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Original Research Article

A STUDY TO EVALUATE THE EFFICACY AND DISINFECTION METHODS FOR OPERATION THEATRE IN THE HOSPITALS

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Abstract
Disinfectants play a vital role in global infection control as a crucial weapon against the transmission of nosocomial pathogens/infections combating global disease outbreak. Because of the multifactor causation of infections, the environment of operation theatre plays a great role in the onset and spread of infections
Keywords: Disinfection, OT

INTRODUCTION

Disinfectants play a vital role in global infection control as a crucial weapon against the transmission of nosocomial pathogens/infections combating global disease outbreak. Because of the multifactor causation of infections, the environment of operation theatre plays a great role in the onset and spread of infections [1]. Wound infections are the second most prevalent cause of hospital-acquired infectious disease. Nosocomial infections are caused owing to the use of tainted antiseptic solutions capable of processing infectious microorganisms such as *Pseudomonas aeruginosa* as well as *Klebsiella species* [2]. These complications of surgical procedures cause considerable morbidity and it can also lead to mortality as high as 77% when it occurs deep at the site of the procedure [3]. As in this advancing medical era, the microbial contamination of the hospital environment, especially the operating theatre, intensive care units had continued an increased prevalence ofnosocomial infection. The people who are at risk do not only involve the patients but the health professions including the nurses as well [4]. We can control a major part of exogenous infections by maintaining a sterile environment in the operation theater. Fumigation is an old age process of sterilization and has been an accepted method of sterilization for areas where microbiological cleanliness is required. Formaldehyde vapor fumigation is the most widely used process due to its cost-effective technique. The sanitizers used in hospitals ought to be newly prepared and of sufficient strength [5]. It has been indicated that formaldehyde should be handled only in the workplace as it is a potential carcinogen and an employee exposure standard for formaldehyde has to be set that limits an 8-hour time-weighted average exposure concentration of 0.75 ppm [6]. Formalin is commercially

ISSN: 0975-3583, 0976-2833 VOL 15, ISSUE 10, 2024

available as a 40% solution of formaldehyde in water. When formalin is heated, formaldehyde vapor is generated [7]. Formaldehyde fumigation has been accepted as a method of disinfection for operation theatres (OT) and critical care units in developing countries because of its cost-effective nature but due to their potential carcinogenic and irritant nature, we may opt for other agents such as hydrogen peroxide, hydrogen peroxide with silver nitrate, per-acetic acid and quaternary ammonium compounds [8]. The most effective method to prevent exposure to formaldehyde is to substitute a safer, less toxic highly penetrating disinfectant. Many other compounds are emerging for safer use in the field. Another such emerging compound used for the sterilization of the operating theatersis Bacillocid and Virkon. Previously studies have shown that air disinfection by fogging using quarternary ammonium compounds (QUAT compounds) is an important tool for infection control in operation theatres. Passive air sampling is performed using settle plate method.Inert particles carrying microbes fall on to the surface of the nutrient ,with an average deposition of 0.46cm/sreported so far. After incubation ,the settle plates grow colonies proportionate to the level of microbial contamination in the air. (The index of microbial air contamination,Journal of hospital infection control,(2000)46:241-256)The settle plate method sampling of air is a reliable and reproducible procedure. There is very little literature on means of monitoring operation theatre environment for bacterial contamination .[9] This meager literature has inspired us to research about the effectiveness of different air disinfectant compounds which could be of value in not only ensuring a clean OT environment for surgeries but also help protect housekeeping staff who are often exposed to infection in their cleaning procedure.The objective of this study was to evaluate the efficacy of different disinfection methods for operation theatres.

MATERIALS AND METHODS:

This study is conducted at the Dept. Of Microbiology , ESIC Medical college and hospital, kalaburagi

PASSIVE AIR SAMPLING:

Pre-fogging: 5% Sheep Blood agar plates (10cm Size) after labeling with the date and site of sampling was exposed to OT environment for 1 hour at 1 meter above the floor and 1 meter away from the wall before disinfection by fogging. Approximately 180 bacteria/m^3 of air corresponds to 10 colonies on settle plate method. The acceptable limit of CFU as per British bacteriological standards for ultraclean operating rooms is <10CFU/m^3,so the operating room is certified as satisfactorily sterilized when the bacterial load is less than 10 CFU /m^3.

