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OCCURRENCE OF BACTERIAL CONTAMINATION IN OPERATION THEATER AND RELATED TO SURGICAL SITE INFECTION IN MEDICAL BENGHAZI CENTRE

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Abstract:-

Surgical site infections (SSIs) are leading cause of morbidity and mortality in hospitals. Both the antimicrobial resistance and SSIs are the worst complications that directly affect a patient health and safety. The present investigation aimed to study bacterial contamination in operation rooms in Benghazi Medical Centre (BMC).Ninety seven swabs were collected from several parts of the operation theatre. The specimens were collected during the period from 2017 – 2018. Bacterial isolates were identified, and tested against common used antimicrobial agents the results revealed that the spread of bacterial contamination in operation room was 67%. All isolates from operation room were sensitive to imepenem ,azithromycin, levofloxacin, ciprofloxacin (100%) followed tobramycin,ceftazidime, gentamycin(66.67%) whereas, all isolates were resistant to cefexim, tetracyclin, carbencillin, septrin, cephalexin, augmentin, cefoxtin, cefuroxime sodium by (100%), on other hand, the rate of infection in surgical site was (75%), the most prevalent pathogens was Klebsiella pneumonia(16%) followed by Acinetobacter bummannii, Pseudomonas aerginosa and Staph aurues (12%) Protues mirablis (10%) Enterococus spp (8%) followed Enterobacter aerogenes (4%) Yersinia enterocolitica (2%). Obtained results showed that most of the isolates from surgical site were multidrug resistant to common used antimicrobials as well as suggest the importance of environmental and surface contamination control to prevent SSI.

Keywords: - *Operation Theater, bacterial contamination Surgical Site Infection, antibiotic-resistant microorganisms.*

INTRODUCTION

Microbial contamination of operating theatres is one of the most life-threatening sources of nosocomial infection for patients (1). It is considered to be a risk factor for surgical site infections (SSIs) (2-4). SSI previously termed postoperative wound infection is defined as that infection presenting up to 30 days after a surgical procedure if no prosthetic is placed and up to 1 year if a prosthetic is implanted in the patient (5). SSI delays wound healing, prolongs hospitalization, increases morbidity and the overall costs [6-7]. Multiple reservoirs have been reported as being responsible for hospital contamination, particularly the operating theatre, including unfiltered air, ventilation systems, antiseptic solutions (2), drainage of the wounds, transportation of patients and collection bags, surgical team, extent of indoor traffic, theater gown, foot wares, gloves and hands, use of inadequately sterilized equipment, contaminated environment and grossly contaminated surfaces.[2, 3,8-9].

Medical staff (anesthesia providers, doctors, nurses) still represent an exogenous contaminant source in operating theatres (10) and personnel move back and forth between the operating theatre and other parts of the hospital without changing their gowns or slippers. The impact of these sources on the degree of microbial contamination differs, depending on the numbers of pathogens involved. Most SSIs the source of the pathogen comes from the patient's skin, mucous membranes or bowel and rarely from another infected site in the body i.e. endogenous sources. Exogenous sources of SSI pathogens are occasionally responsible e.g. organisms from members of surgical team, contaminated surfaces in the operating room, contaminated instruments, surgical gloves and other items used in surgery and exogenous organisms are primarily aerobic staphylococci or streptococci species. Some SSIs originating from an exogenous source could be acquired indirectly after transmission of pathogens from contaminated surfaces to the hands of healthcare workers.

The role of surface contamination in the transmission of nosocomial pathogens is being recognized increasingly (11). Contaminated surfaces and air are important source of infection in the operating room (OR) and both act as reservoirs on which microorganisms can survive for several months, increasing the risk of cross-contamination through direct or indirect contact with patients. Other contamination sources of infection include water supply and pluming [12], medical equipment [13], inanimate surfaces (e.g., walls, tables, floors, and equipment surfaces) [14, 15,16] badges and computer mice (17) have been considered a potential source for pathogen that may lead to transmission of bacteria and cause SSIs.

