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Research Article

A Prospective Study to Evaluate the Prevalence of Hospital Acquired Infection and Risk Factors-Associations among ICU Patients in a Private Hospital in Bangladesh

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Abstract

Background

Available research data on prevalence of hospital acquired infection (HAI) among ICU patients in Bangladesh are limited. A prospective study was carried out from March 2014 to August 2014 to evaluate the predominance of hospital acquired infection and risk factors-associations among ICU patients of private hospital, Bangladesh.

Objectives

To evaluate the dominance of hospital acquired infection and risk factors-associations among ICU patients.

Patients and Methods

A total of 134 patients from intensive care unit of suspected of having hospital acquired infection were studied. The most common organism isolated was Acinetobacter spp. 37(27.6%), followed by Serratia spp. 22 (17.9), Klebsiella spp. 21 (17.1%), Pseudomonas spp. 18 (14.6%), E-coli. 13 (10.6%), Candida spp. 10 (8.1%), Streptococcus spp. 4 (3.3%) and Staph aureus 1 (0.8%). Acinetobacter spp. was the predominating organism in tracheal aspirate and urine whereas Pseudomonas spp. and Klebsiellapneumoniae was the predominating organism isolated from blood sample.

Result

Among the study population tracheal aspirate were collected from all 86 patients, blood from 85 and urine from 75 patients. The culture positivity was highest in tracheal aspirate samples 86 (78.2%) followed by blood 22 (25.9%) and urine 15 (20%). It was an evident from the study, visitors had played a significant role in the developed of HAI ($p<0.05$). HAI was found significantly associated with applications of invasive device statistically ($p<0.05$).

Conclusion

The study showed statistically significant ($p<0.05$) of developing HAI those were treated with immunosuppressive therapy. Pre and post- operative surgical interventions showed statistically significant association of developing HAI ($p<0.05$). Hospital related factors studied in this study did not show any positive correlation with HAI ($p>0.05$) except cleaning materials ($p<0.05$).

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Keywords: Evaluate; acquired infections; intensive care unit; visitors; *Acinetobacter*; Immunosuppressive conditions.

Introduction

Despite progress in public health and hospital care, infections develop in hospitalized patients without any concession. The effect of 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 [1]. Intensive care unit is a specially staffed and equipped hospital ward dedicated to the management of patients with life threating illness, injuries or complication [2]. Patients hospitalized in intensive care units (ICUs) are 5 to 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 [3].

Mechanical ventilation itself has been viewed as major risk factor for hospital acquired infection in ICU. Endotracheal tube by pass the natural upper airway filters and therefore interferes with laryngeal and cough reflexes and impedes muscularly clearance Pharyngeal flora leaks around the cuff of endotracheal tube and by pass into the lungs predisposing to the development of pneumonia [4]. In the year 2007, from general ICU of BSMMU, Dhaka, 157 critically ill patients were studied for association between mortality and interventions/therapies [5].

Acinetobacter emerged as an important pathogen and the rate of isolation has increased since the last two decades worldwide. To see the incidence of *Acinetobacter* infection at a tertiary care hospital at Kashmir, India, an investigation was carried out over a period of 2 years [6]. *Pseudomonas aeruginosa* is one of the main organisms responsible for drug resistant nosocomial infections and is a leading cause of bacteremia and nosocomial pneumonia [7].

Methods

Setting and sample collection

All the admitted patients to ICU available after 48 hours during the data collection period fulfilling the selecting criteria were included. The total numbers of respondent were 134 from intensive care unit of United Hospital Ltd., Bangladesh. Three types of specimens were collected from patients such as blood, tracheal aspirate, and urine.

Isolates identifications

In this study, blood culture was analyzed by the instrument BACTEC 9120 series which is automated system following FAN (Fastidious antibiotic neutralization) method. This fluorescent instrument is designed for the rapid detection of bacteria in clinical blood cultures [8].

