

OPERATION THEATERS: A SOURCE OF NOSOCOMIAL INFECTION

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ABSTRACT

Bacterial contamination of operating theaters (OTs) is a major source for spread of healthcare associated infections (HAIs) among patients during surgical procedure cause an exogenous type of infections. The aim of this study was to evaluate the prevalence of microbial contamination and species typing of isolates. Swabs and exposed plate were collected from 10 items that were distributed over two categories (equipment and environment). Total 60 swabs and 8 exposed plates were collected at pre- and post-operation stages and were inoculated on blood agar and Macconkey's agar plates and the identification of the isolates were done using standard microbiological methods. High microbiological contamination of air, wall, floor and table were detected. An instrument which used in surgical procedure already sterilized by autoclave showed no growth, however, other heat labile instruments which were sterilized by chemical disinfectants were found with pathogenic bacteria, total bacteriological counts in air samples were high. Conclusions: This study shows the prevalence of microbial contamination in operating theaters, which may increase the risk factors for developing surgical-site infections.

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KEYWORDS: Operation theatre, Hospital, Microorganism, Fumigation.

INTRODUCTION

Bacterial contamination of operating theaters (OTs) is a major source for spread of healthcare associated infections (HAIs) among patients during surgical procedure cause exogenous type of infections (1-4). Also, it is considered as a risk factor for surgical site infections (SSIs) in patients after surgical procedure. (2-5) due to SSI, patients may suffer with delayed wound healing, prolongs hospitalization, it increases morbidity and the overall costs for the treatment (6-8). Various supplies have been accounted for as being in charge of the tainting of the OT, including unfiltered air, ventilation frameworks and germicide arrangements, waste of the injuries, transportation of patients and accumulation packs, careful group, degree of indoor traffic, theater outfit, foot products, gloves and hands, utilization of insufficiently disinfected gear, defiled condition and terribly polluted surfaces (2,4,9-14). The study reported that the major pathogens associated with infection of implantable biomedical devices are *Staphylococcus aureus* and the coagulase negative staphylococci (CoNS) (9). Few studies reported that the clinical implication of microbial contamination in the OT is enormous on both the patient and the caring surgical team (2,4,5) About 10% of all infections may have a serious burden to patients, i.e. increased morbidity,

mortality and prolongs hospitalization and overall costs (15). However, it can be prevented through proper cleaning and fumigation of OT, reduction of airborne bacteria in the OT by about 13-fold, would reduce the wound contamination by about 50%. (2,4) The present study will help to find the prevalence and type of bacterial contamination in OTs and the role of fumigation in the OTs.

MATERIALS AND METHODS

This prospective and retrospective study was carried out at the Department of Microbiology at N.C. Medical College and Hospital, Israna, Panipat, Haryana, India, for the period of one year from January 2016 to December 2016. Samples were collected by moistened sterile swabs and by settle plate methods. Total 300 swabs (150 swabs were before and 150 after fumigation) and 60 exposed plates (30 before and 30 after fumigation for 30 minutes) were collected from the six different operation theatres of N.C. Hospital (1. Eye OT, 2. General OT, 3. ENT OT, 4. Orthopaedics OT, 5. Gynaecology OT and 6. Emergency OT). Petri dishes containing blood and MacConkey's and nutrient agar were transported to operation theatres in sealed plastic bags. The culture plates were labeled with sample number, site, date and time sample collection. The plates were placed at four chosen places in the operation theatre, and exposed for 30

minutes. Then the plates were covered with their lids, sealed with paraffin tape and transported to the laboratory in sealed plastic bags and plates were incubated at 37°C for 24 hours.

Samples were collected using swab moistened in nutrient broth from the floor, walls, equipments, instruments, operation tables, wash basin etc. All the samples were labeled properly and immediately transported to the microbiology laboratory of N.C. Medical College and Hospital for processing.