Multi-studies revealed that the majority of organisms causing SSI are Gram- positive cocci e.g *Staphylococcus aureus* and Gram- negative bacilli *e.g. Echerichia coli*, Klebsiella, pseudomonas and Enterobacter spp*(*18,19). However, the most significant change in the microbiology of SSI has been the increased involvement of antibiotic resistant bacteria (9``). Infections with antibiotic resistant bacteria such as MRSA (Methicillin Resistant *Staphylococcus Aureus)* are transmitted primarily by the contaminated hands of healthcare providers. Organisms associated with SSIs vary with type of procedure and anatomic location of the operation coagulase negative staphylococcus (CNS), Enterococcus species and *E.coli* are 3 most frequently isolated pathogens, an increasing number of SSIs are caused by antimicrobial resistant pathogens and incidence of fungal SSIs has risen in part because of increasing numbers of patients with HIV/AIDS (20). The aim of present work was design to study bacterial contamination in operation rooms (ORs) and the relation with the surgical site infections (SSIs) in Bengazi Medical Center (BMC), Libya.

MATERIAL AND METHODS

A total of 148 collected specimen include 51 surgical patient`s wounds admitted and made operations in operations rooms at Medical Benghazi Centre (MBC) in Benghazi, Libya. Whereas 97 samples were collected from inanimate surfaces; suctions bottles, surgical instruments, supply machine, clamsp applier, sinks, tips of dispenser, mask ventilator, flow meter and healthcare worker hands. All these samples were taken from operation theatre at Medical Benghazi Centre (MBC) in Benghazi, Libya.

All samples (patients, and Environment) were incubated onto riches media, blood agar and differential media MacConkey agar. The plates were incubated for 18-24hr at 37C. Isolation and identification of microorganisms were done according to standard procedures. Bacteria were identified by examination of colonial morphology, Gram staining and rapid biochemical tests (catalase, oxidase, urease, citrate and TSI).in addition the isolated bacteria were confirmed by Phoniex system.

In terms of, drug susceptibility testing was performed by the method of disk diffusion according to guidelines of the National Committee for clinical Laboratory Standards (NCCLS). The culture of each isolate was diluted to have turbidity around 0.5 Mcfarland standard, than plated onto Muller-Hinton agar plate (HIMEDIA). Antibiotic disks (Bioanalyse) were applied to each plate. After incubation at 35C for 18-24hrs, the zone of inhibition diameter was measured. The isolates which were resistant to common antimicrobial drug examined by synergism experiment to detect choice treatment for patient`s wounds.

RESULTS

Isolation and identification of pathogen isolates from inanimate surfaces and hands.

A total of 97 samples were collected and identified from different parts in operating room, in the Benghazi medical center during 2017-2018. These isolates were included *Micrococcus laylai* (27%), it was the higher percentage, while the lowest rate of contamination by Bacillius *cereus* and *Arcanobacterium pyogen* (up to 5%) (Figure 1). The results showing the

rate of bacterial contamination on the operating theater was positive (33%) (Figure 2). Surgeon hands were the most infected samples (11%) compare with anesthetics hands (8.2%). However, the high percentage of contamination were in the dispenser tips and tip of tap water (16.2%, and 8%), respectively (Figure 3).