Post fogging: Once the fogging is over, 6-8 hours later the theatre is opened and air samples are taken. 6 blood agar plates (2 each for left, right and center) per theatre are exposed for 1 hour at 1 meter above the floor and 1 meter away from the wall. Following the air sampling the plates are closed and transported to the microbiology sectionof Central Laboratory, Dept. Of Microbiology , ESIC Medical college and hospital, kalaburagi, and they are incubated at 37 degrees Celsius for up-to 48 hours. Plates are observed for growth at 24 and at 48 hour intervals. The number of colony forming units/plate are counted and colony counts derived. Presumptive bacterial identification is done by grams staining and specific bacteria are identified using biochemical tests.

Formalin Disinfection method:

For each 1000 cu.ft, 500 ml of formalin with 1000ml of water were mixed and added to fogger. After initiation of FOGGING, the room was left and sealed. After the fogging process, the

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formalin vapors were neutralized with 250ml of 10% ammonia for 1000cu ft. The ammonia solution as placed in the center of the room and left for 3hours.

Totasep fogging:
10ml of Totasep disinfectant solution is added in 990ml of water and added to the fogger and left inside the operation theatre after switching on the theatre is sealed for 6-8 hours before taking air samples.

Environmental Sampling: For newly opened theatres and theatres undergoing civil work, environmental sampling was also done. Sterile cotton swabs (from. Himedia cat. No. PW005) were used to collectsamples. Swabs were opened and removed from the collection tube and moistened with Peptone water and surface swabbing was done from OT table, OT floor, OT wall, OT light, Boyle's apparatus, drug trolley, anaesthesia machine and AC vent. The swabs are transported to microbiology laboratory from operation theatre. In microbiology lab, the swabs are inoculated in Robertson's Cooked Meat Medium(RCMM) and incubated at 37deg Celsius for7 days and observed for growth and identification of bacteria grown was done using gram staining followed by Biochemical tests.

- **Inclusion criteria**

Fumigated Major, Minor, Emergency and Labour Operation theatres from where swab and open plate samples was collected 6-8 hours pre-and post-fumigation.

- **Exclusion criteria**

Other hospital premises other than operation theatre e.g. Wards, Staff rooms.
Results

Table 1: No. of colony forming units/plate (After Totasep)

	Months			
	March	April	May	June
OT-1	3	2	3	10
OT-2	3	3	4	3
OT-3	0	3	4	1
OT-4	0	0	1	6
OT-5	1	0	4	1

Table 2: No. of colony forming units/plate (Before Totasep)

OT-NAME	MONTHS			
	March	April	May	June
	(No of colony forming units/plate (Before Totasep)			
OT-1	8	20	12	40
OT-2	17	25	10	30
OT-3	9	35	19	15
OT-4	13	33	11	20
OT-5	15	18	10	15

ISSN: 0975-3583, 0976-2833 VOL 15, ISSUE 10, 2024

Table 3: No. of colony forming units/plate (After Formalin)

OT Name	July	August	September	October	November	December	January	February
	(No of colony forming units/plate-After formalin)							
OT-1	3	5	5	7	8	9	11	4
OT-2	4	0	4	10	4	5	4	2
OT-3	3	1	3	10	2	6	20	1
OT-4	3	10	3	6	3	5	12	3
ER-OT		2	2		6	7	6	5

Table 4: No. of colony forming units/plate (Before Formalin)

OT NAME	MONTHS							
	July	August	September	October	November	December	January	February
	(No of colony forming units/plate-Before formalin)							
OT-1	22	22	25	15	11	12	>20	8
OT-2	21	30	30	12	8	14	13	17
OT-3	30	40	27	11	10	10	10	11
OT-4	26	35	34	10	14	9	8	8
ER-OT	20	15	20		12	14	>20	14

