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RISK INDICATORS OF MORBIDITY AND MORTALITY IN ABDOMINAL INJURIES
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ABSTRACT

Objective: **To establish the risk factors for morbidity and mortality in patients with abdominal injuries.**
Design: **A descriptive, prospective, hospital-based study.**
Setting: **The adult general surgical wards of Kenyatta National Hospital (KNH), a tertiary Teaching and Referral Hospital in Nairobi, Kenya from November 2004 to February 2005.**
Subjects: **Eighty consecutive admissions of adult patients with either blunt or penetrating abdominal injuries.**
Main outcome measures: **Demographic data, type and cause of injury, degree of injury, vital signs at the time of admission, duration prior to admission, instituted intervention as to whether treated conservatively or operatively, duration prior to surgery, complications, admission to Intensive Care Unit (ICU), blood transfusion and mortality.**
Results: **Complications and mortality were predominantly in males and those in the age bracket 40 years and below. Penetrating abdominal injuries had higher rates of complications while blunt abdominal injuries had greater mortality. The independent indicators of morbidity and mortality in abdominal injuries were type of injury, cause of injury, degree of injury and the physiological state of patient at admission. Multivariate analysis showed age, duration prior to admission, surgery, duration prior to surgery, blood transfusion and admission to ICU as indirect predictors of morbidity and mortality.**
Conclusion: **The greatest determinants of morbidity and mortality in abdominal injuries are the degree of injury and the physiological state of patient at admission. The rest of the indicators are interplays of these two factors.**

INTRODUCTION

Trauma remains a leading cause of surgical admission the world over with 10-15% of the trauma cases being to the abdomen (1). Abdominal injuries on the other hand are a major cause of morbidity and mortality. They are predominantly in males with the majority in the third decade of life (2).

Progress in diagnostic methods, surgical intensive care and improved education of trauma surgeons can reduce mortality (2,3), but despite tremendous efforts to unravel the mysteries of abdominal trauma, a number of surgeons find themselves inadequately prepared to handle abdominal injuries (4).

An experienced general surgeon trained in techniques required to perform life-saving emergency surgery is vital in the management of major trauma. But training need not be directed only to surgeons. Quality, skilled medical care at the site of trauma with use of analgesics and infusion therapy has been suggested as an important influence on outcome (5). Optimal medical care at pre-hospital stage with trained medical staff and appropriate life-saving apparatus can increase the potential for recovery from abdominal injury (5).

Physiologic state at admission is the most important factor in predicting mortality in patients with abdominal injury (6). This is in turn determined by the age, cause of injury, severity and multiplicity of injury, presence or absence of comorbid factors, and the duration prior to presentation to hospital (7).

Difficulty with and delays in diagnosis are known causes of increased morbidity and mortality (8,9). Delay in operative intervention adversely affects outcome also (10).

Transfusion requirement (11) and admission to Intensive Care Unit (ICU) with associated abdominal compartment syndrome (12) have also been correlated with outcome of abdominal injury. Intra-Abdominal Hypertension (IAH) provokes release of pro-inflammatory cytokines which may serve as a second insult for induction of Multiple Organ Failure (MOF) (13).

While multiple abdominal trauma accounts for about 5% of all abdominal injuries (14) it compounds the other parameters and is a major cause of high mortality rates like the 28.5% found in this category of patients in this study. If factors that are responsible for higher morbidity and mortality in abdominal injury are anticipated and preempted (15), it would help a lot in the management of patients with abdominal injuries. This paper looks into the factors that influence the outcome of abdominal injuries based on an African setting, an area dominated by paucity of this important information.

MATERIALS AND METHODS

Eighty consecutive adult admissions to the surgical wards of Kenyatta National Hospital, Nairobi, Kenya, with abdominal injuries were recruited into the study.

Abdominal injury in this study was considered as one that met either or both of the following criteria:

(i) Evident trauma to the abdomen with or without obvious injury to intra-abdominal contents and requiring in-patient care in the general surgical wards.
(ii) Patients involved in multiple injury states such as road traffic accidents or mob attacks but whose main signs and symptoms are ascribable to the abdomen with need for in-patient care as above.

The inclusion criteria were:

(i) Significant abdominal injury requiring admission.
(ii) Patients fit for either conservative or operative modes of management.
(iii) Patients granting informed consent.