In the laboratory, the tip of the plastic suction tube was rolled over the blood agar, chocolate agar and Mac Conkey's agar in sterile way and then streaking with sterile wire loop. Blood agar and chocolate agar were incubated in candle extinction jar at 370C for overnight and Mac Conkey' sager incubates aerobically at 370C for overnight. Identification of the organisms was done from tracheal aspirate and urine by (i) colony morphology, (ii) Gram staining, (iii) relevant biochemical tests [9, 10].

Statistical analysis

The data were analyzed using SPSS software 16. Chi squared test was used to test statistical significance for differences between two groups. Statistical significance was defined by $p<0.05$.

Results

A total of 134 respondents suspected of having hospital acquired infection were studied. The result of this study has been discussed based on blood, tracheal aspirate and urine samples as well as patient related factors and

Hospital-related factors associated with hospital-acquired infection (HAI), and causative microorganisms. Among the 134 respondents, 72 (54%) were males while the remaining 62 (46%) were females as illustrated in (Figure 1).

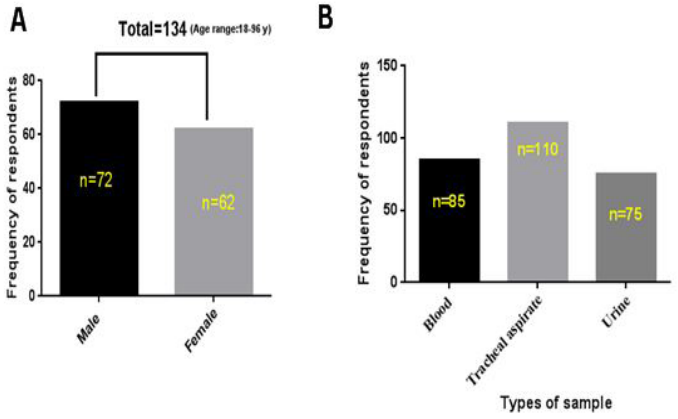

Figure 1: Distribution of respondents with sex specified and types of sample.

Total tracheal aspirate were collected from all 110 patients. Blood were collected from 85 and urine from 75 patients.

The rate of culture positivity of tracheal aspirate, blood and urine samples were 86 (78.2%), 22 (25.9%) and 15 (20%) respectively (Figure 2).

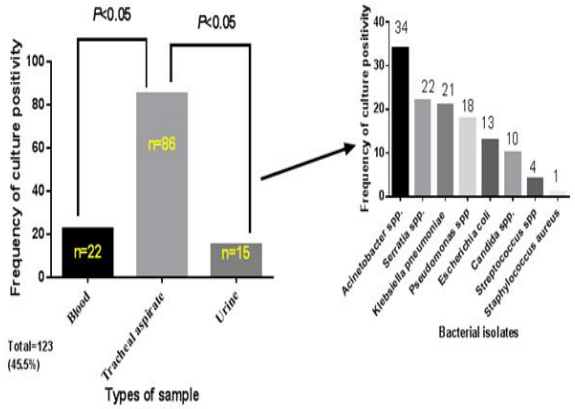

Figure 2: Culture positivity of tracheal aspirate, blood and urine samples.

In total 123 culture positive cases, highest number of isolates were *Acinetobacter* spp. in 34 (27.6%) cases followed by *Serratia spp*. 22 (17.9%), *Klebsiellapneumoniae* 21 (17.1%), *Pseudomonas spp*. 18 (14.6%), *E-coli* 13 (10.6%), *Candida spp*., 10 (8.1%), *Streptococcus spp*. 4 (3.3%) and *S. aureus* (0.8%) cases.

Among 86 culture positive cases isolated from tracheal aspirate, highest number of isolates were *Acinetobacter spp*. in 22 (25.6%) cases followed by *Serratia spp*. 17 (19.8%), *Klebsiellapneumoniae* 16 (18.6%), *Pseudomonas spp*. 13 (15.1%), *Candida spp.*, 7 (8.1%), *E-coli* 7 (8.1%), *Streptococcus spp*. 3 (3.5%) and *S. aureus* (1.2%) cases. (Figure 3 A, B, C).

