

## Tertiary Trauma Survey: Evaluation of Missed Injuries at a Teaching Hospital in the Developing World.

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**Background:** The gold standard in the care of the multiply injured is the prompt identification of all life-threatening and associated injuries by using the Advanced Trauma Life Support protocol (ATLS). The main objective of this study was to determine the incidence of missed injuries in patients presenting to our hospital and to identify the primary contributing factors for each missed injury.

**Methods:** An initial evaluation of our trauma registry data for missed injuries in a 90% population of trauma victims yielded an incidence of 12%. However, to determine the true incidence of missed injuries, a prospective tertiary trauma survey was performed on all injured patients admitted during a six month period. After the primary and secondary surveys, all injuries and treatments were documented in the patients' trauma medical records. They were then re-examined immediately by the senior orthopaedic registrars and subsequently by the investigator.

**Results:** Fifty-two missed injuries were found in 46 patients (10.5%) out of 438 cases. Reasons for missed injuries include haemodynamic instability 3 (0.7%), head injury 17 (3.9%), low index of suspicion 5 (1.1%), lack of symptoms 6 (1.4%) and technical problems 12 (2.7%).

**Conclusion:** There is a need to re-appraise our trauma care practice to reduce the incidence of missed injuries.

### Introduction

The management of multiple trauma patients presents a worldwide diagnostic and therapeutic challenge to trauma, orthopedic and general surgeons<sup>1</sup>. Trauma care in a busy hospital setting brings about medical errors as a result of unstable patients, incomplete histories, time-critical decisions, synchronous tasks, involvement of many disciplines, and inexperienced personnel working after-hours<sup>2</sup>. Significant injuries can be missed during primary and secondary surveys in multiply injured patients, who require simultaneous resuscitation, diagnosis and therapy. Unfortunately, 34% of missed injuries during trauma treatment occur in the Emergency Department.<sup>1,3</sup>. A common quality indicator in trauma care is missed injury<sup>4</sup>.

A missed injury may draw attention as the most exciting event in a patient's clinical course, clouding the brave efforts of the trauma team<sup>5</sup>. Missed injuries occur in the time-critical and complex assessment of severely injured trauma patients in the Emergency Department. Altered level of consciousness, distracting injury, or early surgical intervention may prevent adequate and detailed assessment of the trauma patients. These difficulties with initial examinations may therefore lead to injuries going undetected and their subsequent management may increase morbidity<sup>6</sup> or even mortality<sup>6,7</sup>. Injuries can be missed at any stage of the management of the trauma patient, including intra-operatively, and may involve all regions of the body<sup>8</sup>.

Missed injuries are a potential source of morbidity and mortality and may also represent varying degrees of clinical inexperience and are common reasons for litigation<sup>9</sup>. Missed injuries are often associated with prolonged length of hospital stay resulting in increased costs of care as well as consumption of hospital resources<sup>9, 10</sup>. The incidence of missed injuries has been reported in trauma literature to range between 0.6% and 65%, and less missed injuries have been found in retrospective studies<sup>11</sup>. In a prospective study in Uganda, the rate of missed injuries was reported to be 19.4% and the commonest contributing factor for missed injuries was inadequate assessment<sup>12</sup>.

To reduce undiagnosed injuries, hospitals need effective means of identifying errors and error associated deaths, which have been found to be 2.7–6.5%.<sup>13</sup> There is a general disinclination of physicians to admit and account for their errors which is further complicated by paucity of literature and difficulties in researching this area.<sup>12, 13</sup> Missed injuries are defined variously as injuries identified after the initial period of resuscitation (primary and secondary survey of Advanced Trauma Life Support®), although they may also be injuries identified after a defined time period after injury, such as 12 or 24 hours<sup>14</sup>. However, there is no absolute definition, since some missed injuries may be asymptomatic and may present long after the initial event. Missed injury has been a source of concern to clinicians for many years; however, what is surprising is that injuries are missed even in developed countries with experienced units and facilities<sup>15</sup>.

The main objective of this study was to determine the incidence of missed injuries in patients presenting to our tertiary hospital and to identify the primary contributing factors leading to each missed injury and the attendant morbidity and mortality.

### **Patients and Methods**

A questionnaire was completed for all trauma patients presenting in the emergency department of our hospital after the initial evaluation and resuscitation. The medical officers in conjunction with the postgraduate surgical registrars initially evaluate the patients before subsequent review by the consultants in the emergency medicine department. Patients were eventually referred to various departments according to the parts of the body and pattern of injuries sustained for definitive management. Those referred to the orthopaedic and trauma department were then re-examined immediately by the senior registrars in the unit. They were then reviewed by the investigator who is an orthopaedic and trauma surgeon before ambulation, discharge from the intensive care unit, hospital, and in head-injured patients, upon regaining consciousness. All missed injuries were identified and documented, including type, site and number of injuries, reasons why they were missed, how they were identified and any attendant morbidity and mortality. Patients were also re-examined at the initial follow up visit to the surgical outpatient department by the investigator.

