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ORIGINAL ARTICLE

An Exploratory Study of Contamination of Surgical Equipment's in Hospital Setting

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ABSTRACT

The research has been carried out on the microbial hazards by using contaminated surgical instruments. In the operating room medical devices that have contact with sterile body tissues or fluids are considered as dangerous surgical tools. These surgical tools should be sterile when used because any microbial contamination could result in disease transmission and would leads to high number of Surgical Site Infections (SSI). The aim of this study is to establish the possible presence of known bacterial pathogens on surgical instruments in hospital settings, and to evaluate their antibiotic susceptibility profile. For this purpose a comparative research was conducted; the 40 samples were collected from instruments at the start and end of the procedure with the sterile cotton swabs; from the Gynea department, Abbasi Shaheed Hospital. These samples were cultured on the selective and differential media and incubated at 37°C for 24hr. Next day, these samples were processed and identified in Microbiology laboratory as per standard microbiological techniques; including the microscopy, biochemical tests, enzymes test and other culture characterizations test. The isolated microorganisms include *E.coli, Staph aureus, Staph. saprophyticus, Strep viridians, Strep. bovis, Bacillus subtilis,* and *Pseudomonas spp.* These microorganism were isolated from both autoclaved and non-autoclaved pre and post-operative surgical instruments respectively. Antibiotic susceptibility test was carried out by Kirby Bauer Method. Meropenum found to be the most effective against *E.coli*, Gentamycin and *Novobiocin* shows activity against *S.aureus*, Erythromycin also give zone of inhibition against *S.bovis*, Vancomycin shows activity against *S.viridans*, where Cephalenin and Ampicillin were also found to be effective against *S. saprophyticus.* Surgical instruments should be regarded as a possible source of nosocomial infection s since bacteria from them can be carried from the hands of theatre personnel to the patient undergoing surgery or through re-dispersed bacteria from surfaces during surgery. Therefore surgical procedure to prevent cross contamination instruments are sterilized and decontaminated. There has been advance in Surgical Site Infection (SSI) control practices which involves improved operating room ventilation, sterilization methods, surgical methods and availability of antimicrobial prophylaxis.

Keywords
Surgical site infection (SSI), sterilization, bioburden, perioperative.

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Introduction

Sterile processing professionals understand that instrumentation is a primary front for infection prevention because instruments come into contact with body fluids and other matter that could potentially introduce or transmit pathogens to patients (1). Infection that arises at the operative site referred to as surgical site infection (SSI) (2). SSIs are infections that occur in surgical incisions, affecting tissues, organs and cavities manipulated during surgery and may be diagnosed up to 30 days after a procedure (3). SSI has harmful effect on

Patient who goes through surgery. Surgical instruments could be Contaminated with Blood borne Pathogens (HBV, Hepatitis C Virus, HIV), Antibiotic-Resistant Bacteria (e.g., Vancomycin-Resistant Enterococci, Methicillin-Resistant *Staph*ylococcus *aureus*, Multidrug Resistant Tuberculosis), or Emerging Pathogens (e.g., Cryptosporidium, *Helicobacter pylori, Escherichia coli* O157:H7, *Clostridium difficile, Mycobacterium tuberculosis*, Severe Acute Respiratory Syndrome Coronavirus), or microbial agents. Pathogens which are responsible in most surgical site infection are part of the patient's own endogenous flora. *Staph*ylococcus *aureus*, coagulase-negative *Staph*ylococci and *E.coli* are the most commonly isolated organisms (5).

Surgical site infections (SSIs) are serious operative complications that occur in approximately 2% of surgical procedures and account for some 20% of health care-associated infections. Despite modern infection control practices, the incidence of SSIs remains high. SSIs have been estimated as the third most frequently reported type of healthcare-associated infection. In most hospitals, SSIs are the first or second most frequent sites of infection (3). Despite advances in asepsis, environmental controls, and antimicrobial prophylaxis, SSIs continue to cause morbidity and mortality among surgical patients. In July 2005, the Pennsylvania Health Care Cost Containment Council (PHC4) reported on hospital-acquired infections in the state, estimating that patients with SSIs had a mortality rate of 3.1% (4).

