JOURNAL OF PURE AND APPLIED MICROBIOLOGY, October 2010. Vol. 4(2), p. 903-906

Evaluation of Selected Nosocomial Bacterial Pathogens Isolated from Hospital Aerosol and their Antibiotic Susceptibility Pattern

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(Received: 27 February 2010; accepted: 14 April 2010)

Air sample from various wards of different hospitals of Allahabad city were analyzed for the incidence of pathogenic microorganisms. Evaluation of isolates for detection of selected pathogen in various samples. *Staphylococcus aureus* (43.85%) gave highest incidence, which causes major microbial infection. Least incidence was found to be of *Pseudomonas aeruginosa* (8.9%). Antibiotic susceptibility pattern of the isolated pathogen showed highest resistance against Gentamycin and Methicillin. Imipenem was found to be most effective against all the isolates. There is a pressing need for a continued surveillance that must be applied periodically to detect possible changes in the level of microorganism. Monitoring of multidrug resistance pattern is also required for these bioaerosols, along with adequate ventilation control and the occupant density.

Key words: Air sample, Hospital environment, Nosocomial infection, Antibiotic resistance pattern.

The indoor air quality may be compromised by microbial contaminants (mold, bacteria), that can affect health of human population. The health of the people more or less depend on the indoor air quality because they spend 80 – 90 % of their time in indoors like building, malls, offices & hospitals etc. Among these, hospitals are important as it represents a special environment, serving health care to patients and as a work environment for medical and other staffs. One of the major ecological problems in a society is the specific problem of health-care facilities (hospitals, inpatient and outpatient departments). There are many risk factors (chemical, physical, biological and psychosocial) which can evoke many disorders and can damage the health of patients as well as staffs (Brooks *et al*., 1995; Sobotova *et al.,* 2006*)*.

A nosocomial infection is any infection acquired during hospitalization that was neither present nor incubating at the time of the patient's admission to the hospital. It may become clinically apparent either during the hospitalization or after discharge. Airborne nosocomial infections are transmitted directly or indirectly through air and may cause respiratory (primarily pneumonia) and surgical-site infections.

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Pathogenic microorganism settles with dust particle on the medical devices and other surgical instrument which causes nosocomial infections. Kowalski (2007) reported that 16 percent of ICU infections result from airborne-pathogen transmission. About 70 to 80 percent of all nosocomial infections are caused by gram-negative bacilli (Lolekha *et al.,* 1981). The hospital operating rooms contained higher numbers of microorganisms associated with dust and soil and lower numbers of vegetative microorganisms associated with humans like *Staphylococcus spp., Micrococcus spp., Streptococcus spp.,* and *Corynebacterium spp.* (Favero *et al.,* 1967).

MATERIALS AND METHODS

Sample collection

For the present study air samples from different wards and units (general ward, private ward, operation theater, intensive care unit etc.) of hospitals (Allahabad city) were taken for screening of selected bacterial pathogens (*Staphylococcus aureus*, *Streptococcus pyogens, Klebsiella pneumonia, E.coli,* and *Pseudomonas aeruginosa*). Sample collection was done by settling plate technique. Nutrient agar, blood agar and MacConkey's agar plate was exposed for 5 minute in different ward and unit of hospitals. The plates were transported to laboratory and incubated at 37°C±2 for 24 to 48 hours.

Identification of collected isolates by using different tests

The identification of the isolates on the basis of cultural, morphological & biochemical test were done as per given in the Bergey's manual of Systematic Bacteriology (Holt *et al*., 1984).

Cultural and Morphological examination

The colony characteristics (size, shape, colour, type of margin, etc) were observed from the agar plates. Colony was picked from plate and smear preparation which was done on clear glass slide and thereafter gram's staining was done for morphological identification (size, shape, arrangement etc).

Biochemical Tests

Different biochemical tests (sugar fermentation, indole production, methyl red reaction, voges proskeur reaction, citrate utilization, nitrate reduction test, urease hydrolysis, triple sugar iron test, catalase test, oxidase test, gelatin liquefaction test and coagulase test) were performed for the identification of the nosocomial pathogens.

Antibiotic susceptibility test of bacterial isolates

For conducting the antibiotic susceptibility tests, the following antibiotic discs like Azotreonam, Ceftazidime, Imipenem, Cortrimoxazole, Ciprofloxacin, Gentamicin Netilmicin, Cetriaxone, Penicillin-G, Kanamycin, Oxacillin and Methicillin were used, which has been purchased from HI-MEDIA, Mumbai.

Antibiotic susceptibility test was done by using Disc diffusion method (Bauer *et al.,* 1966). In this method the test organism was swab inoculated on the nutrient agar plate. Under sterile condition antibiotic discs was placed on the surface of the inoculated plate. The plates were kept for incubation at 37°C±2 for 24 hours and the zone of inhibition was measured and recorded in millimeter (mm). The values obtained were compared with CLSI (Wayne, 2003) to determine the sensitivity resistance pattern of the test organism.

