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Original Article

Hospital-Acquired Infections in Patients with Major Trauma – Outcome Evaluation in a Tertiary Care Hospital

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Abstract

Introduction: Hospital-acquired infections (HAIs) following major trauma result in significant mortality and morbidity in a generally active population. Delay in diagnosis and treatment results in a worse outcome. Our study aims to delineate the magnitude of the problem in a tertiary care teaching hospital and evaluate the major types of HAIs prevalent in such a setting.

Materials and Methods: This institution-based, observational descriptive study was conducted over a period of 18 months. The sample included patients with major trauma to the head, abdomen (blunt and penetrating), and chest. Patients with isolated orthopedic trauma and burns were excluded from the study. Incidence of HAIs including pneumonia, urinary tract infection (UTI), and wound sepsis was recorded. Various factors likely to affect final outcome were recorded. The appropriate treatment was provided and post-operative recovery and any complications including mortality data were recorded and analyzed.

Results and Analysis: A total of 101 patients were included in the study. Males outnumbered females. Mean age of presentation was 35.16 years signifying a younger population. Abdominal trauma was the most common presentation followed by chest injury and head injury. Mortality rate was 6.93%. Of the HAIs, pneumonia was the most common followed by sepsis, UTI, and wound infection. HAIs significantly increased the length of hospital stay.

Conclusion: HAIs in patients with severe trauma are a stumbling block in the recovery and rehabilitation of patients, especially in a young and active population. Efforts to reduce their incidence are the need of the hour and measures to decrease the resulting mortality and morbidity are definitely possible in a well-equipped, tertiary care setting. This requires sincere, well-directed measures and strategies to defeat this major impediment to a quick recovery.

Key words: Trauma, Infection, Hospital, Pneumonia

INTRODUCTION

Trauma remains one of the main causes of mortality worldwide and is responsible for nearly one-third of "all lost years of productive life before age 65, exceeding losses from heart disease, cancer, and stroke combined." In India too, trauma is a major problem.

Infections are second only to head injury as the leading cause of death beyond the first 3–4 days of trauma and are responsible for 80% of late deaths in adult trauma patients.

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Patients with traumatic injuries are at increased risk for infections. The interruption of tissue integrity, hemorrhage and tissue hypoperfusion, frequency of invasive procedures, and impaired host defense mechanisms all have a major impact on subsequent infection. A hospital-acquired infection (HAI) is usually one that first appears 3 days after a patient is admitted to a hospital or other health-care facility. Infections acquired in a hospital are also called nosocomial infections.

HAIs can be caused by bacteria, viruses, fungi, or parasites already present in the patient's body or coming from the environment. Hospital-acquired infections may develop from surgical procedures, catheters placed in the urinary

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tract or blood vessels, or from material from the nose or mouth that is inhaled into the lungs.

Pneumonia, urinary tract infections (UTIs), and surgical wound infection are the most common HAIs encountered.

Trauma patients with HAIs have longer hospital stays, increased risk of dying, and higher inpatient costs.

The interaction between victims of trauma and intensive care unit (ICU) is considered additive for morbidity, mortality, hospital days, and carries an economic burden for both patient and hospital.

With the recent establishment of trauma care centers in India and a multidisciplinary approach to handle these patients, it is important to understand the epidemiology of infections, which will be the first step toward prevention and effective treatment.

This study aims at finding out the incidence of HAIs and evaluates the type of infections prevailing in patients with major trauma in a tertiary care hospital so that appropriate measures may be initiated to minimize the incidence of HAIs and prevent loss of productive man-years.

Aims

The aims of the study were as follows:

1) To find out the incidence of HAI in patients with major trauma.
2) To evaluate the impact of HAI on in hospital mortality.
3) To compare the length of hospital stay in patients with major trauma with or without HAIs.

REVIEW OF LITERATURE

Ancient physicians initially treated injuries by observation and only by tentative trial and error were surgical interventions developed. The surgeons of Egypt, surely some of the first trauma surgeons, are reported to have performed amputations, lithotomies, and removal of cataracts, extraction of foreign bodies, and the dressing of wounds. Egyptian civilization, which began as early as 6000 BC, has produced various medical documents to this effect.[1]

The Edwin Smith papyrus, dated 1600 BC, presents 48 cases of trauma described from head to foot, capita ad calcem, an approach still in use.[2]

The Sushruta Samhita, which was probably written around 600 BC, emphasized the importance of adequate preparation of the surgeon, as well as cleanliness throughout the operative procedure.[3]

In India, trauma is a major problem, due to a very high incidence of vehicular accidents (6% of global vehicular accidents), other accidental injuries, crime, and violence.[4]

In the United States too, injuries constitute the fourth leading cause of death over all ages (6% of all deaths) and the leading cause of death among children, adolescents, and young adults aged 1–44.[5]

