

Assessment of Microbial Load in Operation Theater Ward Before and After Fumigation Using Bio Luminometer

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Abstract:

Background:

Microbial contamination of the operating theater is a major cause of nosocomial infection. The study assessed the level of microbial contamination and determined the antimicrobial resistance of the bacterial isolates. Microbial growth was found on surfaces and semi-critical articles. On the other hand, articles which were sterilized by autoclave showed no microbial growth.

Materials and Methods:

Samples were collected and using bio luminometer results were obtained.

Results:

The results indicate proper cleaning - fumigation of OT significantly reduced the microbial contamination.

Conclusion:

There was high-level of microbial contamination in the OT, particularly in air and semi-critical articles. However, it has been dramatically reduced through proper cleaning fumigation of the OT.

Keywords: Microbial contamination, operating theater, fumigation, bio luminometer, sterilization.

1. INTRODUCTION:

Microbial contamination of the operating theater (OT) is a major cause of nosocomial infection. Its clinical and implication is enormous on both the patient and caring surgical team. Approximately 10% of all infections can have serious consequences in terms of increased patient mortality,

morbidity and length of hospital stay and overall cost among patients admitted for post-operative surgery. Antimicrobial resistance results in increased illness, death cases and health care costs.(1). The emergence of multi-drug-resistant strains in hospital environment particularly in developing countries is an increasing infection control problem and associated

with high frequency of nosocomial infections and antibiotic resistance rate. (2)

An exceptionally efficient biosensor that offers a sensitive, non-destructive, and real-time test is adenosine triphosphate (ATP) bioluminescence. Because ATP is a significant biological energy source found in many different microbes, the ATP bioluminescence-sensing test is based on the idea that it reflects the presence of living microbes. Since years, biological and environmental systems have been subjected to quantitative observations of ATP bioluminescence. By delivering information that is physiologically significant in reaction to a pollutant, ATP bioluminescence helps to clarify the situation. Real-time data are produced through the quick and convenient measurement of bioluminescence. Whole-cell bioluminescent sensors are quicker, less expensive, and less time-consuming than conventional techniques.

Multiple reservoirs have been reported as being responsible for the contamination of the OT, including unfiltered air, ventilation systems and anti septic solutions, drainage of the wounds, transportation of patients and collection bags, surgical team, extent of indoor traffic, theater gown, footwears, gloves and hands, use of inadequately sterilized equipment, contaminated environment and grossly contaminated surfaces. (3)

The impact of the sources of the degree of microbial contamination differs, depending on the number of pathogens involved.(4). In order to quickly identify food-borne infections, enzyme-linked immunosorbent tests (ELISA) are frequently used. However, both live and dead cells can produce an antigenic response. In order to

2. MATERIALS AND METHODS:

Sample collection was done using Ultraspap swabs to collect swabs from specific areas such as IV stand, bed handle,

detect living cells while preserving sensitivity and specificity, a combined ATP bioluminescence immunoassay would be of significant relevance. Our team has extensive knowledge and research experience that has translate into high quality publications (5–14)((15–24)

Microbial contamination of the OT can be prevented through adequate application of infection control practices. Reduction of airborne bacteria in the OT by about 13-fold, for example, would reduce sound contamination by about 50%. This depends primarily on improving cleaning proper disinfection and regular fumigation of OT. (25).

The operating theater complex is the heart of any major surgical hospital. Good operating theatre design means the functional needs of theater care professionals. Operating theatre design must be careful consideration of traffic patterns, the number and configuration of nearby operating rooms, the space required for staff, administration and storage, provisions for sterile processing and systems to control airborne contaminants. (26)

Fumigation is a method of pest control or the removal of harmful microorganisms by completely filling an area with gaseous particles or fumigants to suffocate or poison the pests within. It is used to control pests in buildings, soil, grain, produce and is also used during processing of goods to be imported or exported to transfer of exotic organisms.(27). The aim of the research is to study the microbial load in operation theater before and after fumigation using a bio luminometer.

medicinal trays that are often touched by healthcare practitioners. Total of 8 swabs when collected before disinfection at various places. Disinfection is done using sodium hypochlorite. Again total of 8

swabs were collected after disinfection at the same places. The swabs were then tested for microbial load using a bio luminometer. The luminometer used here is Hygiena (SystemSURE Plus) to get immediate results (Figure 1)

