

MICROBIOLOGICAL SURVEILLANCE OF OPERATION THEATRES AND ICUs OF A TERTIARY CARE HOSPITAL, LAHORE

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ABSTRACT

The aims of this work was to study the level of bacterial contamination of air, surfaces and equipment in operation theatres of a tertiary care hospital in Lahore. Settle plates method was used for air samples and swabs for surfaces and other articles. High bacteriological contamination of air and sucker machine was detected and total bacteriological counts in air samples was high. On the other hand surfaces showed less bacterial contamination. It is concluded that microbiological surveillance of operating theaters can play an important role in reducing bacterial contamination consequently peroperative infectious episodes can be reduced considerably.

INTRODUCTION

Environmental monitoring means the microbiological testing of air, surfaces and equipment in order to detect changing trends of microbial counts and micro-flora¹. Hospital-associated infections are an important cause of patient morbidity and death². Infection control and basic hygiene should be at the heart of good hospital management³. Infection of the surgical-site is a leading complication of surgery⁴. Microbiological contamination of air in the operating room is generally considered to be a risk factor for infections of surgical site in clean surgery.^{4,5} Evaluation of the quality of air in operating theatres can be performed routinely by microbiological sampling and particle counting⁴. It is recommended that for conventional operating theatres the bioload should not exceed 35 cfu/m³ in an empty theatre or 180 cfu/m³ during an operation⁶. It is also suggested that for ultra-clean operating theatres the bioload should be less than 1.0 cfu/m³ in the centre of an empty theatre and less than 10 cfu/m³ during an operation and should not exceed 20 cfu/m³ at the periphery⁷. However according to Audurier et al the airborne bacterial concentration in a modern ventilated operating room should not exceed 30 cfu/m³⁸.

In this study air and surface contamination was measured in all operation theatres (OT) and ICUs. Samples were taken without prior discussion with the cleaning staff.

MATERIALS AND METHODS

Collection and Transport of specimens: Air and surface samples were taken from all operating theatres of a tertiary care hospital in Lahore.

Air sampling was performed with settle plates methods. Petri dishes containing blood and MacConkey agar were transported to operation theatres in sealed plastic bags. The plates were labelled

with sample number, site within theatre, time and date of sample collection. The plates were placed at four chosen places in the operation theatre at about 1 metre above the ground, and exposed for 15 minutes. After this exposure, the plates were covered with their lids and taken to laboratory in sealed plastic bags and incubated at 37°C for 24 hours.

A swab soaked in nutrient broth was used to collect samples 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 Postgraduate Medical Institute (PGMI) for processing.

PROCESSING OF SAMPLES

Swabs taken from different articles were streaked in Blood and MacConkey agar. These culture plates along with those exposed in air were incubated at 37°C under aerobic conditions for 24 hrs. After incubation the colonies were counted and identification of isolates was performed. Concentration of airborne bacteria was expressed as colony forming units per cubic meter cube (cfu/m³).

RESULTS

The results of air and surface samples were as follows:

Samples from Air:

Staphylococcus aureus was isolated from all the air samples obtained from the various OTs except ENT. Surgical OT showed 62.5% prevalence of *Staphylococcus aureus* in the air (Table 1).

Coagulase negative *Staphylococci* (CoNS) were isolated from the air sample from all the OT with the lowest prevalence in Eye (50%) and urology (48%). The rest of the air samples showed growth

of CoNS. *Bacillus* sp. was present in the air of the various OTs with lowest prevalence being 60% in the urology OT, 62.5% in the Surgical OT and 66.6% in the Orthopaedics OT. Air samples obtained from ENT, Eye and Gynae & Obstetrics showed 100% positivity for *Bacillus* spp. *Streptococcus pneumoniae* was isolated from the Eye (50%) and Surgical OT (62.5%) only.

Samples from surfaces and articles:

Bacillus was the predominant organism isolated from various surfaces and articles. It was present in 77% of the surfaces sampled from the ENT OT, 42.6% from Surgical OT surfaces and 30.8% of the surfaces/articles from the orthopaedic OT.

Urology (27.3%), Eye (15%) and Neurosurgery (10%) operation theatre surfaces and articles were

Table 1: Organisms isolated from air samples of various operation theatres.