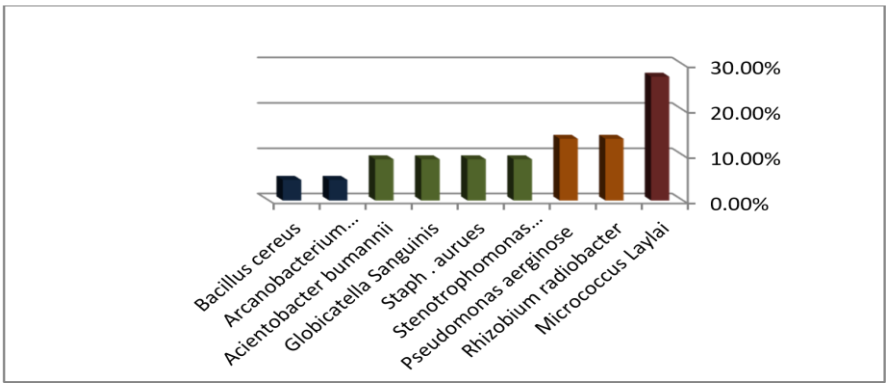

Fig.1 prevalence of isolated bacteria in Operation Theater

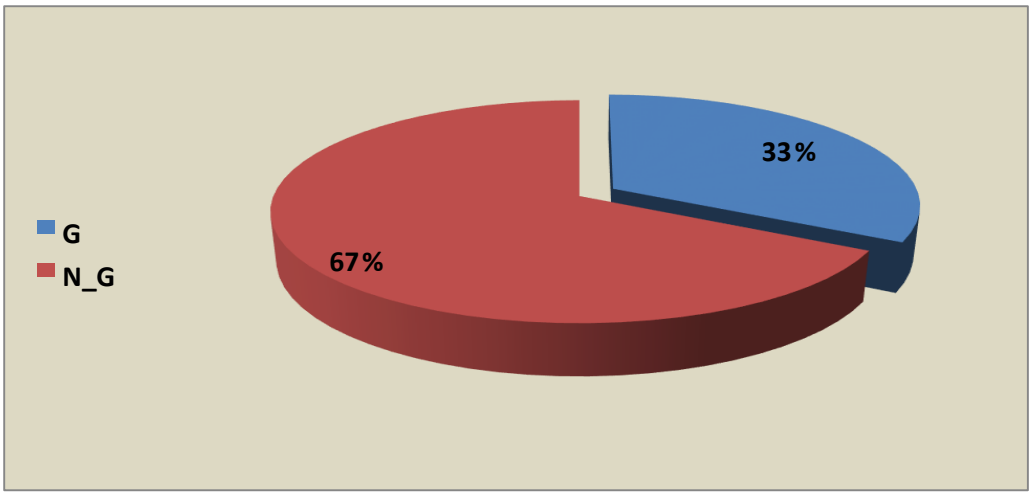

Fig.2 Rate of bacterial contamination in Operation Theater

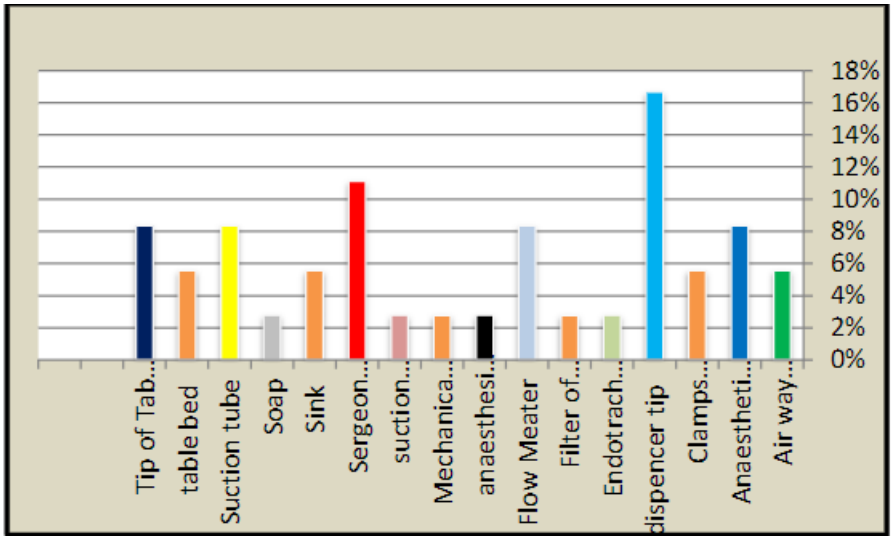

Fig.3 Types of contaminated specimens in Operation Theatre

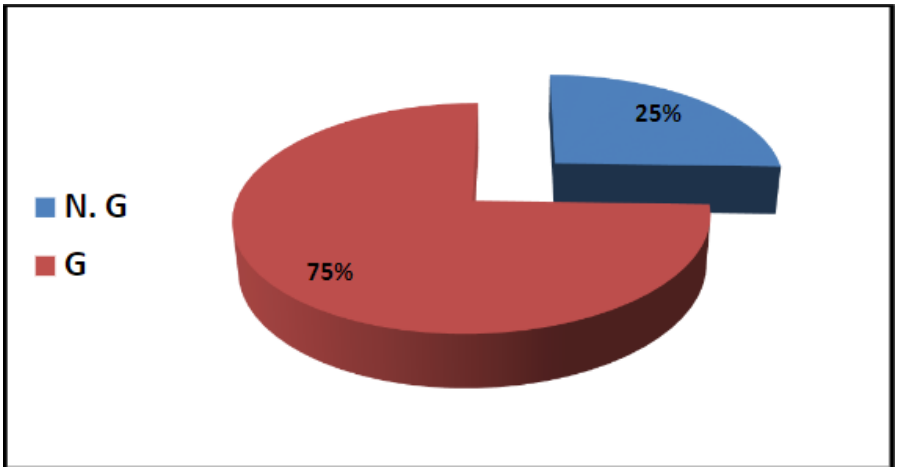

