



Medical and Surgical Complications in Three Tertiary Hospitals in the Northeast of Iran: A Multicenter Study

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ABSTRACT

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Introduction: An adverse event (AE) is defined as an intended condition caused by medical errors or during hospitalization. Evidence in this regard is scarce and outdated. The present study aimed to evaluate the prevalence of medical and surgical AEs in three tertiary hospitals in the northeast of Iran.

Methods: This cross-sectional study was conducted on all the admitted patients to three trauma-specialized hospitals affiliated to Mashhad University of Medical Sciences due to AEs (n=1,121) in 2014. Identification of the AEs was accomplished using the International Classification of Diseases 10.

Results: The prevalence of AEs was estimated at 1.2%. The mean age of the patients exposed to AEs was 36.5±19.5 years, and 74% of these cases (n=830) were male. The mean length of hospital stay in these patients was 9.8±12.7 days. The majority of the reported AEs (n=1,020; 91%) were caused by surgical and other medical procedures, such as the abnormal reaction of patients, later complication, and not mentioning the misadventure upon the procedure. The mortality rate among the patients was determined to be 2.4%.

Conclusion: Although the rate of postoperative complications was relatively low, more strict academic protocols must be exploited in order to prevent AEs, especially in critical periods, such as summer.

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Introduction

Each year, several patients experience adverse events, which may result in temporary disabilities or even death (1). An adverse event (AE) is defined as an unintended condition, which is caused by errors in medical management and hospitalization (2). Medical complication analyses could be considered a criterion for drug approval and efficacy (3-5). Today, healthcare decision-makers pay special attention to AEs in order to determine effective

medical policies and future scheduling (6).

In a research conducted at Harvard University, 3.7% of hospital admissions were reported to be associated with AEs, 70% and 7% of which caused temporary and permanent disabilities, respectively. Moreover, the mortality rate of AEs has been estimated at 14% (7). Studies have also reported corroborant findings in this regard despite some discrepancies (8-10). Some countries have even

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reported considerably high rates of AEs (e.g., 90%) (11). It is notable that approximately 35% of AEs are preventable (12).

According to a report published by the United States Institute of Medicine, the mortality rate of AEs is higher than other leading causes of death, such as road accidents, breast cancer, and AIDS (13). Furthermore, AEs pose an economic burden on the community, even in developed countries (14, 15). Comparison of the monthly expenses of the patients with and without AEs indicates a substantial difference in this regard (5320 versus 854 dollars) (16). Surgical AEs are extremely severe, while preventable as well (17). According to the literature, the ratio of adverse drug reactions and operative AEs is higher than diagnostic AEs (7).

International Classification of Diseases (ICD) has been developed to classify diagnoses and other health-related data of hospitalized patients. This protocol facilitates the collection of morbidity data in a standard format, as well as the collection, storage, and analysis of comparable data in every country (18). In total, 110 countries use the 10th revision of ICD, including Iran (19). To the best of our knowledge, only one study in Tehran (the capital of Iran) has been focused on this issue. According to the findings, 11% of patients experienced AEs during their hospitalization in 2012 (12). Given the importance of access to the data on the frequency of AEs and the current knowledge gap in this regard, the present study aimed to evaluate the prevalence of medical and surgical AEs based on ICD-10 in three tertiary, teaching, trauma-specialized hospitals in the northeast of Iran.

Methods

This cross-sectional study was conducted on all the admitted patients in three hospitals that provide specialized care for trauma patients in Mashhad, Iran in 2014. With an estimated population of 3,312,090, Mashhad is the second most populated city in Iran after Tehran, located in the northeast of this country (20).

Identification of AEs was accomplished using the ICD-10 diagnostic code. The ICD-10 codes regarding AEs are within the range of Y40-Y84. The cases in the present study were divided into three subgroups. The ICD-10 codes Y40-Y59 constituted the first subgroup, which included drugs, medications, and biological substances that cause adverse effects with therapeutic use. The second subgroup represented by Y60-Y69 codes included the misadventures of patients during surgical and medical procedures. The last subgroup was represented by Y83-Y84 codes and included surgical and other medical procedures as the cause of the abnormal reactions of patients or later compli-

cation, without the mention of the misadventure upon the procedure.

Data on gender, date of admission and discharge, and discharge status (alive/deceased) were obtained from the hospital information system anonymously for the study population using a checklist. The study protocol was approved by the Ethics Committee of Mashhad University of Medical Sciences (code: IR.MUMS.REC.1394.750).

Data analysis was performed in SPSS version 16 using descriptive statistics (frequency, percentage, mean, standard deviation and range) and inferential statistics, including Chi-square and analysis of variance (ANOVA). In all the statistical analyses, two-tailed P-value of less than 0.05 was considered significant.