At the emergency department of our hospital, about 600 new cases of traumatic injuries present for management every month. Our emergency department is composed of 4 consultants (one surgeon, one anaesthetist and two physicians) 4 postgraduate year 2 surgical registrars on emergency medicine rotation and eighteen medical officers who are at least two years post qualification from medical schools awaiting placement into the residency training programmes of our hospital. There is also a dedicated trauma team which can be summoned

at any time. Neurosurgical, cardiac and other surgical subspecialty care is available for 24 hours of the day. A dedicated operating theatre for trauma is available on request. Portable ultrasonography, echocardiography, radiological facilities and computerized tomography scan were available 24 hours of the day in the hospital. We also have facilities for performing laboratory analyses and consultations from any department are available on request.

## Results

The ages ranged between 2 and 100 with a mean of  $37.0 \pm 20.0$  years. Figure 1 shows the age distribution and the number of patients who had missed injuries. There were 273 males and 165 females with a male to female sex ratio of 1.7: 1. A total of 52 (10.5%) missed injuries were found in 46 patients out of 438 patients seen. They included 27 males had missed injuries while 19 females also had missed injuries. These included fractures of the clavicle, scapular, ulna, radius, pelvis, acetabulum and femoral condyles. Others are shoulder dislocation, brachial plexus and transverse colonic injuries. Tibia plateau fractures (1.4%) were the most commonly missed injuries. 4 Patients (0.9%) had multiple missed injuries (Table 1). The injury severity score in patients who presented for trauma care is shown in Table 2.

Factors contributing to missed injuries included haemodynamic instability necessitating early surgery in 3 (0.7%), head injury in 18 (4.1%), low index of suspicion in 5 (1.1%), lack of symptoms in 7 (1.6%) and technical problems in 13 (3.0%) of the patients with missed injuries..

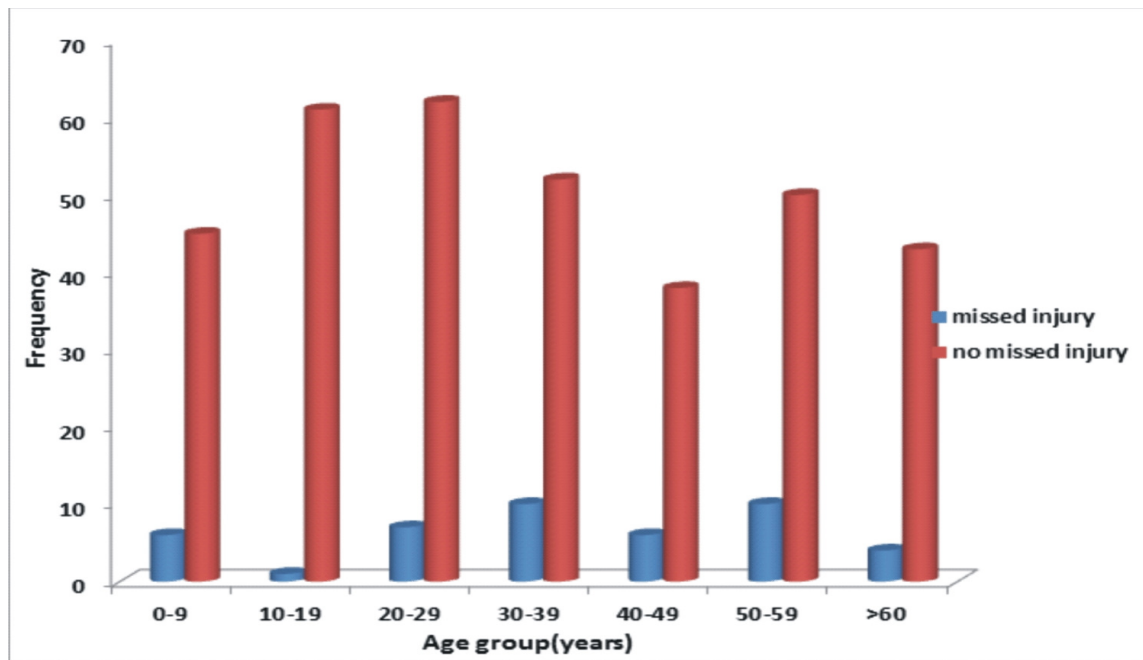
**Table 1.** Missed Injuries in Trauma Patients after Completion of Primary and Secondary Surveys

Missed injuries	Frequency (%)
Clavicular fractures	2
Scapular fractures	3
Brachial plexus injury	1
Shoulder dislocation	2
Ulnar fractures	2
Distal radial fractures	4
Pelvic fractures	4
Acetabular fractures	4
Femoral condylar fractures	2
Tibia plateau fractures	6
Tibia fractures	2
Metatarsal fractures	2
Malleolar fractures	3
Transverse colonic injury	1
Multiple missed injuries	4
<b>Total</b>	<b>52</b>

