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BACTERIAL ETIOLOGY OF HOSPITAL ACQUIRED INFECTION AMONG THE INTENSIVE CARE UNIT (ICU) PATIENTS ADMITTED AT A PRIVATE HOSPITAL IN DHAKA CITY

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ABSTRACT

Context: Hospital acquired infections (HAIs) increases mortality and morbidity among Intensive Care Unit (ICU). **Objectives:** The Purpose of the present study was to assess the frequency of hospital acquired infection in ICU patients with their association to patients and hospital related factors. **Materials and Methods:** This was designed as analytical type of cross sectional study. The study population comprised of admitted ICU patients in United Hospital Ltd., Dhaka, Bangladesh who were available 48 hours after admission from March 2014 to August 2014. Blood, Tracheal Aspirate and Urine of specimens were collected from patients. The organisms were isolated from specimen by inoculation and subculture on blood agar and MacConkey agar media. Identification of the organisms was done by colony morphology, gram staining and standard biochemical tests. All the isolates were tested for sensitivity against antimicrobial agents by disc diffusing method of Kirby Bauer et al (1966). The potency of each batch of disc was standardized by the reference strain of ATCC *Esch. Coli*, No 25922 and *Pseudomonas aeruginosa* No 27853. Zone of inhibition were compared with the standard value and was considered as sensitive (S), Intermediate sensitive (IS) and resistant (R) according to the NCCLS (1998). Data were checked, verified and coded into computer by using SPSS (Statistical Package for Social Science) Programme version (16.0). **Result:** A total number of 134 patients from ICU having HAI were studied. Among the study population, tracheal aspirate were collected from 86, Blood from 85 and urine from 75 patients. The culture positivity was highest in tracheal aspirate of samples 86(78.2%) followed by blood 22 (25.9%) and urine 15 (20%). The predominant organisms were *Acinetobacter spp.* (27.6%), followed by *Serratia spp.* (17.9%). The antibiogram showed *Acinetobacter spp*. were 83% sensitive only to colistin followed by imipenem 67%. High resistances (100%) were found against amikacin, amoxyclavonic acid and ceftriaxone. *K. pneumoniae* were 100% sensitive to colistin followed by imipenem 80%. Increasing number of visitors was reported at more risk of HAI. Application of invasive device, use of immunosuppressive therapy, immunosuppressive condition and surgical interventions were found statistically significant association of developing HAI ($p<0.05$). Hospital related factors does not show any positive correlation with HAI ($P>0.05$). Conclusion: Study may be concluded that culture positivity was highest in tracheal aspirate and predominant organism was *Acinetobacter spp*. Bacteria isolated from ICU were resistant to commonly used antibiotics which makes more difficult to effective interventions. Risk factors like use of invasive device, Immunosuppressive therapy, surgical procedures are found responsible to develop HAI.

KEYWORDS: Hospital Acquired Infection (HAI), Intensive Care Unit (ICU), Respondent, Tracheal aspirate, blood, urine, antibiogram.

INTRODUCTION

The hospital- acquired infections are among major causes of death and increased morbidity in developed and developing countries resulting to significant burden both for patients as well as public health (World Health Organization (2002). Intensive care unit is a specially staffed and equipped hospital ward dedicated to the management of patients with life threaten illness, injuries or complication (Weinstein RA (1998). Patients hospitalized in intensive care units (ICUs) are 5 to 10 times more likely to acquire nosocomial infections than other hospital patients. Antimicrobial resistance is more prevalent in nosocomial bacterial strains than in those acquired from the community. ICUs in the hospital areas have the highest prevalence of multi drug resistant bacteria and also have the highest rates of use of high level antibiotics (Weber et al. 1999). Mechanical ventilation itself has been viewed as major risk factor for HAI in ICU.

