Original Article

Nosocomial infections in a Surgical Floor of the General Ba'qubah Hospital; Iraq

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Abstract:

Background: Prevention against nosocomial infection is an important issue of health care field and considered a challenge of patients' since it reflects its effect on their quality of life. This due to that it will lead in most cases to prolonged hospitalization and also more cost.

Objective: To determine the prevalence of different types of nosocomial infection and to demonstrate the association of different risk factors (hospital environment, workers, visitors) with nosocomial infection.

Patients: this study was carried out in eleven months at Ba'quba general Hospital; Iraq. A total of 81 clinical specimens (urine, pus from abscess , burn swab, nasal swab, ear swab and wound swab) taken from surgical patients,102 specimens from hospital workers,50 specimens from patient visitors,335 specimens from hospital environment and 64 specimens from 18 newly admitted patient were studied.

Methods: all microorganisms which were isolated from patients, workers, visitors control group and environment were identify using standard bacteriological and mycological methods.

Results: the present findings demonstrates that the percentage of nosocomial infection (N.I) types found to be highest with urinary tract infections 21 (40%), followed by surgical site infections 19 (35.8%) and respiratory tract infection 12 (23%).

Conclusion: most of the isolated microorganisms were resistant to antibiotics and most of them have ability to produce β-lactamase enzyme.

Keywords: Nosocomial infection. Hospital acquired infection,

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Introduction:

A hospital acquired infection (HAI) or a nosocomial infection, is an infection whose progress is favored by a hospital environment, such as one acquired by a patient during a hospital visit or one evolving among hospital staff (1). This infection may not clinically appear until after discharge. Patients already incubating an infection and admitted to hospital may not show any clinical manifestations of the infection until a day or more after admission, in which case it is not a nosocomial infection but a community- acquired infection (2). In most cases, clinical manifestations appears after admission (3). Nosocomial infections may be endogenous, exogenous and not present or incubating at time of their admission (4). These infections usually manifest 48 hrs. or more after hospital admission, or within 30 days after discharge (5). Nosocomial pathogens are microorganisms, including bacteria, virus, algae, protozoa and fungi (6). Staphylococcus aureus among the most agents that cause exogenous infections (7).Data indicate that gram negative bacteria are responsible for more than 30% of HAI, and these bacteria predominate in cases of ventilator-associated pneumonia (47%) and urinary tract infections (45%)(8). In intensive care units (ICUs) in the United States, gram-negative bacteria account for about 70% of these infections, and similar data are reported from other parts of the world(9). A range of gram negative organisms are responsible for HAIs, the Enterobacteriaceae family being the most commonly identified group overall Unfortunately, multidrug-resistant organisms, including Pseudomonas aeruginosa, Acinetobacter baumannii, and extended-spectrum β-lactamase (ESBL)–producing or carbapenemase-producing Enterobacteriaceae, are increasingly being reported worldwide (10).There are numerous preventive measures ranging from conventional to high-tech measures. The goals are to avoid transmission by hand, by air, and by blood. Hand washing is the single greatest improvement, but this hygiene action is often lacking in many staff. Other measures include avoiding hand contact, especially to the conjunctiva or nasal areas. Various sterilization measures are helpful ranging from simple acts like sterilizing ventilators to full scale air filtering systems in the hospital. In some cases it may be appropriate to vaccinate certain patients against particular pathogens. (11,12).

Patients and Methods:

Clinical specimens: the present study consisted of eighty one patients (45 male and 36 female) admitted to surgical ward in the general Ba'qubah hospital. The patients age was ranged between few day's to over seventy years old. Eighty one clinical specimens including urine specimen, pus from abscess,

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burn, nasal, ear swabs and wound swab. The samples were collected from all patients through the period of 12 months. Hospital's staff specimens: thirty eight hand scrubs, 22 nasal swabs, ,42 gown swabs, were collected randomly from 32 worker's including doctors, nurses, food handlers, cookers, and other employees during one month period. Patient's visitor specimens: twenty five nasal swabs and 25 hand wash samples were collected from 25 patient's visitors. .Control group specimens: twenty five nasal swabs,13 hand skin,7 throat swabs along with 19 urine specimens were collected from 18 patients within 24-48 hours of admitted to surgical ward. Hospital environment specimens: one hundred eighty six samples and swabs were collected from nine surgical wards, shaving, and cleaning and toilet rooms. The specimens were taken twice during two months period .The samples included different sites of washing sinks, patients' beds, hospital walls, floors and an electric ventilators. . (13, 14) One hundred forty nine swabs or samples were collected from the patients' preparation rooms, three operating theatres and an intensive care unit. Swabs were collected from an anesthetic equipment, sucker's, patients' beds cover, theatre lightening, cooling system, walls, floor, sinks, waste baskets, gauze and surgical instruments. All the samples and swabs were inoculated on laboratory media, incubated and the isolated microorganisms were identified according to microbiological laboratory methods (15). Identification of microorganisms: all microorganisms were identified by microscopic examination of fixed Gram's stained smears and by routine microbiological techniques (13, 14, 15).

