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Microbiological Surveillance of Operation Theaters of Hospitals in Jabalpur

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Abstract

Microbiological surveillance in the operating theatres is one of the most important strategies for determining potential sources of contamination and putting infection control strategies into effect. Regular monitoring establishes the environment conducive to surgical site infections and helps in formulating necessary interventions. Prior studies have shown that the increased levels of microbial contamination in the surgical environment necessitate strict microbiological monitoring. The present study was conducted to identify bacterial colonization of surfaces and equipment in the OTs and to determine the microbial contamination of air in the OTs of a tertiary care hospital.

Keywords: Microbiological surveillance, Operation Theaters, Bacterial infection

1. Introduction

Hospital acquired infections (HAIs) prolong hospital stays, create long-term disability, increase resistance to antimicrobials, represent a massive additional financial burden for health systems and cause unnecessary deaths. Invasive procedures, high antibiotic usage and transmission of bacteria between patients due to inadequate infection control measures may explain why OTs and ICUs are “hot zones” for the emergence and spread of microbial resistance. Sources of infection can either be endogenous or exogenous from the theatre environment like air, surfaces, and articles in operation theatre (OT). So, the preventive measure may be achieved by making improvement in cleaning by using disinfectants, needs periodic fumigation of these OTs and with routine microbial surveillance. Microbiological surveillance” provides data about the factors contributing to infection. Environmental monitoring by the microbiological testing of surfaces and equipment is useful to detect changing trends of types and counts of microbial flora. Evaluation of the quality of air in operating theatres can be performed routinely by microbiological sampling and particle counting. The quality of indoor air depends on external and internal sources such as ventilation, cleaning procedures, the surgical team and their activities. One such problem in contemporary healthcare is microbial contamination within operating theatres, stretching from increased morbidity to extended 3 hospital stays and raised healthcare costs, constituting a profound burden on both patients and the health system. The WHO has emphasized precautions to prevent infections and implement control measures within surgical settings to address these issues. The operating room environment is a very complex and dynamic ecology characterized by various factors, which can influence the microbial growth, air quality, surface cleanliness, and the practices of surgical staff. Airborne pathogens pose a particularly great degree of concern, as they can directly contaminate the surgical site throughout procedures. Surfaces throughout the operation theatre, such as floors, walls, surgical tables, anesthesia equipment, and surgical trolly, may serve as reservoirs for pathogenic microorganisms and complicate control of infection. Microbiological surveillance in the operating theatres is one of the most important strategies for determining potential sources of contamination and putting infection control

strategies into effect. Regular monitoring establishes the environment conducive to surgical site infections and helps in formulating necessary interventions. Microbiological surveillance in the operating theatres is one of the most important strategies for determining potential sources of contamination and putting infection control strategies into effect. Regular monitoring establishes the environment conducive to surgical site infections and helps in formulating necessary interventions.

2. Literature Review

The quality of air in operation theaters (OTs) plays a critical role in maintaining aseptic conditions and reducing the risk of surgical site infections (SSIs). Microbiological air quality surveillance, which involves the detection and quantification of airborne microbial contaminants, is essential for evaluating and ensuring sterile environments.

Airborne microorganisms are a significant source of contamination in surgical settings. Studies have shown that microorganisms can be transported via skin particles, dust, and respiratory droplets, posing a threat to sterile surgical fields (Lidwell, 1983) [19]. Surveillance is particularly crucial because airborne transmission accounts for a considerable proportion of SSIs, especially in Orthopaedic and implant surgeries (Mangram *et al*., 1999) [20]. International guidelines, such as those from the Canters for Disease Control and Prevention (CDC) and the World Health Organization (WHO), recommend regular air quality assessments using microbial sampling (WHO, 2009; CDC, 2003). The permissible microbial load in OTs ranges from 10 to 25 colony-forming units per cubic meter (cfu/m3) in an empty theatre, and should not exceed 180 cfu/m3 during surgery (Nerandzic *et al*., 2010) [21].

3. Materials and Methods

General purpose glassware used in experiment for various purposes like measuring cylinders, conical flasks, beakers, pipettes, test tubes etc. were washed with phosphate free detergent i.e. Lanoline (Qualigens, India) and rinsed with distilled water. The glass wares were air dried prior to use.

