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A STUDY ON THE INCIDENCE AND PREVALENCE OF ANESTHESIA WORKSTATION CONTAMINATION IN A TERTIARY CARE TEACHING HOSPITAL

Dr Nikila Devarayasamudram Gopal[1], Dr. Rajkumaran Kamaraj[2*], Dr Niranjni S[3], Dr Lakshmi R[4], Kona Sanyasi Rao AHS[5]

1.Assistant Professor, Department of Anaesthesiology, Saveetha Medical College, Chennai
2.Assistant Professor, Department of Anaesthesiology, Saveetha Medical College, Chennai
3.Assistant Professor, Department of Anaesthesiology, Saveetha Medical College, Chennai
4.Professor and HOD, Department of Anaesthesiology, Saveetha Medical College, Chennai
5.Intern, Department of Anaesthesiology, Saveetha Medical College, Chennai

***Corresponding author:**
Dr. Rajkumaran Kamaraj, Assistant Professor, Department of Anaesthesiology, Saveetha Medical College, Chennai

ABSTRACT

Aim: The aim of the present study was to identify the risk factors of anaesthesia workstation contamination in different operation theatres.

Material & methods: Total 120 samples were taken from different sites and equipment's of 5 OTs. Sterile swabs in nutrient broth were used to collect samples. They were placed back into the broth after collection. All the samples were labelled properly and immediately transported to the Microbiology laboratory and incubated 37°C for 4 hours. Swabs taken from different sites were inoculated on Blood agar and MacConkey agar. These culture plates were incubated at 37°C under aerobic condition for 24 hours. Isolation and identification of isolates were done as per standard guidelines.

Results: In the category of before decontamination, 40% of the samples are reported in General surgery OT, 20% of them are reported in ENT surgery, 20% of them are reported in Ortho surgery and another 20% of them are in the Oncology surgery OT In the category of before decontamination, 25% of the samples are reported with APL, 25% of them are reported with Oxygen Flowmeter, 25% of them are reported with Vaporizer Dial and another 25% of them are reported with Workstation Desk surface. 30% of the samples are reported with positive growth and 70% of them are not reported with sample positive growth. 13.3% of the samples are reported with low level of decontamination, 6.7% of the samples are reported with intermediate level of decontamination and 80% of the samples are not reported with decontamination. It was concluded from the analysis that OT name and Decontamination are not associated.

Conclusion: Anaesthesia workstation contamination is a not rare contamination. Pre wash swab collection decontamination is associated with high incidence of contamination with

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surgical sites infections as compared to post wash swab collection decontamination is associated with low incidence of contamination with surgical site infections.

Keywords: Anaesthesia Machine, Anaesthesia Workstation, Checklist, Hazards, Scavenging

1. INTRODUCTION

Hospital-associated infections are the major cause of patient morbidity and mortality. Invasive procedures, high antimicrobial agent usage and transmission of bacteria between patients due to inadequate infection control measures may explain why OTs and are “hot zones” for the emergence and spread of microbial resistance.[1] Microbial contamination of operating theatre, especially in an anaesthesia workstation and other specialized units had continued to increase prevalence of nosocomial infections. [2]

Anesthesia machines are known to be active reservoirs for pathogens contributing to the burden of HAIs transmission of bacterial pathogens via anaesthesia machines occurs both during and between patient cases due to high task density, frequent contact with body fluids, invasive procedures, and adequate hand hygiene.[3] The anaesthesia work area issues have been identified as one of the causes of postoperative surgical site infection, blood stream infection, central line infection, and ventilator acquired pneumonia in patients undergoing surgery. Source of this contamination could be the transfer of organisms from the patient themselves or from workstation equipment reservoirs such as the anaesthesia machine design of the makes routine disinfection, sterilization, and cleaning difficult, with complete decontamination all but impossible in daily practice. [4]

