Hospital acquired blood stream infection as an adverse outcome for patients admitted to hospital with other principle diagnosis

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ABSTRACT

Background: Hospital acquired infections (HAI) have emerged as an important public health problem and are a leading cause of morbidity and mortality worldwide. They affect both developed and resource-poor countries and constitute a significant burden both for the patient and for the health care system. Specific objectives in this study are assessment of HAI rate among patients admitted with other principle diagnosis, to identifying the causative agents of hospital acquired infections and to identify some possible risk factors associated with each type of infection, both health related and non-health related. **Patients and Methods:** The study was done on selected diagnosis groups during year 2010. The infections were found among 250 patients (43.6% males) have been exposed to episodes of infections. Median age of patients was 56. Data were abstracted from the archived patients' files in medical record department using the annually infection control log-book prepared by the infection control department. The Data collected were demographic information about the patients (age and sex), clinical condition (diagnosis and the length of hospital stay) and possible risk factors for infection as smoking, diabetes mellitus, hypertension and exposure to invasive devices or exposure to surgical procedures. **Results:** Liver diseases 22.8%, cardiac diseases 22.8%, Gastro-Intestinal System diseases 20%, urinary system diseases 13.6%, and endocrinal disorder 13.6% Prostate gland diseases 7.2%. Episodes of infections caused by 9 types of organisms divided into 47.2% for blood stream infection and 52.8% for other types. 66% acquired blood stream infection were exposed to central venous line. **Conclusion:** Most common type of HAIs was blood stream infections. Liver, cardiac diseases and gastro-intestinal diseased patients show more proportion of HAIs while urinary system and prostate disease patients show less proportion of HAIs. Gram negative bacilli were the most common organisms found in our study (60%).

Key words: Adverse outcome, hospital acquired infection, principle diagnosis

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INTRODUCTION

Hospital acquired infection (HAI) is defined as one that was neither present, nor incubating, at the time of admission to hospital and which manifests itself 48 h or more after hospital admission. HAI became an increasing worldwide problem, as every year many lives are lost because of the spread of infections in hospitals.[1]

This is why a new revolution in the infection control field has been started all over the world. This has not been only coincided to the well-developed countries, but also developing countries started to focus on such issue. It became very important to review and update the epidemiology and outcome of infections; including an examination of the associated possible risk factors that are most strongly related to HAI.[2]

Understanding these variables will help to prioritize resources and plan strategies for decreasing the mortality and morbidity associated with each type of infection and to enhance infection control procedures in hospital and to assist the infection control practitioners in minimizing

the number of infected patients through understanding the profile of HAI.[3]

Specific objectives in this study are assessment of HAI rate among patients admitted with other principle diagnosis, identifying the causative agents of HAI and to identify some possible risk factors associated with each type of infection, both health-related and nonhealth-related, regarding blood stream infection (BSI).[4]

MATERIALS AND METHODS

This is a cross-sectional hospital-based descriptive study, conducted in a university hospital. A total of 920 beds with an established infection control system that performs a continuous active surveillance among 250 inpatients admitted to the study hospital in period of time during 2010 with other principle diagnosis, other than cause of nosocomial infections, traced by infection control department during this period (primary and secondary infections).

The infection control log-book was reviewed and all cases meeting our inclusion criteria were selected. Infection control log-book in the infection control department is created as follows: Each patient admitted to the study hospital had his own file with unique medical identification number. If any admitted patient developed any signs or symptoms suspicious of infections; hence, samples were collected according to the type of infection and sent to the microbiology laboratory to be examined. Type of infection for each patient is determined according to preset clear case definition approved and documented in the infection control guidelines of the hospital. Case definition is based on the clinical picture and the bacteriological examination. Confirmed types of infections are verified as previously stated, the cases are then recorded into the infection control log-book.

Medical identification number of the patients selected from the infection control log-book was used to retrieve the archived files of the patients. Items collected in a data collection sheet were sociodemographic information, clinical condition of the patients (diagnosis and the length of hospital stay), and medical history of the patients (smoking, diabetes mellitus, and hypertension), exposure to invasive devices or exposure to surgical procedures.

