Research Paper

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Study of Microorganisms Associated with Hospital Acquired Infection in Intensive Care Unit and their Antibiotic Resistance Pattern

Medical Science

KEYWORDS : : hospital acquired infection, microorganisms, antibiotic and intensive care unit.

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ABSTRACT

Patients in intensive care unit are about 5 times more likely to acquire nosocomial infection than other ward patients. Present study aimed to study distribution of HAIs in ICUs by anatomical sites, microorganisms associated with HAIs in ICUs and their antibiotic resistance pattern. Study design: The present study was conducted in ICUs of our general hospital during period from November 2008 to November 2010 among 100 randomly selected patients who developed HAIs in ICUs. Results: The most common HAIs in ICUs was LRTI (44.0%) followed by UTI (31.0%), skin, soft tissue and surgical site infection (17.0%) . Most common microorganism associated with HAIs in ICU was P. aeruginosa (31.0%) followed by Klebsiella Spp. (28.0%), E.coli and other enterobacteriaceae (19.0%). Most of the microorganisms associated with HAIs were resistant to commonly used antibiotics, also a higher rate of resistance to higher antibiotics like aztreonam, cefepime, imepenem and amikacin. No resistance was seen to polymyxin B and colistin among gram negative bacilli associated with HAIs. Recommandetions: Every hospital having ICUs must have policies for proper and judicious use of antibiotics and develop protocols to take proper measures to prevent common health care associated infections. Key words: hospital acquired infection, microorganisms, antibiotic, intensive care unit.

INTRODUCTION

Nosocomial infections, also called healthcare acquired infections or health care-associated infections, is defined by the CDC as a localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s), without any evidence that the infection was present or incubating at the time of admission to the hospital.[1]

Patients in intensive care unit are about 5 times more likely to acquire nosocomial infection than other ward patients.[2]

The incidence of nosocomial infection is most commonly expressed as the number of infections per 100 patients hospitalized and is highest in burn, surgical and neonatal ICUs (5–30%), intermediate in medical and pediatric ICUs (5–7%) and lowest in coronary care units (1–2%).[2,3,4]

Study of microorganisms associated with hospital acquired infection in ICU patients helps in effective management of nosocomial infection in ICU patients. It helps in decision making regarding empirical antibiotic therapy for nosocomial infection, awaiting the reports of microbial culture and antibiotic sensitivity pattern. It also helps in formulating effective strategies for prevention of nosocomial infections.

Most studies related to health care associated infections were conducted in the developed countries. Limited data exists regarding nosocomial infections in ICU in India.

So, we have designed to study hospital acquired infections in intensive care unit, especially microorganisms associated with hospital acquired infections in ICU at our general hospital.

AIMS AND OBJECTIVES

1) To study distribution of HAIs in ICUs by anatomical sites.
2) To study microorganisms associated with HAIs in ICUs.
3) To study antibiotic resistance pattern of common microorganisms associated with HAIs in ICUs.

STUDY DESIGN AND PROTOCOLS

The present study was conducted in ICUs of our general hospital during period from November 2008 to November 2010.

We studied 100 randomly selected patients who developed hospital acquired infections in ICUs.

INCLUSION CRITERIA

Patients admitted in ICU for atleast 48 hours and who developed evidences of hospital acquired infections.

EXCLUSION CRITERIA :

1) Patients discharged or transferred to other ward or expired within 48 hours of admission to ICUs.
2) Patients already having evidence of infection (either clinical or laboratory) at the time of admission to ICUs are not included.
3) Age < 13 years.

Hospital acquired infection in ICU :

Hospital acquired infections are defined as those not present or incubating at the time of ICU admission and developing 48 hours after admission to ICU.

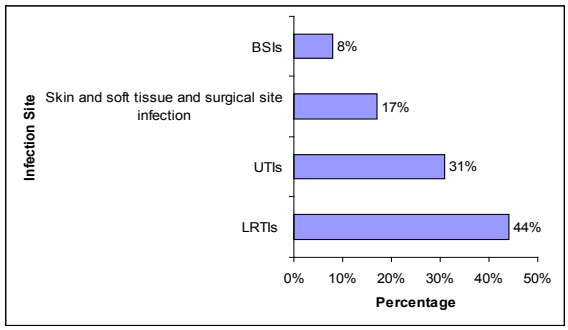
OBSERVATION AND RESULTS

The present study is conducted in ICUs of our general hospital during period from November 2008 to November 2010.

We studied 100 randomly selected patients who developed hospital acquired infection in ICUs.

