



A COMPREHENSIVE STUDY ON MICROBIOLOGICAL SURVEILLANCE OF OPERATION THEATRES IN A TERTIARY CARE HOSPITAL OF NORTH BIHAR

Medical Microbiology

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ABSTRACT

The operation theatre (OT) environment plays a vital role in postoperative recovery. Hospital-associated infections significantly increase morbidity, mortality, hospital stay, and financial burden. This study assessed the prevalence and types of microorganisms on OT surfaces. A total of 183 swabs were collected after cleaning and disinfection with quaternary ammonium compounds. Of these, 96 (52.4%) showed growth, mostly non-pathogenic (aerobic spore-forming bacilli, micrococci). Surgery, gynaecology, and laparoscopic OTs showed the highest growth (59%), while Eye OT had the lowest (30%). Findings indicate OT surfaces are predominantly contaminated with non-pathogenic organisms, with highest rates in surgery-related OTs.

KEYWORDS

Pathogenic Microorganisms, Operation Theatres, Microbiological Surveillance

INTRODUCTION

“A man laid on the operation table in one of our surgical hospital is exposed to more chance of death than was the English soldier on the field of Waterloo” quote by Sir James Young Simpson, surgeon and Professor of medicine in 1860s(1).

The environment of operation theatre (OT) plays very important role in the postoperative recovery of the patients. Medical science has made remarkable strides since Joseph Lister introduced the concept of antiseptics. Lister significantly reduced the incidence of wound infections, by using carbolic acid(2). Hospital-associated infections are major source of morbidity and mortality in inpatients and in postoperative patients. Sources of infection can be contaminated surfaces like OT bulb, table, equipment, or from the theatre environment like air, surfaces. Several factors contribute to air contamination, including the number of individuals in the theatre, the type of ventilation system in place, the rate of air exchange, the quality of air supplied, and the types of organisms present(3). Infections acquired in operating theatres (OTs) result in increased morbidity and mortality rates, extended hospital stays, and increased financial burden on both patients and healthcare facilities. However, employing rigorous theatre protocols, adhering to standard cleaning procedures, and ensuring proper sterilization practices can significantly reduce the incidence of infections in OTs(4). Microbiological surveillance is needed to monitor the environment by the microbiological testing of surfaces and equipment and in infection control programs, providing data on microbial flora types and counts.

MATERIALS AND METHODS

This retrospective study was conducted over a period of one year from June, 2023 to May 2024 in the Department of Microbiology, Shree Narayan Medical Institute and Hospital (SNMIH), Saharsa, a tertiary care centre of North Bihar. A total of 183 samples were taken after proper sterilization and disinfection of the OTs. Swabbing was used for sample collection. Sterile gloves, masks and gown were worn for collection to prevent the contamination of media and OT surfaces.

Sterile swabs soaked in nutrient broth were used for sample collection from different sites and equipment (Wall, table, light, AC vent, Boyles, trolley and floor) of 5 OTs (surgery, gynaecology, laparoscopic, eye, orthopaedic) of the hospital. They were labelled properly and transported immediately to the microbiology laboratory for processing. Inoculation was done on Blood agar and MacConkey agar and incubated at 37°C for 24 hours under aerobic conditions. Bacterial species were isolated and identified by conventional methods.

Inclusion Criteria – Under the appropriate sterile conditions, samples were taken on Monday from every OTs.

Exclusion Criteria – Samples from OT were not collected if the OT was opened before 12 hours. Also, it was rejected if contamination occurred during collection or transport.

RESULTS

Of the 183 swab samples collected, 96 (52.4%) showed bacterial growth. Most of them were non-pathogenic organisms like Aerobic spore forming bacilli (ASB) and micrococci.

In all operation theatres, non-pathogenic organisms (83), such as aerobic spore-forming bacilli and micrococci, were found in higher numbers compared to pathogenic organisms (13). The surgery, gynaecology, and laparoscopic operating theatres exhibited the highest bacterial growth rate of 59%, while the eye operating theatre showed the lowest contamination level, with a bacterial growth rate of 30% (5 positive samples out of 17). From the 96 isolates obtained across various OTs, 64 (34.9%) were identified as *Bacillus* species, 6 (3.27%) as coagulase-negative *Staphylococcus* species (CONS), 19 (10.38%) as micrococci, and the remaining 7 as *Escherichia coli* Table 1.

The differences between sterile and positive swabs, as well as between pathogenic and non-pathogenic isolates, are presented in Table 2.