The glassware previously used for the growth of microorganisms i.e., Petriplates and test tubes were decontaminated prior to washing. The Petri plates and test tubes were kept in pressure cooker, filled with tap water and kept in boiling state for 45 minutes for decontamination.

Pressure was released after45 minutes and all the glassware were removed from the cooker with the help of tong. Gloves were used during the process for the safety. Glass wares were washed with Lanoline, rinsed with methanol or spirit than dried in the plastic trays.

All the glass wares were sterilized by autoclaving. For this the glassware were wrapped with the help of acid paper and placed in autoclave. Sterilization is done at 121 ºC and 15 lbs pressure for 15 minutes under steam.

4. Results

The present study was aimed at identifying the risk of hospital acquired infections due to poor air quality in operation theatres. The hospitals of Jabalpur were chosen for the study. The air samples were collected by exposing the soybean casein digest agar plates for 10 min in the operation Theatre.

Table 1 shows the details of air samples collected for the study, supported by the Fig 1 showing the air sampling in the operation theater. In total 6 samples could be collected for the study. After the sampling, the plates were immediately transported to the laboratory and incubated for 48 h at 37 °C. The colonies appearing on the plates were counted and reported as CFU per plate (Fig 2). The bacterial colonies appearing onto the plate were further isolated and subjected to Gram staining (Fig 3), which gave the first-hand information for the identification of the bacteria. The isolated colonies were further subjected to the biochemical tests for confirmation. Fig 4 shows the results of biochemical tests from the isolated bacteria.

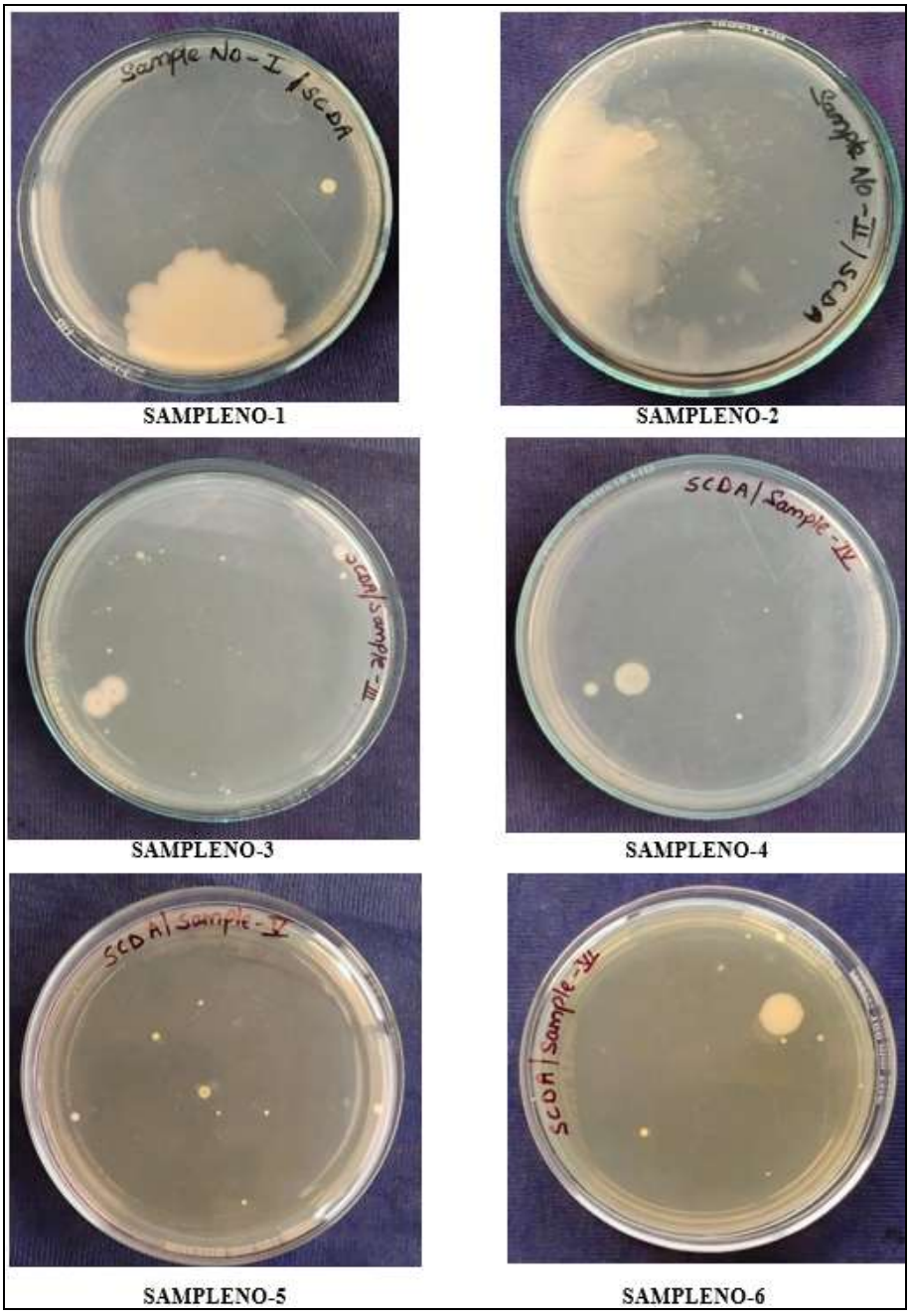
Based on macroscopic features of colonies, microscopic characters after Gram staining as well as the results of biochemical tests, the bacteria were identified from the air of the operation theater (Table 2). It is to be noted that out of 6 samples, CFU count in two cases were more than 10, exceeding the safe limits set for a general operation theater. Further, Klebsiella was the 24 most abundant bacteria, identified in 3 cases (50%). The presence of pathogenic bacteria i.e., Escherichia coli and Salmonella was also confirmed. The study shows the potential risk of hospital acquired infections due to the presence of pathogenic bacteria in operation theaters of Jabalpur.