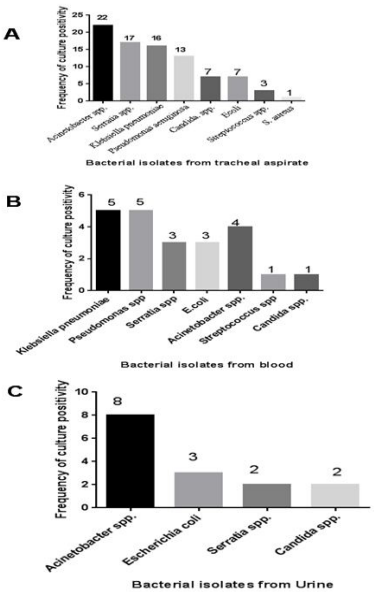

Figure 3: Bacterial isolates distribution among tracheal aspirate, blood and urine samples

The distribution of respondents by type of infection as illustrated in (Figure 4 A, B and C).

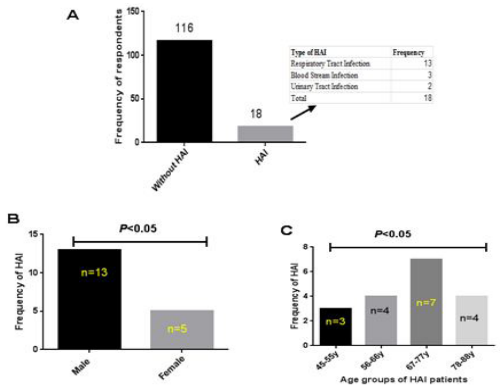

Figure 4: The distribution of respondents by HAI where out of 134 respondents (admitted patients), 18 (13.4%) respondents developed hospital acquired infection.

Where out of 134 respondents (admitted patients), 18 (13.4%) respondents developed nosocomial infection. Only 3 types of HAI were found among the respondents such as, 72.22% Respiratory Tract Infection (RTI) which was the highest followed by 16.67% Blood Stream Infection (BSI) and Urinary Tract Infection (UTI) was 11.11%.

The study found that visitor had played a significant role in the developed of HAI. It is an evident from the study that 18.2% respondents developed nosocomial infection that were visited by more than three visitors while 4.5%, 4.7% and 9.1% respondents developed HAI who were visited by one, two or three visitors re respectively (Figure 5A).

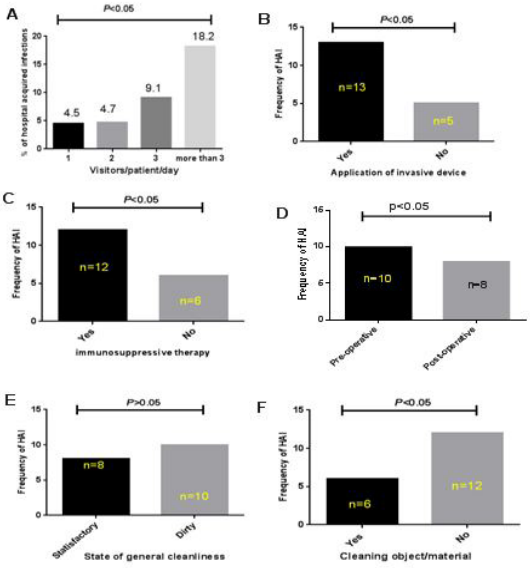

Figure 5: Patients and hospital related risk factors how relates hospital acquired infections.

The figure 5B shows out of 68 who did have invasive device application, 13 (19.1%) of them developed infection whereas out of 66 respondents of not having invasive device, only 5 (7.6%) of them had infection. HAI was found significantly associated with application of invasive device statistically ($p<0.05$). Out of 37 respondents who were given immunosuppressive therapy, 12 (32.4%) developed infection in comparison to 6 (6.2%) out of 97 not treating with immunosuppressive therapy (Figure 5B).

The study result found the association of developing HAI because of treating with immunosuppressive therapy as the difference was found statistically highly significant ($p<0.05$). Presence of immunosuppressive condition among the respondents developing HAI illustrates that out of 134 respondents, 39 were undergone treatment along with immunosuppressive condition and 95 did not have such condition. Distribution of respondent developed HAI by immunosuppressive condition, 11 (28.2%) developed infection while 7 respondents (7.4%) out of 95 developed infection who did not have the condition. The study result found statistically highly significant ($p<0.05$).