Swabs taken from different articles were streaked in Blood and MacConkey's and nutrient agar. After inoculation, culture plates along with those exposed in air were incubated at 37°C under for 24 hours. After incubation the colonies were counted and identification of isolates was performed. Bacterial count was expressed as colony forming units per cubic meter (cfu/m3).

Statistical Analysis

Statistical analysis will be done using Chi-square test. Descriptive analysis will be done to estimate the percentage of microorganisms and the Chi Square test will be done to assess the difference in proportions. Level of significance will taken at $p < 0.05$.

RESULTS

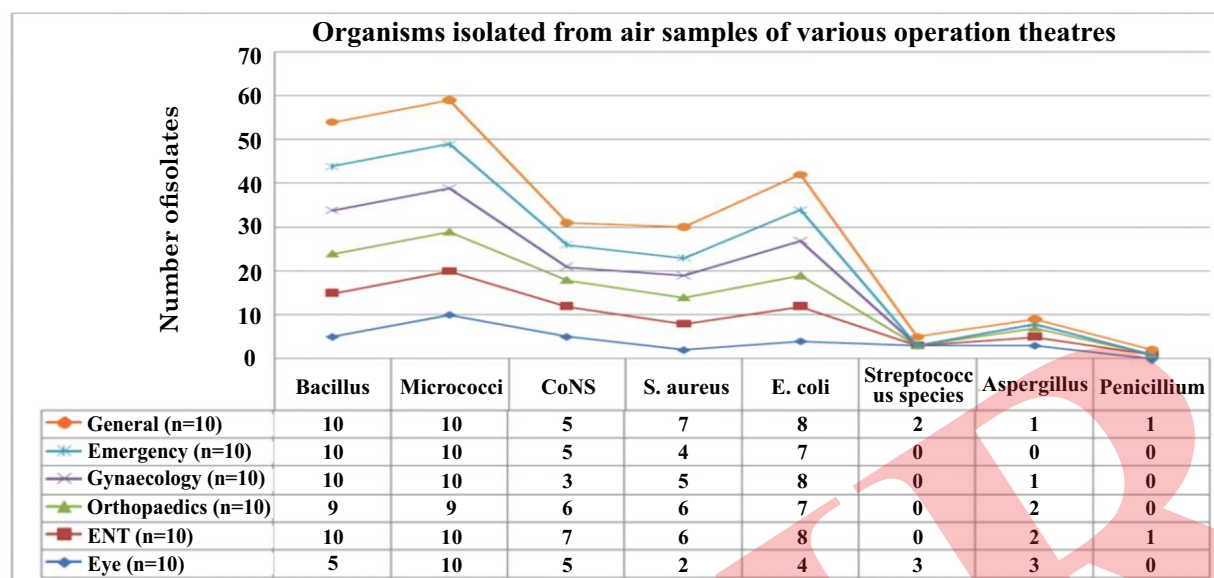
Bacillus was isolated from all the air samples obtained from the various operation theatres (OTs) i.e. ENT, Gynaecology, Emergency and General OTs 100% each, followed by Orthopaedics and Eye i.e. 90% and 50 respectively. *Micrococci* was isolated from all OTs from all the air samples obtained from the various operation theatres (OTs) i.e. Eye, ENT, Gynaecology, Emergency and General OTs 100% each, followed by Orthopaedics i.e. 90%. Coagulase negative staphylococci was from all the air samples obtained from the various operation