RESULTS AND DISCUSSION

The incidence of selected bacterial pathogen from aerosol of hospital was described in table 1 and Fig. 1. The total samples taken from different hospitals out of which, 212 bacterial isolates were obtained. *Staphylococcus aureus* showed maximum incidence (43.8%). Similar to present study, *Staphylococcus aureus* has been previously observed the maximum incidences (Kumar, 2006 and Srikanth *et al.,* 2007). The other organisms isolated were *E.coli* (17.9%), *Klebsiella pneumonia (*16%) and *Streptococcus pyogens* (13.2%). The minimum incidence of that was *Pseudomonas aeruginosa* (8.9%).

The overall incidence of the present study was found to be greater than the reported by Kowalski (2007). Evaluated concentration of microorganism depend on the quality of indoor air which further depend on external and internal sources as ventilation, cleaning procedure, human activity etc. climatic condition also may affect the concentration of bacteria in air.

The resistance patterns of the isolated

Table 1. Overall incidences of selected bacteria from aerosol of hospitals

Total number of air samples	Total number of bacterial isolates	Pathogens (%)				
		Staphylococcus aureus	*Streptococcus pyogenes*	*Pseudomonas aeruginosa*	*E. coli*	*Klebsiella pneumoniae*
60	212	93(43.85)	28(13.2)	19(8.9)	38(17.9)	34(16)

Figures in parenthesis indicate percentage.

Table 2. Antibiotics susceptibility pattern of microorganism

S. No.	Antibiotics (µg)	*E. coli*	*Klebsiella pneumoniae*	*Pseudomonas aeruginosa*	*Streptococcus pyogenes*	*Staphylococcus aureus*
1.	Gentamycin(30 µg)	-	-	-	-	-
2.	Imipenem(10 µg)	+++	+++	+++	+++	+++
3.	Oxacillin (1 µg)	-	++	+++	-	-
4.	Aztreonam (30 µg)	-	-	+++	-	-
5.	Cotrimoxazole(25 µg)	-	-	-	+++	+++
6.	Netillin (30 µg)	+++	+++	+++	+++	+++
7.	Penicillin- G (10 µg)	-	-	-	++	++
8.	Ceftazidime (30 µg)	+++	-	++	-	+++
9.	Ciprofloxacin(5 µg)	+++	+++	+++	+++	+++
10.	Ceftriaxone (30 µg)	++	+++	++	+++	++
11.	Methicillin (5 µg)	-	-	-	-	-
12.	Kanamycin (30 µg)	++	++	-	+++	++

+++Sensitive, ++ Intermediate, - Resistance

bacterial pathogen from various hospitals environment are summarized in Table 2. Evaluation of antibiotic susceptibility showed that gram negative bacteria were more resistant than gram positive bacteria. Mathur *et al*. (2005) reported similar results.

All the isolates showed resistance to Gentamycin and Methicillin where, sensitivity against Imipenem, Nitillin and Ciprofloxacin was observed. Most of isolates showed intermediate zone against Kanamycin, Ceftriaxone and Penicillin G. *E. coli, Klebsiella pneumoniae* and

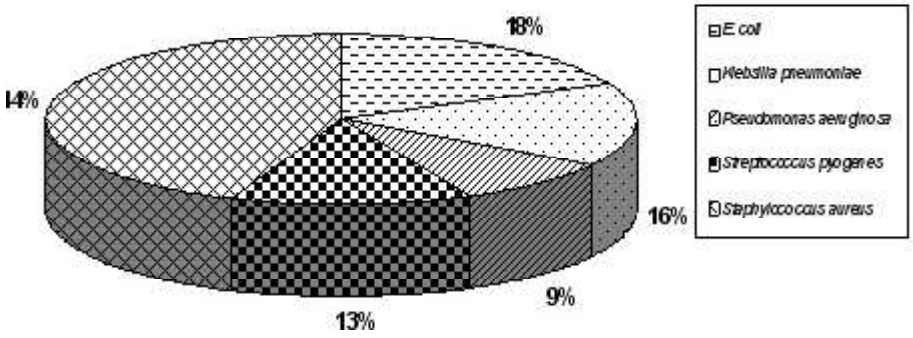

Fig. 1. Overall incidence of Bacterial Pathogen in Hospital Environments

Pseudomonas aeruginosa were found to be sensitive against Cotrimoxazole and Penicillin–G. Aztreonam was effective against all isolates except *Pseudomonas aeruginosa.* As per the given study similar reports have been observed by Babay (2006) for *Pseudomonas aeruginosa* which showed resistance to the same antibiotics.

CONCLUSION

It is of high relevance to remember that hospital represents a special environment due to the nature of activities developed. There is a pressing need for a continued surveillance that must be applied periodically to detect possible changes in environmental conditions. Monitoring of multidrug resistance pattern is also required for these bioaerosols, along with adequate ventilation control and the occupant density. Over all emphasis should be aimed at welfare and health of the people exposed to climatic hospital air.

ACKNOWLEDGMENTS

Facility provided by the Allahabad agricultural institute- deemed university. Allahabad towards undertaking the above research is thankfully acknowledged.

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