Distribution of respondents developing hospital-acquired infection by surgery at present showed that out of 134 respondents, 32 respondents undergone surgery at present 8 respondents (25%) developed infection (postoperative) while 10 respondents (9.8%) out of 102 developed infections who did not undergo any surgery at that period (Figure 5D). The association between surgery at present and development of hospital-acquired infection was found statistically significant ($p<0.05$).

In figure 5E/F, 6 respondents (10%) developed infection out of 60 respondents where cleaning of object /material were regularly done, while 12 (16.2%) out of 74 respondents developed HAI where cleaning of objective /material were not done regularly. The association of state of cleaning object /material of patients and development of nosocomial infection was not found statistically significant ($p>0.05$).

Discussion

Generally people in the ICU had a life threatening illness or conditions. ICUs have come to represent the most frequently identifiable source of infections within the hospital, with infection rates and rates of antimicrobial resistance several fold higher than in the general setting41. The higher rate of collection of samples were tracheal aspirate due to higher number of suspected pneumonia patients in ICU (Fever, cough, higher respiratory rate after prolong ventilation).

In the present study, the culture positivity was highest in tracheal aspirate samples 31 (78.2%) followed by blood samples 22 (25.9%) and urine 15 (20%). In Europe, Vincent et al, in 1995 showed that pneumonia being most common infection (46.9%) & followed by lower respiratory tract infection (17.8%), urinary tract infection (17.6%) & blood stream infection (12%) [11]. In the present study, the most common organisms isolated were *Acinetobacter spp*. 34 (26.6%) followed by *Serratia spp*. 22 (17.9%), Klebsiella spp. 21 (17.1%), *Pseudomonas spp*. 18(14.6%), E-coli 13 (10.6%), *Candida spp*. 10 (8.1%), *Streptococcus spp*.4 (3.3%) & Staph. aureus 1(0.1%). In Kashmir, India, Lone in 2009 found *Acinetobacter spp*. was most prevalent bacteria in the intensive care unit (29.84%) [12]. In Shiraz, Iran, Hassanzadeh etc. found most prevalent bacteria of *E-coli* (23.8%) *Acinetobacter spp*. (19.7%) *Klebsiella spp*.(19.5%), *Candia spp*. (19.5%) & *Enterobacter* (10.9%) in the intensive care unit [13]. Pathogens isolated in different studies indicate that the nature of pathogens vary in different situations & varies from country to country.

In the present study, *Acinetobacter spp* (25.6%) was the predominating organism in tracheal aspirate followed by *Serratia spp*. (19.8%) & *Klebsiella spp*. (18.6%). In a study by Fagon et al in 1993 showed that most ventilator associated pneumonias (VAPs) were due to *Pseudomonas spp*. (22%) followed by Acinetobacter spp. (13%) [14]. In the present study, *Candida spp*. 05 (45.4%) was the predominating organism of urine sample followed by Acinetobacter 08 (53.3%) and *E-coli*. 03 (20%). This increased Acinetobacter infection is related presumably to an increase in the use of broad spectrum antibiotics, use of mechanical device, prolonged patient survival in a relatively immunosuppressed environment. In humans, *Acinetobacter* can colonize skin, wounds, and the respiratory and gastrointestinal tracts. *Acinetobacter* can survive for months on clothing's, bedclothes, bed rails, ventilators and other surfaces in the environment including sinks and doorknobs, making nosocomial transmission extremely difficult to control. Many outbreaks of A. baumannii infections or colonization in medical, surgical, neonatal and burn ICUs have been reported [15, 16].