theatres (OTs) i.e. ENT 70%, followed by Orthopaedics 60%, Eye, emergency and General OTs 50% each and lowest prevalence in Gynaecology OTs i.e. 30%. *Staphylococcus aureus* was isolated from all the air samples obtained from the various operation theatres (OTs) i.e. General OT 70%, followed by ENT and Orthopaedics 60% each, Gynaecology OT showed 50%, Emergency OT 40%, and Eye OT 20%. *Escherichia coli* were isolated from all the air samples obtained from the various operation theatres (OTs) i.e. ENT, Gynaecology and General OT 80% each, followed by Orthopaedics and Emergency OT 70% each, Eye OT 40%. *Streptococcus species* were isolated from two air samples obtained from the various operation theatres (OTs) i.e. Eye OT 30% and General OT 20%. Fungi isolated were *Aspergillus* species and *Penicillium* species. *Aspergillus* species were isolated from all the air samples obtained from the various operation theatres (OTs) except Emergency OT. i.e. Eye OT 30, followed by ENT and Orthopaedics 20% each, Gynaecology and General OT 10% each. *Penicillium* species were isolated from only two air samples obtained from the various operation theatres (OTs) i.e. ENT and General OT 10% each. (Table 1, Graph 1).

Bacillus was the predominant organism isolated from various surfaces and articles. It was present in 80% of the surfaces sampled from the Eye and Emergency OT, 76% from ENT, Orthopaedics and General OT surfaces and 68% of the surfaces/articles from the Gynaecology OT. Micrococci were isolated from various surfaces and articles i.e. from Eye OT 76% followed by ENT OT 72%, Orthopaedic OT 68%, Gynaecology and General OT 64% each and Emergency OT 44%. Coagulase negative staphylococci was isolated from various surfaces and articles, it was present in 44% of the surfaces sampled

Organisms isolated	Name of OT											
	Eye (n=10)		ENT (n=10)		Orthopaedics (n=10)		Gynaecology (n=10)		Emergency (n=10)		General (n=10)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bacillus	5	50	10	100	9	90	10	100	10	100	10	100
Micrococci	10	100	10	100	9	90	10	100	10	100	10	100
CoNS	5	50	7	70	6	60	3	30	5	50	5	50
Staphylococcus aureus	2	20	6	60	6	60	5	50	4	40	7	70
E. coli	4	40	8	80	7	70	8	80	7	70	8	80
Streptococcus species	3	30	0	0	0	0	0	0	0	0	2	20
Aspergillus species	3	30	2	20	2	20	1	10	0	0	1	10
Penicillium species	0	0	1	10	0	0	0	0	0	0	1	10

Table 1: Organisms Isolated From Air Samples Of Various Operation Theatres



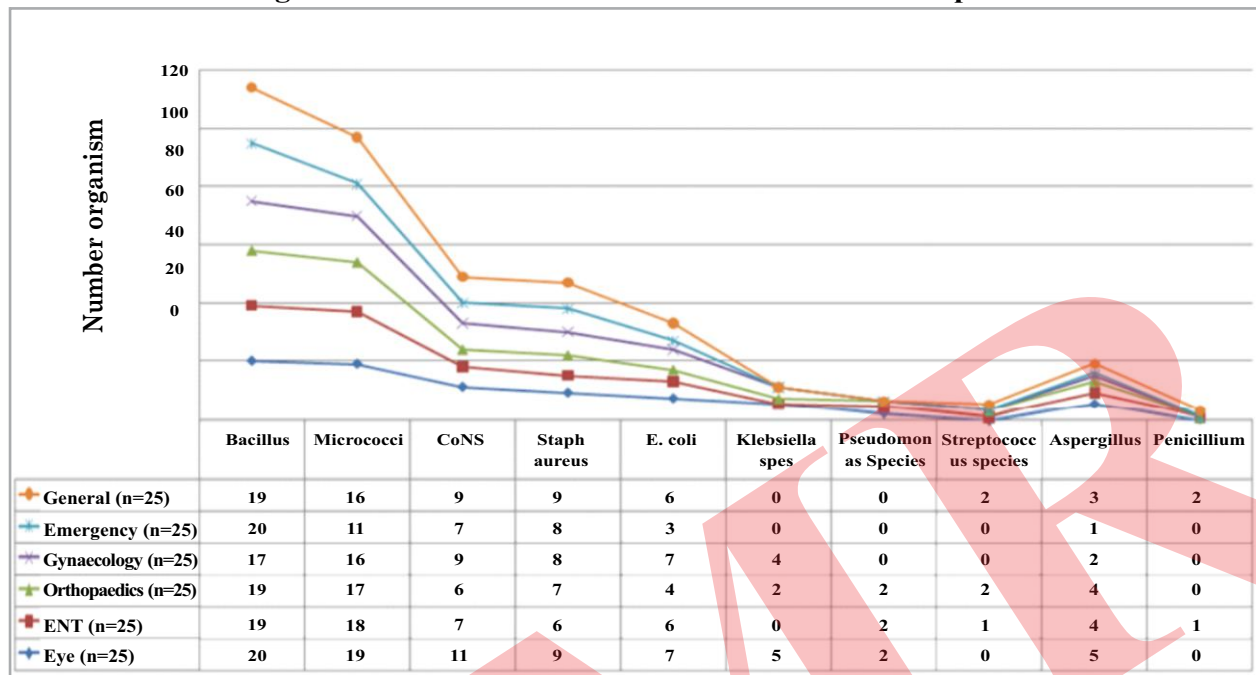
Graph 1: Organisms Isolated From Air Samples Of Various Operation Theatres

