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Study on the Contamination of Tobruk Medical Center Environment by Aerobic Bacteria

Samiya Sabea Khamees
Biology Department, Faculty of Science & Tobruk, University, Libya

***Abstract*—** *Cleaning and disinfection of the hospital environment play important role in controlling nosocomial infection, Considerable studies indicated that contamination of the environmental surfaces in hospital wards take part in the transmission of nosocomial pathogens. This study was conducted to identify the type of bacteria causes contaminating different sites of the hospital. A total of 448swabes samples were collected from different sites, bacterial growth was observed in 337(84%), these gave 742bacterial isolate. Gram positive bacteria were the most common bacterial isolates and they occurred as follows Staphylococcus epidermidis 319 (42.9%), Staphylococcus aureus 210 (28.3%), and Bacillus spp 81 (10.9%). Gram-negative bacteria that isolated in this study were Escherichia coli 19(2. 5%), Pseudomonas aeruginosa 18 (2.4 %), Proteus mirabilis 17(2.29%), Klebsiella pneumonia 11(1.48%) and 10 isolate for both Shigella dysenterria and Stenotrophomonas maltophilia. Several uncommon bacterial isolates were observed in this study*.

***Keywords*—** *Hospital environment, contamination, Staphylococcus epidermidis Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa*.

I. INTRODUCTION

Hospital environment sometimes harbor many pathogenic microorganisms that persist and causing in nosocomial infection. The microorganisms causing nosocomial infection are, bacteria, fungus, parasite and viruses, but the most common are bacteria (Chakraborty, 1998) .The prevalence of pathogenic bacteria in hospital environment is more serious than in other institutions. Several strains of pathogenic bacteria have been frequently identified contaminating inanimate surfaces or objects closed to or touched by infected patients such as, beds, tray tables, bedside, patient chairs (Schmidt et al., 2012). The prevalence of pathogenic bacteria in the air of the hospital has been recorded by Richard, (1998). Although many efforts is made to eliminate the growth of microorganisms in the hospital, the hospital environment is major reservoir for various types of pathogens ,as that certain normal microbial flora of human body are opportunistic pathogens and represent strong danger to hospital patient (Schmidt et al., 2012) .In addition to increase morbidity and mortality, however the danger of acquiring nosocomial infections increase the longer the patient stayed in hospital(Maclean et al., 2010).In addition of being opportunistic, some bacteria become resistant to antibiotics which are commonly prescribed in that hospital such as penicillin, and aminoglycosides (Strylenes, 1998). The most common multidrug resistant bacteria are *Staphylococcus, Enterococcus,* and *Pseudomonas* (Ghaidaa *et al*., 2018). The surfaces, and medical equipment are colonized by variety of pathogenic bacteria and the surfaces and environment in a room of infected patient are frequently contaminated with pathogens that are capable of surviving on hospital room surfaces and medical equipment for prolong period of time . Contact with hospital surfaces and medical equipment by medical staff frequently lead to contamination of hands and / or gloves. Many studies have shown that pathogens can survive for weeks on touched surfaces in hospitals, the longer the nosocomial pathogen persist on the surfaces and different sites in the hospital, the longer it may be the source for transmission to susceptible patient (Otter *et al*., 2011)

The prevalence of nosocomial infection in developing countries is neither recorded nor prissily reported for many reasons (Allegranz & Pittt, 2008) It has been reported that nosocomial infections are the fifth leading cause of death in critical care(Dharm *et al*., 2018). Risk of transmission is directly depending on the duration of pathogen survival on colonized objects. The prevalence and survival depend on many factors such as geographical and environmental condition, like temperature, humidity, presence of organic matter, ability to form biofilm and the most important are the precautions taken to control infections (Kramer *et al.,* 2006; Carter, 2002). Gram positive and gram-negative bacteria have been reported to survive up to months on dry inanimate surfaces in the hospitals (Kramer *et al.,* 2006). The pathogenic organisms from equipment and different sites in the hospital are transmitted to healthcare worker, patients and even visitors. This study was conducted to investigate the distribution and diversity of bacterial isolates contamination of hospital environment, surfaces and equipment. Identification of these sites and bacterial isolates may help in reducing pathogens transmission.

II. II. MATERIALS AND METHODS

A total of 448 swabs were screened from different sites of Tobruk medical center / Tobruk /Libya, which include, Male and Female medicine ward (68); Male and Female Surgical ward(64); Male and Female Orthopedic ward (76); Gynecology and Obstetrics ward (28);Obstetric delivery room (26); Male and Female Ophthalmology ward(21);Pediatric ward A,B (79);Nephrology ward(16); Cardiac care unit (30);Intensive care unit (12); Operation theater(23) .Sterile cotton swabs that containing transport medium were used for this purpose. The swabs were taken to the microbiology laboratory in of the medical center and cultured on nutrient

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agar, blood agar and MacConkey agar. Isolation and identification of bacterial isolates was performed according to standard microbiological methods such as colony morphology, gram stain, and microscopic feature and biochemical reaction and using API system for *Staphylococcus* and API 20 for gram-negative bacteria.