Data were entered in Excel Sheet, and then transferred to SPSS version 14 for data analysis. Simple frequency tables and cross tabulation were generated to describe the data. Chi-square and *t*-test were used to compare qualitative and quantitative data respectively. Significance was set at 0.05 level. Current study was approved by the Ethical

Committee. Data were coded and patient names or identity did not appear in any of data collection forms or during statistical analysis.

RESULTS

The study was done on selected diagnosis groups during the period of 12 months of year 2010. The infections detected were found among 250 patients of both sexes (43.6% males) [Table 1].

The 250 patients have been exposed to episodes of HAI. Liver diseases 22.8%, cardiac diseases 22.8%, gastrointestinal system diseases 20%, urinary system diseases 13.6%, and endocrinal disorder 13.6% prostate gland diseases 7.2% [Table 2].

Among the study group 35%, 43%, and 43% were smoker, diabetic and hypertensive, respectively [Table 3].

About 81% of the patients had only a single episode of infection. 19% of the patients had multiple episodes of infection. Less than one-third (28%) of the gastrointestinal system diseases patients had multiple episodes followed by the liver diseases patients (22%) and then urinary system

Table 1: Sex distribution

Gender	Number	Percentage
Male	109	43.6
Female	141	56.4
Total	250	100

Table 2: Distribution of diagnoses among 250 patients

Diagnosis group	All patients	
	Number	Percentage
Liver diseases	57	22.8
Cardiac diseases	57	22.8
Gastrointestinal system diseases	50	20.0
Endocrinal disorders	34	13.6
Urinary system diseases	34	13.6
Prostate gland diseases	18	7.2
Total	250	100.0

Table 3: Some characteristics of our study population

Characteristics of study population	Yes		No		Total
	Number	Percentage	Number	Percentage	
Smoking	88	35	162	65	250
Diabetes	108	43	142	57	250
Hypertension	108	43	142	57	250

diseases patients (20%) and at last the prostate gland diseases patients by (11%). Thus, the gastrointestinal system diseases patients were more prone to acquire single episode of infections, cardiac and endocrinal diseases acquired multiple episodes [Table 4].

Blood stream infection was the most common type of HAI in the study population (odds ratio [OR] = 4.34), (*P* = 0.00). 47.2% for BSI and 52.8% for other types of HAIs. Gram-negative *Bacilli* were the most common organisms found in our study 60% [Figure 1].

A total of nine organisms were detected in all episodes of infections. *Escherichia coli*, *Enterococcus*, cons and *Pseudomonas* are the most common organism involved in HAI with percent 16%, The most common organism isolated from hospital acquired BSI episodes-related to liver disease patients was *E. coli* (21.7%). The most common organism isolated from HAI-related to renal and urinary tract disease cases were *E. coli* (21.7%). The most common organism isolated from HAI belonging to gastrointestinal tract disease cases were cons (17.9%) and *Pseudomonas* (14.3%) [Figure 2].

50% of the patients with HAI are those who underwent use of operation room, performing arterial line, or ventilated. About 66% of the infected patients had urinary catheterization. 75% of the patients with HAI had a central venous line performed [Table 5].

There was statistical significance between the length of the hospital stay and HAI (*P* < 0.01).

DISCUSSION

In our study, 43.6% of the hospital infection episodes were related to male patients, however, another study showed that males are more responsive to infections, whereas females are more responsive to noninfectious inflammation (the ratio is 4:1) and to auto-inflammatory diseases.[5]

The mean age of the patients included in our study was (56.21 ± 15.36) which shows that most of the infected patients were relatively old. Many studies described age as a risk factor for infections, especially the extremities

Table 4: Distribution of the diagnosis group with single infection episode

Diagnosis group	All patients		Single episode	
	Number	Percentage	Number	Percentage
Liver diseases	57	22.8	55	22
Gastrointestinal system diseases	50	20.0	70	28
Urinary system diseases	34	13.6	50	20
Prostate gland diseases	18	7.2	28	11
Cardiac diseases	57	22.8	0	0
Endocrinal disorders	34	13.6	0	0
Total	250	100.0	203	81

Table 5: Proportion of the hospital acquired infection by type of hospital intervention