**Table 2.** Injury Severity Scores in Patients Who Presented for Trauma Care .

Injury severity score	No of pts with missed injuries		No of pts without missed injuries	
	Number	%	Number	%
16-18	26	9.0	264	91.0
19-21	10	14.1	61	85.9
22-24	2	6.3	30	93.8
25-27	5	16.7	25	83.3
>28	3	20.0	12	80.0
<b>Total</b>	<b>46</b>	<b>10.5</b>	<b>392</b>	<b>89.5</b>

$\chi^2$ - value = 4.966, P-value=0.291



**Figure 1.** Age Distribution of Patients with and without Missed Injuries

## Discussion

All emergencies resemble each other at first sight, but each emergency has its own reasons for a missed diagnosis<sup>16</sup>. The primary and secondary surveys outlined by the Advanced Trauma Life Support (ATLS) protocol and the tertiary survey have helped to minimize the incidence of missed injuries. However, many injuries can still entirely escape detection at the hospital<sup>17</sup>. Missed injuries are defined variously as injuries identified after the initial period of resuscitation (primary and secondary survey of Advanced Trauma Life Support®), although

they may also be injuries identified after a defined time period after injury, such as 12 or 24 hours. The definition of missed injuries also varies between studies. Some studies describe it as ‘any injury missed by the primary and secondary surveys, and detected as a result of the tertiary trauma survey’ (i.e. Type I)<sup>14, 18</sup>.

Another study defined it as any injury that escaped detection at the time of the tertiary trauma survey and then subsequently discovered either while the patient is still in the hospital or after discharge from the hospital (i.e. Type II)<sup>19</sup>. In this study, missed injuries are classified as injuries detected during or after the tertiary trauma survey. Our rate of missed injuries of 10.5% is comparable to that reported by Enderson et al<sup>6</sup> and better than that reported by some other studies.<sup>5, 10, 20</sup> In this study most missed injuries were in the 4<sup>th</sup> and 6<sup>th</sup> decades of life.

Patients with injury severity score of between 16 and 18 recorded the highest number of missed injuries in this study which finding differed with earlier reports<sup>17, 21, 22</sup> which reported higher rate of missed injuries with higher injury severity scores. The reason for this disparity may be because of higher early mortality associated with high injury severity scores at our centre and the rudimentary state of our pre-hospital emergency medical care where patients with such high injury severity scores may not have survived the initial trauma. Patients who appear to be most at risk for missed injuries include those who cannot cooperate with the examinations due to head injury or the effects of drugs or alcohol and patients whose initial assessment is rushed because of haemodynamic instability. Therefore, in patients presenting in such fashion, a careful tertiary trauma survey to seek missed injuries is recommended. Head injury is responsible for most of the missed injuries in this study due to lack of cooperation on the part of the patients because of their injuries.

Technical problems as a factor responsible for missed injuries also featured prominently in this study. Such technical challenges include inadequate radiographic facilities especially during the off-peak hours, incessant power outages leading to non functioning elevators needed for transporting patients from the emergency department to other parts of the hospital, inadequate supporting facilities such as para-medical staffs, trolleys, for example. There is need for construction of useful alternatives to elevators like stair-cases to facilitate moving patients from the emergency department to other parts of the hospital during power outages. The fact that trauma care in this environment is also on “cash and carry” basis also contributes to this problem as most trauma victims in the initial post traumatic period have financial constraints which delays or precludes complete ancillary investigations.

It is a fact that for many missed injuries, it is impossible to discover which determinant was the main cause of delay in detection of the injury, and multiple contributing factors can be ascribed to a single missed injury.<sup>16, 23</sup> In our study, radiological challenges included inappropriate views of radiographs, no availability of x-ray cartridges, delay in reporting radiographs, misinterpretation by the clinicians, among others. In studies investigating the characteristics of patients with missed diagnosis in addition to the reasons mentioned above, several other features included communication problems (language barrier, infant), admission into the intensive care unit, the patient being directly dispatched to the operation room from the emergency department, emergency department admissions during the night time,

misleading medical history, haemodynamic instability, and multiple injuries in the same extremity<sup>6, 24</sup>.

Some patients who presented for follow-up in the surgical out-patient department also had missed injuries. However, their injuries were not life-threatening and subsequently managed. It is expedient that we improve our pre-hospital emergency medical care services to enhance the survival of patients with severe injuries and to increase the number and cadres of surgical residents on emergency medicine rotation with respect to the number of medical officers who are less experienced in trauma care to minimize the risk of missed injuries.

### Conclusion

Our rate of missed injuries is comparable to that in other parts of the world. However, there is a need to re-appraise our trauma care practice in order to reduce the incidence of missed injuries. Tertiary trauma survey should be included in the evaluation of our patients and this should be taught to trauma care providers.

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