A regular use of chemical cleaning reduces the incidence of bacterial contamination of the anaesthesia workstation during induction and intubation. Microbiologic swab sampling is used as needed to determine the numbers and types of microorganisms. Controlling pathogens in health facilities is not only important for the safety of the patient, but it is also important for hospital. There is a clear need for surveillance and early warning systems that can pick up signs of emerging and/or increasing microbial resistance at the local, regional and national level 5. [5]

“Microbiological surveillance” provides data about the factors contributing to infection. Anesthesia workstation monitoring by the microbiological testing of surfaces and hotspots is useful to detect changing trends of types and counts of microbial flora. Four frequently touched and difficult to disinfect “hot spots” were cultured on each machine preceding and following OT washing day. The density and diversity of cultured colony forming units (CFUs) between the before decontamination and after decontamination of the anaesthesia machines.[5]

Hence the aim was to identify the risk factors of anaesthesia workstation contamination in different operation theatres.

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2. MATERIAL & METHODS

A prospective randomized study was conducted in a single district general hospital with five operating theatres and anaesthetic rooms catering for a wide range of surgical specialties including trauma ⁄ orthopaedic, general, maxillofacial, ear, nose and throat, breast, and emergency surgery. Before this study, AAGBI guidelines for the cleaning of equipment were followed in this hospital. Total 120 samples were taken from different sites and equipment's of 5 OTs. Sterile swabs in nutrient broth were used to collect samples. They were placed back into the broth after collection. All the samples were labelled properly and immediately transported to the Microbiology laboratory and incubated 37°C for 4 hours. Swabs taken from different sites were inoculated on Blood agar and MacConkey agar. These culture plates were incubated at 37°C under aerobic condition for 24 hours. Isolation and identification of isolates were done as per standard guidelines.

INCLUSION CRITERIA:

- More affected workstation in operation theatre like ENT – OT, General surgery – OT, Ortho – OT.

EXCLUSION CRITERIA:

- Less affected workstation in operation theatre like OBG – OT, Ophthalmology – OT where GA were infrequently done.

METHODOLOGY

Two cross-sectional studies were performed, before and after the intervention described below. Total 120 samples should collect for observation of the study, among that 40 samples to be collect before decontamination and 40 samples after decontamination and 40 samples of hand hygiene technique of both before decontamination and after decontamination of anaesthesia workstation for two consecutive months. Examine the samples of hot spots of each anaesthesia workstation from four operation theatres with respect departments like GENERAL SURGERY - OT, ENT – OT, ORTHO – OT, SURGICAL GASTROENTEROLOGY& ONCOLOGY – OT.

Routine Anesthesia workstation Cleaning Protocol:

Sample collection was taken from anaesthesia workstation after elective surgeries in operations theatres at the end of the day, on the prewash day which is known for before decontamination. As there is a chance of infection spread from one patient to another patient and there can be reverse spreading of the infection from doctor to patient or patient to doctor through anaesthesia workstation, so to reduce this infection rate we use the chemical based solution for cleaning the workstation which is mikrobac forte (Aldehyde free surface disinfectant and cleanser) which effectively works against bacteria, micro bacteria, fungi and viruses and there was post cleaning sample collection which is known for after decontamination and this samples are sent to microbiology laboratory for analysing the difference of rate of contamination. After 24hrs of surveillance on the post wash day before starting of any anaesthesia procedure 40 samples were collected from the same sites in the

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same OTs. This process was repeated for two consecutive OT Wash days. In two other OTs along with surface cleaning the anesthesia providers used sterile gloves throughout during GA. A date and time for data collection was decided a priori by examining the theatre timetable for a session in which most theatres were in use.

Bacterial cultures were taken without warning from anaesthetic equipment during normal operating sessions. No warning was given to any anaesthetist or member of theatre staff or Microbiologist collect the Cultures were taken from the surfaces of the anaesthetic and monitoring equipment that are routinely touched by the anaesthetist but do not come into direct contact with the patient: oxygen, nitrous oxide and air flow control knobs; vaporiser dials; breathing system bag; adjustable pressure-limiting (APL) valve; and monitoring control buttons.