TABLE-1
DISTRIBUTION OF HOSPITAL ACQUIRED INFECTION BY ANATOMICAL SITES

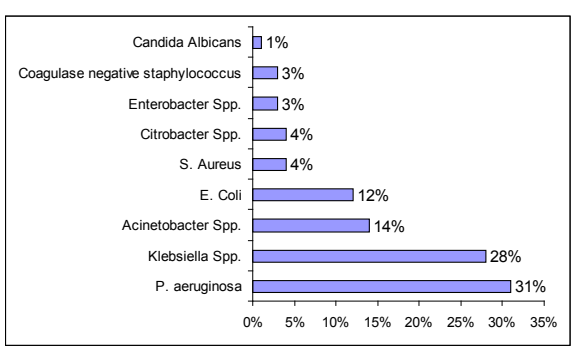
Infection site	Number of HAIs (n=100)	Percentage (%)
LRTIs	44	44.0
UTIs	31	31.0
Skin and soft tissue and surgical site infections	17	17.0
BSIs	08	08.0



In the present study the most common HAIs was LRTIs (44%). This was followed by UTIs (31.0%). Skin and soft tissue and surgical tissue infection contributed to 17.0% of all HAIs in ICU patients. BSIs accounted for 8.0% of all HAIs in ICU patients.

TABLE-2
MICROBIAL ETIOLOGIES OF HAIs IN ICU

	Causative Organism	Occurrence (n=100)	Percentage (%)
1.	P. aeruginosa	31	31.0
2.	Klebsiella Spp.	28	28.0
3.	Acinetobacter Spp.	14	14.0
4.	E. Coli	12	12.0
5.	S. Aureus	04	04.0
6.	Citrobacter Spp.	04	04.0
7.	Enterobacter Spp.	03	03.0
8.	Coagulase negative staphylococcus	03	03.0
9.	Candida Albicans	01	01.0



In the present study most common microorganism associated with HAIs in ICU was P. aeruginosa (31.0%). This was closely followed by Klebsiella spp. (28.0%). This was followed by acinetobacter spp (14.0%) and E.Coli (12.0%) The rate of occurrence of other microorganisms were S. aureus (04.0%), citrobacter spp. (04.0%), Enterobacter spp. (03.0%), coagulase negative staphylococcus (03.0%) and candida Albican (01.0%).

TABLE-3
ANTIBIOTIC RESISTANCE OF COMMON MICROORGANISMS ASSOCIATED WITH HAIs IN ICU

Antibiotics	Percentage of isolates of microorganisms resistant to antibiotics			
	P. aeruginosa	Klebsiella Spp.	Acinetobacter Spp.	E.Coli
Ampicillin + sulbactum	90.3	35.7	00.0	33.3
Ceftriaxone	96.8	92.9	100.0	91.7
Cefepime	87.1	78.7	92.9	66.7
Piperacillin + Tazobactum	41.9	35.7	42.9	33.3
Aztreonam	71.0	85.7	100.0	66.7
Imipenem	77.4	35.7	78.6	41.7
Amikacin	77.4	71.4	92.9	41.7
Levofloxacin	87.1	25.0	50.0	00.0
Polymyxin B	00.0	00.0	00.0	00.0
Colistin	00.0	00.0	00.0	00.0

Most of the isolates of microorganisms are resistant to commonly used antimicrobials. Resistance to third generation cephalosporins ranges from 91.7% to 100% for different microorganisms.

All isolates of gram negative bacilli are sensitive to polymyxin B and colistin (Resistance 00.0%).

P. Aeruginosa :
Antibiotics with good efficiacy against P. acruginosa is polymixin B and colistin (Resistance 00.0%). This is followed by Piperacillin + Tacrobactum (Resistance 41.9%). Resistance to Aztreonam was 71.0%. P. Aeruginosa isolates are highly resistant to third generation cephalosporins (96.8%), Cefepime (87.1%), Levofloxacin (89.1%), Amikacin (77.4%) and Imipenem (77.4%).

Klebsiella Spp :
Antibiotics with good efficacy against klebsiella spp. are polymyxin B and colistin (Resistance 00.0%) Levoflolxacin (Resistance 25%), Ampicillin sulbactum (Resistance 35.7%), Piperacillin + Tazobactum (Resistance 35.7%) and Imipenem (Resistance 35.7%) Resistance to Amikacin and Cefepime among klebsiella spp. are 71.4% and 78.7% respectively. Klebsiella isolates are highly resistant to aztreonam (85.7%) and third generation cephalosporins (92.9%).