S. aureus is a virulent pathogen and the most common cause of SSI (2,3). Methicillin resistance further complicates therapy for *S. aureus* SSI. The prevalence of MRSA has increased dramatically since it was first described in the 1960s. For hospitals with appreciable rates of MRSA SSI, risk factors for MRSA SSI should be evaluated, and preoperative antimicrobial prophylaxis with an agent active against MRSA should be considered for high-risk patients. Contaminants are likely to originate from three main sources: The environment (exogenous microorganisms in the air or those introduced by traumatic injury), (ii) The surrounding skin (involving members of the normal skin microflora such as *Staph*ylococcus *epidermidis*, Micrococci, skin diphtheroids, and propionibacteria), and (iii) Endogenous sources involving mucous -membranes (primarily the gastrointestinal, oropharyngeal, and genitourinary mucosae).

Materials and Method

Sample Collection: The samples were obtained from the surgical instruments of operation theatre, Gynea Department, Abbassi Shaheed Hospital. 20 samples were collected with the help sterile cotton swabs at the beginning of the operation, from sterile (autoclaved) surgical instruments. And 20 samples were collected from the non- sterile surgical instruments at the end of the operation.

Isolation of Bacterial Colonies: The samples were cultured on the selective and differential media including nutrient agar, eosin methylene blue agar, MacConkey agar, mannitol salt agar and blood agar for the isolation of microorganisms. The samples incubated at 37°C for 24 hours.

Identification of Bacterial colonies: The isolated colonies were observed under the light microscope for the identification by performing gram staining. Different biochemical test were also performed including oxidase test, catalase test, Coagulase test, starch hydrolysis test, Urease test and IMVIC.

Antibiotic Susceptibility Test: The microorganisms tested against the antibiotics by the Kirby and Bauer Method. Antimicrobial susceptibility was determined by Kirby Bauer disk diffusion. Overnight peptone water culture of the isolates were matched with McFarland turbidity 0.5 standard and with the help of a swab stick spread over the surface of Mueller-Hinton agar and allowed to dry. On the surface of the medium with the help of sterile forceps Antibiotic discs were placed on plates and incubated at 37°C for 18-24 hours. By using a caliper Zones of inhibition were measured in millimeters. Antibiotics used for susceptibility testing: Trimethoprim, Nalidixic acid, Ampicillin, Erythromycin, Gentamycin, Chloramphenicol, Penicillin, Vancomycin, Cephalexin, *Novobiocin* and tetracycline.

Results

The number of positive culture was 15 of 20 (75%) from the samples collected at the beginning of the surgical

procedures (autoclaved samples). Similarly the number of positive culture was 18 of 20 (90%) from the sample collected at the end of the surgical procedures (non-autoclaved samples). The microbes recovered from the surgical instruments included gram positive cocci and rod, gram- negative rod. The most common microorganism recovered from surgical instruments was Escherichia coli, Streptococcus *viridians*, *Staph*ylococcus *aureus*, *Staph*ylococcus *saprophyticus*, Bacillus, *Streptococcus bovis*, and *Pseudomonas* sp.

Table I: Microorganisms isolated from the autoclaved surgical instruments and their percentages.

Microbes	Number of Positive Culture	Percentage
Escherichia coli	5	25%
S.aureus	4	20%
S. saprophyticus	4	20%
Strep. viridians	2	10%
TOTAL	**15**	**75%**

Table II: Microorganism isolated from the non-autoclaved surgical instruments and their percentages.

Microbes	Number of Positive Culture	Percentage
Escherichia coli	*7*	*35%*
S. aureus	*3*	*15%*
S. saprophyticus	*1*	*10%*
Strep. Bovis	*2*	*20%*
Pseudomonas	*3*	*15%*
bacillus	*2*	*10%*
TOTAL	**18**	**90%**

Table III: Antibiotic Susceptibility Against Isolated Microorganisms

Bacterial Isolates	Antibiotics	Susceptibility
E.coli	Meropenum (Mem)	1.6cm (S)
	Gentamycin (Cn)	1cm(S)
	Trimethoprim-Sulfamethoxazole (Sxt)	No Zone (R)
	Nalidixic Acid (Na)	No Zone (R)
S.aureus	Vancomycin (Va)	0.9mm
	Novobiocin (Nv)	1cm
	Gentamycin (Cn)	1cm
	Chloromaphenicol(C)	0.9mm
S.bovis	Penicllin (P)	No Zone (R)
	Ampicillin (Aml)	No Zone (R)
	Erythomycin (E)	0.8mm
S.saprophyticus	Gentamycin (Cn)	0.8mm
	Cephalenin (Cl)	1.3cm
	Nalidixic Acid (Na)	No Zone (R)
	Novobiocin (Nv)	No Zone (R)
Bacillus	Vancomycin(Va)	4mm
	Chlormaohenicol(C)	4mm
	Gentamycin(Cn)	5mm
	Erytromycin(E)	8mm
	Amoxycillin(Aml)	No Zone (R)
Pseudomonas	Meropenum(Mem)	No Zone (R)
	Amikacin	No Zone (R)