The exclusion criteria were:

(i) Patients with abdominal injury managed as outpatients.
(ii) Patients deemed mentally unfit to grant informed consent in the period of study.
(iii) Patients who declined to participate in the study.

Recruitment into the study was at any point from time of admission to the final outcome as long as the patient was in a position to and granted permission to participate.

Data were collected to meet a pre-designed questionnaire aimed at establishing the demography, type and cause of injury, duration prior to admission, vital signs at admission, associated injuries, mode of management instituted, duration prior to surgery, complications, admission to ICU, use of blood, duration of stay in hospital and final outcome as to whether discharged or deceased.

Recruited patients were followed up during their stay in hospital for change in mode of management, intra-operative findings and benefit from instituted management. The complications looked out for included re-bleeding after surgery, wound infection, acute renal failure, wound dehiscence, burst abdomen, enterocutaneous fistula and neurological deficits.

The duration of stay was taken as the period from admission to when attending surgical firms decided to discharge the patient. Some patients stayed in the wards after this while awaiting clearance of hospital bills but the extra days were not included in the study.

RESULTS

There were 74 males and six females, giving a male:female ratio of 12.3:1. The age ranged from 15 years to 56 years; the majority being in the third decade and a mean of 28.2 years. The age and sex distribution is as in Table 1.

Complications and deaths were predominantly in the males with all the complications arising in males. Ninety percent of the deaths occurred in males. All the complications and 90% of the deaths were in the age bracket 40 years.

The factors that corresponded with these findings of morbidity and mortality in this age bracket were the degree of injuries and the physiologic state as of the time of admission. Ninety percent of the abnormal vital signs at admission and majority of patients with multiple injuries were 40 years and below (Table 2).

Eighty percent of the deaths arose in multiple injured patients. The mortality rate in this group of patients was 28.5% as opposed to 3.8% in those only injured in the abdomen.

Patients with abnormal vital signs at admission had 50% chance of dying, the risk rising to 80% in those with blunt abdominal injuries (Table 3).

Nearly 70% of patients with abnormal vital signs after penetrating abdominal injuries survived while only 20% of similar patients with blunt abdominal injuries made it.

This points to better results in the management of penetrating as compared to blunt abdominal injuries.

Both the blunt and penetrating abdominal injury patients had equal chances of getting admitted to Intensive Care Unit (ICU) but the deaths in ICU were accounted for 60% by blunt abdominal injuries. There was no difference in complications among the patients admitted to ICU with the two types of abdominal injuries.

Of the three leading causes of abdominal injuries in Kenyatta National Hospital (KNH) – stab wounds, gunshot wounds and Road Traffic Accidents (RTAs) the latter was the leading cause of death despite its being the third most common cause of abdominal injuries. The risk of dying from abdominal injury sustained in an RTA was close to fifteen times as high as that of dying from a stab wound to the abdomen (Table 4).

The rate of complications was twice as high in gunshot wounds as was in stab wounds.

The duration prior to admission was a determinant of rate of surgical operations, complications, admission to ICU, need for transfusion and death (Table 5).

Table 1

Age and sex distribution of patients with abdominal injuries

Age (years)	Male	Female	Total	(%)
10–20	12	1	13	16.3
21–30	41	2	43	53.8
31–40	15	3	18	22.5
41–50	3	0	3	3.7
51–60	3	0	3	3.7
Total	74	6	80	100

Table 2

Age, degree of injury and vital signs in abdominal injury patients

Age (years)	Single injury	Multiple injuries	Vital signs		
			Normal	Abnormal	Deaths
10–20	13	0	11	2	2
21–30	26	17	34	9	5
31–40	11	7	11	7	2
41–50	1	2	2	1	1
51–60	1	2	3	0	0
Total	52	28	61	19	10

Table 3

Abdominal injuries, vital signs and mortality

Type	Abnormal signs		Normal signs		
	Discharged	Died	Discharged	Died	Total
Penetrating	7	4	42	0	53
Blunt	1	4	20	2	27
Total	8	8	62	2	80

Table 4

Leading causes of abdominal injuries and their respective morbidities and mortalities

Type	Uncomplicated	Complicated	Death	Total
Stab wound	28	5	1	34
Gunshot wound	9	5	3	17
RTAs	7	0	5	12