Eight machines in the anaesthetic rooms and eight machines within operating theatres were studied.

Five swabs were taken from each machine. Replicate Organism Detection and Counting (RODAC) blood agar plates were applied directly to the surfaces of anaesthetic equipment by two investigators using the same technique for all samples. The lids were immediately replaced and taped before being transported for incubation. Within 5 h the plates were placed upside down in a Raven incubator set at 37 C in the Microbiology Department. These culture plates were incubated at 37°C under aerobic condition for 24 hours. Isolation and identification of isolates were done as per standard guidelines. All isolates were divided in to three broad categories:1) Normal flora e.g., Coagulase Negative Staphylococcus (CONS) 2) Contaminant e. g. Bacillus sp. 3) Pathogen e. g. Klebsiella sp.

After 48 h, the plates were removed from the incubator and the colonies counted. Organisms were identified from colonial morphology and gram stain reaction by experienced microbiologists.

STATISTICAL ANALYSIS

The prevalence of pathogenic bacteria on cultures before and after the wash were compared using the Chi squared test, with significance taken as $p < 0.05$. Confidence intervals for proportions were calculated by normal approximation to the binomial distribution.

3. RESULTS

Table 1: Number of samples according to OT name and according to Hotspots

			Decontamination		Total
			Before	After	
OT name	General surgery	N	24	24	48
		%	40	40	40
	ENT surgery	N	12	12	24
		%	20	20	20
	Ortho surgery	N	12	12	24
		%	20	20	20
	Oncology surgery	N	12	12	24

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		%	20	20	20
Total		N	60	60	120
		%	100	100	100
			Decontamination		**Total**
			Before	**After**	
Hotspots	**APL**	N	15	15	30
		%	25	25	25
	Oxygen Flowmeter	N	15	15	30
		%	25	25	25
	Vaporizer Dial	N	15	15	30
		%	25	25	25
	Workstation Desk surface	N	15	15	30
		%	25	25	25
Total		N	60	60	120
		%	100	100	100

In the category of before decontamination, 40% of the samples are reported in General surgery OT, 20% of them are reported in ENT surgery, 20% of them are reported in Ortho surgery and another 20% of them are in the Oncology surgery OT. It was also noted that in the category of after decontamination, 40% of the samples are reported in General surgery OT, 20% of them are reported in ENT surgery, 20% of them are reported in Ortho surgery and another 20% of them are in the Oncology surgery OT. In the category of before decontamination, 25% of the samples are reported with APL, 25% of them are reported with Oxygen Flowmeter, 25% of them are reported with Vaporizer Dial and another 25% of them are reported with Workstation Desk surface. It is also observed that in the category of after decontamination 25% of the patients are reported with APL, 25% of them are reported with Oxygen Flowmeter, 25% of them are reported with Vaporizer Dial and another 25% of them are reported with Workstation Desk surface.

Table 2: Decontamination according to Sample with positive growth and according to low level, intermediate level and high level.

			Decontamination		**Total**
			Before	**After**	
Sample with positive growth	**Yes**	N	18	5	23
		%	30	8.4	19.2
	No	N	42	55	97
		%	70	91.6	80.8
Total		N	60	60	120
		%	100	100	100
			Decontamination		**Total**
			Before	**After**	

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Sample	**Low level**	N	26	8	34
		%	43.4	13.3	28.4
	Intermediate	N	17	4	21
		%	28.3	6.7	17.5
	Nil	N	17	48	65
		%	28.3	80	54.1
Total		N	60	60	120
		%	100	100	100

In the category of before decontamination, 30% of the samples are reported with positive growth and 70% of them are not reported with sample positive growth. It is also noted that in the category of after decontamination, 8.4% of the samples are reported with positive growth and 91.6% of them are not reported with sample positive growth. In the category of before decontamination, 43.4% of the samples are reported with low level of decontamination, 28.3%. Before category of the samples are reported with intermediate level of decontamination and 28.3% of the samples are reported with Nil. In the category of after decontamination, 13.3% of the samples are reported with low level of decontamination, 6.7% of the samples are reported with intermediate level of decontamination and 80% of the samples are not reported with decontamination.

