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Reseach Article

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The Antibiogram of Postoperative Wound Bacterial Infections in Tripoli, Libya

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ABSTRACT

Surgical-wound infections remain one of the major health problems that is implicated in spreading of antibiotic resistant bacteria and increasing morbidity and mortality rates. To improve appropriate antimicrobial therapy and reduce the incidence of antibiotics resistant bacteria, information on the antibiotic susceptibility is urgently needed. Therefore, the aim of this study was to identify bacterial pathogens from hospital acquired surgical wound infections and investigates their antimicrobial resistance patterns among patients at Tripoli Medical Center in Libya.

This study was conducted over the period between March 2014 and October 2014 at Tripoli Medical Center. A total of 114 bacterial isolates were cultured onto bacteriological media such as MacConkey agar and blood agar. Identification of retrieved bacterial isolates was done using standard diagnostic microbiological laboratory methods and antibiogram was determined by VITEK ® 2 compact automated system.

A total of 114 bacterial pathogens were isolated. A 39% (45/114) of bacterial isolates were Gram positive bacteria, while 61% (69/114) were Gram negative bacteria. The most predominant isolates were *Staphylococus aureus* accounting for (20%), followed by *Escherichia coli* (14%), *Klebsiella pneumoniae* (13%), *Enterococcus faecalis* (11%), *Pseudomonas aeruginosa* (10%), *Proteus mirabilis* (7%), *Acinetobacter baumannii* (7%), *coagulase negative Staphylococci* (5%), *Citrobacter freundii* (4%), *Enterococcus faecium* (3%). The lowest rate of isolation was *Morganella morganii* (2%). Most (80%) of the15 *K. pneumoniae* isolates, (50%) of the 16 *E. coli*, (40%) of 11 *P. aeruginosa* and (13%) of *P. mirabilis* isolates were extended spectrum beta-lactamase (ESBLs) producing strains. Of the Gram positive isolates, 50% of the 23 *S. aureus* isolates were MRSA strains. Drug resistance profiles were variable and showed at least two or more antibiotics resistance by each isolated bacteria.

Antibiotic resistance profile showed quite high antibiotic resistant bacteria. To reduce that, proper usage of antibiotics and strict aseptic techniques during and after surgery are needed.

Keywords: *Post-surgical wound infection; Bacteria; Antibiotics susceptibility.*

INTRODUCTION

Surgical wound infections are still one of the major health problems that contribute to serious complications, which include long hospital stay, higher heath care costs, increasing morbidity and mortality rates.[1] Post surgical wound infections are responsible for about 14-16% of hospital acquired inpatient infections.[2] The risk of infection after surgical operations on hospitalized patients is relatively high. It has been reported that post operative surgical nosocomial infections result in approximately 77% of patients' deaths.[3] Furthermore, the risk of bacterial infections is increasing in developing countries where civil clashes and wars are rising with concurrent lack of healthcare admittance to the patients.

The hospital environment, healthcare worker and patient hands' contaminations play crucial roles in the cross-transmission of antibiotic resistant bacteria.[4] The national nosocomial infection surveillance system reported that bacteria isolated from postoperative wound infection have not been changed dramatically during the last 10 years where *Staphylococcus aureus*, *Coagulase-negative Staphylococci* (CoNS), *Enterococcus* spp and *Escherichia coli* were the most commonly isolated bacteria.[5] Several studies have found that *S. aureus* accounts for 20-40% and *Pseudomonas aeruginosa* 5-15% of nosocomial infections. Further, other bacteria such as *Entercocci* and some species of *Enterobacteriaceae* have been implicated from patients after abdominal surgical operation.[6]

Hospital acquired infections are more complicated by increasing of high antibiotics resistant bacteria, such as *Methicillin resistant Staphylococcus aurous* (MRSA), *Methicillin resistant coagulase* negative *Staphylococci* (MRCoNS) and *Vancomycin resistant Entrococci* (VRE)