Results:

Patients: the microorganisms isolated from 81 patients specimens (urine, pus from abscess and burn, nasal, ear, wound swabs) was shown in table 1.The patients were 43 male and 38 female, 53 (65.4%) gave positive culture results while 28 (34.6%) were negative. Table (1) shows the incidence of 19 isolates of S.aureus (23.5%), Ps.spp 17 (21%), E.coli 7(8.64 %), Kleb.spp 6 (7.4%), Enterobacter 1 (1.24%), candida albicans 1 (1.24%). Out of 53 (65.4%) positive specimens culture, only 2 (2.48%) revealed mixed bacterial growth.

Table 1: Microorganisms isolated from 81 surgical patients specimens:

Microorganisms	Specimens						Total	%	Comparison of Significant	
	Urine	Pus	Burn swab	Nasal swab	Ear swab	Wound swab			P-value	Sig.
S.aureus	5	1	3	4	3	3	19	23.5	0.227	Non Sig. (P>0.05)
Pseudomonas spp.	7	3	1	0	4	2	17	21		
E.coli	5	0	0	1	0	1	7	8.64		
Klebsiella spp.	3	1	0	0	0	2	6	7.4		
Enterobacter	0	1	0	0	0	0	1	1.24		
Candida albicans	1	0	0	0	0	0	1	1.24		
Mixed growth*	1	0	0	0	0	1	2	2.48		
NO growth**	20	2	1	2	0	3	28	34.5		
Total	42	8	5	7	7	12	81	100		

* Presence of two or more bacterial isolates ** No bacterial or fungal isolates

Control group: Table (2) demonstrates the presence of microorganisms isolated from 64 specimens of 18 control study cases. The specimens were (urine, nasal, skin and throat swabs) taken within 24-72 hours of patients admission to surgical wards. Fifty two (81.3%) specimens out of 64 specimen revealed positive culture result while only 12 (18.7%) specimens gave negative growth culture. Forty one (78.8%) bacterial isolates were recovered in pure cultures while 11 (21.2 %) bacterial isolates were present in mixed cultures. Staphylococcus epidermidis was the most common microorganism isolated which represented 12 (18.7%) from all specimens, these were followed by S.aureus 10 (15.6%), Kleb. spp 6 (9.3%), E.coli 5 (7.8%), Ps spp 4 (6.3 %), Proteus 3 (4.7 %), Strep. Spp 1(1.6%) isolated from all specimens.

Table 2: Microorganisms isolated from 64 specimens of 18 control group from (urine and nasal, skin, throat swabs) admitted to surgical wards.

Microorganisms	Specimens				Total	٪	Comparison of Significant	
	Urine	Nasal swab	Skin swab	Throat swab			P-value	Sig.
Staph. epidermidis	2	7	2	1	12	18.7	0.046	Sig. (P<0.05)
S.aureus	3	6	1	0	10	15.6		
Klebsiella spp.	3	2	0	1	6	9.3		
E.coli	2	1	2	0	5	7.8		
Pseudomonas spp.	0	0	4	0	4	6.3		
Proteus spp.	1	2	0	0	3	4.7		
Streptococcus spp.	0	0	0	1	1	1.6		
Mixed growth*	3	4	2	2	11	17.2		
NO growth**	5	3	2	2	12	18.8		
Total	19	25	13	7	64	100		

