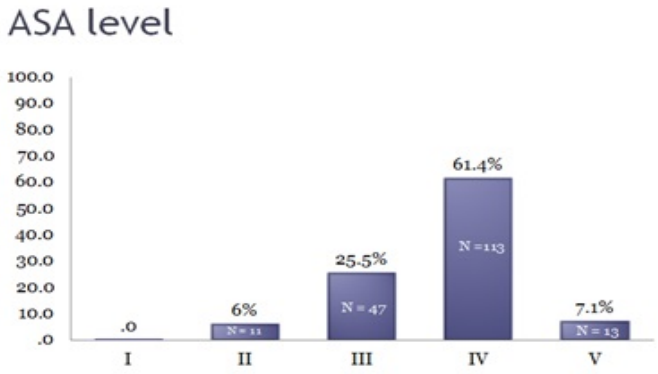

Chart 1: ASA level of patients

The average APACHE II score of our patients on admission to the ICU was 19.59 +/- 7.6, with most of the patients are in the 15-24 score range (**Table 3**).

APACHE II*	
0-4	0.4% (n=10)
5-9	7.4% (n=18)
10-14	7.4% (n=18)
15-19	24.3% (n=59)
20-24	22.2% (n=54)
25-29	11.9% (n=29)
30-34	5.8% (n=14)
35 and onwards	4.5% (n=11)

Table 3: APACHE II score of patients

*Unable to calculate APACHE II score of 5 patients due to incomplete data

The morbidities were then divided in a systemic manner. Among the abdominal complications, the morbidities observed were intra-abdominal collection/bleed in 7% of the patients, paralytic ileus in 2.9%, intestinal obstruction in 0.4% and compartment syndrome in 1.6%. 86.4% of the patients had no abdominal morbidities and this can be explained by the fact that majority of the patients had an abdominal pathology to begin with and we excluded those morbidities that were secondary to the primary pathology or secondary to the surgical intervention. Even in the above mentioned morbidities encountered during the surgical ICU stay, there probably is a considerable overlap with the primary pathology **(Chart 2)**.

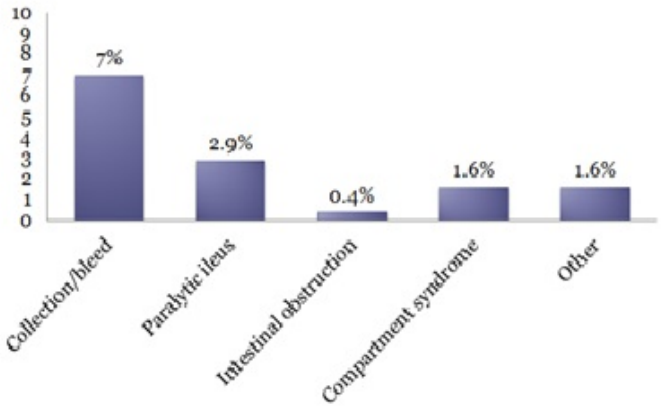

Chart 2: Abdominal morbidities

Among cardiac morbidities, 6.6% patients suffered an MI during their ICU stay and 7% were diagnosed with new onset arrhythmias. The renal outcomes of patients were also looked into (Chart 3). 38.3% patients suffered from AKI requiring diuretic use, 5.3% underwent hemodialysis and 15.2% were subjected to continuous renal replacement therapy (CRRT). No neurological morbidities were encountered in 86.8% of patients. Of the remaining, ICU induced psychosis and hypoxic injury were seen in 2.9% patients of patients respectively, seizures in 2.1%, acute infarction in 1.6% and diffuse axonal injury in 1.2% patients **(Chart 4)**. Hepatic dysfunction was seen in 16% patients.