Table 5: Swabbing (Environmental sampling) Fumigation

	Pre-fumigation		Post fumigation	
Swab site	Growth	No growth	Growth	No growth
Table(n=10)	6	4	0	10
Wall(n=10)	5	5	3	7
Light(n=10)	6	4	1	9
Trolley(n=10)	3	7	0	10
Crash Cart(n=10)	6	4	3	7
Boyle's apparatus(n=10)	6	4	2	8
floor(n=10)	3	7	1	9
Total	35(50%)	35(50%)	10(14.28%)	60(85.7%)

Table 6: Difference between Pre-fogging and Post fogging

	Pre-fogging		Post fogging	
Swab Site	Growth	No growth	Growth	No growth
Table(n=13)	8	0	5	8
Wall(n=15)	10	1	4	11
Floor(n=15)	9	6	3	12
AC(n=5)	5	0	3	2
LIGHT(n=6)	5	1	3	3
Trolley(n=14)	10	4	3	11

ISSN: 0975-3583, 0976-2833 VOL 15, ISSUE 10, 2024

Crash Cart(n=11)	7	4	3	8
Boyles app(n=12)	10	12	1	11
Penden(n=6)	5	1	0	6
TOTAL(n=97)	69(71.1%)	29(29.86%)	25(25.7%)	72(74.22%)

Discussion

In our study, the OT1 colony forming unit was higher than OT 2 CFU (Table 1 and 2) which may be due to human activity that significantly increases the bacterial count and reaches the peak at the end of the day in both the OTs and was established by Pasquarella et al., (2004) and Ekhaise et al.. [10,11] .The colony forming unit after the use of QUAT compound was always less when compared to formalin indicating its efficacy. In the emergency OT (OT1),colony forming units(CFU) were higher as compared to elective operation theatres (OT 2). By air sampler whether it is formalin or the commercial product, the colony forming units at 1 feet height and above the OT table were within limits. Counting microbes in the air is not an easy task, but through air sampling it is possible to evaluate bacterial contamination of OT air. [12] .In our study, bacterial count of air is in a range from 9 to 171 CFU/m3.This is in contradiction to surveillance study at Lahore (Javed et al., 2008) have reported a significantlyhigher bacterial air count in the range of 6500-15730CFU/m3. [13] This wide variation may be attributed to the surveillance method used, time of sampling, disinfectant used and mechanical ventilation of OTs. It was observed that counts in the range of 700-1800 CFU/m3 were related to significant risk of infection and the risk was slight when they were below 180 CFU/m3 (Parker et al., 1978). [14] Human activity and related factors have more influence on colony forming unit, whether it is measured by settle plate or by air sampler (Fleischer et al., 2005). [15] It is evident that there is increase of colony forming unit comparing preoperative and post- operative counts from day 1-6 (Table 1 and 2). The microbicidal activity of the quarternary ammonium compounds against common isolates was good at 1% concentration within 10 minutes (Table 3). Hence, such products with proven efficacy may be used as an alternative to formalin. The environments in the OTs are dynamic and subject to continuous change. The preoperative bacterial counts were within acceptable limits in both formaldehyde and quarternary ammonium(QUAT) compounds but the colony forming units after QUAT compound fogging weresignificantly less as compared to formaldehyde. The bacterial counts increased at the end of all surgeries than before the start of surgeries by air sampling method after disinfection with formalin or QUAT compounds in allthe operation theatres. Organisms most commonly detected in the Operation theatres were *Acinetobacter*

baumanii, Methicillin sensitive *Staphylococcus aureus*, Coagulase Negative *Staphylococcus sp, Micrococci* and *Bacillus sp*. The bactericidal activity of 1% concentrationwas effective at 10 minutes against the commonly isolated organisms. Surface swab with RCMB culture can only yield *Clostridium tetani* were as settle plate can detect aerobic pathogens as well fungus in air. Settle plate is more useful because aerobic postoperative infections are more common than anaerobic postoperative infection. Surface swab technique is mandatory in places where civil work is undertaken and in orthopedics due to RTA (road traffic accidents) cases & trauma cases. Monitoring both aerobic and anaerobic organisms in air by settle plate and surface swab method can provide a simple and cost-effective way of detecting the contamination.OTs which employ both the air sampling and environmental swabbing methods, more efficiently detect

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pathogens in OTs and subsequently help prevent hospital associated infections.