Fig. 4 prevalence of surgical site infection in patient's wounds

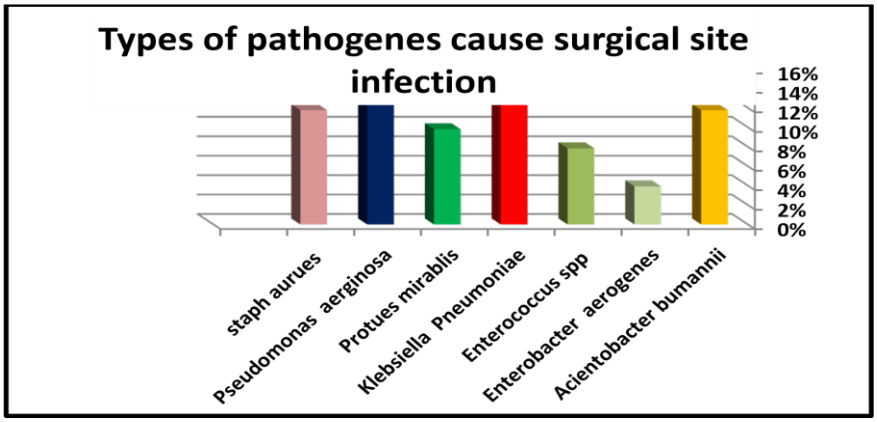

Fig .5 Types of pathogens cause surgical site infection

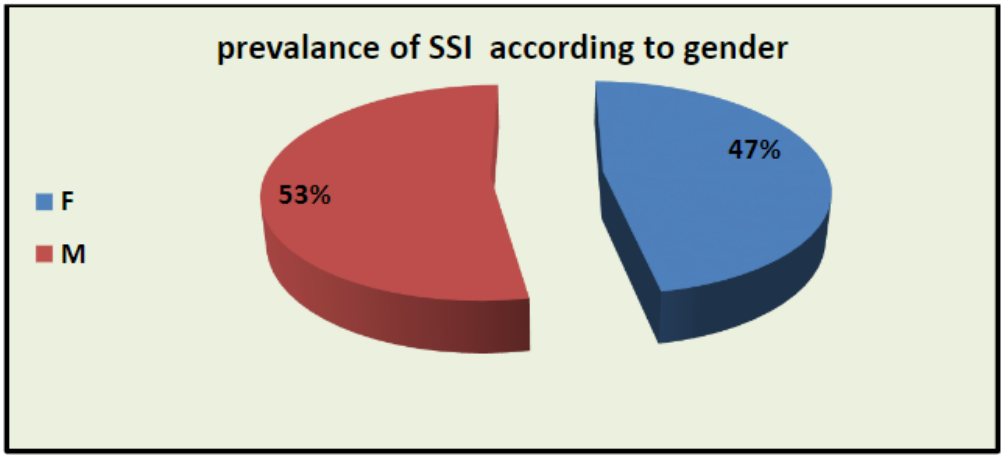

Fig. 6 prevalence of surgical site infection in patients wounds according to gender

The prevalence of surgical site infections.