from the Eye, 36% Gynaecology and General OTs each, 28% ENT and Emergency OT each and 24% orthopaedic OT. *Staphylococcus aureus* was maximum isolated from Eye and General OT i.e. 36% each, followed by Gynaecology and Emergency OT i.e. 32%, Orthopaedic OT 28% and ENT OT 24%. *Escherichia coli* was maximum isolated from Eye and Gynaecology OT i.e. 28% each, followed by ENT and General OT i.e. 24% each, Orthopaedic OT 16% and Emergency OT 12%. *Klebsiella* species was maximum isolated from Eye OT i.e. 20% followed by

Gynaecology OT 16% and lowest from Orthopaedic OT i.e. 8%. *Pseudomonas* species was isolated from Eye, ENT and Orthopaedic OT i.e. 8% each. *Streptococcus* species was isolated from Orthopaedic and General OT i.e. 8% each and ENT OT 4%. *Aspergillus* species was maximum isolated from Eye OT i.e. 20% followed by ENT and Orthopaedic OT 16% each, General OT i.e. 12%, Gynaecology OT 8%, and Emergency OT 4%. *Penicillium* species was isolated from General OT i.e. 8% and ENT OT i.e. 4%. (Table 2, Graph 2).

Organisms isolated	Name of OT											
	Eye (n=25)		ENT (n=25)		Orthopaedics (n=25)		Gynaecology (n=25)		Emergency (n=25)		General (n=25)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bacillus	20	80	19	76	19	76	17	68	20	80	19	76
Micrococci	19	76	18	72	17	68	16	64	11	44	16	64
CoNS	11	44	7	28	6	24	9	36	7	28	9	36
Staph. aureus	9	36	6	24	7	28	8	32	8	32	9	36
E. coli	7	28	6	24	4	16	7	28	3	12	6	24
Klebsiella species	5	20	0	0	2	8	4	16	0	0	0	0
Pseudomonas species	2	8	2	8	2	8	0	0	0	0	0	0
Streptococcus species	0	0	1	4	2	8	0	0	0	0	2	8
Aspergillus species	5	20	4	16	4	16	2	8	1	4	3	12
Penicillium species	0	0	1	4	0	0	0	0	0	0	2	8

Table 2: Organisms Isolated From Surfaces/articles Of Various Operation Theatres

Organisms isolated from surfaces/articles of various operation theatres**Graph 2: Organisms Isolated From Surfaces/Articles Of Various Operation Theatres**

DISCUSSION

Microbiological sully of air in the working room is commonly viewed as a hazard factor for surgical site infections (SSIs) (17). According to Pasquarella et al (18) microbiological nature of air might be considered as reflection of the clean state of the task theaters. The nature of indoor air relies upon outside and inside sources, for example, ventilation, cleaning techniques, the careful group and their activity (19).