Table 1: Identification of bacteria from air samples of Operation theaters based on macro-and microscopic characters as well as biochemical tests

Sample no.	Growth on SCDA	Colony count CFU/plate	Gram staining	Indole	MR	VP	TSI	Citrate	Urease	Bacteria identified
1	Round creamy moist colony white filaments colony	2	-ve Bacilli	_	+	+	Y/Y	+	+	*Klebsiella pneumoniae*
2	White filaments	1	–ve bacilli	-	+	+	Y/Y	+	+	*Klebsiella pneumoniae*
3	White moist colony	26	–ve bacilli	–	–	–	R/Y + Gas	–	–	*Enterobacter aerogenes*
4	Pale cream moist colony	5	–ve bacilli	+	+	+	Y/R	_	_	*E.COLI*
5	Smooth colony	9	–ve bacilli	–	+	_	Y/B	_	_	*Salmonella sp.*
6	Smooth colony	12	–ve bacilli	–	+	+	Y/Y	+	+	*Klebsiella pneumoniae*

SAMPLENO 1 **SAMPLENO 2**

Fig 1: Air Sampling on SCD agar plates from operation theaters



SAMPLENO-1 **SAMPLENO-2**

SAMPLENO-3 **SAMPLENO-4**

SAMPLENO-5 **SAMPLENO-6**

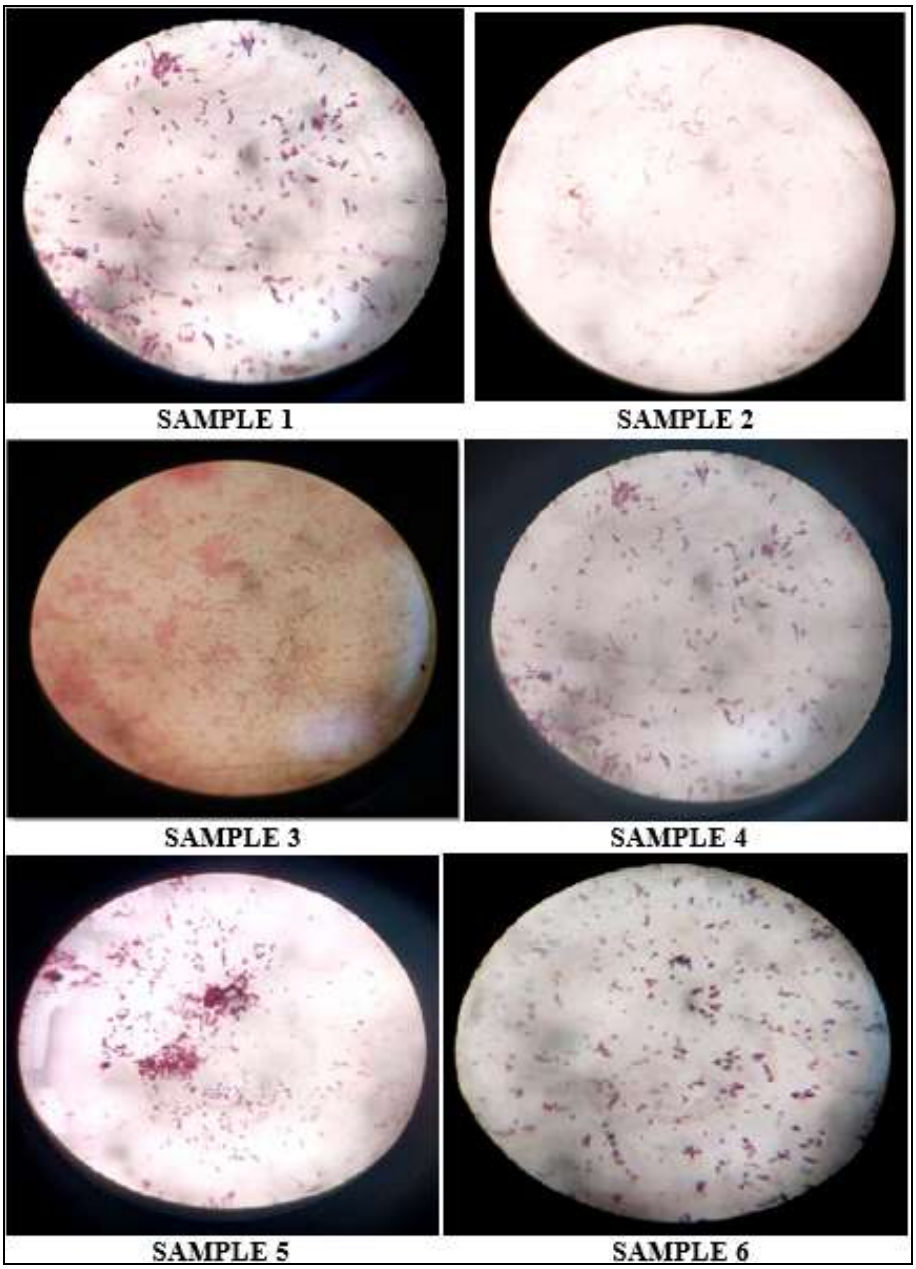


Fig 2: Colony count

4. Discussion

This study underscores the importance of microbiological surveillance in operating rooms and the correlations with patient safety. The evaluation of infection control practices is imperative to finding gaps and areas for improvement in the maintenance of sterile conditions within operating theatres: evaluation of adherence to institutional cleaning and disinfection protocol and compliance with hand hygiene practices among surgical teams and evaluation of the efficacy of usage of personal protective equipment. Continuous audits and feedback should be put in place in ensuring the upward trending compliance with infection control measures in healthcare facilities. In addition, further training programs should be established to upgrade the knowledge and skills of health workers regarding infection control strategies.

5. Conclusion

Microbiological surveillance is an important part of infection control program, providing data regarding types, and counts of microbial flora. The present study was conducted to identify bacterial colonization of surfaces and equipment in the OTs and to determine the microbial contamination of air in the OTs of a tertiary care hospital.

The identification of various pathogens, especially from hyper-risks zones, such as septic patients and gastroenterology operating theatres, warrants strict infection control measures. Strengthening training and compliance would yield a step-change to reduce SSIs and enhance patient outcome further. Future studies can prioritize developing standardized protocols for environmental monitoring and explore innovations on disinfection techniques to further improve patient safety in surgical settings

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