* Presence of two or more bacterial isolates** no bacterial or fungal isolates

Hospital's workers: Out of 102 specimens collected from 32 hospitals staff which were 38 hand scrubs, 22 nasal swab, and 42 gown swab. Seventy (68.6%) specimens gave positive culture, while only 32 (31.4%) specimens gave negative culture results, 64 (91.4%) specimens showed pure results while 6 (5.9%) gave mixed culture results. In the present study S.aureus 25 (24.5 %) was the most common microorganism isolated, S.aureus was the second isolates 12 (11.7%), these were followed by E.coli, bacillus 7 (6.9 %) , Enterobacter spp 6 (5.9 %), Kleb. Spp 5 (4.9%) and Candida albicans 2 (2%). Hospital's Visitors: Out of 25 nasal swabs, 24 (96%) gave positive culture results and only one nasal swab 1 (4%) gave negative culture while 2 (8%) nasal specimens demonstrated mixed growth culture results. Staphyloococcus epidermidis was the most common microorganism isolated from nasal specimens 7 (28 %), S.aureus was the second common isolates 6 (24%), followed by P.aeruginosa 3 (12%), proteus 3 (12%), E.Coli 2 (8%), Kleb.spp. 1 (4%). This table demonstrates also that out of 25 hand washes 24 (96%) specimens gave positive culture results ,while only 1 (4%) specimen showed negative culture results and 2 (8%) gave mixed bacterial growth. S.aureus was the most common microorganisms isolated 7 (28%), S. Epidermidis was the second isolates 5(20%), followed by E.Coli 4 (16%), Kleb.spp 3 (12%), Proteus 2 (8%), P. aeruginosa 1(4%). Hospital environment (kitchen, operation room including floor, intensive care unit, emergency unit, treatment room, and water cycle): Out of 149 specimens 100 (67.1%) gave positive culture results while 49 (32.9%) were negative. Out of 100 positive specimens 95 (95%) gave pure cultures while 5 (5%) showed mixed bacterial growth. Staphylococcus epidermidis was the most common microorganisms isolated from hospital environment 35 (23.5%), followed respectively by Escherichia coli 20(13.4%), bacillus 17(11.4%), P.aeruginosa 11(7.4%), Klebsiella spp.7 (4.7%), S.aureus 3 (2%) and candida albicans 2(1.3%). Hospital environment (9 hospital wards): Out of 186 specimens 173(93%) gave positive culture results while 13(7%) showed negative culture and out of 173 positive culture specimens 133(76.8%) demonstrated pure culture while 40(21.5%) showed mixed bacterial growth. Escherichia coli was the most common microorganisms isolated 46 (24.7%), bacillus was the second isolates 33(17.7%), followed respectively by enterobacter spp. 20 (10.7%), Ps.spp. 19(10%), S.aureus10 (5.3%), Kleb.spp 4 (2.1%), and candida species 1 (0.5%). Antibiotic sensitivity test (AST) (disc diffusion method): All the Staphylococcus isolates were sensitive to ampiclox, Amikacin and Gentamycin .While Streptococcus was sensitive to Pencillin, Ceftriaxone, Rifampicin, Ampicloxacillin and Erythromycin, but resistant to Co-trimoxazole, Ampicillin and Gentamycin. Out of 10 Ps.spp 1(10%) was resistant to all Antibiotics, 2 (20%) were sensitive to (cefriaxone and Co-triamoxazole) and resistant to other antibiotics, 7(70%) were sensitive to (Gentamycin, cefriaxone and Ciprofloxacin) but resistant to other antibiotics. Out of 6 Klebsiella spp. 1(16.7%) were resistant to all antibiotics, 2 (33.3%) were sensitive to (ceftriaxone and ciprofloxacin) but resistant to other antibiotics,3 (50%) were sensitive to (Gentamycin, ceftriaxone and ciprofloxacin) but resistant to other antibiotics. Also the tables show the AST of 1 E.Coli and 1 Proteus were resistant to (Ampicillin and Amikacin) and sensitive to other antibiotics. Beta-lactamase production test: Out of twenty nine of resistant isolates of both gram positive cocci and gram negative bacilli chosen randomly from different nosocomial infected patients were tested for production of β-lactamase enzyme by direct capillary method 20(69%) of these isolates show ability to produce β-lactamase while 9 (31%) were non producer. Out of 10 (34.5%) antibiotic resistant S.aureus 6 (30%) were β-lactamase producer while 4(44.4%) of this microorganism non-β-lactamase producer ,10(34.5%) of Pseudomonas spp 8(40%) were β-lactamase producer while 2(22.2%) were unable to produce this enzyme,6(20.7%) of Klebsiella spp also were tested for production of this enzyme and the results were 4(20%) were producer this enzyme while 2(22.2%) were non producer, Also1 (5%)streptococcus and 1(5%) proteus spp . was beta- lactamase producer and 1 (11.1%)E.coli was non producer. Microorganisms isolated from hospitalized patient compared to those isolated from control group: Out of 51 microorganisms isolated from patients and 41isolated from case control study .the S.aureus19(37.3%) was the most common microorganism isolated from patients and 10 (24.4%) from control group, while S.epidermidis 12 (29.3%)was most common isolates from case control study but was not isolated from patients. Pseudomonas spp. 17 (13.7%) was isolated from patients and only 4 (9.8 %) from control group, E.coli 7(13.2%) was isolated from patients and 5 (12.2%) from case control study, Klebsiella Spp. 6(11.8%) were isolated from patients and also 6 (14.6%) from control group, Enterobacter and candida albicans 1(2%) isolated only from patients, while proteus 3(7.3%) and streptococcus spp. 1 (2.4%) only isolated from case control study.