SystemSURE Plus luminometer, it is said to be a complete monitoring solution for the environment. It has modernized software with better memory. Linearity and sensitivity of ATP hygiene monitoring systems is well maintained. The sleek way of instrument makes it easy to carry and take to any place. It is completely operable

with one hand, making your life that much easier. Dimensions are 3" x 7" x 1" (7.6cm x 17.8cm x 3cm) (Figure 2). Ultra snap is an user friendly and eco friendly mode of device used for ATP surface test. It is so convenient and easy to use (Figure 3). Remove the Ultrasnap swab from the outer tube. Press firmly down the swab tip, collect a sample from a 10 x 10 cm (4 x 4 in) area. Use a side-to-side and up-and-down motion while rotating the swab tip (Figure 4). Samples are being collected from the hospital ward (Figure 5).



Figure 1 SystemSURE Plus luminometer, it is said to be a complete monitoring solution for the environment. It has modernized software with better memory. Linearity and sensitivity of ATP hygiene monitoring systems is well maintained.



Figure 2 The sleek way of instrument makes it easy to carry and take to any places . It is completely operable with one hand , making your life that much easier . Dimensions are 3" x 7" x 1" (7.6cm x 17.8cm x 3cm).



Figure 3 Ultra snap is an user friendly and eco friendly mode of device used for ATP surface test. It is so convenient and easy to use.



Figure 4: Remove the Ultrasnap swab from the outer tube. Press firmly down the swab tip, collect a sample from a 10 x 10 cm (4 x 4 in) area. Use a side-to-side and up-and-down motion while rotating the swab tip.



Figure 5 Samples are being collected from the hospital ward

3. RESULTS AND DISCUSSION:

The results obtained before proper cleaning - fumigation indicates higher mean microbial count (313.286). The microbial load reduced significantly to acceptable levels after proper cleaning fumigation of the OT. The results

obtained after proper cleaning - fumigation indicates lower mean microbial count (197.571). T test was performed to interpret the data which are obtained from our study (Figure 6). It is the comparison between pre fumigation and post fumigation. We can easily find the difference between the values of pre and post fumigation (Figure 7).

T-Test										
Paired Samples Statistics										
		Mean	N	Std. Deviation	Std. Error Mean					
Pair 1	Pre	313.29	7	134.531	50.848					
	Post	197.57	7	118.589	45.201					
Paired Samples Correlations										
Pair 1	Pre & Post	N	Correlation	Sig.						
		7	0.535	0.218						
Paired Samples Test										
		Paired Differences			95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper				
Pair 1	Pre - Post	115.714	123.218	46.572	1.797	229.672	2.485	6	0.048	

Figure 6 T test was performed to interpret the data which are obtained from our study.

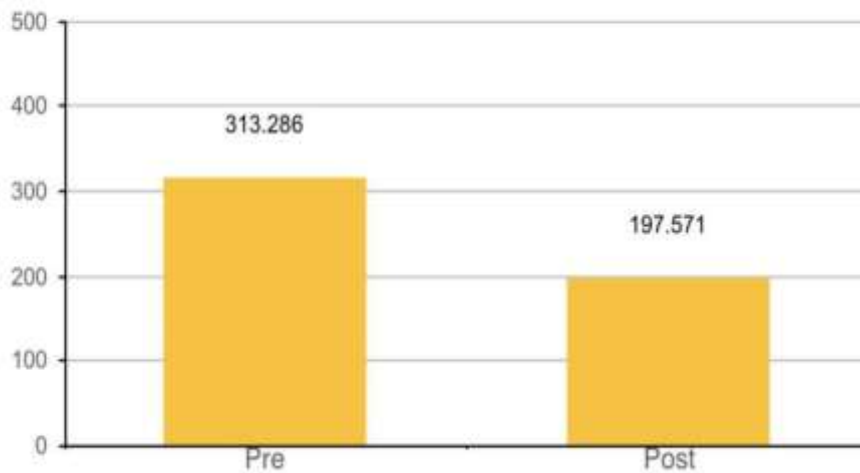


Figure 7 It is the comparison between pre fumigation and post fumigation. We can easily find the difference between the values of pre and post fumigation.