III. Result and Discussion

Out of 448 environmental swabs were collected from different sites in Tobruk Medical center , 377 (84%) samples gave positive bacterial growth , while 71(16%) gave negative growth .This result is in agreement with the result of Dhram *et al*., 2018. 742 bacterial isolate ewer identified from the positive growth swabs, (Table 1). This result is higher than the result of .reported by Sergent *et al*., 2012 which was (78%) and much higher than the result reported by Ivan *et al*., 2018 which was (44.2%). The result of this study showed that the most contaminated sites were male & female Ophthalmology wards (95%), followed by male & female surgical wards and Nephrology with (94%) both, Obstetric delivery room gave (88%)contamination. In addition male &female medical wards, Cardiac care unit CCU, Operation theater all gave (87%). The swabs obtained from these sites were screened from different sources such as air, floor, beds and different medical instruments, positive growth swabs and negative growth swabs from these sources is shown in (Table 2). The result showed that the floor was the most contaminated source (95%), and this is obvious result because of this medical center is so busy and no adequate precaution were taken to maintain disinfection and sterilization the hospital environment, according to the present situation with lack of efficient routine inspection and shortages of efficient disinfectant and the cleaning worker, often just using ordinary detergents thus the floor of the hospital wards became contaminated with variety of bacteria and becoming a reservoir for pathogenic bacteria However, mopping or mechanical scrubbing will reduce large percentage of bacterial isolates but eventually recontaminated with bacteria after 1 hour (Kelly Pyrek, 2018). In addition, the result of this study showed that the tables and the medical instrument touched by patients and medical staff were contaminated with (89%) and (85%) respectively. This result is higher than the result of Saka *et al*., 2017 as they reported (60%) contamination. The air of the hospital is contaminated with (79%), this result is in agreement with the result of Ghaidaa *et al*., 2019 as they reported the air of the hospital kitchen contamination was (83.8%).

TABLE 1: Growth swabs, negative growth swabs, and their sources

Swab source	Swab total No	Positive growth Swab No (%)	Bacterial isolate No (%)	Negative growth Swab No (%)
Male and Female medicine wards	68	59 (87)	102 (!4)	9 (13)
Male and Female surgical wards	64	60 (94)	130 (18)	4 (6)
Male and Female Orthopedic wards	76	63 (83)	130 (18)	13 (17)
Gynecology and Obstetrics ward	28	20 (71)	44 (6)	8 (29)
Obstetric delivery Room	26	23 (88)	52 (7)	3 (12)
Male and Female Ophthalmology wards	21	20 (95)	37 (5)	1 (5)
Pediatric wards A, B	79	59 (75)	79 (10)	20 (25)
Nephrology ward	16	15 (94)	37 (5)	1 (6)
Cardiac care Unit CCU	30	26 (87)	69 (9)	4 (13)
Intensive care unit	17	12 (71)	23 (3)	5 (29)
Operation Theater	23	20 (87)	34 (5)	38 (35)
Total	448	377	742	71

TABLE 2: The prevalence of gram- positive and gram-negative bacteria isolated from different hospital environment sources

Source	Swabs Total No	Positive growth swab No (%)	Bacterial isolate No (%)	Gram positive bacteria No (%)	Gram negative bacteria No (%)
Floor	100	95 (95)	266 (36)	216 (29)	50 (7)
Beds	100	75 (75)	154 (22)	140 (19)	14 (2)
Air	100	79 (79)	181 (24)	156 (21)	25 (3)
Table	100	85 (85)	103 (14)	81 (11)	22 (3)
Instrument	48	43 (89)	83 (5)	31 (4)	7 (1)
Total	488	377 (100)	742 (100)	624 (84)	116 (16)

Table 3 demonstrate the prevalence of gram positive and gram negative bacteria isolated from the environment of the hospital and it is clear that *Staphylococcus epidermidis* was the most common bacteria with (42.9%),this was different from many studies (Ivan *et al*., 2018; Mohammed 2013; Kihla *et al*., 2014; Saka *et al* .,2017) followed by *Staphylococcus aureus* (28.3%) this was much lower than the result of Ivan *et al.,* (2018), who reported that the contamination with *Staphylococcus aureus* was (75.5%) . The prevalence of *Bacillus species* with (10.9 %) is indication for insufficient cleaning and accumulation of dust on the instruments and other parts of the hospital environment. The result of this study clear that the prevalence of gram positive bacteria is higher than gram negative bacteria and this was in agreement with the result of Mohammed, (2013), However the prevalence of gram positive bacteria higher than gram negative bacteria in hospital environment has been reported long ago by Lidwell *et al*., 1950. Although gram-negative bacteria were resistant to most disinfectant but gram-positive, bacteria could survive for many weeks on dry condition (Hirai. Y, 1991).