Table 5

Duration prior to admission, morbidity and mortality in abdominal injuries

Hours	Uncomplicated	Complicated	Operated	Conserved	ICU adm.	Transfusion	Death	Total
≤6	43	6	43	14	7	19	8	57
7-12	2	0	2	1	0	1	1	3
13-18	1	0	0	1	0	0	0	1
19-24	9	1	7	3	0	2	0	10
>24	5	3	4	5	1	1	1	9
Total	60	10	56	24	08	23	10	80

The overall complication and mortality rates were each 12.5%. Sixty percent of the complications and 80% of the deaths occurred in patients presenting within six hours of the abdominal injury. How soon a patient presented to hospital was determined by the severity and not the type of abdominal injury.

A patient presenting within six hours of the injury had a 75.4% chance of being operated on as opposed to less than 50% chance of surgery if presenting more than 24 hours after the injury. Nearly all patients admitted to ICU and 82.6% of those transfused presented within six hours of the abdominal injury.

Fifty six patients were operated on, giving an operation rate of 70%. There was no significant difference between the rates of conservative management for blunt and penetrating abdominal injuries. Of those operated on, 71.4% had penetrating abdominal injuries.

Ninety percent of the complications arose in patients who had undergone surgery for their abdominal injuries. The duration prior to surgery was an indicator of morbidity and mortality. There were high rates of complications, admission to ICU, need for blood transfusion and deaths in patients operated on within the first 12 hours of admission as compared to those operated on in the second half of the first 24 hours following admission.

All admissions to ICU were after surgery, while 21 of the 23 patients (91.3%) who received blood transfusion had been operated on. Sixty percent of the deaths arose in patients who had undergone surgery for the abdominal injuries. Two thirds of these deaths arose in patients operated on within six hours of admission.

Ten percent of the patients with abdominal injuries were admitted to ICU. The ICU mortality rate of these patients was 62.5%. Eighty percent of the deaths in ICU had had blood transfusion. The chances of an abdominal injury patient requiring blood transfusion dying in ICU were twice as high as the chance for surviving. Almost all patients admitted to ICU had multiple injuries.

In general, patients who received blood transfusion had a 69.6% chance of survival but this was true for patients who either did not get operated on or get admitted to ICU. The combination of surgery and blood transfusion accounted for 50% of the deaths while blood transfusion and ICU admission contributed 80% of the deaths. The sum total of patients who either developed complications or died after transfusion was higher than those who survived free of complications.

The independent risk factors for morbidity and mortality in this study are the type, cause and severity of abdominal injury and the physiologic state at the time of admission. Age, duration prior to admission, surgery, duration prior to surgery, the need for and use of blood transfusion and admission to ICU were found to be indirect predictors of morbidity and mortality in abdominal injuries.

The duration of stay in hospital was only an important indicator of morbidity in patients who developed complications after abdominal injuries. Those who had blunt abdominal injuries stayed almost twice as long as those with penetrating abdominal injuries.

DISCUSSION

Abdominal injuries remain a major source of morbidity and mortality the world over (1). An understanding of the risk factors that influence the morbidity and mortality in this condition would therefore be important in the effective management of the patients.

There was a preponderance of morbidity and mortality among the men and people in the ages 40 years and below but this was found to be related to the degree of injuries and the physiologic state at admission. Subramaniam and colleagues in Tasmania found age to be of no significance in morbidity and mortality in abdominal injuries (11). But as in other studies done elsewhere (6,9,14), they found that the severity of injuries and haemodynamic instability were important indicators of morbidity and mortality. As in this study, the physiologic state of the patient at admission was an important predictor of morbidity and mortality in abdominal injuries.

A number of factors would play a role in how stable or unstable physiologically a patient would be at admission. This study identified degree of injury as one such factor. Efimenko *et al* found that the quality of pre-hospital care with analgesics and intravenous fluid infusion was also an important factor (5).

Patients with haemodynamic instability fared differently for the two types of abdominal injuries. The better interventional outcome in penetrating abdominal injuries could be accounted for by the mechanism of injury. Penetrating injuries, unlike the blunt ones, have a trajectory path of injury while the blunt ones have diffuse energy dissipation. The blunt abdominal injuries were also more associated with extra-abdominal injuries in this study.