MATERIALS AND METHODS

This was designed as analytical type of cross sectional study. Patients who were admitted in the ICU of United Hospital Limited, Dhaka, Bangladesh and were available after 48 hours of admission were studied as study population. This study was carried out from March 2014 to August 2014 for a period of six months. Patients who died or discharged from the hospital within 48 hours of admission were excluded from this study. Three types of specimen were collected which were blood, tracheal aspirate and urine. The study population was followed-up 48 hours after admission to see any evidence of infection. The study populations were kept under observation till a first event of infection or discharge without infection. After the events of hospital-acquired infections were determined on the basis of clinical evidences, the specimens of infected personnel were sent to Microbiology department to confirm the laboratory diagnosis. If culture yielded growth of organism, antibiogram was done. A questionnaire and checklist were used for data collection. On the day of admission, screening was carried out by physical examination and reviewing of medical chart to make a note whether the respondents had any infection before admission. After the study population was screened on the day of admission to confirm whether any infection acquired before admission, they were followed up till either development of first event of infection or discharge without infection. Data were entered into the SPSS (Statistical Package for Social Science) Programme Version (16.0). Results were considered statistically significant if the p value was <0.05.

RESULTS

Among 134 respondents, 72(54%) were males while the remaining 62(46%) were females (Figure 1). The rate of culture positivity of tracheal aspirate, blood and urine samples were 86(78.2%), 22(25.9%) and 15(20%) respectively (Table 1).

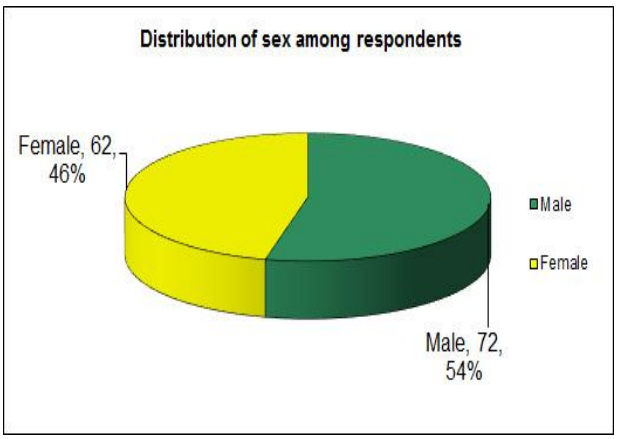

Figure 1: Distribution of respondents according to sex (n=134).

Table 1: Culture positivity in different samples of study population.

Specimen	Culture		Total
	Positive	Negative	
Blood	22(25.9%)	63(74.1%)	85
Tracheal aspirate	86(78.2%)	24(21.8%)	110
Urine	15(20.0%)	60(80%)	75
Total	123(45.5%)	147(54.5%)	270

Among 123 culture positive cases, highest number of isolates were *Acinetobacter* spp. (27.6%) followed by *Serratia spp.* (17.9%), *Klebsiella spp.* (17.1%), *Pseudomonas spp*. (14.6%), *Esch. coli* (10.6%), *Candida spp.* (8.1%), *Streptococcus spp. (3.3%) and Staph. aureus* (0.8%) cases (Figure 2).

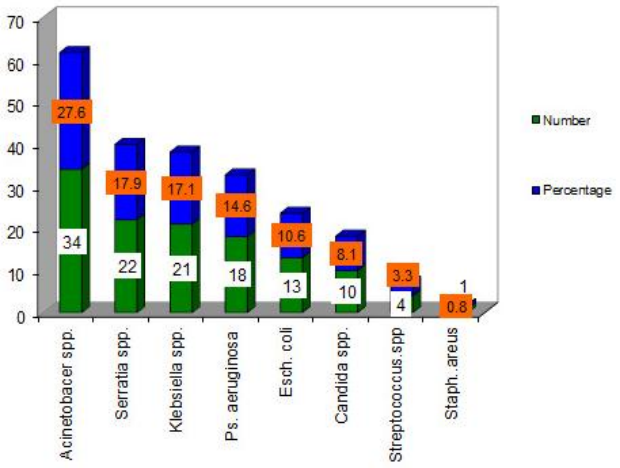

Figure 2: Types of organism isolated from culture positive cases (n=123).