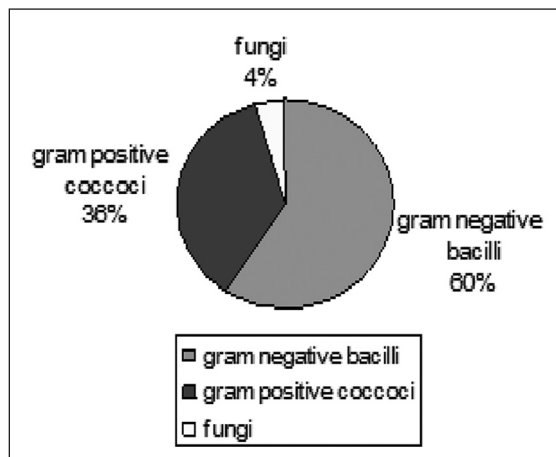| Type of intervention	Number of patients with known status toward interventions	Cases exposed to the intervention	Percentage
Central venous line	66	50	75.8
Urinary catheterization	65	43	66.2
Utilize operation room	66	33	50
Arterial line	65	34	50
Ventilated	65	35	50

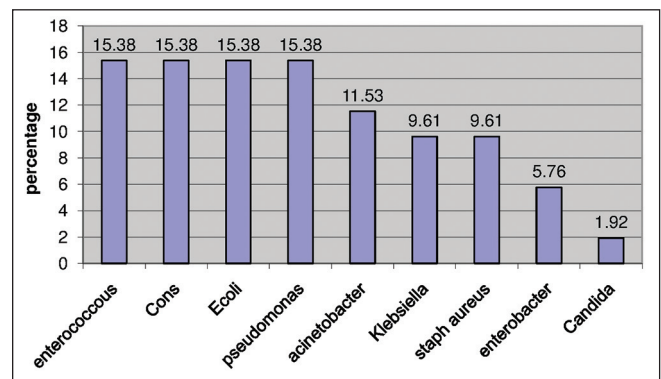**Figure 1:** Type of organisms found in all episodes according their gram type

Figure 2: Causative organisms isolated from hospital acquired blood stream infections episodes

of age. Very old and very young patients (premature and neonates) are considered the vulnerable group and the most susceptible for immunity system dysfunction as proved in other studies [Figure 3].[6]

Our study showed that the gastrointestinal system diseases patients had the biggest contribution (28%) to those who suffered from multiple episodes of infections, followed by the liver diseases patients (22.9%), then urinary system diseases patients (20.6%), and finally the prostate gland diseases patients by (11.1%).

Several studies showed that the gastrointestinal system diseases patients have higher chances of getting infections due to immunomicrobiological characteristics of the intestine.[7]

It was also found that the translocation of the enteral micro-flora in acute intestinal obstruction was accompanied by the penetration of infective agents into the general blood stream.[8]

In our study, liver and gastrointestinal diseases groups show more HAI. On the other hand, urinary system and prostate diseases show less proportion of HAI. Several studies concluded that liver disease patients, especially those with cirrhosis, have altered immune defenses and are considered immune-compromised individuals. Changes in gut motility, mucosal defense, and micro-flora allow for translocation of enteric bacteria into mesenteric lymph nodes and the blood stream. In addition, the cirrhotic liver is ineffective at clearing bacteria and associated endotoxins from the blood, thus allowing for seeding of the sterile peritoneal fluid.[9]

In our study, we found that BSI episodes were the most common type of infection affecting 56%, 42%, and 32% of liver diseases patients, urinary system diseases patients and gastrointestinal system diseases patients, respectively. Similar finding was concluded in another study found that

Figure 3: Age-related infection

BSIs were the most common type of infection affecting 33% of living donor liver recipient and 24% of cadaver donor liver recipient.[10]

Blood stream infection was the most common type of HAI in the study population (OR = 4.34). A total of 358 nosocomial infections were diagnosed among 1051 neonates admitted to the neonatal intensive care unit. BSI was the most frequent nosocomial infection (in 195 neonates [54.5%]), followed by pneumonia (46 [12.8%]). Gram-negative *Bacilli* were the most common organisms (60%) found in our study, followed by Gram-positive cocci (36%) and then fungi (4%). The same findings were found in another study at National Cheng Kung University Hospital from 1996 to 2003. There were 4038 episodes of nosocomial BSIs.[11]