The prevalence percentage of infection in patients' wounds in Figure 4 and the study showed that there spread of bacterial growths in wounds, where up to 75% of patient's wounds were infected. Characterization of isolates from patient's wounds showed clearly a high prevalence of Gram-negative bacteria (Figure 5). Bacterial identification showed a predominance of *Klebsiella pneumoniae* (16.2%), *Pseudomonas aeruginosa* (12.70%), *Acientobacter bumannii* (11.70%), *Protues mirablis* (9.80%) and *Enterobacter aerogenes* (5.90%). Gram-positive bacteria also isolated from patients wounds. The most prevalent pathogen was *S. aurues* and *Enterococcus* spp (11.8%, 3.90%) respectively (Figure 5). Results clearly demonatrated the presence of *P. aeruginousa, S. aurues* and *Acientobacter bumannii* in both OT and SSI. SSI isolation of Gram-negative bacteria was higher while the isolation of Gram-positive bacteria from OT was higher. Obtained results showed that a rate of SSI of 53% in males compared to 47% in female (Figure 6).

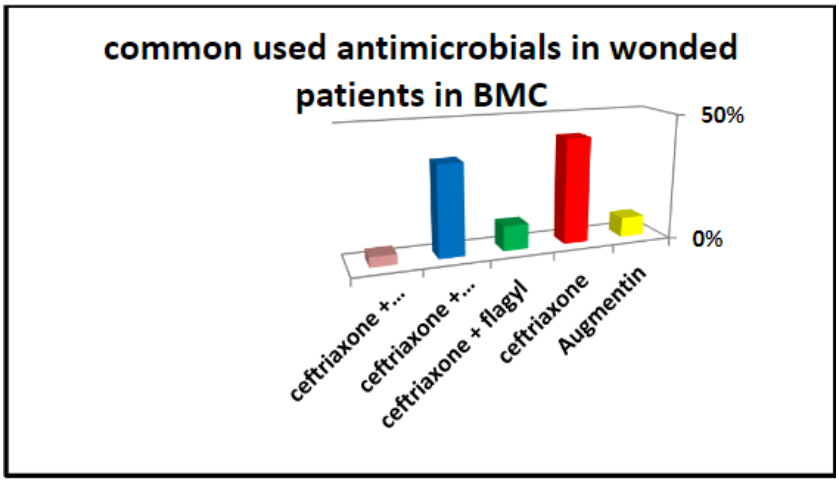

Fig. 7: Common used antimicrobials in patient's wounds in BMC

Determination of drug resistant strains

Patients' wounds were treated by common antimicrobial drugs. The wounds were resulted from different types of surgical operations. Figure 7 show the popular antibiotics, include, agumentin and ceftriaxone, in addition applying the combination drug also in treatments such as ceftriaxone + gentamycin; ceftriaxone+ flagyl +gentamycin and ceftriaxone + flagyl. The resistance issue of isolated bacteria was evaluated from BMC. The majority of Gram-negative bacteria were characterised by the high resistance to amoxicillin + calvulanic acid (AMC); cefuroxime (CXM), carbenicillin (CAR) and cefixime (CFM). However, low rates resistance to amikacin (AK) were registered. Moreover, this study highlights the lowest frequency of resistance to imipenem (Figure 8).In addition, gram-negative bacteria isolates were detected by the high sensitivity to amikacin (AK) (70%) compare with other common antibiotics. In terms of the Grampositive bacteria isolates up to 90% were resistant to erythromycin, clindamycin, and vancomycin. In general, a high rates of sensitivity in gram-positive bacteria was observed against the greater part of antibiotics. Approximately 100% of all gram positive isolates were very highly sensitive to tetracycline and vancomycin (Figure 9). The greater number of gram-positive bacteria which isolated from operation theater were resistance to oxacillin and vancomycin (100%), while there are another isolates were highly sensitive to imipenem, levofloxain, and ciprofloxacin (Fgure 10), and what is worth to mention also the results showed that the gram negative bacteria which isolate from OT the highly resistant to CFM, TE, PX, SXT,CL, AMC, FOX , while the same isolates revealed the extremely sensitivity to other common used antibiotics in the BMC (Figure 11).