Conclusion

Newer less toxic disinfecting agents are alternative to formalin and may be used at short intervals for better outcome. Since human activity plays a major role in microbial air quality, meticulous cleaning, thorough washing and strict adherence to operation theatre protocol are essential.The advantage of using QUAT Compounds for OT disinfection is that it is human-friendly and the theatres can be reopened for surgeries within a span of 1-2 hours following disinfection. The extra cost spent on this disinfecting agent is worth, considering the long term impact of formalin, an irritant, toxic, corrosive, and carcinogenic chemical. Nevertheless Fogging cannot replace manual cleaning.

REFERENCES:

1. Hernndez A, Martró E, Matas L, Martí n M, Ausina V. Assessment of in-vitroefficacy of 1% Virkon® against bacteria, fungi, viruses and spores by means of AFNOR guidelines. J Hosp Infect. 2000;46(3):203– 9.
2. Pillai S. Theater asepsis and sterilization of equipment [Internet]. Manual of Anesthesia for Operation Theater Technicians. 2013;119–119.
3. Gasparini R, Pozzi T, Magnelli R, Fatighenti D, Giotti E, Poliseno G, et al. Evaluation of in vitro efficacy of the disinfectant Virkon. Eur J Epidemiol. 1995;11(2):193–7.
4. Anbu RT, Suresh V, Gounder R, Kannan A. Comparison of the efficacy of three different bone regeneration materials: An animal study. Eur J Dent. 2019;13(1):22– 8.
5. Ashok V, Ganapathy D. A geometrical method to classify face forms. J Oral Biol Craniofac Res. 2019;9(3):232–5.
6. Ganapathy DM, Kannan A, Venugopalan S. Effect of coated surfaces influencing screw loosening in implants: A systematic review and meta-analysis. World Journal of Dentistry. 2017;8(6):496–502.
7. Jain AR. Clinical and functional outcomes of implant prostheses in fibula free flaps. World Journal of Dentistry. 2017;8(3):171– 6.
8. Ariga P, Nallaswamy D, Jain AR, Ganapathy DM. Determination of correlation of width of maxillary anterior teeth using extraoral and intraoral factors in Indian population: A systematic review. World Journal of Dentistry. 2018;9(1):68– 75.
9. Evaluation of corrosive behavior of four nickel–chromium alloys in artificial saliva by cyclic polarization test: An in vitro study. World Journal of Dentistry. 2017;8(6):477–
10. Pasquarella, C., Masia, M. D. N., nanga, N., Sansebastiano, G.E., Savino, A., Int.J.Curr.Microbiol.App.Sci (2017) 6(11): 3081-3090 3090 Signorelli, C. and Veronesi, L. Microbial air monitoring in operating theater: active and passive sampling. Ann Ig. 2004; 16(1-2): 375-86
11. Ekhaise FO, IghoseweOU, and Ajakpovi OD. Hospital indoor airborne microflora in private and government owned hospitals in Benin City, Nigeria. World J of Medical Sciences.2008;3(1):19-23.
12. Ranganathan H, Ganapathy DM, Jain AR. Cervical and incisal marginal discrepancy in ceramic laminate veneering materials: A SEM analysis. Contemp Clin Dent. 2017;8(2):272–8.
13. Javed, I., Hafeez, R., Zubair, M., Anwar, M. S., Tayyib, M.and Hashain, S. Microbiological surveillance of operation theater and ICU'S of a tertiary care hospital, Lahore. Biomedica 2008; 24:99-102.
14. Parker, M. T. In Hospital Associated Infections, Guidelines to laboratory methods. WHO,

ISSN: 0975-3583, 0976-2833 VOL 15, ISSUE 10, 2024

Regional Office for Europe, Copenhagen. 1978; 28-32.
15. Fleischer M, Bober-Gheek B, Bortkiewicza O, Rusiecka-Ziólkowska J. Microbiological control of airborne contamination in hospitals. *Indoor Build Environ.* 2006;**15**(1):53–6.