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spp.[7], which have contributed in the increasing difficulty of prevention and treatment post-surgical wound infections.[8] Furthermore, in developing countries as Libya, antibiotic resistant bacteria are growing causing serious problems among hospitalized patients. For several reasons including the war that is incriminated in poor health care management, crowded hospital, irrational use of antibiotics without prescription. Hence, there is an urgent need for investigating the prevalence of antibiotic resistant bacterial strains post-surgical procedure in Libya, as this different from one place to the other place. The antibiotic sensitivity data will provide clinicians and surgeons useful information that guide them in prescribing the suitable antibiotic for surgical wound infection. Therefore, the aim of this study was to identify bacterial pathogens from hospital acquired surgical wound infections and investigates their antimicrobial resistance patterns among patients at Tripoli Medical Center in Libya.

MATERIALS AND METHODS

This study was carried out over the period between March to October 2014 at Tripoli Medical Center, Tripoli, Libya. A total of 114 clinical samples were collected from 84 patients who had post-operative surgical wound infections during the examination of surgical wards. Collected samples were transported immediately to the Microbiology Laboratory.

The specimens were cultured onto nutrient agar, MacConkey agar, mannitol salt agar, blood agar and chocolate agar (Oxoid, Basingstoke, and Hampshire, UK, England). Plates incubated aerobically at 37°C for 24-48 hours. Primary cultures were sub cultured according to the standard procedures.[9] Growth on culture plates were identified using standard diagnostic microbiological laboratory methods like Gram stain, oxidase test, catalase test, coagulase test, API 20NE and API 20E (BioMérieux, Marcy L'Etoile, France). The isolates were also detected by VITEK® 2 compact automated system (Biomeriux, North Carolina/USA), using Gram positive GP and Gram negative GN identification card and antimicrobial susceptibility testing card AST P580, AST P586, AST-N222 and AST-GN75. Antibiogram results were expressed as susceptible, intermediate or resistant according to the criteria of the clinical laboratory standards institute (CLSI) M100-S23 (2013).[10]

RESULTS

Positive bacteriological cultures were obtained from 84 patients with post surgical wound infections. A total of 114 bacterial pathogens were isolated. The distributions of pathogenic bacteria isolates are shown (Table 1). A 39% (45/114) of bacterial isolates were Gram positive while 61% (69/114) were Gram negative bacteria. The most predominant isolate was *S. aureus* accounting for (20%), followed by *E. coli* (14%), *Klebsiella pneumoniae* (13%), *Enterococcus faecalis* (11%), *P. aeruginosa* (10%), *Proteus mirabilis* (7%), *Acinetobacter baumannii* (7%), *coagulase negative Staphylococci* (5%), *Citrobacter freundii* (4%), *Enterococcus faecium* (3%). Whereas the lowest rate of isolation was *Morganella morganii* (2%). Most (80%) of the15 *K. pneumoniae* isolates, (50%) of the 16 *E. coli*, (40%) of 11 *P. aeruginosa* and (13%) of *P. mirabilis* isolates were ESBLs producing strains. Of the Gram positive isolates, 50% of the 23 *S. aureus* isolates were MRSA strains.

The antimicrobial drug resistance profile of the bacteria isolates against 41 antibiotic agents is summarized in (Table 2 and 3). Gram positive bacteria resistance profile illustrated that most of *S. aureus* isolates were highly resistant (91%) to Benzylpencillin and moderate (40-50%) to Amoxicillin, Imipenem, Oxacillin antibiotics; some had low resistance (4-14%) to Levofloxacin, Tobramycin, Fusidic acid, Gentamicin, Moxifloxacin, Clindamycin, Erythromycin, Rifampin. All of the isolates (100%) *S. aureus* were however, sensitive for Vancomycin, Nitrofurantoin, Mupirocin, Teicoplanin, Tigecycline, Trimethoprim/sulfamethzole and Linezolid. A 100% resistance rate of *CoNS* was observed for Benzylpencillin Oxacillin and Tetracycline. All isolates of *CoNS* showed equally (100%) sensitivity pattern as *S. aureus* except for Trimethoprim/sulfamethzole was 31% resistance. Isolated *E. faecalis* strains were 100% sensitive to Ampicillin/sulbactam, Vancomycin, Nitrofurantoin, Teicoplanin, Tigecycline and Linezolid. While Tigecycline, Linezolid and Gentamicin high level synergy antibiotics showed 100% effective against *E. faecium.*