Table 3: Association between OT name and Decontamination and Chi-square analysis for Hot spots according to Decontamination

			Decontamination		**Total**	**Chi-Square**
			Before	**After**		
OT name	**General surgery**	N	5	3	8	**0.000 (p=1.000)**
		%	40	15	40	
	ENT surgery	N	4	2	5	
		%	20	10	20	
	Ortho surgery	N	2	0	2	
		%	20	10	20	
	Oncology surgery	N	3	2	5	
		%	38	12	20	
Total		N	60	60	120	
		%	100	100	100	
			Decontamination		**Total**	**Chi-Square**
			Before	**After**		
Hotspots	**APL**	N	25	5	30	**0.000 (p=1.000)**
		%	19	6	25	
	Oxygen Flowmeter	N	18	12	30	
		%	22	3	25	
	Vaporizer Dial	N	22	8	30	

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		%	14	11	25	
	Workstation Desk surface	N	25	5	30	
		%	17	8	25	
Total		N	60	60	120	
		%	100	100	100	

It was observed that there is no significant association between OT name and Decontamination. Chi- square value (0.000) shows that the null hypothesis H01 was accepted at 5% level. Hence it was concluded from the analysis that OT name and Decontamination are not associated. It observed that there is no significant association between Hotspots and Decontamination. Chi- square value (0.000) shows that the null hypothesis H02 is accepted at 5% level. Hence it is concluded from the analysis that Hotspots and Decontamination are not associated.

Table 4: Association with Sample with positive growth and Decontamination and Association with Sample and Decontamination

			Decontamination		**Total**	**Chi-Square**
			Before	**After**		
Sample with positive growth	**Yes**	N	30	04	34	**4.164* (p=.036)**
		%	30	26.7	28.3	
	No	N	60	26	86	
		%	70	73.3	71.7	
Total		N	60	60	120	
		%	100	100	100	
			Decontamination		**Total**	**Chi-Square**
			Before	**After**		
Sample	**Low level**	N	10	4	14	**4.848* (p=.027)**
		%	58.8	26.7	43.8	
	Intermediate	N	7	11	18	
		%	41.2	73.3	56.3	
Total		N	17	15	32	
		%	100	100	100	

It was observed that there is significant association between Sample with positive growth and Decontamination. Chi-square value (4.164) shows that the null hypothesis H03 was rejected at 1% level. Hence it was concluded from the analysis that Sample with positive growth and Decontamination are well associated. It was evident that most of the patients (73.3%) who were not reported with positive growth are present in after decontamination. It was observed that there is significant association between Sample and Decontamination. Chi-square value (4.848) shows that the null hypothesis H04 was rejected at 1% level. Hence it is concluded from the analysis that Sample and Decontamination are well associated. It was evident that

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most of the samples (73.3%) who were reported with intermediate level of decontamination are present in after decontamination.

4. DISCUSSION

This study has shown that potentially pathogenic bacteria are present on anaesthetic machines, and that a simple and easy intervention can significantly reduce the colonisation of anaesthetic equipment with pathogens. The transmission of bacterial pathogens via anesthesia machines occurs both during and between patient cases due to high task density, frequent contact with body fluids, invasive procedures, and provider errors, such as omission of adequate hand hygiene. All of these risk factors are performed within the small confines of the anesthesia work area. These issues have been identified as one of the causes of 30-day postoperative surgical site infection, blood stream infection, central line infection, and ventilator acquired pneumonia in patients undergoing surgery.[1,2,6]