Among 86 culture positive cases isolated from tracheal aspirate, highest number of isolates were *Acinetobacter spp.* (25.6%) followed by *Serratia spp.* (19.8%), *Klebsiella pneumoniae (18.6%), Pseudomonas spp*. (15.1%), *Candida spp.* (8.1%), *Esch. coli* (8.1%), *Streptococcus spp.* (3.5%) *and Staph. aureus* (1.2%) cases (Figure 2). A total of 22 blood culture positive cases, highest equal number of isolates were found from both *Klebsiella pneumoniae* (22.7%) *and Pseudomonas spp*. (22.7%). 2nd highest *Serratia spp.* (13.6%) and *Esch. coli* (13.6%) both, *Acinetobacter spp.* (18.2%), *Streptococcus spp.* (4.5%) *and Candida spp*. (4.5%) cases (Table 2)**.** Out of 15 culture positive urine samples, highest number of isolates were *Acinetobacter spp*. (53.3) followed by *Esch. coli* (20.0%), *Serratia spp.* (13.3) and *Candida spp*. (13.3%) (Table 2).

Table 2: Bacterial distribution in three types of specimen.

Bacteria	Tracheal aspirate	Blood	Urine	Total
Acinetobacter spp.	22(25.6%)	4(18.2%)	8(53.3%)	34
Serratia spp.	17(19.8%)	3(13.6%)	2(13.3%)	22
Klebsiella spp.	16(18.6%)	5(22.7%)	-	21
Pseudomonas spp.	13(15.1%)	5(22.7%)	-	18
Candida. spp.	7(8.1%)	1(4.5%)	2(13.3%)	10
Esch. coli	7(8.1%)	3(13.6%)	3(20.0%)	13
Streptococcus spp.	3(3.5%)	1(4.5%)	-	4
Staph. aureus	1(1.2%)	-	-	1
Total	86(78.2%)	22(25.9%)	15(20%)	123(45.5%)

It is an evident from the study that 41.5% respondents developed nosocomial infection who were visited by more than three visitors while 12.1%, 14.4% and 32.0% respondents developed HAI who were visited by one, two or three visitors respectively (Figure 3). Table 3 showed that out of 68 patients using invasive device application, 13(19.1%) of them developed infection; whereas out of 66 respondents without invasive device, only 5(7.6%) of them had infection. HAI was found significantly associated with application of invasive device statistically ($p<0.05$).

Table 3: Distribution of respondents developed HAI by the presence of invasive device.

Invasive device	HAI Infection		Total
	Present	Absent	
Yes	13(19%)	55(81%)	68(100%)
No	5(7.6%)	61(92.4%)	66(100%)
Total	18(13.4%)	116(86.6%)	134(100%)

Test statistics: $X^2 = 3.837$, df=1, $p<0.05$

Out of 37 respondents taking immunosuppressive therapy, 12(32.4%) developed infection in comparison to 6(6.2%) out of 97 not treating with immunosuppressive therapy. The study result found the association of developing HAI because of treating with immunosuppressive therapy as the difference was found statistically highly significant ($p<0.001$) (Table 4).

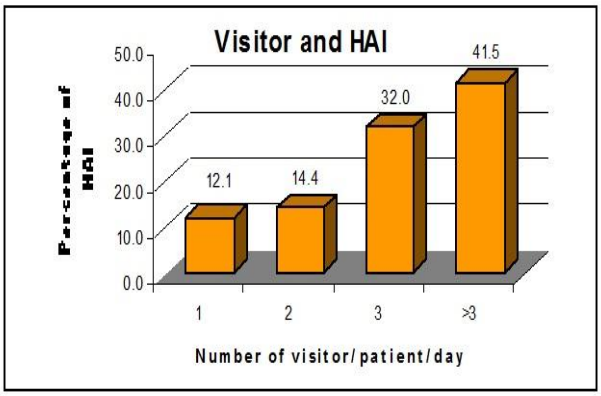

Figure 3: Number of visitor per day per patient and development of HAI.

