

Observational Study

Prevalence of nosocomial infections in intensive care units and operation theatres in Agartala Government Medical College and Hospital

Shibabrata Bhattacharya¹, Raunak Bir², Tapan Majumdar¹

Nosocomial infection is an important cause of prolonged hospital stay. In India 10-30% of patients admitted in hospitals acquire nosocomial infection. The main objective of the study was to find prevalence of nosocomial infection, causative pathogens and their antibiogram. This study was done in the department of Microbiology, Agartala Government Medical College and Hospital from May-July, 2011. 210 samples were included in the study which after collection from Neonatal Intensive Care Unit, Pediatric Intensive Care Unit, Intensive Care Unit, Orthopaedics Operation Theatre, General Surgery Operation Theatres, Postoperative care unit and orthopaedics wards were sent to microbiology laboratory for bacteriological examination and antibiogram. Though the rate of nosocomial infection is 44% but highest prevalence ie, 70% is found in orthopaedics wards. *Klebsiella pneumoniae* (21.8%) and *Enterococcus faecalis* (8.7%) showed highest frequency among gram-negative bacilli and gram-positive cocci respectively. Organisms isolated from patient samples were highly resistant to β -lactam antibiotics (100%), macrolides (80%), fluoroquinolones (70%), aminoglycosides (60%) and vancomycin (40%). Prevalence of nosocomial infection is high in the study. There is a continuous need of surveillance and formulation of an antibiotic policy for the hospital.

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Key words : Antibiogram, β lactam antibiotics, Nosocomial infection.

Nosocomial (nosos- illness and komein- treat) infection, - also called “hospital acquired infection”, are the infections occurring within 48 hours of hospital admission, 3 days of discharge or 30 days of an operation which were neither present nor incubating at the time of admission¹.

Nosocomial infection (NI) concerns 2 million cases annually worldwide ie, 5-15% of hospitalized patients. Among them, 10 per cent of patients acquire poly-microbial infections. In India 10-30 per cent of patients admitted to hospitals and nursing homes acquire NIs².

Major NI includes urinary tract infection (UTI), blood stream infection (BSI), ventilator-associated pneumonia (VAP) and surgical site infection (SSI)³.

Delving further into various studies about NI it becomes evident that most frequently isolated micro-organism is bacteria (93-97%) whereas rest comprise fungi. Among bacteria, Enterobacteriaceae, *Pseudomonas* spp, *Aceinetobacter* spp, *Staphylococcus aureus* and *Enterococcus* spp are the pathogenic organisms. In the group of fungi *Candida* spp. is the most common agent causing NI^{4,5}.

This study was carried out in AGMC Hospital to

analyse the prevalence of NI with an objective of estimating the risk-factors, the micro-organisms responsible and their resistance pattern which in turn may guide us to devise ways to combat NI and development of antibiotic resistance in order to formulate uniform antibiotic policy.

MATERIALS AND METHOD

This was a hospital based cross sectional study conducted in Neonatal Intensive Care Unit (NICU), Paediatric Intensive Care Unit (PICU), Intensive Care Unit (ICU), Orthopaedics Operation Theatre, General Surgery Operation Theatres, Postoperative care unit (PCU) and orthopaedics wards (ORTHO) of AGMC Hospital over a period of two calendar months (May-July, 2011) as a part of STS project of ICMR and has been cleared by the institutional ethical committee.

Sample size : A total of 210 samples were collected which include,

- **Environmental samples** — A total of 110 swab samples were collected from the study area which include samples from wall, floor, bed linen, AC vent, oxygen mask, dust bin, basin, tray, operation theatre (OT) clothes, antiseptics and disinfectants, instruments.

- **Patient samples** — 50 samples were collected which include patient’s secretions and excretions according to the system involved admitted in study area.

Department of Microbiology, Agartala Government Medical College, Tripura 799006

¹MD (Microbiology), Assistant professor and Corresponding author

²MBBS, Student

• **Samples from health service provider** — 50 samples consisting of hand impressions from on-duty doctors, nurses, dressers and other health service providers of the study areas were collected.