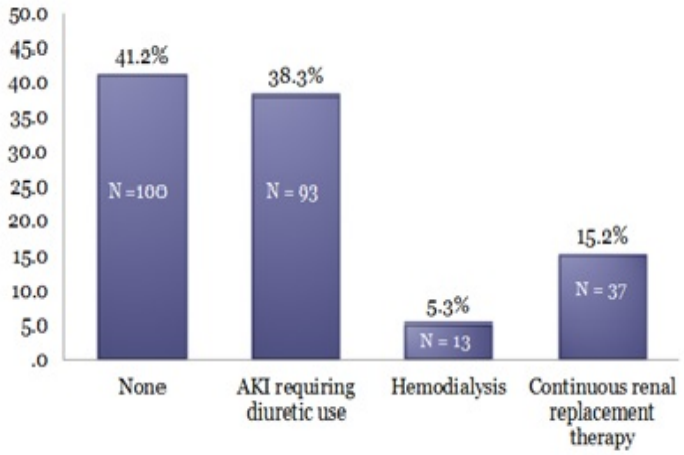

Chart 3: Renal morbidities

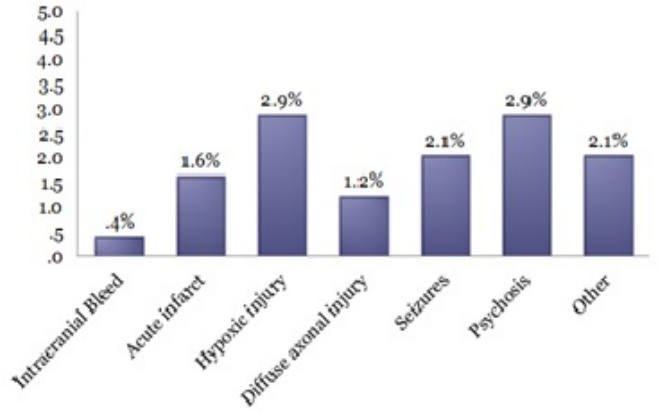

Chart 4: Neurological morbidities

The rate of infectious complications was also looked into (Table 4). Hospital or ventilator acquired pneumonia (HAP/VAP) diagnosed as positive tracheal cultures or findings on radiology was documented in 33% patients in the ICU. Blood stream infections were observed in 27% patients, classified as patients who had positive blood cultures. 4% of patients had central line associated blood stream infections (CLABSI) and 30% of patients were found to have catheter associated urinary tract infections (CAUTI) during their surgical ICU stay.

	AKU
HAP/VAP	33%
Blood stream Infection	27%
CLABSI	4%
CAUTI	13%

Table 4: Rates of infectious complications

The overall mortality rate in the surgical ICU was found to be 45.3%. Of these cases, the causes of death were listed as septic shock with multi-organ system failure in 71% patients, hemorrhagic shock in 12%, isolated cardiac failure and respiratory failure in 5.56% respectively, and hepatic failure and hypoxic brain injury in 2.78% respectively.

The mortality was stratified according to different patient characteristics (Table 5). Patients who were less than 65 years had a mortality rate of 39.4% (n = 180), while those more than 65 years had a rate of 61.9% (n = 63), and this value reached statistical significance (p = 0.001). There was no statistical significance found as far as gender was concerned. Of those patients with no co-morbids, there was a mortality rate of 40.3% (n = 119) and those with one or more than one co-morbid had a mortality rate of 50% (n = 124) but this did not reach statistical significance (p = 0.066). 44.7% (n = 217) of the patients admitted via emergency room expired, while 50% (n = 26) of elective patients expired (p = 0.336). It should be noted that the number in the elective group was significantly smaller as compared to that of the emergency group. 39.8% (n = 163) of the patients who were planned to be sent to the ICU on admission expired. Those who were not planned for ICU and later shifted to ICU (for previously mentioned reasons) had a mortality rate of 56.3% (n = 80). This was a statistically significant finding (p = 0.009).

When looking at the cause of ICU admission, trauma patients had a mortality rate of 34.7% (n = 70) as opposed to 49% (n = 165) in the non-trauma patients. This value also reached statistical significance (p = 0.028). 47.1% (n = 193) of patients undergoing surgery expired as opposed to 38% (n = 50) of the non-operative cases (p = 0.163).

Out of the patients with deranged renal functions, 66.7% (n = 8) of those who underwent hemodialysis and 91.9% (n = 34) of those who underwent CRRT expired. However, this is most likely linked to the severity of the illness and not because of the hemodialysis or CRRT itself.