Name of OT*	Total No. of Samples	Organisms Isolated											
		CoNSx		Bacillus		Staph. Aureus		Strep. PN		Strep. SPP		Aspergillus	
		No.	% Age	No.	% Age	No.	% Age	No.	% Age	No.	% Age	No.	% Age
ENT	2	2	100%	2	100%	-	-	-	-	-	-	-	-
Neurosurgery	2	2	100%	-	-	2	100%	-	-	-	-	1	50%
Eye	2	1	50%	2	100%	2	100%	1	50%	-	-	1	50%
Surgery	8	8	100%	5	62.5%	5	62.5%	5	62.5%	-	-	5	62.5%
Urology	5	2	40%	3	60%	5	100%	-	-	-	-	1	20%
Gynae & Obs.	3	3	100%	3	100%	3	100%	-	-	-	-	-	-
Orthopaedics	3	3	100%	2	66.6%	3	100%	-	-	-	-	-	-

*OT: Operation Theatre; xCoNS: Coagulase Negative Staphylococcus; Staph: Staphylococcus; Strep: Streptococcus; GNR: Gram Negative Rods. (Includes *E. Coli*, *Pseudomonas*, *Klebsiella*, *Proteus*)

Table 2: Organisms isolated from surfaces/articles of various operation theatres.

Name of OT	Organisms Isolated													
	CoNS		Bacillus		Staph. Aureus		Strep. PN		Strep.		Aspergillus		GNR	
	No.	% Age	No.	% Age	No.	% Age	No.	% Age	No.	% Age	No.	% Age	No.	% Age
ENT (13)	-	-	10	77	-	-	01	7.7	01	7.7	-	-	-	-
Neurosurgery (20)	04	20	02	10	08	40	-	-	-	-	01	5	-	-
Eye (20)	04	20	03	15	04	20	01	5	01	5	01	5	02	10
Surgery (54)	29	53.7	23	42.6	09	16.7	08	14.8	03	5.6	07	13	06	11.1
Urology (22)	03	13.6	06	27.3	09	40.9	-	-	-	-	02	9.1	05	22.7
Orthopaedics (13)	05	38.5	04	30.8	05	38.5	-	-	-	-	-	-	03	23.1
Gynae & Obs (22)	08	36.4	05	22.7	09	40.9	-	-	1	4.5	-	-	2	9.1
ICU	-	-	-	-	-	-	-	-	-	-	-	-	-	-

found to be contaminated with *Bacillus* spp. *Staphylococcus aureus* was pre-dominantly isolated from urology (40.9%) and Neurosurgery (40%) articles / surfaces whereas the surgical OT instruments/surfaces growth of coagulase negative *Staphylococcus* (53.7%). *Streptococcus pneumoniae* and other *Streptococcus* sp. were isolated with equal frequency from both ENT and Eye OT, 7.7% and 5% respectively. However, *streptococcus pneumoniae* was isolated in a higher percentage (14.8%) from the surgical OT as compared to other *Streptococcus* species (5.6%). *Pseudomonas*, *Escheria coli* and *Klebsiella* were the gram negative rods isolated. Orthopaedics and Urology OT showed the highest rate of contamination (23.1% and 22.7% respectively). *Aspergillus* was found in Surgery (13%), urology (9.1%), eye (5%) and neurosurgery (5%) operation theatres (Table 2).

DISCUSSION

Microbiological contamination of air in the operating room is generally considered to be a risk factor for surgical site infections in clean surgery.⁵ According to Pasquarella et al¹² microbiological quality of air may be considered as mirror of the hygienic condition of the operation theatres. The quality of indoor air depends on external and internal sources, such as ventilation, cleaning procedures, the surgical team and their activity.¹³

A number of studies have been carried out in operation theatres to determine relationship between total bacterial air count in OT and risk of infection. It has been observed that counts in the range of 700-1800/m³ were related to significant risk of infection and the risk was slight when they were below 180/m³.¹⁴ In the present study, bacterial count in air ranged from 65,00 to 15,730 cfu/m³ in different operating theatres. Bacterial count in air was more in neurosurgery, urology and orthopaedic theatres located in the new block as compared to surgical operation theatres, Gynae, Eye and ENT OTs located in old blocks.

The instruments and articles which were sterilized by autoclave showed no growth whereas instruments like tubings of sucker machine and ventilators, sucker tip, laryngoscope blade which were heat labile and disinfected by chemicals showed heavy growth of pathogens like *Staph aureus*, *E. coli*, *Klebsiella* and *Pseudomonas* spp.

In our results, relatively clean sites were floors and walls of all OT except neurosurgery, urology and orthopedic 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 *Staphylo-*

coccus aureus, *Klebsiella* sp. *E. coli* and *Pseudomonas* sp.

From one operation theatre *E. coli* and *Pseudomonas* spp. were recovered from 2% cidex solution. However 2% cidex solution in other operation theatres used for dipping laparoscopic equipment showed no growth. ICU surfaces and air revealed no pathogens.

As **conclusion** these findings demonstrate that the microbiological quality of air and surfaces in operation theatre may be considered a mirror image of the hygienic conditions of the operating theatre. Settle plate's method for air and swabbing technique for surfaces proved to be more valuable in detecting the contamination level in our set up with limited resources. Routine sampling of floor, walls or furniture which are not in direct contact with patients are not the sources of infection. They do not contribute in the prevention of nosocomial infection, unless there is an epidemic.

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