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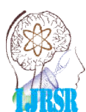

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ABSTRACT

The trauma patients present a diagnostic and therapeutic challenge to the treating clinicians, to develop a balance between the discovery of all injuries and resuscitation of these patients. Lack of universally acceptable definitions of missed injuries, standardized management protocols and uniform working conditions call for further research in this area. In this literature review, we are concentrating on the various aspects of these missed injuries in light of recent literature, while assessing the clinical impact of these missed injuries.

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INTRODUCTION

The aim of the management of trauma patients is to diagnose all injuries in emergency room itself so that the overall complications including morbidity and mortality can be minimized. Missed injuries can add to the misery of the initial injury. Missed injuries are the common indicator of quality of clinical assessment. The first description of the missed injuries was made by Gordon from South Africa in 1986 (Gordon *et al.* 1986). Since then, a number of series have been published dealing with various aspects of missed injuries. While missed injuries are not new, it is quite surprising that these are occurring even nowadays in almost all clinical setups globally despite of the improvement in clinical, diagnostic and therapeutic protocols. We have reviewed the literature available so that we can define, identify and manage these missed injuries quickly. In this review we have also analyzed the factors affecting the nature and pattern of these missed injuries as well as their clinical impact.

Definitions

We have tried to differentiate two commonly used terms: *missed injuries* and *delayed diagnosed* injuries, which are frequently used in given literature. There is no universal definition of these term, so various workers have used arbitrary definitions. For the purpose of this review, we define missed injuries as those injuries which are not diagnosed at the time of initial diagnosis. Others define it as an injury not diagnosed at timely manner but diagnosed after patients were discharged (Houshian *et al.* 2002). We define delayed diagnosis as an injury diagnosed after the resuscitation but before it can manifest clinically, however others define it as an injury detected after initial resuscitation but before the discharge (Stawicki *et al.* 2009). Various studies defined clinically significant missed injuries differently: Hoff *et al.* (2004) subgrouped these injuries into two-Level I: missed injury would likely lead to morbidity or mortality and Level II: missed injuries alters care in management protocol; Vles *et al.* (2003) described as any missed injury that's leads to change in treatment resulting from detection of missed injury and Huynh *et al.* (2010) commented that clinically significant missed injuries that are judged as such by trauma attending and required intervention.

Burden of Problem

Lack of standard definitions may lead to under estimation of the incidence of these injuries. Depending upon the definitions, the incidence varies from around 1.3% to as high as 3.9% (Pfeifer *et al.* 2008; Thomson *et al.* 2008; Houshain *et al.* 2002). The original paper on missed injury examined paediatric missed injuries in a newly developed paediatric trauma unit and observed about 2.5% missed injuries in admitted paediatric patients with trauma but only in 0.3% these were noticed after discharge (Gordon *et al.* 1986). Muckart and Thompson reported an incidence of 2.6% in penetrating injuries while 4% missed injuries in blunt injuries. They noted that overall mortality rate increased to 88% if the missed injuries were missed at urgent basis (Muckart *et al.* 1991). In a recent international review of 35000 patients (Texeira *et al.* 2009), it was noted that out of these patients only 1% developed complications. Out these patients with complications, only 14%

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complications were due to missed injury. They commented that 35% complications due to missed injuries require change in line of management. Malhorta *et al*. (2009) from Virginia reported 2.5% missed injury in follow up patients. Of all missed injuries, 15-22% were clinically significant which requires change in management (Thomson *et al*. 2008; Houshian *et al*. 2002).

Classification of Missed Injuries

Gerben *et al*. (2012) classified missed injuries into three types: Type I: injury missed at initial assessment (primary and secondary survey and emergency intervention), but detected within 24 hours, before or through Trauma Tertiary Survey (TTS) (Pfeifer *et al*. 2008; Thomson *et al*. 2008; Enderson *et al*. 1990); Type II: injury missed by TTS but detected in hospital, after 24 hours and Type III: injury missed during hospital stay including TTS, detected after hospital discharge. Stawicki *et al*. (2009) divided missed injuries in two broad categories: *avoidable* and *unavoidable*. Avoidable missed injuries are due to avoidable factors, so these are preventable but unavoidable missed are because of the circumstances which are beyond the control of the examining clinician.