About 50% of all deaths occur within minutes of the injury either at the scene or on route to the hospital. These immediate deaths are typically the result of massive hemorrhage or severe neurologic injury. An additional 20–30% die primarily of neurologic dysfunction within several hours to 2 days post-injury. The remaining 10–20% die of infection or multiple organ failure many days or weeks after the injury.[6,7]

Elderly trauma victims have been shown to have increased morbidity and mortality compared to younger trauma victims.[8]

Chronic diseases have also been shown to have a significant impact on morbidity and mortality in the trauma victim independent of age and injury severity.[9,10]

Cardiopulmonary, hepatic and renal disease, diabetes mellitus, malignancy, or neurologic disorders have been found to have increased mortality rates compared to their disease-free counterparts.[11]

Morris *et al.* identified liver cirrhosis, chronic obstructive pulmonary disease (COPD), congenital coagulopathy, diabetes mellitus, and congenital heart disease as preexisting conditions with a worse prognosis following trauma.[10]

The incidence of infection following traumatic injury is approximately 25%.[12]

Trauma patients are at high risk of infection for many reasons, including the host immunosuppressive response to injury,[13] direct inoculation of wounds by clothing, dirt, or debris, inadequate infection control practice under emergency conditions, blood transfusions, and poor control of blood sugar.

Infections following injury occur in the injured tissue itself (or an incision made to treat the injury) or as nosocomial infections, such as pneumonia or catheter-related blood stream infection (CR-BSI) and UTI.[14]

A HAI is usually one that first appears 3 days after a patient is admitted to a hospital or other health-care facility.

Among the HAIs, pleuropulmonary infections (e.g., pneumonia and empyema) are more common than CR-BSIs, which, in turn, are more common than UTI.[15]

Hospital-acquired infections can be caused by bacteria, viruses, fungi, or parasites. These microorganisms may already be present in the patient's body or may come from the environment, contaminated hospital equipment, health care workers, or other patients [Table 1].[16]

Pneumonia is the most common type of hospital-acquired infection with organisms sourced from contaminated equipment or the hands of health care workers. Trauma patients are particularly susceptible particularly if they require mechanical ventilation. Ventilator-associated pneumonia (VAP), defined as pneumonia occurring at some point after endotracheal intubation, is the most common infection in the ICU among trauma patients. The incidence of VAP increases with the duration of mechanical ventilation at a rate of 3% per day during the first 5 days, 2% per day during days 5–10, and 1% per day after that [Table 2].[17,18]

Sepsis is the second most common type of HAIs. It is systemic inflammatory response to infection, that is, SIRS plus documented infection.

In UTIs, Gram-negative bacteria predominate.[19]

Table 1: Hospital-acquired infections in the intensive care unit

Common	Uncommon
Pneumonia	Sinusitis
Catheter-related infection	Empyema
Intra-abdominal (in surgical units)	Endocarditis
Urinary tract infection	Endophthalmitis
Skin/soft tissue	Parotitis
Decubitus ulcer	Suppurative phlebitis
Surgical site infection	

Talmor *et al*. Relationship of SIRS to organ dysfunction, length of stay, and mortality in critical surgical illness: Effect of ICU resuscitation. Arch Surg 134:81, 1999

Table 2: Risk factors for ventilator-associated pneumonia[18]

Age > 60 years	Blood transfusion
Acute respiratory distress syndrome	Organ failure
Chronic obstructive pulmonary disease	Supine position
Coma or impaired consciousness	Large volume gastric aspirate
Serum albumin<2.2 g/dL	Sinusitis
Burn trauma	Immunosuppression

Celis *et al*. Nosocomial pneumonia: A multivariate analysis of risk and prognosis. Chest 93 (2):318-24, 1988

MATERIALS AND METHODS

It is an observational descriptive study carried out at a tertiary care hospital over a period of 18 months. Patients admitted with principal diagnosis of trauma (head injury, chest trauma, blunt trauma, or penetrating trauma) and length of hospital stay >3 days were included in the sample. Patients with burns and isolated orthopedics trauma or presenting with late effects of injury were excluded from the study.

On admission, they were assessed for preexisting sepsis, pneumonia, or UTI by blood investigations, urine examination, chest X-rays, and computed tomography thorax. Patients with major trauma were assessed for the presence of HAIs starting 3 days after admission. Evaluation included development of wound sepsis, pneumonia, and UTI. The mortality, morbidity and length of stay in the hospital were recorded.

The collected data were analyzed using standard statistical methods with SPSS v25 statistical software including frequency analysis and descriptive statistics.

RESULTS AND ANALYSIS

A total number of 101 patients ($n = 101$) with major trauma were included in the study. Males numbered 86 (85.1%) with 15 (14.9%) females. Ages ranged from 13 years to 66 years (mean= 35.17 years). Most of them suffered from abdominal trauma ($n = 56$, 55.4%) and others had head injury ($n = 16$, 15.8%) and chest trauma ($n = 29$, 28.7%).

Among chest injuries, contrast-enhanced computed tomography (CECT) thorax revealed pneumothorax ($n = 12$), hemothorax ($n = 5$), and hemopneumothorax ($n = 3$).