Drug resistance profile against isolated Gram negative bacteria was variable. All *Enterobacteriaceae* displayed high magnitude of resistance to Ampicillin but all were sensitive to meropenem and Amikacin; and moderate resistant to most of the antibiotics tested. Isolated *E. coli* were 100% sensitive to Imipenem, Ertapenem and Meropenem; *K. pneumoniae* were 100% sensitive to Amikacin and Tobramycin. *P. mirabilis* showed 100% sensitive to Ampicillin/sulbactam, Cefepime, Imipenem, Amikacin, Ertapenem, Meropenem, Gentamicin, Ciprofloxacin, Tobramycin and Levofloxacin. *M. morganii*were 100% sensitive Cefepime, Amikacin, Ceftriaxone, Meropenem, Piperacillin, Ciprofloxacin, Ceftazidim and Levofloxacin. Interestingly, 100% of *P. aeruginosa* isolates were sensitive only to Imipenem, but were100% resistant to the most antimicrobial agents tested. The majority of *A. baumannii* isolates were highly resistant (80-100%) to most antibiotics agents; however 20%, 33% and 43% of them appeared to be resistant to Tobramycin, Meropenem and Gentamicin respectively.

DISCUSSION

Contamination by pathogenic bacteria is a serious issue in hospitals, particularly after surgical operations where the clean surgical wound becomes contaminated and possibly gets infected.[11] Furthermore, increase of antimicrobial resistance against hospital pathogens have also made a major challenge in the control and treatment of surgical wound infections.[12] Therefore, it is essential to know the

appropriate antimicrobial therapy and their antibiotic-resistant profile of bacteria involved in post surgical wound infections in hospital like Tripoli Medical Center in Libya.

The most predominant isolate in the present study was *S. aureus* accounting for 20% of the retrieved isolates. This finding is in agreement with previous studies that have reported that Gram positive bacteria predominantly *S. aureus* are the most common surgical wound infection contaminating pathogen.[13-15] The possible reason for high infections rate with this organism is because of its normal existence as normal flora on skin and nose of humans. Such pathogen can contaminate the wounds as previously illustrated by Angu and Olila.[16] Infection with such organism may also be happened through contamination from the hospital environment, surgical instruments or contaminated hands of the health care workers.[17] In the current study, *E. coli* (14%) was the second most common isolated bacteria that were associated with surgical wound infection followed by *K. pneumonia*e (13%), *E. faecalis* (11%), *P. aeruginosa* (10%) and *P. mirabilis* (7%). The infections by these bacteria occur most likely through contamination from the bowel as these bacteria are intestinal normal flora and/ or from more resistant strains that acquired from hospital environment.[18,19] A recent study conducted in Tripoli Central Hospital[20], showed higher wound infections with *P. aeruginosa* (42%). The possible explanation for such dissimilarity might be due to the presence diabetic patients and contamination of surgical award by diabetic foot ulcer predominant *P. aeruginosa* organism that mostly infects compromised hosts [21]and cause severe tissue damage in diabetic foot ulcer.[22]