Gram-negative *Bacilli*, Gram-positive-cocci and fungi were responsible for 51%, 37% and 10%, respectively In our study, the common organisms detected in HAI are *E. coli* (found in 18.4% and 29.2%, respectively), followed by *Pseudomonas* (14% and 4.6%, respectively), Klebsiella (13.2 and 6.2%, respectively) and Enterococcus (13.2 and 15.4%, respectively). Almost similar results were found in a study describing the highly resistant microorganisms in a teaching hospital at The Netherlands.[12]

It was found that *E. coli* contributed to 56%, while Klebsiella contributed to 6.5% of infections in our study, the most common organisms isolated from hospital acquired BSI were coagulase-negative staphylococci (Cons), *Pseudomonas*, *E. coli*, and Enterococcus. Each had a 15.4% contribution to hospital acquired BSI. The same findings were concluded in a study that stated that the most frequently isolated microorganisms were coagulase-negative staphylococci (Cons).[13]

We found that 42.3% of the organisms isolated from BSI were Gram-positive cocci and 55.8% were Gram-negative organisms. However, the reverse was found by Diekema *et al*. who stated that 60% of the organisms were Gram-positive and 31% Gram-negative.[14]

In our study, the most common organisms isolated from community acquired BSI were Cons (29.2%), Enterococcus (16.7%), *Staphylococcus aureus* (12.5%) and *E. coli* (12.5%). A study was performed in National Tokyo Medical Center from the period between November 2000 and October 2001 found that the most common organisms were *E. coli*, viridan group of streptococci, Streptococcus pneumonia.[15]

Twenty-seven of 32 patients who suffered from hospital acquired BSI were exposed to central venous line before the onset of infection (66%). Nearly, the same findings were found
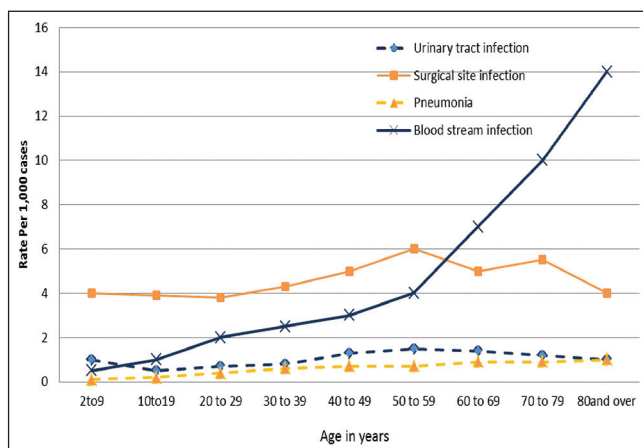
Table 6: HAI and length of hospital stay

Type of cases	Number of cases	Number mortality	Percent mortality	Average length of stay (in days)	Average charge
Cases with HAI	19,154	2,478	12.9	20.6	$185,260
Cases without HAI	1,550,010	36,238	2.3	4.5	$31,389

HAI: Hospital acquired infections

in a study conducted by Argentina's National Surveillance of Hospital Infections Program on 127 illnesses.[16]

Bloodstream infections took second place, at 20.5%, with 61% of these cases being associated with a central catheter. Several studies confirmed that prolonged hospitalization will not only act as a risk factor for the development of nosocomial infections, but it increases the incidence of infection by multidrug resistance organisms.[17]

In our study the median of the hospital length was 28.5 days in HAI cases while the median for community acquired episodes was 7 days. Hospital acquired infections directly proportionated with length of hospital stay in other study at which average length of stay was 20.6 days for cases with HAI in comparison to 4.5 days in cases without [Table 6].[17]

CONCLUSION

The most common type of HAI was BSI episodes. Liver, cardiac diseases and gastrointestinal disease patients show more HAI. Urinary system and prostate disease patients show less proportion of HAI. Gram-negative *Bacilli* were the most common organisms found in our study (60%). The most common organisms isolated from hospital acquired BSIs were Cons, *Pseudomonas*, *E. coli*, and Enterococcus.

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