The more the number of visitor, the higher the probability of developing HAI was the present. 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 Hussain et al. [17] where 37.5% respondents developed infection having 9visitors/day in comparison to 21.8% with 0-2 visitor/day. According to khan Husain Mohiuddin et al. [17] where number of visitor/day/patient was associated in developing HAI ($t=13.526$, $df = 51.583$, $p<0.001$). 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. It is evident in the present study that 13 (19.1%) developed HAI who used application device out

of 68. On the contrary 5 (7.5%) respondents developed HAI out of 66 of not having invasive device. The devices include: Nasogastric tube, intravenous catheter, mechanical ventilator, Tracheostomy tube, urinary catheter and orthopedic fixation device. In the present study, the association between development of HAI and application of invasive device was found statistically highly significant. The present study is also consistent with study findings of a cohort study, which was conducted by Coello R, et al [18] who found the association of application of Nasogastric tube, urinary and intravenous catheter as risk factor in developing HAI. In the present study, the administration of immunosuppressive therapy and development of HAI shows that out of 37 respondents having immunosuppressive therapy 32.4% developed HAI while out of 97 respondents of not having such therapy, 6.2% developed infection. The study shows the association of immunosuppressive therapy and development of HAI and the difference was statistically highly significant. This study is consistent with Napolitano M. Lena that infected patients were more likely to have received steroids before developing infection (RR=3.45, 95% CI 1.38-8.59) [19]. It is evident from the present study that out of 39 respondents were with immunosuppressive condition while out of 95 respondents did not have such condition. Among the respondents having immunosuppressive condition, 28.2% developed HAI in comparison to 7.4% who did not have such condition. The study result found the association statistically highly significant. A study conducted by Cardoso T et al. [20] where patients who developed hospital-acquired respiratory infection (HARI) had cancer, DM which is similar to present study as HAIs were influenced in both the cases by immunosuppressive conditions where respondents were more susceptible to infection.

Among 32 respondents undergone surgery, 25% developed HAI in postoperative period while 9.8% out of 102 respondents developed infection that did not undergo surgery. The association of development of HAI and stage of surgery was found statistically significant. This study accords with Hossain et al, [21] where they found higher postoperative cases (49%) developed HAI in comparison to preoperative cases (15.9%) and the association was statistically significant ($p<.05$). The present study reveals that higher postoperative infection may be due to failure of aseptic measures during surgery, breach of asepsis in the post -operative period, prolonged stay in hospital due to surgery and exposure to large number visitors. Around 14.3% respondents developed HAI whose general cleanliness was satisfactory in comparison to around 12.8% respondents developed infection which was not satisfactory. The association of general cleanliness and development of HAI was found statistically not significant. The study reveals that general cleanliness may maintain because of very strict administration of this hospital, sufficient staff and awareness of infection control department might have contributed to these factors. The object/materials that come in contact with patients should be considered as potentially contaminated. Cleaning of patients-care items, beside equipment, and frequently touched surfaces of patients named as contact precaution played a major role for HAI. 10% of respondents developed infection where cleaning of object/material was done regularly contrary to 16.2% of respondents where cleaning of object/material were not done regularly. The association was found statistically not significant. In the present study, among 134 respondents who were at risk, 18 (13.4%) events of infection, 72.22% respiratory tract infection (RTI), 16.67% blood stream infection (BSI), 11.11% urinary tract infection (UTI) were found. In 1990, Hussain et al [21] conducted a cross-sectional study at DMCH where they found four types of HAI as SSI (36.1%), UTI (23.6%), RTI (15.2%) and gastro-intestinal tract infection (12.6%) which differs with present study. This study is also not consistent with Rahman Motiur ASM et al [22] where UTI (36.69%) was found highest HAI rate. Jumulitrat S, et al. [23] conducted a prospective study in 2002 in Thailand.

The most common organisms were *Acinetobacter spp*. 34 (27.6%) followed by *Serratia spp*. 22 (17.9%). Bacteria isolated from ICU were resistant to commonly used antibiotics which makes more difficult to effective interventions. Based on analysis, number of visitors, Invasive device application, Immunosuppressive therapy and surgical procedures are significantly responsible to develop hospital acquired infection. From the present study it may be concluded that, the culture positivity was highest in tracheal aspirate samples 86 (78.2%) followed by blood 22 (25.9%). As the study was smaller one, a large-scale study should be carried out to find out the overall magnitude of the problems.

Conflict of interest

There is no conflict of interest.

Author's contributions

All authors Contributed substantially to the design, the analysis and the interpretation of data.

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