Antimicrobial Susceptibility Patterns of Aerobic Bacterial Species of Wound Infections in Baquba General Teaching Hospital-Diyala

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Abstract

Background: Wound infections are the most common hospital-acquired infections and are an important cause of death.

Objective: This study was carried out to determine the isolation rate of different aerobic bacterial pathogens from wound infections of hospitalized patients, and their antimicrobial susceptibility patterns in Baquba General Hospital in Diyala province.

Materials and methods: This prospective study was conducted for six months from November 2010 to April 2011 in surgical units of Baqubah General Teaching Hospital. Wound swabs were obtained from hospitalized patients who developed wound infections and processed in microbiology laboratory. Pus swab from each patient was collected aseptically, and inoculated on culture media. Isolates were characterized, and identified, and Antibiotic susceptibility patterns were determined using the Kirby-Bauer diffusion method.

Results: of total (100) swabs studied, (88%) were culture positive and (12%) were negative. *Staphylococcus aureus* isolates were 34(38.6%), followed by *Escherichia coli and Pseudomonas aeruginosa* were 28(31.8%), 24(27.3%) respectively. Both of *Klebsiella pneumonia* and *Proteus vulgaris* were 14(15.9), *Streptococcus pneumonia* and *Streptococcus pyogenes* were 12(13.6%), 4(4.5) respectively. The antibiotics susceptibility pattern for Ciprofloxacin and Gentamycin were (78.5%), (69.2%) respectively, followed by Streptomycin (43.1%) , Ampicillin (20%) and Amoxicillin (12.3%).

Conclusion: *S. aureus* and *E. coli* were the most common isolates from wound infections. Ciprofloxacin and Gentamycin were the most effective antibiotics.

Key words: Nosocomial infections, Wound infections, Antimicrobial susceptibility test.

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Introduction

Wound infections are one of the most common hospital acquired infections, and are an important cause of morbidity and account for 70-80% mortality. [1,2] Development of such infections represent delayed healing, cause anxiety and discomfort for patient, longer stays at hospitals and add to cost of healthcare services significantly. [3]

The importance of wound infections, in both economic and human terms, should not be underestimated. [4] In a study, on average, patients with a wound infection stay about 6-10 days more than if the wounds heal without infections. [5] This additional stay almost doubles the hospital cost.[6] Wound infections can be caused by different groups of microorganisms like bacteria, fungi and protozoa [7]. However, different microorganisms can exist in polymicrobial communities especially in the margins of wounds and in chronic wounds [8]. The

infecting microorganism may belong to aerobic as well as anaerobic group [9]. Most commonly isolated aerobic microorganism include *Staphylococcus aureus* (31%), Coagulase-negative staphylococci (5%), Enterococci (5%), *Escherichia coli* (9%), *Pseudomonas aeruginosa* (14%), *Klebsiella pneumoniae* (3%), *Enterobacter species* (9%), *Proteus mirabilis* (3.5%), other streptococci (3%), Candida (1.3%) with 80% *Candida albicans*, Group D streptococci (2%) and Acinetobacter (2%). Other gram-positive aerobes (2%) and anaerobes (2.7%) also cause wound infections [10]. The objectives of the present study were to identify the etiologies of wound infections and characterize the antimicrobial susceptibilities of the isolated bacterial pathogens.

Materials and Methods

This prospective study was conducted for six months from November 2010 to April 2011 in surgical units of Baquba General Teaching Hospital. One hundred (100) wound swabs were obtained from hospitalized patients in the General Surgery Department, who had undergone surgical operations and developed wound infections thereafter. Human privacy was respected by getting patient's consensus. Swabs were inoculated onto plates of MacConkey agar and 5% sheep blood agar was carried out in Biology and Microbiology Department / College of Science / Diyala University. The samples collected were processed as follows:

1) Direct microscopic examination of Gram's stained smear.

2) Swabs inoculated onto blood agar and MacConkey agar plates.

3) identification of isolates was based on colonial characteristics and biochemical tests which include catalase, oxidase , slide coagulase, urease production, IMVC and TSI. optochin and bacitracin test.

5) Antibiotic sensitivity. The sensitivity of bacteria to antibiotics was determined according to the method of Kirby and Bauer (1966). [11] Antibacterial activity was expressed as the mean of inhibition diameters in millimeters.

Results

This study was carried out on one hundred wound swabs. Patients included were 40 (40%) males, 60 (60%) females from those admitted to Baqubah General Teaching Hospital. The rate of bacterial isolation was (34 %) and (54%) from male and female respectively, while the negative results were in (6%) for both male and female as showed in table (1).

Table (1): Rate of bacterial isolation from study groups by genders

Gender	No. of samples	No. (%) Bacterial isolation	No. (%) of No growth
Male	40	34 (34 %)	6 (6%)
Female	60	54 (54 %)	6 (6%)
Total	100	88 (88%)	12 (12%)

According to table (2), the relationship between age groups and percentages of bacterial isolation, (100%) of cases at age groups that more 60 years which considered the highly percentage of isolation, (90%), (94%) and (62.5%) of isolates were in (0-19), (20-39) and (40-59) age groups respectively.

