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Research Article

Bio-aerosols in Neonatal Intensive Care Units in a District Hospital

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Abstract: Bio-aerosols are airborne particles that are living (bacteria, viruses, fungi) or originate from living organisms. The health effect of bio-aerosols includes infectious diseases, acute toxic effects, allergies, cancer and threat of bio-terrorism. Hence monitoring of these bio-aerosols in neonatal intensive care units (NICUs) by surface swabbing from various sites and air sampling by settle plate count (SPC) method was the prime goal of our study. The Material and Methods in The study was conducted in a tertiary care teaching hospital from Jan-Dec.2010. A total of 403 samples were collected from various sites by surface swabbing, transported to laboratory in Cary-Blair media and inoculated on Muller-Hinton agar (MH). If grown isolates were indentified and subjected to antimicrobial susceptibility testing (AST). MH agar plates were used for SPC. The Results were four isolates (1%) were detected from the samples, 2 of Klebsiella spp, 1 of CONS and 1 of Pseudomonas spp, with variable AST patterns. In Conclusion Bio-aerosol monitoring in hospitals provides information for epidemiological investigation of nosocomial infectious diseases, research into airborne microorganism spread and control, monitoring bio hazardous procedures and use as quality control measure to determine the quality of indoor air.
Keywords: Bio-aerosols, monitoring neonatal intensive care units (NICUs).

INTRODUCTION

Bio-aerosols are airborne particles that are living (bacteria, viruses and fungi) or originate from living organisms. Bio-aerosols are ubiquitous, highly variable, complex, natural or man-made in origin [1]. Bio-aerosols contribute to about 5-34% of indoor air pollution [2, 3]. Their presence in the air is the result of dispersal from a site of colonization or growth. The health effects of bio-aerosols include infectious diseases, acute toxic effects, allergies and cancer coupled with the threat of bioterrorism [4, 5].

Bacterial cells and cellular fragments, fungal spores and by- products of microbial metabolism present as particulate, liquid or volatile organic compounds may be components of bio-aerosols [6]. Inhalation, ingestion and dermal contact are the routes of human exposure to airborne micro-organisms, inhalation being the predominant. The particles in a bio-aerosol are generally 0.3 to 100 µm in diameter; however the respirable size fraction of 1 to 100 µm is of primary concern [7]. Bio-aerosols ranging in size from 1.0 to 5.0 µm generally remain in air, whereas larger particles are deposited on surface [8].

Due to its hazardous effects sampling and analysis of airborne micro-organisms has received attention in recent years. This analysis of bio-aerosols in neonatal intensive care units (NICUs) was the prime objective of our study.

MATERIAL AND METHODS

The study was conducted in Dept. of Microbiology from a tertiary care teaching hospital from Jan-Dec 2010. Samples were collected from neonatal intensive care units (NICUs) in the hospital. A total of 403 samples were collected by swabbing from various sites as cradles, suction machines, warmers, oxygen units, phototherapy units and kattas (granite surfaces). They were transported to the laboratory in Cary-Blair medium. Then they were inoculated on Mueller – Hinton agar (MH) and incubated overnight to check for growth of isolates. If grown the isolates were identified by standard tests and subjected to antimicrobial susceptibility testing (AST). Antibiotic panel was chosen depending upon the profile of the organism and tested by disk diffusion method following standard guidelines. Simultaneous air sampling of these NICUs by settle plate count (SPC) method was done using MH plates.

RESULTS

Results of the total 403 samples only 4 samples (1%) showed growth of relevant organisms – Table-1. These isolates were coagulase negative Staphylococci (1), Klebsiella (2), Pseudomonas species (1) from various sites – Table-2. AST pattern of these

organisms is shown in Table-3. SPC did not show any significant colony counts (less than 10 CFU/m^3).

Table-1: Distribution of total samples.

Duration	Total	Positive	Negative
Jan-Dec 2010	403	4 (1%)	399 (99%)

Table-2: Organisms isolated from positive samples

Organism	Number of isolates	Sites of isolation
Coagulase negative Staphylococci	1	Suction Katta
Klebsiella Species	1	Phototherapy Unit
Klebsiella oxytoca	1	Oxygen unit
Pseudomonas Species	1	Suction Katta
Total	**4**	**4**

Table-3: Antimicrobial susceptibility pattern of positive isolates.

Organism	Sensitive	Intermediate	Resistant
Coagulase negative Staphylococci	Imipenem, Cefotaxime,Vancomycin	-	Erythromycin, Ciprofloxacin, Co-trimaxozle
Klebsiella Species	Ciprofloxacin, Ceftriaxone	Amikacin	Ampicillin, Gentamicin, Ceftazidime
Klebsiella oxytoca	Amikacin, Ciprofloxacin	-	Ampicillin, Gentamicin, Ceftazidime
Pseudomonas Species	Amikacin, Gentamicin, Ciprofloxacin, Meropenem	-	Ampicillin

DISCUSSION

Biologic hazards to man arise from exposure to high concentrations or unfamiliar forms of bio-aerosols and three major groups of diseases associated with bio-aerosol exposure are infectious diseases, respiratory diseases and cancer [4]. Tuberculosis, legionellosis, mycotoxicosis, allergic broncho pulmonary aspergillosis, COPDs are a few examples of these bio-hazards. Increasing incidence of nosocomial and occupational diseases due to bio-aerosol exposure [9, 10] indicate a need for thorough knowledge in this respect.

In our study only 1% of the samples have shown growth of relevant microorganisms from various surfaces. Identification of these isolates and their drug susceptibility patterns serve as useful markers for epidemiology and nosocomial investigation purpose.

Airborne nosocomial infections are transmitted directly or indirectly through air and may cause respiratory (primarily pneumonia) and surgical-site infections. Earlier studies have shown increasing evidence of airborne transmission in nosocomial outbreaks of methicillin resistant Staphylococcus aureus (MRSA) [11, 12], Acineto bacter spp [12, 13] and Pseudomonas spp [14].

A variety of bacteria such Acineto bacter, Bacillus, Corynebacterium, Escherichia, Listeria, Micrococcus, Staphylococcus and Streptococcus and fungi such as a Alternaria, Aspergillus, Cladosporium, Penicillium and Scopulariopsis were isolated from operating theatres, birthing-room, emergency department, service area for infectious diseases, intensive care units (ICUs) and canteen in Trakya University Hospital, (Edrine, Turky) [15].

In another study the frequency of nosocomial infection related to air-colonization was higher in patients of anaesthesia intensive care unit (16.4%) than in general surgery intensive care unit (4.9%), the most frequent being bacteraemia and surgical would infections respectively. The most frequently isolated microorganisms were MRSA and Acinetobacter baumannii suggesting that airborne viable particles in operating theaters and intensive care units can be significant risk factors for the development of nosocomial infections [16].

The Central Pollution Control Board (CPCB), New Delhi, India [17] studied the bacterial, fungal and total pathogenic populations in different months in various settings including operation theatres and hospitals and found seasonal variations in fungal and bacterial concentration. Thus our study has also been an effort to collect, identify and quantify the bio-aerosols present in NICUS.

Bio-aerosol monitory in hospital provide information for epidemiological investigation of nosocomial infectious diseases, research into airborne microorganisms spread and control, monitoring bio hazardous procedures and use as a quality control measure to determine the quality of indoor air [6].

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