Interventions done were exploratory laparotomy (53 of 56 abdominal injuries) and intercostal water seal chest drain insertion (26 of 29 chest injuries). Twenty-two patients were treated conservatively.

Forty-nine patients developed HAIs while 52 did not. Of the HAIs, pneumonia was the most common ($n = 20$, 40.8%), followed by sepsis ($n = 16$, 32.6%), UTI ($n = 7$, 14.3%), and wound infection ($n = 6$, 12.2%).

Comorbidities ranged from type II diabetes mellitus ($n = 7$), hypertension ($n = 4$), and obstructive airway disease ($n = 5$).

Mean hospital stay in patients with HAIs was 15 days whereas patients without HAIs stayed for a mean of 9 days in hospital.

Seven patients died postoperatively, four due to pneumonia and three due to sepsis (mortality rate of 6.93%).

Statistical analysis of the data shows up factors such as age, gender, type of injury, and presence of comorbidities which may or may not affect outcomes such as mortality, postoperative complications (morbidity), and length of hospital stay.

Using the Pearson's method, no significant correlation could be found between these factors and outcomes ($P > 0.05$) except that hospital stay was significantly affected by all the above factors. HAIs were significantly more common in the elderly and those with comorbidities. A longer hospital stay was associated with a higher mortality [Table 3].

DISCUSSION

Rising population, urbanization, industrialization, and a drastic rise in vehicular transport have contributed to an annual increase in road traffic accidents. As most of them are young adults, with no underlying illness, there is a greater need to save them. Thus, there is a growing population of traumatized patients requiring highly sophisticated and specialized care in India.[4]

In our study, the mean age of the trauma patients was 35.17 years ranging from 13 years to 66 years.

HAIs are one of the most important causes of death in traumatized patients. Infections are second only to head injury as the leading cause of death beyond the first 3–4 days of trauma.[20]

In our study, it has been found that out of 101 major trauma patients, 49 (48.51%) patients developed HAI such as pneumonia, sepsis, UTI, and wound sepsis. The most common infections in trauma patients are pneumonia (49%), blood stream infections (19%), and UTI (12%).[21]

In our study, it has been found that among 101 trauma patients who had HAI, 20 (40.8%) patients developed pneumonia, 16 (32.6%) developed sepsis, 7 (14.3%) developed UTI, and 6 (12.2%) patients developed wound sepsis.

Table 3: Correlation between factors affecting adverse events (*P* values from two-tailed test)

	Complications	Hospital stay	Mortality
Age	0.005 (sig.)	0.002 (sig.)	0.245
Sex	0.071	0.003 (sig.)	0.256
Type of trauma	0.323	0.004 (sig.)	0.337
Comorbidities	0.038 (sig.)	0.001 (sig.)	0.148

Pearson's correlation; Sig: Significant ($P<0.05$)

It is found that trauma patients with HAIs have longer hospital stays, increased risk of dying, and higher in patient cost.[22] In this study, trauma patients who developed HAIs had longer duration of hospital stay (average 15 days), whereas in 63 trauma patients without HAIs, the average length of hospital stay was 9 days.

Comorbid conditions such as diabetes mellitus, hypertension, COPD, immune suppression, and other illnesses have been associated with an increased risk of HAIs in trauma patients, which cause increased morbidity and mortality after major trauma.[23]

In our study, seven patients had diabetes mellitus, four patients had hypertension, and five patients had COPD, out of which 10 patients developed HAIs.

CONCLUSION AND SUMMARY

Our study aims at finding out the incidence of HAIs and evaluates the type of infections prevailing in patients with major trauma in a tertiary care hospital so that appropriate measures may be initiated to minimize the incidence of HAIs and prevent loss of productive man-years.

In our study, 101 cases were evaluated with the objective to find out the incidence of HAIs and the infections prevailing among the major trauma patients by history and clinical features, imaging (chest X-ray and CECT thorax), blood counts, urine for routine and microscopic examinations, urine for culture, and sensitivity.

Additional features studied were age, sex, and history of comorbid conditions such as diabetes mellitus, hypertension, and COPD.

In our study, it has been found that out of 101 major trauma patients, 48.51% of patients developed HAIs.

The most prevailing infections were pneumonia (40.8%), sepsis (32.6%), and UTI (14.3%). It is seen that trauma patients with comorbidity have more chances of HAIs.

In this study, it has been found that major trauma patients who develop HAIs had longer duration (mean 15 days) of hospital stay in comparison to patients without HAIs.

This study reports various types of HAIs in major trauma patients in a tertiary care hospital.

There was high incidence of HAIs in patients with major trauma. Trauma patients with HAIs are at increased risk for morbidity as well as mortality.

In light of the preventability of many HAIs and the magnitude of the clinical and economic burden associated with HAIs, policies aiming to decrease the incidence of HAIs may have a potentially large impact on outcomes in injured patients.

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