Bioluminescence assay is a technique used to measure the cleanliness of a surface, ATP bioluminescence detects the amount of ATP, which is an indirect measurement of the amount of microorganisms on a surface that has the potential to support

microbial growth and also microbial biomass. (28). It measures the dirt or filth on a surface indicating the need for cleaning and sanitizing. ATP bioluminescence assay is probably the most widely used technique in the field of

medicine for hygiene monitoring and cleaning validation.(29)

All live cells contain ATP, which is the foundation of the ATP bioluminescence-sensing test. The reaction of luciferin and luciferase with ATP allows for its detection . The luciferin-luciferase reaction's mechanism states that light is released because the reaction creates oxyluciferin in an electrically excited state. As oxyluciferin transitions back to its ground state, the process releases a photon of light. All live cells have intracellular ATP, which is necessary for the control of the stored metabolic energy, for the upkeep of the enzyme systems, and for the manufacture of cellular components throughout all growth phases. Measurement of intracellular ATP is an ideal indicator of the amount of alive cells since damaged or dead cells are unable to manufacture ATP, which is broken down within a few minutes of death.

The principle of ATP bioluminescence assay is that all living cells contain ATP. It is based on fireflies ATP luminescent reaction.(30) The firefly has two chemical components - Luciferin and Luciferase that react with

the insects ATP to produce bioluminescence light. The ATP collected from a surface reacts with Luciferin or Luciferase compounds present in the sample swab to create bioluminescence light. The amount of bioluminescence light is measured by the Luminometer and is expressed in relative Light Units (RLU).

(31) RLU numbers are directly proportional to the amount of ATP and therefore the amount of microbial biomass on the sample surface.(30,32). Our team has extensive knowledge and research experience that has translate into high quality publications ((33), (34), (35), (36), (37,38), (39), (40), (41), (42), (43), (44), (45), (46).

The advantages of ATP bioluminescence assay is that it is simple, highly sensitive, cost-effective, rapid (compared to conventional methods which take days) and provide real-time results within minutes. It can also be used to detect microbial load in raw milk, assess microbiological quality of beef and pork carcasses and minced meat, monitor microbiological activity in indoor air, monitor sanitary conditions in clinical settings, monitor yeast and bacteria in beverages and fruit juices, monitor water quality and verify cleaning.(47)

In the non-specific detection and quantification of bacteria in food products, such as milk and animal feed, the ATP test can be an excellent auxiliary method. Moreover, bioluminescence assays can be used to distinguish between living and dead cells.

The critical articles which were sterilized by autoclave showed no microbial growth whereas articles like endotracheal tubes and laryngeal scope which were heat liable and disinfected by chemicals and surfaces like floors, operating table, and OR light showed heavy growth of pathogens. (48)

The in vitro disinfectants were effective against bacterial isolate and control bacterial strains hence the microbial growth on the OR articles may be due to improper preparation or application of these chemicals.(49)

Future Scope:

The study can be extended for testing hygiene in places like malls, shops, restaurants and the food industry.

4. CONCLUSION:

Disinfecting Operation Theater is important because patients are already exposed to an infection. Maintenance of hygiene is the prime role of hospital and healthcare practitioners. Regular check and disinfecting areas prone to infection is necessary. Disinfection is also important so

that healthcare professionals aren't infected while treating patients.

The microbial load was found to be reduced in the operation theater after fumigation when checked with the help of bio luminometer. Patients undergoing surgery are usually immune compromised and require 100% hygienic environment. Bioluminometer is a boon as it can show the infection level within seconds and the area can be disinfected and 100% hygienic environment can be guaranteed for the patient.

Conflict of Interest :

The authors hereby declare that there is no conflict of interest in this study.

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Author Contribution :

A) Amba Esakki - contributed in designing the study, execution of the project, statistical analysis, manuscript drafting.

B) Dr. Jayalakshmi - contributed in designing the study, execution of the project, statistical analysis, manuscript drafting.

C) Dr.V.Vishnupriya - contributed in study design, guiding the research work, manuscript correction.

D) Dr. Gayathri R - study design, statistical analysis, manuscript proofreading and correction.

E) Dr. Kavitha S - study design, statistical analysis, manuscript proofreading and correction.

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