Inclusion criteria :

• Patients admitted in NICU, PICU or ICU (ICUs), staying there for more than 48 hours and developing signs of infections after 48 hours of admission which were not present at the time of admission.

• Patients undergone operation, admitted in PCU or ORTHO falling in the category of surgical-site infections according to the Center for Disease Control and Prevention (CDC) definition⁶.

• Doctors, nurses, dressers and other health service providers working in the study sites.

• Samples yielding pure isolates.

Exclusion criteria :

• Patients admitted in ICUs, but are removed or discharged before completion of 48 hours.

• Patients were admitted in ICUs, with some community-acquired infectious disease.

Study method :

The swab samples and urine samples were collected in sterile container under strict aseptic care. Blood samples under aseptic conditions were immediately injected in blood culture bottle containing Brain-Heart infusion broth. All the samples were transported immediately to the laboratory. The swab samples and urine samples were inoculated in Blood agar (BA) and MacConkey agar (McA) plates and incubated at 37°C for 24 hours. Blood culture bottles were incubated at 37°C and serial subcultures were made on 3rd, 5th and 7th day in BA and McA plates. Hand impression smears were collected directly on BA and McA plates. Colony morphology and characteristics were observed after 24 hours in BA and McA plates. If growth was not observed after 7 days in blood culture then the sample was labelled as negative. In case of antiseptic solutions and disinfectants In-use test was done⁷. Identification up to species level was done by gram staining and biochemical tests⁷. Antibiotic susceptibility test was performed in Mueller-Hinton agar by Kirby-Bauer disc diffusion method following Clinical and Laboratory Standards Institute (CLSI) guidelines^{7,8}.

Data analysis :

Data was analysed using SPSS software.

OBSERVATIONS

The rate of NI in the study was found to be 44% (22/50). On further analysis, NI is found to be more prevalent in ORTHO ie, 70% followed by PCU, NICU and PICU with 40% each and lastly ICU, having NI rate of 30%. Among 22 NI patients, 41% were suffering from SSI. Rate of BSI and UTI was 32% and 18% respectively. Lastly rate of VAP was 9%.

Among 22 NI cases 21(95.5%) had single and 1(4.5%) had double infection. More than 80% of the NI was caused by gram-negative bacilli, predominantly *Klebsiella pneumoniae* (21.8%), *Pseudomonas aeruginosa* (17.5%), *Escherichia coli* (13%), *Proteus mirabilis*, *Citrobacter freundii* and *Acenitobacter baumannii* (8.7%) each and *Enterobacter aerogenes* (4.3%). Rest of Nis were caused by gram-positive cocci, which included *Enterococcus faecalis* (8.7%), *Staphylococcus aureus* (4.3%), Coagulase negative *Staphylococcus* (4.3%).

Klebsiella pneumoniae is predominantly isolated from NICU followed by PICU. *Pseudomonas aeruginosa* was mostly found from PCU and ORTHO. A single isolate of *Escherichia coli* was found in PCU, ORTHO and ICU each. *Citrobacter freundii* and *Acenitobacter baumannii* were isolated from ORTHO whereas single isolate of *Proteus mirabilis* was found in PCU and ORTHO. Among gram-positive cocci, the most commonly encountered organism was *Enterococcus faecalis* in ICU and PICU. Single isolate of *Staphylococcus aureus*, Coagulase negative *Staphylococcus* were isolated from ICU and PICU respectively.

Organisms isolated from patient samples are highly resistant to β -lactam group of antibiotics including cephalosporins (100%) and extended spectrum penicillins (100%). Among aminoglycosides and fluoroquinolones, amikacin and ofloxacin showed good sensitivity rate respectively. *Klebsiella pneumoniae* were mostly sensitive to ofloxacin (80%) followed by amikacin (60%). *Pseudomonas aeruginosa* were sensitive to amikacin (50%) whereas *Escherichia coli* were mostly sensitive to amikacin (66.7%). Among gram-positive cocci, penicillin and erythromycin resistance was 100% except in case of *Enterococcus faecalis* which showed 50% resistance toward erythromycin. Vancomycin resistance was very high, 50% in *Enterococcus faecalis* and 100% in *Staphylococcus aureus*.