Table (3) Demonstrates the most common bacterial spp. isolated from patients, visitors, workers, solutions, and equipment and hospital sites.

Table (3) the prevalence of different bacterial isolates according to the site of isolation.

Site of isolates	Microorganism
Workers (Nasal swab) (Hand wash)	E.coli S. aureus
Visitors (Nasal)	S. epidermidis S. aureus
Hospital's ward (Ventilation) (Bed)	E.coli, bacillus spp.
Treatment room (Table)	E.coli
Operating theatre	
1) Cooling system	Klebsiella spp., Pseudomonas aeruginosa
2) Normal saline	E.coli , Klebsiella spp, Candida albicans
3) Anesthetic equipment	S.aureus, Klebsiella spp.
4) Surgical equipments	Pseudomonas aeruginosa , S. aureus
5) Theatre lightning	Pseudomonas aeruginosa, Klebsiella spp.
6) Gauze	S.aureus, E.coli
7) Antiseptic solution	Pseudomonas aeruginosa, Klebsiella spp.
8) Oxygen mask	S.aureus

Types of nosocomial infections: Staphylococcus aureus was the most common microorganism causes N.I 19(35.8%), followed by Ps. Spp. 17(32.1%), Escherichia coli 7(13.2%), Kleb.spp 6(11.3%),Enterobacter spp. and candida albicans were equally isolated 1 (1.9%) from all types.Microorganisms isolated from hospital personal and environment: Out of 632 specimens taken from hospital 496(78.5%) were positive growth while 136(21.5%) gave no growth. Out of 81 specimens which were taken from hospitalized patients 53(10.7%) show positive growth and 28 (20.6%) show no growth. Also from 64 specimens which were taken from control group 52(10.5) gave positive results while 12(8.8%) gave no growth. Out of 335 specimens were taken from different parts of hospital 273(55%) gave positive growth and 62(45.6%) gave no growth. Out of 50 specimens were taken from 25 hospital's visitors 48(9.7%) gave positive results while 2(1.5%) gave negative results. Also from 102 specimens were taken from 32 different hospital's staff 70(14.1%) gave positive growth while 32 (23.5%) gave no growth.Figure (1) demonstrates the different types of nosocomial infections and their percentages of 53 cases who were admitted to surgical wards of the hospital. Urinary infections were the highest 22 (42%), followed by surgical site infections19 (35.8%), and finally respiratory tract infections sites which were 12(23%).

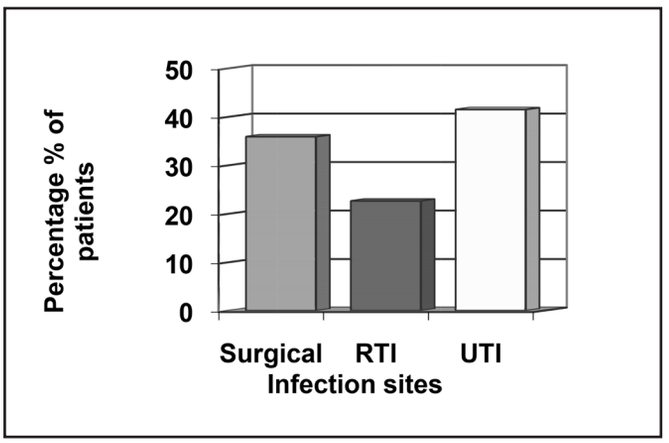

Figure 1: Different types of nosocomial infections from different specimens.