Factors Influencing Missed Injury (Stawicki *et al*. 2009)

The reasons for injuries being missed are complex and multifactorial. Mistriage occurs if very old patients or very young children are involved. Other factors include patient factors, technological factors, the healthworkers' physical and emotional state, ambient climatic and working conditions, physical structure of the facility, social, legal and cultural influences, and finally the quality of the hospital organization (Olson *et al*. 2002). The factors involved in unavoidable cases of missed injuries are altered sensorium, haemodynamic or respiratory instability, distracting injuries, Polytrauma, paralysis and late presentation. Inadequate or incomplete examination, inexperience, overall urgency and factors related with diagnostic protocols are the factors which can be associated with avoidable missed injuries.

Which Injuries Are Missed?

The missed injuries can present with a wide spectrum but following factors may be associated high prevalence of these injuries:

1. ***Relationship of missed injuries with mechanism of trauma*** - Mechanism of injury may be suspected with the mechanism of injury. Each mechanism of injury makes a particular area(s) more prone for the injury. So while examining one must concentrate on these areas.
2. ***Missed injuries related with type of injury: blunt injury versus penetrating injury*** - The most common factors contributing missed injury associated with blunt injuries are: altered sensorium, presence of distracting injuries, effect of administered analgesics and sedatives. On the other hand common causes of missed injuries associated with penetrating injuries include: misidentification of surface wound, Polytrauma, preexisting missiles, other distracting injuries and altered sensorium.
3. ***Regional consideration***: in Polytrauma and patients with head injury, cervical injuries are frequently missed. The causes of these missed injuries can be incomplete examination, inadequate exposure, inadequate imaging and incorrect evaluation of radiology. About 50% missed injuries in several studies have been in the extremities. Most common most common musculoskeletal missed injuries in extremities are sprain, contusions, physeal injuries in children and small bone fractures involving foot and hand. Fracture of ribs, diaphragm injuries, pneumothorax and haemothorax are frequently missed amongst the chest trauma. Abdomen including retroperitoneum and perineum is another region where missed injuries do occur frequently. Small bowel injuries usually missed in the cases of solid organ injuries. Neurovascular injuries as well as compartment syndromes are other very vital missed injuries as they may lead to morbidity to mortality. Impacted foreign materials (including small glass pieces), broken tooth, avulsed nails and scalp abrasions and lacerations are some of the other missed injuries.

Impact of Missed Injuries

Missed injuries are notorious for the bad name and medicolegal complications. Fortunately, majority of missed in all most in all series were not associated with significant increase in morbidity and mortality. Majority of these injuries usually do not increase the ICU or hospital stay or the cost of treatment. As per Cooper *et al*. (2005), as high as 30% injuries were clinically significant but out of these only less than 2% were lethal. Gedeborg *et al*. (2009) while analyzing autopsies were concluded that 6.5% of deaths were attributed to missed injuries. In a meta-analysis of 18 studies, it was observed that the life threatening complications due to missed injuries were as low as 1-4% (Muckart *et al*. 1991).

DISCUSSION

The aim of the trauma management is to identify and treat the whole spectrum of injuries in the timely manner. This review of literature was written to evaluate the missed injuries, its causes, factor responsible for these injuries and impact of these on the management of patients. Croskerry *et al*. (2006) observed that missed injuries can be reduced by proper training of the staff, by standardizing the protocols, regular review of trauma patients and by optimizing the working atmosphere of emergency rooms. The concept of TTS was introduced to decrease the chances of missed injury. The TTS should be done either at arrival in the ICU or after 24 hours after the admission. They advised that it should be done by the senior most clinician of the team. It has been proved that TTS is more crucial for the blunt injuries than the penetrating injuries. The proper training of the trauma surgeons on line of ATLS training and availability of skilled nursing staff would decrease the incidence of missed injuries. The quantification of the long term impact of missed injuries may support the concept of TTS. The concept of missed injuries is quite broad than the scope of this article so we have tried only to highlight the critical principles that are central to the missed injuries and delayed diagnosis.

CONCLUSION

Missed injuries pose a significant problem to the trauma services around the globe. Though all efforts must be made to minimize the occurrence of missed injuries, but could not be

ruled out. So these should not be taken as embarrassment. It is this knowledge, combined with clinical experience that will ultimately reduce the real burden of missed injuries. Try to find out these injuries as soon as possible and should be manage promptly so that their clinical impact may be reduced. Proper dealing with missed injuries will ultimately reduce the litigations associated with trauma care system.

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