Out of 134 respondents, 39 patients were undergone treatment along with immunosuppressive condition and 95 patients did not have such condition. Among the patients under immunosuppressive condition, 11 (28.2%) cases developed infection; while out of 95 cases without immunosuppressive condition 7(7.4%) respondents developed infection The study result found statistically highly significant ($p<0.001$) (Table 5).

Table 4: Distribution of respondents developed HAI by immunosuppressive therapy.

Presence of immunosuppressive therapy	HAI Infection		Total
	Present	Absent	
Yes	12(32.4%)	25(73.6%)	37(100%)
No	6(6.2%)	91(93.8%)	97(100%)
Total	18(13.4%)	116(86.6%)	134(100%)

Test statistics: $X^2 = 15.867$, df=1, $p<0.001$

Table 5: Distribution of respondents developed HAI presence of immunosuppressive condition.

Presence of immunosuppressive condition	HAI Infection		Total
	Present	Absent	
Yes	11(28.2%)	28(71.8%)	39(%)
No	7(7.4%)	88(92.6%)	95(%)
Total	18(13.4%)	116(86.6%)	134(100%)

Test statistics: $X^2 = 10.323$, df=1, $p<0.001$

Out of 134 respondents, 32 respondents undergone surgery at present 8(25%) respondents developed infection (postoperative) while 10(9.8%) respondents out of 102 developed infections who did not undergo any surgery at that period. The association between surgery at present and development of hospital-acquired infection was found statistically significant ($p<0.05$) (Table-6).

Table 6: Distribution of respondents developed HAI by stage of operation.

Stage of operation	HAI Infection		Total
	Present	Absent	
Post operative	8(25%)	24(75%)	32(100%)
Pre operative	10(9.8%)	92(90.2%)	102(100%)
Total	18(13.4%)	116(86.6%)	134(100%)

Test statistics: $X^2 = 4.837$, df=1, $p<0.05$

Around 14.3% respondents developed infection lodging in wards /departments/cabin with satisfactory general cleanliness, while around 12.8% developed infection who lodged in wards which was dirty. The association of general cleanliness and development HAI was found not statistically significant ($p>0.05$) (Table 7).

Table 7: Distribution of respondents developed HAI by general cleanliness of the wards/departments.

State of general cleanliness	HAI Infection		Total
	Present	Absent	
Satisfactory	8(14.3%)	48(85.7%)	56(100%)
Dirty	10(12.8%)	68(87.2%)	78(100%)
Total	18(13.4%)	116(86.6%)	134(100%)

Test statistics: $X^2=0.06$, df=1, $p>0.05$

DISCUSSION

In the present study, the culture positivity was highest in tracheal aspirate (78.2%) followed by blood (25.9%) and urine (20%). Shorr et al 2005 found major infecting agents were *Pseudomonas aeruginosa* and *Staph. aureus*. In the present study, the most common organisms isolated were *Acinetobacter* spp. (27.6%) followed by *Serratia spp.* (17.9%), *Klebsiella spp*. (17.1%), *Pseudomonas spp*. (14.6%), *Esch. coli* (10.6%), *Candida spp.* (8.1%), *Streptococcus spp*. (3.3%) and *Staph. aureus* (0.1%). In India, Lone et al (2009) found *Acinetobacter spp*. was the most prevalent bacteria in the intensive care unit (29.84%). In Iran, Hassanzadeh et al (2009) found *Esch. coli* (23.8%), *Acinetobacter* species (19.7%), *Klebsiella spp.* (19.5%), Candia spp. (19.5%) and *Enterobacter spp*. (10.9%) in the intensive care unit. In the present study, *Acinetobacter spp.* (25.6%) was the predominating organism in tracheal aspirate followed by *Serratia spp*. (19.8%) and *Klebsiella spp.* (18.6%). J. G. Ding et al 2009 showed *Acinetobacter baumannii (18.9%)* and *Klebsiella pneumoniae (15%)* were the most frequently isolated pathogens followed by *Pseudomonas aeruginosa (11.3%).*

The higher rate of infection by *Acinetobacter spp*. is most probably due to hospitalization of the patient for prolonged period (Garnaco et al 2005). Presence of invasive devices seems to encourage such infection. *Acinetobacter* outbreaks have been traced to common-source contamination, particularly contaminated respiratory-therapy and ventilator equipment (Garnaco et al 2005). Some strains of *Acinetobacter* can survive environmental desiccation for weeks, a characteristic that promotes transmission through fomite contamination in hospitals (Michalopoulos et al 2005).