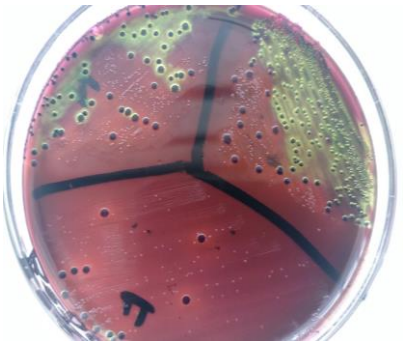

Figure 1: Green Metallic Sheen of *E.coli* on Emb Agar

Figure 3: Alpha & Gamma Hemolysis on Blood Agar

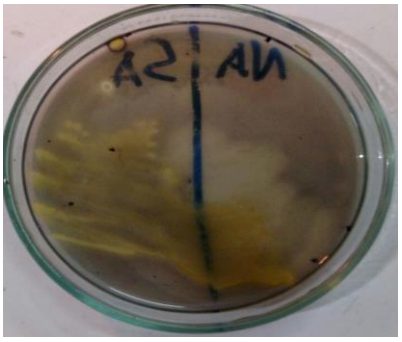

Figure 5: Starch Hydrolyis Test for *Strep bovis*

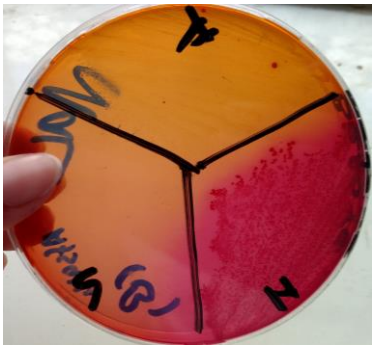

Figure 2: Pink Pin Pointed Colonies of *Staph*ylococcus Specie on Mackonkey Agar

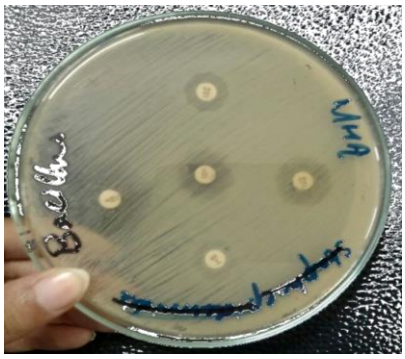

Figure 4: Antibiotic Susceptibilty Test against *Bacillus* on MHA Agar

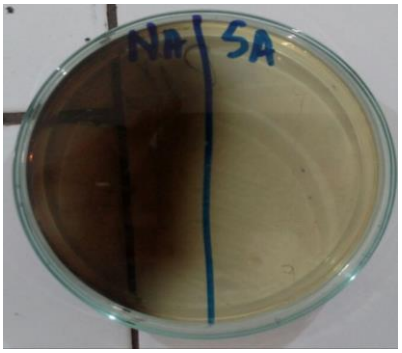

Figure 6: Black Appearance of Strep. *Bovis* on Bile Esculin Agar

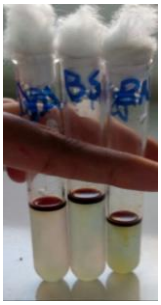

Figure 7: Indole Positive: Cherry Red Ring Appearance

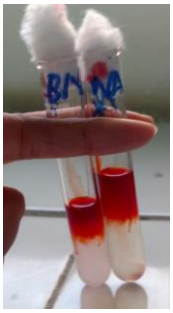

Figure 8: Methyl Red Positive: Red Color Appearance

Figure 9: Voges-Prousker Negative

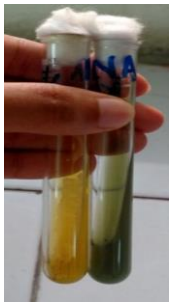

Figure 10: TSI Test and Citrate Utilization Test for Different Bacterial Isolates

Discussion

The current study showed that the operating theatre and inanimate objects like surgical instruments are contaminated by means of microorganisms, some of which are associated with nosocomial infection. This study confirmed that a number of inanimate objects in the operating room linked directly or indirectly with surgical procedures were contaminated with known bacterial pathogens. Even as in the surgical site infections (SSIs) the role of fomites have been controversial, Some investigators (5) have confirmed the fact of known pathogens on surgical instruments for months presents a serious concern lends credence to the possibility of causing nosocomial infections (6).