Out of 110 environmental sample, 2 cases of *Escherichia coli* and 2 cases of *Pseudomonas aeruginosa* were isolated from ICU and ORTHO respectively. Single isolate of *Klebsiella pneumoniae* and Coagulase negative *Staphylococcus* were found in NICU and PICU respectively. No growth could be isolated from the samples collected from orthopaedic and general surgery OTs.

Antibiotic sensitivity for environmental isolates was in the line of patient isolates with high resistance to β -lactam antibiotics and high sensitivity for amikacin and ofloxacin in gram negative bacilli. Gram-positive coccus was sensitive to vancomycin whereas resistant to penicillin and erythromycin.

Out of 50 hand impression smear samples collected, 46 showed growth of different organism. Among these, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella pneumoniae*, *Acenitobacter baumannii*, *Enterococcus faecalis*, *Bacillus* spp, *Corynebacterium* spp,

Micrococcus spp, Coagulase negative Staphylococcus and Candida spp. were isolated (Table 1).

DISCUSSION

Results of the study show the rate of NI in our setup is 44% in the study sites. Though similar results were also obtained by Faruquzzaman *et al* 2011⁹. In India 10-30% patient acquire NI².

Study area included ICUs, PCU and ORTHO, out of which ORTHO showed highest infection rate of 70% whereas rate of NI in PCU, NICU, and PICU was 40% each.

Analysis of spectrum of bacterial pathogens responsible for NI showed predominant organism in NICU and PICU to be Klebsiella pneumoniae. Similar results were also found by Deep A *et al* 2004, Lakshmi KS *et al* 2004 and Kamath S *et al* 2010^{10,11,5}. In case of ICU predominant organisms were Escherichia coli and Staphylococcus aureus. Results similar to the present study were reported by Richard MJ *et al* 2000³. Pseudomonas aeruginosa, Citrobacter freundii and Acenitobacter baumannii were the most frequently occurring isolates in ORTHO and PCU which were shown in the studies done by Faruquzzaman *et al* 2011 and Kamat US *et al* 2008^{9,4}.

In order to study the level of bacterial contamination in hospital, environmental samples were also analyzed. A number of bacterial agents were isolated from these samples comprising of Pseudomonas aeruginosa, Escherichia coli, Klebsiella pneumoniae and Coagulase negative Staphylococcus. Absence of any growth in the samples collected from the OTs implies that proper measures for sterilization were being strictly adhered.

The result of hand impression smear implies about poor compliance of hygienic hand wash practice among health care providers in these units.

Antibiogram of all the isolates showed a 100% resistance to β lactam antibiotics, 80% to macrolides, 70% to fluoroquinolones, 60% to aminoglycosides and 40% to vancomycin; which is a matter of great concern.

To summarize, this short term study shows high rates of NI in the study sites of our hospital setup. Most of the isolates are resistant to multiple antibiotics especially to β lactam antibiotics. This study implies for strengthening of hospital acquired infection control policy, regular surveillance and immediate formulation of an antibiotic policy for the hospital.

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Table 1 — Distribution of isolates in study sites

Organism isolated	Type of sample	Source of patient sample				
		ICU	ORTHO	PCU	NICU	PICU
Pseudomonas aeruginosa	P	0	2	2	0	0
	E	0	2	0	0	0
Escherichia coli	P	1	1	1	0	0
	E	2	0	0	0	0
Proteus mirabilis	P	0	1	1	0	0
	E	0	0	0	0	0
Citrobacter freundii	P	0	2	0	0	0
	E	0	0	0	0	0
Enterococcus faecalis	P	1	0	0	0	1
	E	0	0	0	0	0
Acenitobacter baumannii	P	0	2	0	0	0
	E	0	0	0	0	0
Klebsiella pneumoniae	P	0	0	0	3	2
	E	0	0	0	1	0
Enterobacter aerogenes	P	0	0	0	1	0
	E	0	0	0	0	0
Coagulase negative Staphylococcus	P	0	0	0	0	1
	E	0	0	0	0	1
Staphylococcus aureus	P	1	0	0	0	0
	E	0	0	0	0	0
Total	P	3	8	4	4	4
	E	2	2	0	1	1

P = Patient sample, E = Environmental sample.

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