Our results suggest that hygiene measures should be extended to include anaesthetic equipment that does not come into direct contact with patients. Before the intervention, the proportion of cultures growing pathogenic bacteria was disturbingly high, despite full adherence to the AAGBI guidelines to clean each anaesthetic machine at the end of each list. We believe that this high rate of contamination mandates action to reduce the risk of cross-infection occurring through anaesthetic machines. Furthermore, numerous other strains of drug resistant bacteria are now emerging, under the influence of selection by anti-microbial agents use, from the population of normal human commensals. A pertinent question is whether colonisation with potentially pathogenic bacteria may lead to clinically significant infections. The second possibility for bacterial contamination could be the handling and storage of re-processed internal breathing-circuit-systems. Indeed, the on-site observation of the breathing-circuit-systems and anesthesia breathing machines re-processing showed a number of potential moments supporting this possibility. Pre-processed components of the anesthesia breathing machines were left unprotected air-dry after machine-based cleaning and disinfection. The reassembled breathing-circuit-systems was then wrapped in clean green fabric, and stored on a cupboard in a storage room until their next use. Looking closer at the bacterial species recovered further strengthens the hypothesis of contamination during re-processing the breathing-circuit-systems. More than half of the bacteria belonged to the normal microbial flora of human skin. The presence of Escherichia coli, a typical representative of intestinal human flora, which was found in one breathing-circuit-systems, can be explained by low compliance to hand hygiene. Aerobe spore forming Gram-positive bacteria are ubiquitous in the air. Neisseria species, non-diphtheiroid Corynebacteria and viridans Streptococci are commonly found in the human pharyngeal region and could represent oral contamination through speaking and non-wearing of face masks during wrapping and handling. The possibility of BCS contamination due to possible breaches of preventive measures during handling and storage of internal BCS is also supported by Grote et al[7], who attributed one of his findings to exogenous contamination while assembling and handling such systems.

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However, levels of environmental contamination with Acinetobacter baumannii in intensive care units correlate with colonisation and infection of patient nasal colonisation with MRSA is a risk factor for subsequent MRSA septicaemia and asymptomatic colonisation with Staphylococcus aureus is associated with a greater risk of wound infection. The specific sites showing the most contamination were the surfaces most commonly touched by the anaesthetist during induction of anaesthesia –the ventilator bag, vaporiser dials, and flow control knobs. Also, most of the organisms isolated commonly colonise the upper respiratory tract. This is consistent with the hypothesis that the anaesthetist's hands are the main route of transmission of contaminants, and that the patient's oropharynx is the most likely source. Our concern about the use of a contaminated anaesthetic machine is that it is obligatory for the anaesthetist's hands to go from the patient's airway to the anaesthetic machine and back again without time to change gloves or wash hands. Therefore, handwashing and gloves cannot protect a patient from pathogens present on the anaesthetic machine. However, the intervention applied in our study is inexpensive, harmless and readily acceptable to a majority of staff. In fact, transmission of bacteria species of all kinds, including vancomycin-resistant enterococci (VRE), MRSA, and other pathogens occurs frequently and within just a few minutes of care delivery in the anesthesia workstation.[1,2,8]

As for multidose vials, the recommendation of the Centers for Disease Control and Prevention (CDC) was to use them on a single patient whenever possible. If multidose vials must be used for more than one patient, they should only be kept and accessed in a medication preparation area such as a nurse station. In operating rooms, multidose vials (normally kept in anaesthesia carts) should only be administered to a single patient, so as to prevent inadvertent contamination of the vial through direct or indirect contact with potentially contaminated surfaces or equipment that could lead to infections in other patients.[9-11]

5. CONCLUSION

Anaesthesia workstation contamination is a not rare contamination, there is a statistically significant difference in the development of pre and post wash decontamination. From this study it is concluded that, pre wash swab collection decontamination is associated with high incidence of contamination with surgical sites infections as compared to post wash swab collection decontamination is associated with low incidence of contamination with surgical site infections.

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