	P-Value
Age	0.001
Sex	0.507
Co-morbids	0.066
Mode of Admission	0.336
Planned vsUn-planned ICU Admission	0.099
Trauma vs Non- trauma	0.028
Operative vs Non-oprative	0.013

Table 5: Factors affecting mortality

On a univariate analysis, the factors identified as having a significant effect on mortality were the age of more than 65 years, unplanned ICU admission and non-trauma patients (Table 6).

	P-Value
Age>/=65 Years	0.001
Un-planned ICU admission	0.009
Non- trauma patients	0.028

Table 6: Significant factors affecting mortality

Discussion

Such a study has never been conducted in a surgical ICU in our region so there was no local data to compare it to. We then looked into the mortality rates of surgical ICUs around the world. Thailand had a rate of 9.61%, Brazil 26.1%, Ethiopia 35.4%, Greece 39%, and China 48.7% [3-7]. Since our rate was considerably higher at 45.3% compared to most of these countries, we decided to stratify these patients based on the severity of their illness. One of our theories was that the patients coming to our ICU were sicker than the patients admitted in these other ICUs. This can be supported by our average APACHE II score of 19.59 +/- 7.6, with 44.4% of the patients having an APACHE II score of 20 or more [8].

The standardized mortality ratio was also calculated for these patients. An ideal mortality ratio is 1.0 which means that the number of expected deaths is equal to the number of observed deaths. A mortality ratio of more than 1.0 means that there are more deaths occurring than expected while a ratio of less than 1.0 means that there were less deaths than expected. We stratified our patients based on operative versus non-operative cases and grouped them according to severity of illness based on APACHE II score. We attained an SMR of 1.81 in our operative patients and 1.36 for the non-operative cases (average of 1.56). When comparing our SMR to centers from around the world, it was seen that Mayo Clinic had a ratio of 0.7, the University of Michigan had an SMR of 0.51, and Brazil had an SMR of 1.39 [9-11].

Our SMR is rather high when compared to these areas but one way to explain this discrepancy is that we are comparing our ICU to that of high level and fully equipped surgical ICUs in developed countries. There is a paucity of regional and national data to which we can compare our SMR. Another point of note is that our hospital is one of the largest tertiary care centers in the country - we receive patients from all across the country, some who travel miles by road, and hence, are severely under-resuscitated and already in shock and multi-organ dysfunction when they reach us. For this very same reason, we also receive patients who come to our center as a 'last resort' – after having exhausted all other possible treatment options from other hospitals and in the last stages of their disease process.

A large proportion of these patients come to us after having received a variety of antibiotics, and most are diagnosed with multi-drug resistant infections and the infectious complications described earlier – thus explaining our high rates of hospital acquired infections. We compared the infectious complications in our study with another study done in a surgical ICU in Greece.12 Our rates of pneumonia (33% vs 25.3%) and CAUTI (13% vs 9.5%) were greater as compared to theirs, but our rates of blood stream infection (27% vs 36.1%) and CLABSI (4% vs 10.4%) were less compared to theirs.

The strength of this study was that we had a large sample size and that it is one of the few studies done on surgical ICU patients from our region. The limitations of the study were that it was a retrospective study of a single center and a single ICU. Furthermore, we focused only on general surgery and trauma patients, so we may not have characterized the full extent of the ICU needs of the other surgical services. We also had no regional data for comparison, leading to a very high SMR. We hope our rates can be used as an indicator to which other regional centers can estimate their rates, and may even be the basis for such studies in other centers.

Conclusion

Mortality rate may not be a true estimate as it may not take into account severity of the illness, so the SMR should be used when characterizing these patients. A significant benefit was seen in those patients who were planned for ICU admission on arrival to the hospital, and in those who received multidisciplinary care in the ICU setting. As there is paucity of regional data for comparison, we were not able to properly compare our studies to that of a surgical ICU within our country or within our region. We propose that a prospective multicenter study should be carried out to obtain an SMR for our region.

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