The sample that was taken before the start of the operation found to be 75% contaminated; which is also reported by the other scientist. The isolated microorganisms in or study includes 25% Escherichia coli, 20% *Staph*ylococcus *aureus*, 20% *Staph*ylococcus *saprophyticus*, (10%) *Streptococcus viridians*; & we do not observe any growth in 25% of the samples taken at the beginning of the procedure. The samples taken from surgical instruments after the surgical procedure; we isolated 35% *Escherichia coli*, 15% *Staph*ylococcus *aureus*, 15% *Pseudomonas Specie*, 10% Streptococcus *bovis*, 10% *Bacillus Specie*, 5% *Staph*ylococcus *saprophyticus*, & did not observe any growth in 10% of these samples. Inanimate objects like surgical instruments should be regarded as a possible source of nosocomial infection. Therefore instruments are sterilized & decontaminated to prevent cross contamination.

In this study, the major isolated microorganisms , of *Pseudomonas aeruginosa* , *S. aureus*, Coagulase Negative *Staph*ylococcus (COANS), *Strep* specie, and *E. coli* presents a serious concern for possible of causing nosocomial transmission. Among the bacterial pathogens *Staph*ylococcus *aureus* and *Pseudomonas* aeruginosa were observed. With earlier reports these findings agree on this subject (7-9).

The findings that P. aeruginosa, as a result of various virulence determinants has the ability to spread and survive in hospital environments and resistance to commonly used antibiotics and also disinfectants (10). For that reason *P. aeruginosa* is regarded as a major life threatening agent in operating rooms which is responsible for various outbreaks (11). Some researchers (10) have also reported that there is a connection between the development of post-operative infections such as wound sepsis and microbial contamination in the operating rooms.

This is also reported by other workers that coagulase negative *Staph*ylococcus was most commonly isolated pathogen from both surgical wards and the operating room (7, 12).Especially in surgeries with a lower level of contamination *Staph*ylococcus *aureus* is the most frequently isolated microbe. Currently, the second most frequent causative agent of causing surgical site infections (SSIs) is the coagulase-negative *Staph*ylococcus. In the present study, both the maternity and gynecology theatres *Bacillus* specie not regarded as a pathogen was most frequently observed. The findings of Gebremariam and Declaro (2014), Singh et al. (2013) (13, 14), reported this same organism *Bacillus* specie is the most frequently isolated in their study (15).

In the current study, *E. coli* was the most common pathogen isolated in surgical procedures.

In other studies the prevalence of *E. coli* ranged from 5%-23%.It was also reported that *E. coli* ,Gram-negative bacteria to be commonest pathogen in several other studies (16-18).Gram negative bacteria establish to be causing more infection then gram positive bacteria as Gram negative bacteria responsible for causing more nosocomial infections than gram positive ones.

In this study, most isolates *S. aureus* and *E. coli* showed resistant to the most commonly prescribed antibiotics such as Trimethoprim/Sulfamethoxazole, Nalidixic acid,. This may be due to extensive incorrect and overuse of these antibacterial agents in hospitals. All the *E. coli* that were isolated from surgical instruments were susceptible to Meropenem. While *S. aureus* found to be sensitive to vancomycin, gentamycin, *Novobiocin* and choramphenicol. Some of these antibiotics due to their high cost are not often used in the hospitals, thus, they are rarely misused. 75% of the Coagulase-negative *Staph*ylococcus samples and about half of the *Staph*ylococcus *aureus* samples were found resistant to methicillin/oxacillin in most American and Brazilian large hospitals. The character of isolated organisms and their antibiotic susceptibility profile tends to alter from time to time and from place to place, therefore the choice of antibiotics for prophylactic use and bacterial resistance patterns should take into account the expected flora.

Conclusion

The study reveals that to control postoperative surgical site infection Proper infection control procedures are essential. The finding of well-known bacterial pathogens on fomites is risk for surgical patients. As part of effective infection control policy, It will be essential to establish standard surface cleaning procedures. .After surgery rinse instruments immediately warm running water. So that it should remove all body fluids, tissue and blood.

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