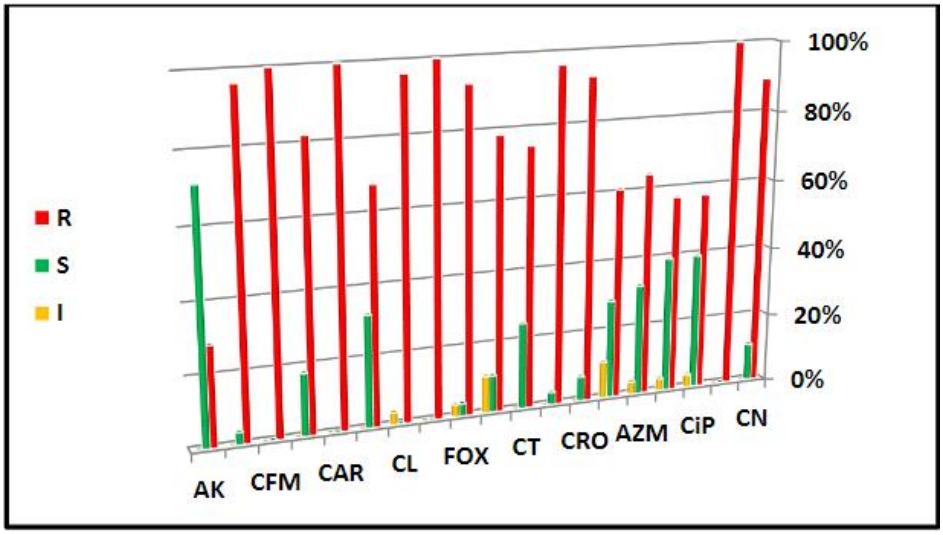

Fig. 8 Susceptibility tests to Gram-negative bacteria isolated from SSI

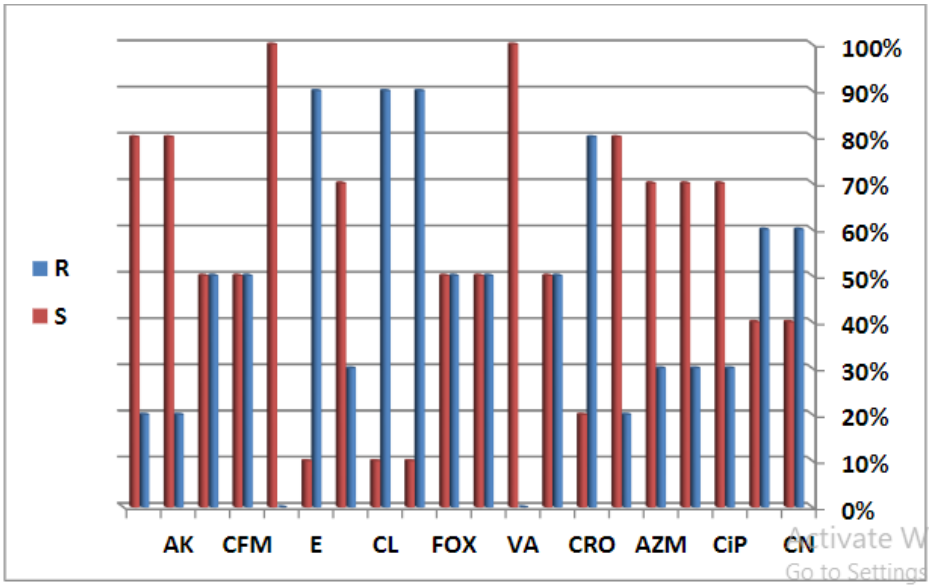

Fig. 9 Susceptibility tests to Gram-positive bacteria isolated from SSI

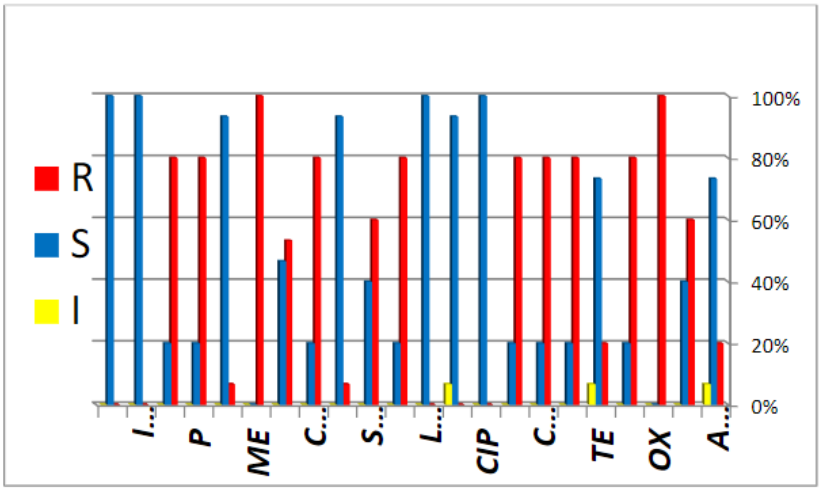

Fig.10 Susceptibility tests to Gram-positive bacteria isolated from environmental OT

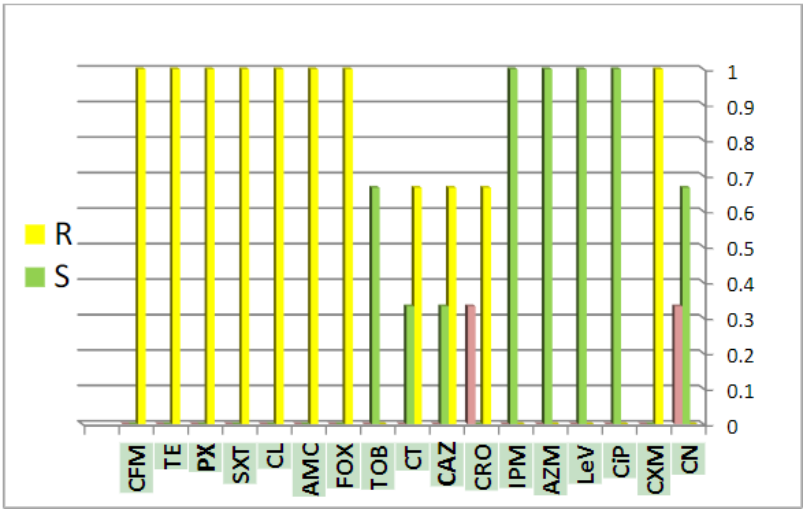

Fig. 11 Susceptibility tests to Gram-negative bacteria isolated from environmental OT

DISCUSSION

Microbial contamination of the operation theater had continued to increase the prevalence of SSI. Diversity of microorganisms in the environment that cause infections in operation theater such as bacteria, fungi and viruses.[18] Some bacterial strains such as *Staphylococcus aurous*,*S. epidermidis*, *Escherichia coli* and *Pseudomonas aeruginosa* have a greater propensity to cause contamination in operation theaters [21]. Results from this study demonstrated the contamination in operation theater were higher. In addition, the most common organism was detected such as *Micrococcus laylae* (27%); *Rhizobium radiobacter* and *Pseudomonas aeruginosa* (14%); *Stenotrophomonas meltopilia*,