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TABLE 3: Gram positive and Gram negative bacteria isolated from hospital environment

Bacterial strains	Number	Percentage
Staphylococcus epidermidis	319	42.99
Staphylococcus aureus	210	28.3
Streptococcus pyogenes	9	1.2
Bacillus spp	81	10.9
Lactobacillus chryseobacterium	3	0.4
Corynebacterium spp	2	0.26
Escherichia coli	19	2.56
Proteus mirabilis	17	2.29
Pseudomonas aeruginosa	18	2.42
Klebsiella pneumonia ozaenae	11	1.48
Shigella dysenteria	10	1.34
Stenotrophomonas maltophilia	10	1.34
Enterobacter cloaca	9	1.21
Neisseria saprophytic	8	1.07
Brucella spp	3	0.4
Photobacterium damsella	3	0.4
Myroides chrysomonas	2	0.26
Aeromonas salmonioida	2	0.26
Pasteurella haemolytica (pnumotropica)	2	0.26
Vibrio fluvials	1	0.13
Chromatobacterium voluceum	2	0.26
Ewingella americana	2	0.26
Total	742	100

TABLE 4: Distribution of Bacterial isolates according to their sources

Bacterial strains	Floor No (%)	Beds No (%)	AIR No (%)	Table No (%)	Instrument No (%)	Total No (%)
Staphylococcus epidermidis	107 (42)	80 (54)	81(44)	37 (38)	14 (36)	319(44.2)
Staphylococcus aureus	79 (31)	39 (27)	54 (30)	3o (31)	8 (21)	210(29)
Streptococcus pyogenes	3 (1.2)	2 (1.4)	2 (1)	2 (2)	-	9 (1.2)
Bacillus spp	24 (9.4)	9 (6.1)	25 (14)	12 (12)	11 (28)	81 (11.2)
Escherichia coli	9 (3.5)	3 (2)	3 (1.6)	3 (3)	1 (2.5)	19 (2.6)
Pseudomonas aeruginosa	8 (3.1)	4 (2.7)	4 (2.2)	1 (1)	1 (2.5)	18 (2.4)
Proteus mirabilis	7 (2.7)	4 (2.7)	4 (2.2)	2 (2)	-	17 (2.3)
Klebsiella pneumonia	4 (1.6)	1 (0.7)	3 (1.6)	2 (2)	1 (2.5)	11 (1.5)
Shigella dysenteria	3 (1.2)	1 (0.7)	3 (1.6)	3 (3)	1 (2.5)	10 (1.3)
Stenotrophomonas maltophilia	4 (1.6)	1 (0.7)	1 (0.5)	3 (3)	1 (2.5)	10 (1.3)
Enterobacter cloaca	3 (1.2)	2 (1.4)	2 (1)	2 (2)	-	9 (1.2)
Neisseria saprophytic	4 (1.6)	1 (0.7)	1 (0.5)	1 (1)	1 (2.5)	8 (1.1)
Total	254 (35)	147(20.3)	183(25.3)	98(13.5)	39(4.5)	721(100)

Many uncommon bacterial isolates were identified in this study but with low frequency such as *Lactobacillus chryseobacterium; Brucella; Photobacterium damsella; Myroides chrysomonas; Aeromonas salmonioida; Pasteurella haemolytica (pneumonia); Vibrio flavials; Chromobacterium voluceum; Ewingella Americana.*

The distribution of most frequent bacterial isolates according to source has been presented in Table 4, which demonstrated that the most contaminated source was the floor and followed by the air.

IV. Conclusion

Variety of pathogenic bacteria inhabit the hospital environment. The hospital floor, air, and surfaces are often contaminated with bacterial flora excreted by patients, medical staff and visitors. The bacterial isolates from this study were obtained from surfaces (tables, beds and instruments), floor and air of Tobruk medical center. Staphylococcus species were predominantly found in all sources and sites of the hospital .Gram negative bacteria isolated with from (2.5% - 0.13%). Heaviest contaminated source was the floor of the hospital followed by the air with 35% and 25% respectively. However pathogenic bacteria population and colonization ratio vary with different medical centers and different part of the world. More research on bacterial prevalence of common sources contacted by medical staff would assist to identify the possible reservoir for pathogenic bacteria and to use the proper and suitable disinfection procedure.

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