Acinetobacter Spp.
Antibiotics with good efficacy against Acinetobacter spp are ampicillin + Sulbactum (Resistance 00.0%), Polymyxin B and Colistin (resistance 00.0%), and Piperacillin + tazobactum (resistance 42.95). 50% of acinetobacter isolates were resistant to levofloxacin. Resistance to imepenem is 78.6%, Resistance to both cefepime and amikacin is 92.9%. All isolates of acinetobacter were resistance to third generation cephalosporins and aztreonam.

E.Coli
Antibiotics with good efficacy against E.coli are levofloxacin (resistance 00.0%), polymyxin B (resistance 00.0%), Ampicillin + sulbactum (resistance 33.3%) and Piperacillin + tazobactum (resistance 33.3%). Resistance to both imepenem and amikacin is 41.7%. Resistance to both cefepime and aztreonam is 66.7%.

E.Coli isolates are highly resistant to third generation cephalosporins. (91.7%).

DISCUSSION AND COMPARISON
In the present study the most common HAI is LRTIs (44.0%). Ding et al also found LRTIs (68.4%) as the most common HAIs. UTIs contributed to 31.0% of all HAIs in the present study. UTI accounted for 15.9% of all HAIs in Ding et al.

TABLE-4

Infection site	Present Study (%)	Ding et al[5] (China) (2007) (%)
LRTIs	44.0	68.4
UTI	31.0	15.9
Skin, soft tissue and surgical site infection	17.0	01.9
BSIs	08.0	05.9

Skin, soft tissue and surgical site infections contribut ed to 17.0% of all HAIs in the present study, but only 01.9% in Ding

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et al. CVC associated BSIs accounted for 08.0% of all HAIs in the present study and 05.9% in Ding et al.

TABLE-5
MICROBIAL ETIOLOGIES OF HAIs IN ICU

Microorganism	Present Study (%)	Mandani et al [6](2007) (%)
P. Aeruginosa	31.0	23.1
Klebsiella spp.	28.0	15.4
Acinetobacter spp.	14.0	24.1
E. Coli	12.0	12.8
S. aureus	04.0	4.6
Citrobacter spp.	04.0	00.0
Enterobacter spp.	03.0	04.1
Coagulase negative staphylococcus	03.0	03.1
Candida spp.	01.0	08.2

In the present study, most common microorganism associated with HAIs in ICU was P. aeruginosa (31.0%). Mandani et al found Acinetobacter spp. (24.1%) as most common microorganism associated with HAIs in ICU. The occurrence rate of Klebsiella spp. was 28.0% in present study but 15.4% in Mandani et al. The rate of occurrence of candida sp. was 08.2% in Mandani et al and 1.0% in present study. The rate of occurrence of citrobacter spp. was 4% in present study, but Mandani et al did not found it in any case. The rate of occurrence of E. coli, S. aureus, coagulase negative staphylococcus and enterobacter spp. was very close to each other in both study.

TABLE-6: ANTIBIOTIC RESISTANCE PATTERN OF COMMON MICROORGANISMS ASSOCIATED WITH HAIs :

Antibiotics	% of isolates of resistant to antibiotics							
	P. AERUGINOSA		KLEBSIELLA SPP.		ACINETOBACTER SPP.		E.COLI	
	Present Study (%)	Lockhart S.R. et al[7] (%)	Present Study (%)	Lockhart S.R. et al[7] (%)	Present Study (%)	Lockhart S.R. et al[7] (%)	Present Study (%)	Lockhart S.R. et al[7] (%)
Ampicillin+ sulbactum	90.3	-	35.7	31.8	00.0	41.2	33.3	43.5
Cefriaxone	96.8	83.9	92.9	16.5	100.0	74.2	91.7	06.7
Cefepime	87.1	27.0	78.7	11.0	92.9	63.2	66.7	03.0
Piperacillin + Tazobactum	41.9	13.2	35.7	15.8	42.9	58.2	33.3	07.6
Aztreonam	71.0	32.9	85.7	16.5	100.0	84.6	66.7	05.8
Imepenem	77.4	18.3	35.7	01.7	78.6	12.1	41.7	00.3
Amikacin	77.4	10.4	71.4	08.2	92.9	28.9	41.7	01.6
Levofloxacin	87.1	33.7	25.0	18.2	50.0	64.8	00.0	17.5

P. AERUGINOSA
Resistance to Cefriaxone among P. aeruginosa is 96.8% in the present study. In Lockhart S.R. et al (2002-2004) resistance to Ceftriaxone was 83.9%. In the present study 87.1% isolates of P. Aeruginosa are resistant to Cefepime,. whereas in Lockart S.R. et al it was only 27.0%. Resistance to Piperacillin + Tazobactum is 41.9% in the present study. It was 13.2% in Lockhart S.R. et al. Resistance to aztreonam is 71.0% in the present study. It was 32.9% in Lockhart SR et al. Resistance to imipenem is 77.4% in the present study. It was 18.3% in Lockhart SR et al. Resistance to amikacin is 77.4% in the present study. It was 10.4% in Lockhart SR et al. Resistance to Levofloxacin is 87.1% in the present study. It was 33.7% in Lockhart SR et al.