Discussion:

Nosocomial infections picked up in health care centers are among the major causes of death and increased morbidity among hospitalized patients (16). HAI take their toll on physiological and psychological aspects of patient's life that reduce the quality of life (17). In the present study and in an effort to evaluate the sources, factors and microorganisms which contribute with N.I. in the General Ba>qubah hospital. The present study consisted of collecting samples from eighty one patients, 32 hospital staff members, 25 patient visitors, 18 case control study and 335 samples were collected from all hospital environment.The highest prevalence of S.aureus were recorded among surgical patients represented 19 (23.5%) followed by Pseudomonas spp 17(21%), E.coli 7 (8.6%), Kleb.spp 6(7.4%), Enterobacter 1(1.2%), and candida albicans 1(1.2%).These result are in agreement with the findings of Mandel and Ralph (1985). The present finding is also agree with the findings of Hierholzer and Zervos (1991) (18). The high incidence of S.aureus become a serious problem not only for patient but for carriers whom they not only transmitting the organism to others but of inoculating their own portals of entry, which could result in self-infection and this in agree with Gorbach et al.(1998)(19).102 specimens were taken from different hospital's worker 70 (68.6%) specimens gave positive culture, while only 32 (31.4%) specimens gave negative culture results. The reasons for high percentage of positive microbial culture probably related to several reasons such as low educational program of most hospital workers for using aseptic technique in addition to their poor hygiene. Most microorganisms isolated were endogenous or normal flora except S.aureus which may contaminate the patient sites .The most microorganisms isolated from the hospital staff (nasal, skin, hand and gown) were S.epidermidis, S.aureus and few species of family Enterobacteriaceae. The hospital staff were harboring these microorganisms in their nose and skin, that contaminated

hand and gown, so this indicates the role of such carriers in the hospitals cross and transferring infections. However, this result is in agreement with the result of study done by Jain, S. et al (20).Health care workers are at risk of acquiring infection through occupational exposure (21). Hospital employees can also transmit infections to patients and other employees. The high percentage of S.aureus, and S.epidermidis isolated may result from repeated handling of the patients by health care professionals and their families with poor handwashing (22). The S.aureus was the most common microorganism isolated from the patient's visitors in high percentage from their noses 6 (24%) and hands 7 (28%) and this is probably due to possibility of transferring the organism from hand to nose and vice versa. This results agree with Gorbach et al. (1998) (19). This concept is now coming to clinical fruition in that pre identification of S.aureus carriers can help in preventing nosocomial infections Microorganisms isolated from 64 specimens of 18 control group taken (24-72) hrs. From patients admission to the surgical wards, 52(81.3%) specimens gave positive results while only 12(18.7%) gave negative growth culture. This high percentage 52(81.3%) of microorganisms isolated from (urine, nasal, skin and throat) of the control group of patients represent the way of transferring such microorganisms from the community to the hospital because of their colonization of microorganisms or by their poor hygiene and this in agree with Larson EL (23). The most common microorganism isolated from the present study was S.epidermidis 12(18.8%) followed by S.aureus 10(15.6%),and then gram negative bacilli, also Streptococcus spp 1(1.6%) was isolated from throat of control group patients and this finding of the present study agree with the findings of Gorbach et al., (1998) (19). Hospital environment (Kitchen, operation room, intensive care unit, emergency unit, treatment room and water cycle), in this S.epidermidis was the most common microorganisms isolated from hospital environment in a high percentage 35 (23.5%). Also the findings showed that S.epidermidis was isolated from operating theater in a high percentage 10(29.4%), and when wounds are exposed for several hours to S.epidermidis which become increasingly important pathogens in surgical site infection, this will complicate the operations involving implantation of foreign bodies and devices and these results are in agreement with findings reported by Finkelstein et al., (2002) (24). Besides the gram-negative bacilli which were isolated from the present study are in agreement with Saene et al., (1989), Kzeer.,(2000) (25,26). Nine hospital wards were contaminated with E.coli, Bacillus spp, Ps.spp and, Enterobacter spp, S. aureus and Klebsiella spp .The findings of the present study are in agreement with Lu, Guo et al. (2013), Sisirak, Zvizdic et al. (2010) (27, 28). All Staphylococci isolates were sensitive to ampicloxacillin, Amikacin and Gentamycin and some of these isolates were resistant to pencillin, ciprofloxacin, ceftriaxone, Co-trimoxazole and Rifampicin. The findings of the present study were in agreement with Aucken et al., (2002), Humphreyes, et al., (2000) (29, 30).Correspondingly streptococcus were sensitive to pencillin, ceftriaxone, and erythromycin but resistant to co-trimoxazole, ampicillin and gentamycin, and these findings were in agreement with scott et al (1989) (31). AST for 18 isolates of Ps.spp, Kleb.spp, E.coli and proteus. One of Ps.spp. was resistant to all antibiotics, 2 were sensitive to(Ceftriaxone and Co-trimoxazole), 7 were sensitive to(Gentamycin, Ceftriaxone and Ciprofloxacin). One of Kleb.spp was resistant to all antibiotics, 2 were sensitive to (Ceftriaxone and Ciprofloxacin), and 3 were sensitive to (Gentamycin, Ceftriaxone and Ciprofloxacin). One of both E.coli and proteus were resistant to (Ampicillin and Amikacin). All isolates were sensitive to ciprofloxacin and ceftriaxone, this result is expected because the percentage of resistance to these antibiotics are very low. These results are in agreement with Humphreys et al., (2000) (30). Twenty nine antibiotic resistant bacterial isolates were randomly selected and test for ability to produce β-lactamase enzyme by Direct Capillary Method. Out of 29 resistant isolates of both gram positive and gram negative bacilli 20(69%) were β-lactamase enzyme producer while 9 (31%) were non producer and thus their resistant to antibiotic probably due to other mechanisms other than β-lactamase enzyme. Structural modifications result in a lower affinity of the target site for antibiotic, so that the antibiotic binding to the target is reduced or even prevented (32). Pathogens often possess multiple mechanisms of antibacterial resistance (33). The findings of the present study are in agreement with (Mohammed, 2000) (34). Hospital environment effect was the highest which contribute with N.I (55%)in a surgical patients, workers were the second factor related to N.I which represent (14.1%), then the control group (10.5%), these results were expected since those workers carried high rates of microorganisms on their nose, skins, throats, hand washes and gowns. The last factor was the patient's visitors which represent (9.7%) which affect N.I. which consider as low risk factor on N.I. except for operating theatres. The present results cannot be compared with other findings because of many different sites, devices and services of admitted patient, environment, workers etc. Urinary tract infections were the highest types related to N.I.22 (42%) and this results was expected because this study was done in general hospital due to the use of urinary catheter and contamination of the hospital environment. Microorganisms isolated from U.T.I of hospitalized surgical patients were Pseudomonas spp 7(13.2 %), followed by Staphylococcus aureus, E.coli 5(22.7%), Kleb.spp 3(13.6%) and Candida albicans 1(1.9%) and these results are in agreement with Burke and Zavsky, (1999) (35). Surgical site infections were 19 (36%) this high percentage in the present study was