From intensive care units in eight hospital in Turkey, Aksary et al (2000) found *Acinetobacter* were resistant to imipenem (44.9%), ceftazidime (91.8%), ceftriaxone (91.2%), cefotaxime (91.5%), cefepime (72.6%), tazobactam (89%), gentamicin (82.9%) and ciprofloxacin (67.1%). In the same study, *Klebsiella pneumoniae* was found 73% resistant to ceftazidime, 57.9% to cefotaxime, 46.8% to amikacin, 29.7% to ciprofloxacin and 3.2% to imipenem.

A study in ICU at BSMMU showed, *Klebsiella pneumoniae* were found 100% resistant to amoxicillin and cotrimoxazole, 80% to ceftazidime and sensitivity was 90% against ciprofloxacin, ceftriaxone and gentamicin (Khan 2006).

Changing patterns of antibiotics resistant were observed in the same ICU within 4 years interval due to indiscriminate use of antimicrobial drugs without specific cause of infection. The study result found that there is strong association between visitor and development of infection as it was found high percentage of HAI with higher visitor number. The present study result accord with the study done by Hossain et al. (1991) where 37.5% respondents developed infection having 9 visitors/day in comparison to 21.8% with 0-2 visitor/day. According to khan et al (2003) number of visitor/day/patient was associated in developing HAI ($p<0.001$). The study reveals that respondents having more visitors than others developed maximum number of events of infection since direct transmission of infection become easier with respondents visited by large number of visitors. Regarding the number of visitors, researcher used to depend upon patients or hospital staff to some occasions.

Regarding in application of device use, the present study is consistent with study Tukenmez Tigen et al (2014) indicating an overall infection rate of 22.1 per 1,000 ICU-days. The central line-associated bloodstream infection rate was 6.4 per 1,000 catheter-days, whereas the ventilator-associated pneumonia rate was 14.3 per 1,000 ventilator-days and the catheter-associated urinary tract infection rate was 4.3 per 1,000 catheter-days.

Regarding immunosuppressive therapy the study is consistent with Leno (2003) that infected patients were more likely to have received steroids before developing infection (RR=3.45, 95% CI 1.38-8.59).

A study was conducted by Cardoso et al (2001) and had reported that patients having cancer, DM developed hospital-acquired respiratory infection (HARI) more commonly which is similar to present study. HAIs were influenced in both the cases by immunosuppressive conditions where respondents were more susceptible to infection.

Pull ter Gunne (2009) reveals that longer surgeries (2-5 hours [P = 0.023] and 5 or more hours [P = 0.009]) were found to be independent significant risk factors for post-operative infection. The present study reveals that higher postoperative infection may be due to failure of aseptic measures during operation (Ellingson et al 2014), breach of asepsis in the post operative period (Agarwal 2003), prolonged stay in hospital due to operation (Beyersmann 2009) and exposure to a large number visitors (Roidad 2014).

In the present study, the rate of HAI was 13.4%. Among them 72.22% respiratory tract infection (RTI), 16.67% blood stream infection (BSI), 11.11% urinary tract infection (UTI) were found. Hossain et al (1991) conducted a cross-sectional study at Dhaka Medical College Hospital where they found four types of HAI. These are surgical site infection (36.1%), urinary tract infection (23.6%), respiratory tract infection (15.2%) and gastro-intestinal tract infection (12.6%) which differs with present study. This study is also not consistent with Rahman et al (2002) where UTI (36.69%) was found highest HAI rate.

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