Table (2): Rate of bacterial isolation by age of patients.

Age group (ys)	No. of sample	Positive culture	Isolation rate
0-19	40	36	90%
20-39	38	36	94%
40-59	16	10	62.5%
> 60	6	6	100%
Total	100	88	88%

Table (3) revealed the percentages of isolation for each species of bacteria, *Staphylococcus aureus* considered the most prevalent organism which were (38.6%) when compared with isolates of *Streptococcus pyogenes* (4.5%), followed by *Escherichia coli* (31.8%), *Pseudomonas aeruginosa* (27.3%), (15.9%) for both *Klebsiella pneumonia* and *Proteus vulgaris*, and *Streptococcus pneumonia* (13.6%).

Table (3): The isolation rate of different bacterial species.

Organisms	No. of bacterial isolates	Isolation rate
Escherichia coli	28	**31.8%**
Klebsiella pneumonia	14	**15.9%**
Proteus vulgaris	14	**15.9%**
Pseudomonas aeruginosa	24	**27.3%**
Staphylococcus aureus	34	**38.6%**
Streptococcus pneumonia	12	**13.6%**
Streptococcus pyogenes	4	**4.5%**

Data present in table (4) showed the rate of the mixed bacterial growth yielded in this study which include (40.9%) of samples.

Table (4): The rate of mixed bacterial growth.

Mixed organism	No. of mixed	% of bacterial isolates
Enterobacteriacae + pseudomonas	2	2.3%
Enterobacteriacae + streptococcus	8	9.1%
Enterobacteriacae + staphylococcus	16	18.2%
Pseudomonas + streptococcus	4	4.5%
Pseudomonas + staphylococcus	4	4.5%
Staphylococcus + streptococcus	2	2.3%
Total	36	40.9%

Table (5) refered to antimicrobial susceptibility patterns, Ciprofloxacin and Gentamycin were (78.5%), (69.2%) respectively, which considered the most effective antibiotics against isolated bacteria from wound infection cases, followed by Streptomycin (43.1%) , Ampicillin (20%) and Amoxicillin (12.3%). The antibiogram pattern of the isolates showed that *S. aureus* and *E. coli* were most sensitive to

Ciprofloxacin (76.5%), (85.7%) and Gentamycin (64.7%), (64.3%) respectively. The percentage of sensitivity has shown a decline when tested for the other commonly used drugs (Ampicillin and Amoxicillin).

Table (5): Antimicrobial susceptibility patterns of different bacterial isolates.

Bacterial species	No.	AMC.	AX.	CIP.	GN.	S.
		No. (%)	No.(%)	No.(%)	No.(%)	No.(%)
S. aureus	34	4(11.8%)	2(5.9%)	26(76.5%)	22(64.7%)	8(23.5%)
E. coli	28	8(28.6%)	6(21.4%)	24(85.7%)	18(64.3%)	16(57.1%)
P. aeruginosa	24	2(8.3%)	2(8.3%)	16(66.7%)	14(58.3%)	10(41.7%)
S. pneumonia	12	2(16.7%)	0(0%)	12(100%)	12(100%)	10(83.3%)
K. pneumonia	14	2(14.3%)	0(0%)	8(57.1%)	8(57.1%)	2(14.3%)
P. vulgaris	14	4(28.6%)	2(14.3%)	12(85.7%)	14(100%)	8(57.1%)
S. pyogenes	4	2(50%)	2(50%)	4(100%)	2(50%)	2(50%)
Total	130	26(20%)	16(12.3%)	102(78.5%)	90(69.2%)	56(43.1%)

***AMC= Ampicillin, AX= Amoxicillin, CIP= Ciprofloxacin, GN= Gentamycin, S= treptomycin**

Results presented in table (6) showed the relationship between antibiotics treated patients and bacterial isolation percentage, there are 70 (79.5%) case of (88) infected with bacteria although treated them with antibiotics .While 18 (20.5%) case of (88) without antibiotics treatment had bacterial infection.

Table (6): Relationship between bacterial isolation rate and pre-antibiotic treatment.

	Patient with Antibiotics Treatment		Patient without Antibiotics Treatment	
Persistence of infection	Present	Not	Present	Not
No. of isolates	70	12	18	0
% of isolates	79.5%	13.6%	20.5%	0%

Discussion

In the present study, an attempt was made to know the various bacterial pathogens responsible for wound infections, their antibiogram and to correlate the organisms with risk factors. Out of 100 cases, 88 wound infections were confirmed by bacteriological study, so the overall infection rate was 88%.