Results

Among the admitted patients to the selected trauma hospitals (n=86,252) in 2014, 1,121 cases (1.2%) suffered from medical and surgical complications. The mean age of the patients was 36.5 ± 19.5 years (age range: 2-90 years), and 74% of the patients (n=830) were male. Distribution of the cases with medical or surgical complications was as follows: hospital A: n=956, 6.6%, hospital B: n=59, 0.4%, and hospital C: n=106 (0.1%).

The chronological analysis indicated that most of the AEs occurred in summer (32.4%), followed by spring (27.7%), autumn (22.4%), and winter (17.6%). In addition, the highest frequency of AEs was observed in August (n=129, 11.5%). In terms of the day of occurrence, the highest frequency of AEs was observed on Tuesdays (n=228, 20.3%), followed by Saturdays (n=183, 16.3%). On the other hand, the rate of AEs was lowest on Fridays (n=81, 7.2%). As can be seen in Figure 1, the time interval of 10 AM-12 PM represented the highest frequency of AEs.

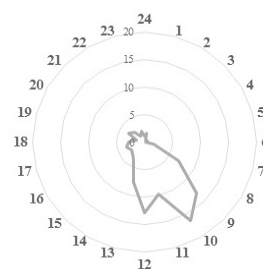


Figure 1. Frequency of Adverse Events at 24-hour Intervals

According to the obtained results, the recovery rate of the patients was 76% (n=850), while the overall mortality rate was estimated at 2.4%. Among known recorded mechanisms, surgeries involving the implant of an artificial internal de-

vice (5.2%) accounted for the highest frequency of complications and AEs followed by Agents primarily affecting blood constituents (4.8%)(Table

1). By ignoring Y60-Y69 category which only had 1 patient, the Y40-Y59 category had the highest mortality ratio.

Table 1. Frequency of Medical and Surgical Complications Based on Code Blocks of ICD10- in Specialized Trauma Hospitals

| ICD-10 code Blocks | Code Description | ICD-10 Code | Code Description | Patients* | Mortalities** |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------|--------------|---------------|
| Y40-Y59 | Drugs, medicaments and biological substances causing adverse effects in therapeutic use | Y40 | Systemic antibiotics | 3 (0.3%) | 6 (6%) |
| | | Y41 | Other systemic anti-infectives and antiparasitics | 1 (0.1%) | |
| | | Y42 | Hormones and their synthetic substitutes and antagonists, not elsewhere classified | 2 (0.2%) | |
| | | Y43 | Primarily systemic agents | 6 (0.5%) | |
| | | Y44 | Agents primarily affecting blood constituents | 54 (4.8%) | |
| | | Y45 | Analgesics, antipyretics and anti-inflammatory drugs | 4 (0.4%) | |
| | | Y46 | Antiepileptics and antiparkinsonism drugs | 2 (0.2%) | |
| | | Y47 | Sedatives, hypnotics and antianxiety drugs | 1 (0.1%) | |
| | | Y49 | Psychotropic drugs, not elsewhere classified | 5 (0.5%) | |
| | | Y50 | Central nervous system stimulants, not elsewhere classified | 1 (0.1%) | |
| | | Y52 | Agents primarily affecting the cardiovascular system | 9 (0.8%) | |
| | | Y54 | Agents primarily affecting water-balance and mineral and uric acid metabolism | 7 (0.7%) | |
| | | Y57 | Other and unspecified drugs and medicaments | 3 (0.3%) | |
| | | Y59 | Other and unspecified vaccines and biological substances | 2 (0.2%) | |
| Y60-Y69 | Misadventures to patients during surgical and medical care | Y60.8 | During other surgical and medical care | 1 (0.1%) | 1 (100%) |
| Y83-Y84 | Surgical and other medical procedures as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure | Y83.1 | Surgical operation with implant of artificial internal device | 56 (5.0%) | 20 (2%) |
| | | Y83.2 | Surgical operation with anastomosis, bypass or graft | 1 (0.1%) | |
| | | Y83.5 | Amputation of limb(s) | 22 (2%) | |
| | | Y83.6 | Removal of other organ (partial) (total) | 8 (0.7%) | |
| | | Y83.8 | Other surgical procedures | 106 (9.5%) | |
| | | Y83.9 | Surgical procedure, unspecified | 103 (9.2%) | |
| | | Y84.4 | Aspiration of fluid | 2 (0.2%) | |
| | | Y84.5 | Insertion of gastric or duodenal sound | 2 (0.2%) | |
| | | Y84.8 | Other medical procedures | 7 (0.6%) | |
| | | Y84.9 | Medical procedure, unspecified | 713 (63.56%) | |

* Patients' frequency percentages are calculated for total admitted patients

**Mortality percentages are calculated for each ICD-10 code block

The mean length of hospital stay in the patients exposed to AEs was 12.7 ± 9.8 days (range: 116-0 days). The patients in the Y83-Y84 category had the highest length of hospital stay, while the patients in the Y40-Y59 category were the eldest ($P < 0.001$). It is also notable that the predominance of males over females was only observed in the Y83-Y84 category (Table 2).