KLEBSIELLA SPP.
Resistance to Ampicillin + Sulbactum among klebsiella spp. is 35.7% in the present study. It was 31.8% in Lockhart SR et al. Resistance to Ceftriaxone is 92.9% in the present study. In Lockhart SR et al it was 16.5%. In the present study, resistance to Cefepime is 78.7%. In Lockhart SR et al it was 11.0%. Resistance to Piperacillin + Tazobactum is 35.7% in the present study. It was 15.8% in Lockhart SR et al. Resistance to Aztreonam is 85.7% in the present study. It was 16.5% in Lockhart SR et al. In the present study 35.7% of Klebsiella isolates were resistant to imepenem. In Lockhart SR et al it was 01.7%. In the present study 71.4% of Klebsiella isolates were resistant to amikacin. In Lockhart SR et al it was 08.2%. In the present study 25.0% of Klebsiella isolates are resistant to levofloxacin. it was 18.2% in Lockhart SR et al.

ACINETOBACTER SPP.
In the present study all isolates of acinetobacter spp. are sensitive to ampicillin + sulbactum. In Lockhart SR et al 41.2% of acinetobacter isolates were resistant to ampicillin + sulbactum. In the present study all isolates of acinetobacter are resistant to ceftriaxone. Resistance to Ceftriaxone was 78.2% in Lockhart SR et al. Resistance to Cefepime is 92.9% in the present study. It was 63.2% in Lockhart SR et al. Resistance to piperacillin + Tazobactum is 42.9% in the present study. It was 58.2% in Lockhart SR et al. All isolates of acinectobacter spp. are resistant to aztreonam in the present study. It was 84.6% in Lockhart SR et al. In the present study resistance to imepenem is 78.6%. In Lockhart SR et al it was 12.1%. In the present study resistance to amikacin is 92.9%. It was 28.9% in Lockhart SR et al. Resistance to Levofloxacin is 50.0% in the present study. It was 64.8% in Lockhart SR et al.

E.COLI
In the present study resistance of E.Coli to ampicillin + sulbactum is 33.3%. It was 43.5% in Lockhart SR et al. Resistance to Ceftriaxone is 91.7% in the present study. It was 06.7% in Lockhart SR et al. Resistance to Cefeprime is 66.7% in the present study. It was 03.0% in Lockhart SR et al. In the present study, resistance to piperacillin + tazobactum is 33.3%. It was 07.6% in Lockhart SR et al. Resistance to Aztreonam is 66.7% in the present study. It was 05.8% in Lockhart SR et al. In the present study, resistance to imipenem is 41.7%. It was 00.3% in Lockhart SR et al. In the present study all isolates of E.Coli are sensitive to levofloxacin. In Lockhart SR et al 17.5% of isolates were resistant to levofloxacin.

SUMMARY AND CONCLUSIONS
1) The most common hospital acquired infection in ICUs was LRTI (44.0%). The second most common hospital acquired infection in ICUs was UTI. The other common hospital acquired infections were skin, soft tissue and surgical site infection (17.0%) and CVC associated BSI (8.0%).
2) Most common microorganism associated with HAIs in ICU was P. aeruginosa (31.0%). This was followed closely by Klebsiella Spp. (28.0%). Other microorganisms associated with HAIs in descending order were E.coli and other enterobacteriaceae (19.0%), acinetobacter spp. (14.0%), S. aureus (4.0%), coagulase negative staphylococcus (3.0%) and Candida albicans (1.0%).
3) Most of the microorganisms associated with HAIs were resistant to commonly used antibiotics. There was also a higher rate of resistance to higher antibiotics like aztreonam, cefepime, imepenem and amikacin. Although, there was also high resistance against ampicillin + sulbactum, piperacillin + tazobactum and levofloxacin, their sensitivity was

somewhat better than the aforementioned antibiotics.

4) No resistance was seen to polymyxin B and colistin among gram negative bacilli associated with HAIs.
5) Every ICU must have periodic surveillance of incidence of HAIs, microorganisms associated with HAIs and their antibiotic sensitivity pattern. Prompt implementation of measures to prevent spread of multidrug resistant strains of microorganisms is required.
6) Every hospital having ICUs must have policies for proper and judicious use of antibiotics. They must also develop protocols to take proper measures to prevent common health care associated infections

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