The presence of associated injuries significantly affects presentation and outcome of patients with abdominal injuries. Eighty percent of the deaths arose in this group of patients whose specific mortality rate was 28.5% as opposed to 3.8% in those only injured in the abdomen. This compares favourably with the study by Nespoli and Gianotti whose mortality in the multiple injured was 43.7% (14). As in this study, Malhotra *et al* found that the multiple injured had greater haemodynamic instability, transfusion, Intensive Care Unit (ICU) admission and mortality than patients with isolated abdominal injuries (7).

The type and cause of abdominal injuries were determinants of morbidity and mortality. Penetrating abdominal injuries, especially gunshot wounds, had high rates of complications than blunt abdominal injuries. The blunt injuries accounted for greater incidence of deaths. RTAs occupied a distinct position as a cause of mortality. Edino in Nigeria suggested that strategies focused on reduction of RTAs, violent crimes and social conflicts would alter the outcome of abdominal injuries (1). On the basis of the outlined findings of this study, efforts aimed at reducing RTAs would yield great rewards in abdominal trauma causes and outcomes.

Major trauma needs to be handled in hospitals dedicated to trauma service (4). This study found that the duration prior to admission was determined

by the degree and not the type of abdominal injuries. This would account for the high levels of morbidity in the form of complications, blood transfusion and admission to ICU and mortality for patients presenting to hospital within the first six hours of the injury. Previous studies found a relationship between duration prior to admission and morbidity and mortality in abdominal injuries (8,10). Other determinants of morbidity and mortality related to the duration from injury to admission include the training and experience in surgical management of torso trauma (2,4) as well as advances in diagnostic methods and surgical intensive care (2,3).

Emergency surgery has previously been found to be an important indicator of morbidity and mortality (15). In this study, surgery was a determinant of complications, need for transfusion, admission to ICU and mortality. The sixty percent accounted for by deaths after surgery and 90% of complications arising in patients subjected to surgery makes surgery an important risk factor for morbidity and mortality after abdominal injuries. This is even clearer when one considers the fact that all the patients admitted to ICU and 92.3% of those transfused had been operated on. But surgery, being an interventional measure, may have been indicated in patients with injuries likely to predispose the patient to greater need for blood transfusion, ICU admission and likely complications and death. There was a higher tendency for the more severely injured patients to be operated on than those relatively better. All in all, the patients in need of surgery got operated on irrespective of the temporal parameters and the outcome may be as much out of surgery as from inherent conditions in the patients (8).

The duration prior to surgery, just like that before admission, was found to be an indicator of morbidity in the form of complications, blood transfusion and admission to ICU as well as mortality. While studies had brought out the deleterious effects of delayed surgery in abdominal injuries (8,10), Musau and others have also demonstrated the dangers of surgery in these patients if inadequately stabilised (2). The morbidity and mortality reflected by time taken before surgery should be looked at from these divergent perspectives.

Blood transfusion and admission to ICU were indicators of morbidity and mortality on their own but one needs to bear in mind that some of the other indicators like severe injuries and haemodynamic instability could lead to either or both of them. Seen that way, it makes sense that the combination of blood transfusion and ICU admission had high levels of morbidity and mortality. Subramaniam *et al* found blood transfusion a significant indicator of morbidity and mortality (11).

Deaths in ICU have been found to be due to Abdominal Compartment Syndrome (ACS) (12,13). Intra-abdominal hypertension may arise primarily due to direct injury to the abdomen or secondarily as a complication of resuscitation with fluids, damage control surgery or blood transfusion (12). Intra-abdominal hypertension, like surgery, provokes pro-inflammatory cytokines which serve as a second insult for the induction of multiple organ failure (13). Since studies have shown that appropriate monitoring would predict ACS, it should also help reduce morbidity and mortality in ICU after abdominal injuries.

The study identified type of injury, cause of injury, the degree of injury and the physiologic state of the patient at admission as the independent indicators of morbidity and mortality. Multivariate analysis brought out age, duration prior to admission, surgery, duration prior to surgery, blood transfusion and admission to ICU as other indicators of morbidity and mortality in abdominal injuries. The findings are similar to those in other studies done elsewhere in the world.

In conclusion, abdominal injuries occupy an integral part in trauma surgery. A competent surgeon would require a good understanding of the risk indicators of morbidity and mortality in abdominal injuries to effectively manage the patients. This study brings out the key determinants as well as the interrelated contributors to morbidity and mortality in abdominal injuries.

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