Antimicrobial resistance pattern of Gram positive *cocci* in the present study showed that 50% of the *S. aureus* isolates were resistant to Methicillin which relatively higher than (38.56%) from Delhi[23] and (21.7%) from Chennai.[24] Fortunately, all of the isolates *S. aureus* in our study were however, (100%) sensitive for Vancomycin, Nitrofurantoin, Mupirocin, Teicoplanin, Tigecycline, Trimethoprim/sulfamethzole and Linezolid, and had low resistance (4-14%) to Levofloxacin, Tobramycin, Fusidic acid, Gentamicin, Moxifloxacin, Clindamycin, Erythromycin and Rifampin. Our finding agrees with previous studies from Ethiopia[25,26], Nepal[27] that showed *S. aureus* sensitive to Gentamicin. Whereas in Nigeria 80%[28] and in Japan 47%[29] of *S. aureus* were resistant to Gentamicin. The bacterial resistance could have happened due to high Gentamicin administration for prophylaxis and treatment. According to our result Oxacillin resistant *CoNS* were 100% resistant to Oxacillin, which higher than the study that reported 72.5% resistant strains.[30] However, All isolates of CoNS were (100%) sensitive to Vancomycin, Nitrofurantoin, Mupirocin, Teicoplanin, Tigecycline and Linezolid. The isolated *E. faecalis* species were 100% sensitive to Ampicillin/ sulbactam, Vancomycin, Nitrofurantoin, Teicoplanin, Tigecycline and Linezolid, which is accordance with the Japanese study which has reported that *E. faecalis* species were100% sensitive to Ampicillin/sulbactam and Vancomycin.[29] Vancomycin is a drug of choice for treatment of MRSA and should be applied carefully when they are urgently required for treatment of MR strains.

The susceptibility profile for Gram negative bacteria; *K. pneumoniae, E. coli, P. aeruginosa* and *A. baumannii* showed high resistance to the most β-lactam antibiotics such Ampicillin, Amoxicillin and Cefoperazone. Ampicillin-sulbactam is not recommended by Infectious Diseases Society of America because of high rates of resistance of *E. coli* to these antibiotics.[31] The high rate of resistance to β-lactam antibiotics was also reported in several studies.[32,33] This resistance might have occurred due to common usages and longtime courses for prophylaxis and treatment with these antibiotics. Yoshio Takesue *et al.* reported that antimicrobial therapy of post-operative wound infection should be limited 4 to7 days, whether there is no further complication.[29]

On the other hand, Imipenem, Ertapenem, Meropenem, Cefepime and Amikacin were relatively effective antibiotics in this study against *Enterobacteriaceae* species. This may probably due to the fact that many of these antimicrobial agents are newly introduced to market and may not be commonly used. *P. aeruginosa* isolates were (100%) sensitive only to Imipenem, but were highly resistant to the most antimicrobial agents tested in the current study. *P. aeruginosa* strains which are highly resistant to aminoglycosides are commonly isolated from many hospital setting.[34] Moreover, the trend of Imipenem resistance *P. aeruginosa* (IRPA) isolates have increased from 2% in 1997 to 40% in 2003.[35] The mechanisms of *P. aeruginosa* resistance to antibiotics can be mediated by membrane impermeability[36], or by enzymatic modifications.[37]

Table 1: Distribution of bacterial pathogens isolated from post-surgical wound infections.

Bacterial isolate	n	%
S. aureus	23	20
CoNS[*]	6	5
E. coli	16	14
K. pneumoniae	15	13
P. mirabilis	8	7
C. freundii	4	4
P. aeruginosa	11	10
A. baumannii	8	7
M. morganii	2	2
E. cloacae	5	4
E. faecalis	13	11
E. faecium	3	3
Total	114	100

[*]Coagulase negative *Staphylococci*.

Table 2: Antimicrobial resistance pattern (in percentages) of Gram positive *cocci* isolated from post-surgical wound infections.

Bacteria	AM	AMS	AML	IMP	OX	VA	BEN	LEV	F	TOB	MUP	TEC	TE	FD	TIG	CN	SXT	MOX	DA	LNZ	E	FOS	RF	QUN	HST	HGN	CXMA
S. aureus	ND	ND	50	40	48	0	91	14	0	5	0	0	26	5	0	5	0	14	4	0	4	14	5	ND	ND	ND	ND
CoNS	ND	ND	ND	ND	100	0	100	20	0	20	0	0	100	60	0	40	33	20	17	0	83	60	20	ND	ND	ND	ND
E. faecalis	25	0	ND	15	ND	0	100	46	0	ND	ND	0	85	ND	0	ND	100	40	100	0	69	ND	ND	100	56	44	100
E. faecium	100	100	ND	100	ND	33	100	100	33	ND	ND	33	67	ND	0	ND	100	100	33	0	33	ND	ND	67	0	100	100