In our study, those results showed in table (1) were very closely to Giacometti *et al.* (2000), in their study of 676 surgery patients with signs and symptoms indicative of wound infection, reported 614 patients (90.8%) to be culture positive for bacteria. [12] But our and these findings weren't acceptable to Ojiegbe *et al.* (1990) who found that (50%) of the samples that collected from wound cases were infected with bacterial species [13], and Anvikar *et al.* (1999) who published that (10.6%) of samples were infected [14], as well as Olson *et al.* (1990) who explained that bacterial isolation were 2.9%. [15] The lower wound infection rate in these study can be attributed to improve sterilization techniques, new techniques in surgical procedures and use of preoperative and preoperative prophylactic antibiotics. Prophylactic antibiotics against

aerobic and anaerobic organisms were administered in all wounded cases.

As shown in table (2), Our results were closely similar to that of Lingaraj (2006) [16]who found that there is a rise in the rate of wound infection as age advances since a gradual rise in the rate from 62.5% in the 40-59 years to 100% in patients more than 60 years. Likewise Cruse and Foord (1980) observed in their study that older patients are more likely to develop infection in clean wounds than younger patient. [17] Similar findings were demonstrated by Mead *et al*, who observed an increasind of wound infection in patients less than 1 year old or greater than 50 years old versus those 1 to 50 years old.[18]

In the present study, results related to the rate of isolation for each species of bacteria, *Staphylococcus aereus* (38.6%) was the commonest, followed by *E. coli, P. aeruginosa, S. pneumonia, P. vulgaris, K. pneumonia and Streptococcus pyogenes* respectively. Similar pattern of results were reported by many workers affarming that *Staphylococcus aureus* was the most common infectious agent isolated from wound infection. [12,15,19-22] However, these results were inconsistent with some published reports which found that Klebsiella was the commonest. [14] Hani and Adnan (2009) found that *Pseudomonas aeruginosa* and *E. coli* were the common isolates [23]. Ali *et al*. (2009) during the study period 112 pus culture and sensitivity reports were analyzed. *E. coli* 68 (60.7%) was the most common organism isolated followed by Klebsiella 23 (20.5%). [24] Interestingly, there is a change in the bacterial etiology of surgical infections from time to time. A century ago, the most feared and frequent pathogen was Streptococcus, twenty years ago the Coagulase positive staphylococcus was the principal offender, Gram negative bacilli are now replacing staphylococcus. [14, 25]

In the present study, mixed bacterial growth was found in (40.9%) of samples. These results were consistent with previous study found that (45.8%) yielded polymicrobial agents, Gram positive and Gram negative organisms were frequently involved in the mixed infections. [16] *Staphylococcus aureus* and *E.coli* were the commonest combination in this study. However, dissimilar results were reported by other studying found that Polymicrobial infections frequently involved Gram positive and Gram negative organisms with *Staphylococcus aureus* and *Pseudomonas aeruginosa* being the most common association [12].

The antibiogram pattern of the isolates in table (5) showed that *S. aureus* and *E. coli* were most sensitive to Ciprofloxacin (76.5%), (85.7%) and Gentamycin (64.7%), (64.3%) respectively. On the other hand, the sensitivity rate was decline against Ampicillin and Amoxicillin. Taiwo *et al*. (2002) found that both gram positive and gram negative organisms demonstrated moderate to high *in vitro* sensitivity to ofloxacin and ciprofloxacin (sensitivity rate 70-94%). [26] Our results were in accordance with the work done by Nwachukwu *et al,* who reported that *S. aureus* isolates were more susceptible to Ciprofloxacin. [20] The quinolones were generally active against the gram negative bacterial isolates. Ciprofloxacin was highly active against all gram-negative organisms examined. Furthermore, it has been found that the susceptibility testing of the gram-negative organisms; *E. coli, P. mirabilis and P. aeruginosa* were highly resistance to Ampicillin and Ceftriaxone (ß-lactam antibiotics). This high resistance of organisms to beta –lactam is not surprising, as these antibiotics are the most abused drugs

in Iraq; vendors are seen selling them in streets without doctor's prescriptions.

Aminoglycosides resistance by *P. aeruginosa* isolates was observed. Out of 24 isolates of the bacterial organisms studied, 10 (41.7%) were resistant to Gentamycin, while 14(58.3%) were resistant to Streptomycin. These results were consistent with the data obtained by other workers suggesting that the resistance is a plasmid determined type of resistance leading to membrane impermeability in addition to drug abuse. [27,28] Ultimately, this pattern of antibiotic sensitivity correlates with the study found that the organisms responsible for surgical site infection are resistant to the commonly used antibiotics. [14]

From this study, Ciprofloxacin stands out to be the most effective antibiotic against pathogens associated with surgical wound infections. The observation that the organisms were highly susceptible to fluoroquinolones group of antibiotic is not surprising. It is recommended that antibiotic sensitivity testing be carried out on all isolates of wounds infection before chemotherapy to avoid selection of drug resistant strains. There is need for the introduction of antimicrobial surveillance programs in Iraq,

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