Table 1: Organisms Isolated From Surfaces/Articles of Various Operation Theatre

Name of OT	No of samples	Micrococci	CONS	ASB	Escherichia coli
Surgery OT	58	5	3 (1MRSA)	25	1
Gynaecology OT	41	6	-	15	3
Orthopaedic OT	40	2	1	12	2
Laparoscopic OT	27	2	2 (1MRSA)	11	1
Eye OT	17	4	-	1	-
Total	183	19 (10.38%)	6 (3.27%)	64 (34.9%)	7 (3.82%)

MRSA- methicillin-resistant *Staphylococcus aureus*

CONS- Coagulase Negative *Staphylococcus* species

ASB- Aerobic spore forming bacilli

OT- operation theatre

Table 2: Surface Sampling of Operation Theatres: Sterility Status and Culture Positivity (Non-pathogenic vs. Pathogenic Isolates)

Name of OT	Total swabs	No. of sterile swabs	No. of positive cultures	No. of Non pathogens	No. of pathogens
Surgery OT	58	24(41%)	34(59%)	33	1
Gynaecology OT	41	17(41%)	24(59%)	21	3
Orthopedic OT	40	23(57.5%)	17(42.5%)	15	2
Laparoscopic OT OT	27	11(41%)	16(59%)	15	1
Eye OT	17	12(70.5%)	05(29.5)	5	
Total	183	87(47.5%)	96(52.5%)	89	7

Table 3. Contamination Status of Surfaces/Articles of Operation Theatre

Organism Isolated	Total number of positive swabs from					Total
	Wall	Table	Light	AC vent	Boyle's apparatus	
ASB	19	13	13	3	16	64
Micrococcus	5	5	2	3	4	19
CONS	2		2		2	6
Escherichia coli		2		5		7
Total	26	20	17	11	22	96

The highest number of positive cultures was detected on OT tables (26), followed by walls (20). Bacillus species were the most frequently isolated organisms from walls, tables, lights, and Boyle's apparatus, as presented in Table 3.

DISCUSSION

Microbial contamination in OT leading to postoperative infections which can have significant consequences for both patients and their families. Any suspected case of hospital-acquired infection (HAI) is investigated by including cultures from other body sites of the patient, other patients, staff, and environment(5). Hospital-acquired infection extends hospital stays, result in long-term disabilities, contribute to increased antimicrobial resistance, impose substantial financial strains on healthcare systems, and, tragically, lead to preventable deaths. To address the issue effectively, a robust infection control program should be implemented. This program would not only enhance staff education and accountability but also promote research aimed at adapting and validating surveillance protocols that align with the reality of developing countries to achieve acceptable performance. This can reduce the incidence of HAIs by around one-third(6).

In the present study, 183 surface swabs were collected from five OTs of the hospital with a bacterial contamination rate of 52.4% (n = 96), which is almost comparable with the other study where positivity rate was 42%(7). It is quite high compared to other studies where positivity rate ranged from 4.4 % to 14.6%(8,9). A study conducted in Nigeria reported a bacterial growth rate of 86% using the swabbing method, which is significantly higher compared to the results of our study(10). Of these 96 isolates obtained from various OTs Bacillus species were most common isolated isolates followed by micrococci, Coagulase Negative Staphylococcus (CONS) species and E.coli. Similar results were reported by Desai et al.(7). This finding aligns with the study conducted by Laxmi et al., where Bacillus spp. was reported as the most common isolate, followed by Coagulase-negative staphylococci (11). Among the six isolated coagulase-negative Staphylococci (CONS), three were identified as methicillin-resistant Staphylococcus aureus (MRSA).

Limitation of our study is that, we focused only on the identification of aerobic bacteria, without assessing fungal or anaerobic bacterial isolates.

Only CONS were screened for MRSA, other antibiotics were not tested against the isolated aerobic bacteria, nor were they screened for Extended-Spectrum Beta-Lactamase (ESBL) production or similar resistance mechanisms.

CONCLUSION

This study indicated that the surfaces of operating theatres (OTs) were predominantly contaminated by non-pathogenic microorganisms. The surgery, gynaecology, and laparoscopic OTs showed the highest bacterial growth. Aerobic spore-forming Bacilli were the most commonly isolated organisms, followed by micrococci, coagulase-

negative Staphylococci, and E. coli. Enhancing surveillance and laboratory capacity will undoubtedly improve infection prevention and control. Routine sampling is highly recommended to raise awareness, helping to identify and manage all potential sources and types of infections. This data can be valuable in establishing regional standards for acceptable levels of microbial populations in hospital environments. It can also be used to propose appropriate guidelines aimed at reducing microbial levels in operating theatres, contributing to improved infection control practices. The presence of potential pathogens in hospital operating theatres (OTs) can pose a significant risk to patients. Our study aimed to gain insights into the surface pathogens present in OTs. In the future, more extensive research should be conducted to determine the prevalence of various bacterial isolates, along with comparative studies on routine sampling methods for detecting the pathogen. Additionally, focusing on infection control measures will be crucial in effectively managing and reducing the risk of surgical site infections (SSIs).

Acknowledgment

The authors acknowledge the Department of Clinical Microbiology for the infrastructure support towards the study.

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