Table 2. Comparison of Some Main Variables between Various ICD Categories.

| ICD-10 Category | Male/ Female | Age (year) | Length of Hospital Stay (day) |
|-----------------|-----------------|-------------------|-------------------------------------|
| Y40-Y59 | 49/51 | 59.96 (19.84)* | 6.71 (7.13) |
| Y60-Y69 | 0/1 | 49 | 55 |
| Y83-Y84 | 781/239 | 34.21 (17.92) | 10.11 (13.08) |
| P-value | - | <0.001 | <0.001 |

*Data represented as mean \pm SD

Discussion

One of the main objectives of the current research was to determine the possible association between age, length of hospital stay, and rate of the complications caused by medical procedures. According to the findings, the frequency of AEs in the selected trauma-specialized hospitals was 1.2% in 2014.

Consistent with the study by Wilson, our findings indicated that surgical AEs had the highest frequency (21). In addition, the results of the present study confirmed that misadventures to patients during surgical and medical procedures were extremely rare. It seems that the number of the cases with AEs due to these procedures has been underestimated in the trauma-specialized hospitals in Mashhad. As such, the revision of the management in this regard is highly recommended.

In recent years, researchers have investigated several approaches to determining the impact of gender on AEs, while there are immense controversies in this regard with no proven conclusion in this regard. For instance, a study published in 2012 reported a complete irrelevance between gender and occurrence of AEs (10). However, the findings of the current research indicated that gender susceptibility varied in different ICD-10 categories. The frequency of male patients was three times higher than females in the Y83-Y84 category. Therefore, it could be concluded that men are more susceptible to AEs, while they are also at the higher risk of traumas compared to women.

The chronological pattern in AE occurrence could be explained by the high number of trips in

summer, especially in August. In addition to referrals from other provinces, this could also be due to medical tourism that has been considerably established in Mashhad in recent years. It is also notable that complicated medical services (e.g., surgeries) are often delivered at low costs in Iran.

Another objective of the current research was to determine the association between the age of patients and frequency of AEs. A report in this regard denoted no association between AEs and age (22). However, our findings indicated that age could be a risk factor for the drugs, medications, and biological substances that may exert adverse effects in therapeutic use. Elderly patients normally use more drugs and medications, which reduces their bone mass and resistance, makes their morale fragile, and remarkably decreases their mobility. Therefore, these patients are highly susceptible to medical and surgical complications (23-26).

According to the results of the present study, agents primarily affecting blood constituents (namely anticoagulants) were the most common sources of complications for the category of drugs and biological substances, which is consistent with the findings of previous studies. Anticoagulants such as heparin have been reported to be the most common drugs to cause adverse drug events (ADEs) in hospitalized patients (27-31). For instance, a study conducted in Boston (USA) indicated that the patients who suffered from the ADEs caused by anticoagulants experienced a high rate of readmission (17.5%) within approximately 30 days. On the other hand, it is estimated that nearly 70% of the AEs that are caused by anticoagulants are preventable (32). This finding is of paramount importance considering the use of new technologies and tools in the care of the patients who require anticoagulant therapy. In this regard, the revision of the current protocols could reduce the rate of the AEs associated with anticoagulant therapy (33,34).

Among the complications caused by surgical procedures, device implantation was observed to cause a higher rate of AEs compared to the other mechanisms in the present study (35). It is assumed that the rapid advancement in the development of the shape, size, and composition of artificial devices has decreased the frequency of the associated AEs. However, the inherent complexity of these procedures should not be overlooked. In general, caution is required in order to ensure the proper and safe implantation of such devices, so that any preventable AEs would be avoided.

One of the limitations of the current research was that it was a one-year, cross-sectional study, and due to the time constraint, the AE trends

could not be assessed. On the other hand, the main strength of the study was the investigation of three main trauma-specialized hospitals in Mashhad; as a result, the findings could be a fair estimation of the entire city. Meanwhile, countrywide research in this regard could uncover exceptionally useful and reliable data on the risk factors for medical complications.

Conclusion

According to the results, the rate of postoperative complications was relatively low. However, more strict academic protocols could prevent the occurrence of AEs, especially in critical periods (e.g., summer).

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Conflict of Interest

The authors declare no conflict of interest.

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