expected because most of patients admitted for operation were exposed to microorganisms which cause surgical site infections. Microorganisms isolated were S.aureus in a high percentage 7(36.8%) and this results was expected because most of isolates from hospital environment, visitors, workers and case control study were Staphylococci spp in addition to colonization of patient's body sites with these microorganisms. These microorganisms followed by Ps.spp 6 (31.6%), Kleb. spp 3(7%), E.coli and Enterobacter 1(5.3%).These findings of the present study are in agreement with Custovic, Smajlovic et al. (2014)(36). Respiratory tract infections among the N.I. were 12(23%) which probably related to the use of contaminated ventilator or due to contamination of the hospital environment, workers, visitors and carriers from patients. Staphylococcus aureus was the most common microorganism isolated from R.T.I in high percentages 7(58.3%) followed by Ps.spp 4 (33.3%) and E. Coli 1(8.3%). these results were in agreement with findings of Serrano, Barcenilla et al. (2014) (37). The results of the percentages of the types of N.I. of the present study were in disagreement with Humphreys et al., (2000), since they got different findings probably because their study were done in several hospitals and wards, and this logically differ because of many reasons such as differences in normal flora according to the site of infection, use of different devices and different hospital environment.

Conclusions:

The most isolated bacteria from clinical specimens or from hospital environment was Staphylococcus species. Some of the microorganisms which cause N.I were endogenous because of high percentage of isolates from control group. Urinary tract infections were the most important types of N.I in the surgical floor of this hospital. Most of the isolated microorganisms were resistant to antibiotics and most of resistant microorganisms have ability to produce β-lactamase enzyme.

Author's contribution:

- Mohammed Ahmed al-Kharkhi: sample collection.
- Sarmad M. H. Mohammed: result analysis.
- Samara M. Ali: references & editing.

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