ND = not done; nil: all are sensitive; AM: Ampicillin; AMS: Ampicillin/sulbactam; AML: Amoxicillin; IMP: Imipenem; OX: Oxacillin; VA: Vancomycin; BEN: Benzylpencillin; LEV: Levofloxacin; F: Nitrofurantoin; TOB: Tobramycin; MUP: Mupirocin; TEC: Teicoplanin; TE: Tetracycline; FD: Fusidic acid; TIG: Tigecycline; CN: Gentamicin; SXT: Trimethoprim/sulfamethzole; MOX: Moxifloxacin; DA: Clindamycin; LNZ: Linezolid; E: Erythromycin; FOS: Fosfomycin; RF: Rifampin; QUN: Quinupristin/Dalfopristin; HST: Streptomicin High level synergy; HGN: Gentamicin High level synergy; CXMA: Cefuroxime-Axetil.

Table 3: Antimicrobial resistance pattern (in percentages) of Gram negative rods isolated from post-surgical wound infections.

Bacteria	AM	AMS	AML	IMP	CFZ	AMC	CXM	CTX	ETP	FEP	FOX	CZ	AK	CRO	MEM	SXT	CN	PIP	CIP	CAZ	TOB	F	LEV
K. pneumoniae	86	50	100	33	100	88	100	100	14	29	36	78	0	86	11	55	22	89	53	71	0	17	43
E. coli	89	100	ND	0	67	29	20	40	0	11	15	67	9	50	0	50	25	78	63	36	44	11	67
P. mirabilis	25	0	ND	ND	ND	ND	ND	ND	0	0	13	13	0	13	0	25	0	13	0	13	0	88	0
M. morganii	100	ND	ND	ND	ND	ND	ND	ND	ND	0	50	100	0	0	0	50	50	0	0	0	50	100	0
E. cloacae	ND	ND	ND	0	ND	100	100	50	0	33	100	100	0	40	0	20	25	33	20	50	33	33	33
C. freundii	ND	ND	ND	0	ND	100	100	50	ND	ND	ND	ND	0	75	ND	100	ND	ND	25	ND	ND	ND	ND
P. aeruginosa	100	100	100	0	67	100	100	67	ND	50	100	100	75	90	60	100	29	100	36	36	75	100	75
A. baumannii	100	83	100	ND	ND	100	100	100	ND	80	100	100	ND	100	33	50	43	80	88	88	20	100	60

ND = not done; nil: all are sensitive; AM: Ampicillin; AMS: Ampicillin/sulbactam; AML: Amoxicillin; IMP: Imipenem; CFZ: Cefoperazone; AMC: Amoxicillin/calvulinc acid; CXM: Cefuroxime; CTX: Cefotaxime; ETP: Ertapenem; FEP: Cefepime; FOX: Cefoxitin; CZ: Cefazolin; AK: Amikacin; CRO: Ceftriaxone; MEM: Meropenem; SXT: Trimethoprim/sulfamethzole; CN: Gentamicin; PIP: Piperacillin; CIP: Ciprofloxacin; CAZ: Ceftazidim; TOB: Tobramycin; F: Nitrofurantoin; LEV: Levofloxa

CONCLUSION

Information on bacterial distribution of post-surgical wound infections and their antibiotic susceptibility pattern are very important to improve appropriate antimicrobial therapy and reduce the incidence of antimicrobial resistant bacteria. This study shows an increase trend of the spread of antibiotics resistant bacteria among surgical wound of patients, therefore periodic monitoring is required. Furthermore, aseptic technique during and after surgical procedure is highly recommended concurrently with antibiotics prophylaxis to minimize the spread of resistant organism.

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