Staphylococcus aureus, *Globicatella sanguinis* and *Acinetobacter bumannii* (10%);*Arcanobacterium pyogen* and *Bacillus cereus* (5%).The results of this work are consistent with the studies of Al Mulhi et al. Who reported the appearance of Staphylococcus aureus and Acinetobacter species [15], however, some other organisms did not detect. In this study showed that a rate of SSI of 53% in males compared to 47% in females. These results in contrast with other studies such as Khairy, *et al*, who reported the higher number of females compared with males [16].The higher number of males in the our study may be due to that the difference in the type of operations[22] and the contaminated areas in operation theaters. Khairy GA, *et al*, reported a significantly higher rate of SSI in emergency operations compared to routine elective surgeries [16].Similar results were found in other studies [23,17]. In this study, were have clearly demonstrated that the contamination in equipments, such as dispencer tip (16.5%), and hand of sergeon (11%) are highe than other surfeace. That ensures the possibility of disseminating microorganisms by staffs (doctors and nurses) who neglect to wash their hands after touching patients [5]. Patients, surgeons, and nurses, as well as operative room atmosphere and instrumentation are prime areas of concern.

Several studies have reported the importance of frequent and adequate hand washing to reduce rates of hospital acquired infections, showed that hands regularly acquire bacterial pathogen, after contact with patients and the environmental surfaces close hospitalized patients [20]. In addition, there are other various factors are considered one of the causes of occurrence of SSI, like the air- borne bacteria in operation theaters .These factors include efficiency of filtration systems, occupant density and type of surgical procedures [24]. In the present study, characterization of bacterial strains showed the predominance of gram-negative bacteria from patients compared to the environmental isolates, where the dominance of gram-positive bacteria were detected more in the operation theater environmental. Similar study carried by Bakkali MEL., *et a*l reported that the description of pathogen strains display the predominance of gram-negative bacteria from patients and surfaces and gram-positive bacteria from hands [5]. Regarding the type of infecting bacteria was the majority grew *Micrococcus lylae* in the operation theater and the *klebsiella pneumoniae and Pseudomonas aeruginosa* from surgical site infections. However, Khairy GA *et al*. in their study showed that the majority grew *E. coli*, which reflects the predominance of SSI operations. In a study from India, the most predominant isolate was *Staphylococcus aureus* of which were MRSA compared to the low isolation rate of *S. aureus* in our study where MRSA, which isolated from Operation Theater [16] were. The possible reason for this difference is the type of operations in the Indian study, compared to our series in Libya, in addition *S. aureus* are also present as a normal flora in our body that may act as opportunistic pathogens under favorable condition. In a major breast surgery study, the commonest isolate was *S. aureus*, more than one third were MRSA [25].

Globally, the dissemination of antibiotics resistant bacteria in hospital environments poses a serious threat to human health. Our results showed that the gram negative bacteria isolated from operation theater were multi- drugs resistant bacteria where more resisrant to cefixime (3rd generation cephalosporine), tetracyclin, trimethoprime/sulfamethoxazole, clindamycin, amoxicillin/clavulanic acid and cefoxitin (2nd generation cephalosporins), while were sensitive to ciprofloxacin, levofloxacin, azithromycin and impenem. On the other hands, the gram positive bacteria isolates were more resistant to oxacillin, vancomycin and azithromycin. Both gram positive and gram negative bacteria was detected as a multi-sensitive strains, in our study. Also resistance strains colonized hospital environment approximatley were similar to those isolated from patients. This suggests that transfer of the DNA molecular from pathogenic strain to other by conjugation or that patients could be contaminated from hospital surface or through healthcare workers [5] In terms of the bacterial resistant strains which isolated from patients, most of isolates were resistant to antibiotics tested. up to 100% gram negative bacteria were resistant to CXM, AMC, CAR, FOX, TE, and CTX. Several studies revealed that the most used antibiotics are cephalosporins, carbapenems, quinolones and aminoglycosides. Our results clearly demonstrated that the rate of drug resistant gramnegative bacteria was much higher than gram-positive bacteria, from both patients and the operation theaters environment. Previous studies showed converse results with a high degree of gram-positive drug resistant isolates from the operation theater environment [26]

CONCLUSION

In this study showed that the resistant bacteria is wide spread in hospital with high rate of MDR bacteria were found in patients and environment of OT. Health care workers do not hand washing correctly to reduce rates of hospital acquired infections and few antibiotics are available for patient treatment also Environmental cleaning is not performed correctly.

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