In the present working theater's condition, the greater part of careful site contamination pathogens begin from nosocomial skin verdure of patients and staff (20). Bacteria on skin squames, build up and different cleans get into the air in the working theater and by fierce air flows store on surfaces. They are additionally spread by direct contact among transporter and twisted, however the significance of airborne microscopic organisms as a wellspring of contamination remains a subject of discussion among experts in disease control (21).

Task theaters which decide connection between all out bacterial air include in OT and danger of disease. An examination was accounted for that it has been seen that includes in the scope of 700-1800/m³ were identified with noteworthy danger of disease and the hazard was slight when they were beneath 180/m³. [14] Studies carried out by researcher on operation theatres to evaluate the relationship between the total bacterial air count in OT and risk of infection and

observed that 700-1800/m³ counts were significant the risk of infection and the risk was low when they were below 180/m³ (14). In the present study, bacterial count in air ranged from 51,00 to 11,210 cfu/ m³ in different operating theatres. Bacterial count in the air was more in general OT, emergency OT, gynaecology OT and orthopedics OT as compared to Eye and ENT OTs.

The instruments and articles which were sterilized by autoclave showed were sterile in culture however instruments like tubings of sucker machine and ventilators, sucker tip, laryngoscope blade which were disinfected by chemicals (due to their heat labile nature) showed heavy growth of pathogens like *Staphylococcus aureus*, *E. coli*, *Klebsiella* species and *Pseudomonas* species. In our results, relatively clean sites were floors and walls of all OT except orthopedics OT from where pathogens like *Pseudomonas*, *Klebsiella* and *Staphylococcus aureus* were recovered from floor and wall. It was observed that sucker machines in most of the operation theatres were heavily contaminated with *Staphylococcus aureus*, *Klebsiella* species, *E. coli* and *Pseudomonas* species. Onwubiko NE et al. (2015) from Nigeria, studied on 1,800 consecutive samples were collected from equipments, floors and walls of the operating rooms in Aminu Kano Teaching hospital, Kano fortnightly for 15 months between January 2009 and March 2010. These were screened for the presence of bacterial and fungal pathogens and identified by

standard microbiological procedures. The theatres examined were, Main, Maternity, and Gynecology theatre. The isolates of clinical importance observed were Coagulase Negative Staphylococcus (COANS) spp. (34.5%), *P. aeruginosa* (26.2%), Non-haemolytic *Streptococcus* spp. (14.5%), *Proteus mirabilis* (10.3%), *E. coli* (8.3%), *S. choleraesuis* (4.1%) and *Staphylococcus aureus* (2.1%). Tesfaye T et al. (2015) from Ethiopia, studied on 120 air, 36 article and 12 surface samples. The most abnormal amount of microbial tainting was distinguished in the OT air before legitimate cleaning-fumigation when contrasted with after the mediation. Culture plate indicates microbial development on surfaces and semi-basic articles, yet sterile which cleaned via autoclave. There were five kinds of microorganisms confined with the most noteworthy predominance of coagulase negative Staphylococci (68; 53.5%) trailed by *Staphylococcus aureus* (42; 33.1%).

CONCLUSION

This study highlights the use of fumigation for the operation theatres before every surgical procedure. Our study showed that health-care associated infection can be minimizing by proper cleaning and disinfection of operation theaters. Settle plate's strategy for air and swabbing system for surfaces ended up being increasingly important in recognizing the pollution level in our set up with constrained assets. Routine samplings of floor, dividers or furniture which are not in direct contact with patients are not the wellsprings of disease. Thus they don't contribute in the anticipation of nosocomial disease, except if there is a scourge. Standard microbiological reconnaissance of the OT and checking may supportive in decreasing microbial defilement thus postoperative irresistible scenes can be diminished extensively.

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