Surgical Site Infections and Associated Risk Factors in Egyptian Orthopedic Patients

[1]Khaleid M. Abdel-Haleim, [2]Zeinab Abdel-Khalek Ibraheim, [3]Eman M. El-Tahlawy

Departments of [1]Orthopedic Surgery, [2] Medical Microbiology and Immunology, Cairo University,
[3]Departement of environmental health, National Research Center, Egypt
we.za.2007@hotmail.com

Abstract: Background:Surgical site infections (SSIs) were identified on inpatient surgical wards, and most were associated with cardiac, abdominal, and orthopedic surgery. SSIs surveillance data are the foundation of effective infection control programs. **Aim of the work**:This study was conducted to estimate the risk factors and major pathogens involved in SSIs in orthopedic ward in a public hospital in Cairo, Egypt. **Materials and Methods**:During a 9-months period; a total of 93 consecutive orthopedic surgery patients were followed prospectively for 30 days after surgery. Risk factors for SSIs development were assessed for each patient. Swabs from infected surgical wounds were inoculated into routine culture media. Isolates were identified to the species level, and antimicrobial resistance patterns were determined. **Results:**The present study detected an overall SSIs rate of 25.8% (from 4.1% in clean wound to 66.7% in dirty contaminated wounds). Surveillance of risk factors of SSI, defined age**,** obesity (Body mass index "BMI" > 25), smoking, length of stay in hospital, class of wound, number of persons in the operating room, duration of operation and National Nosocomial infections surveillance (NNIS) index as independent risk factors for SSIs development. Microbiological study of infected surgical sites detected 47 pathogens. *S. aureus* was isolated most frequently 42.6%, Coagulase negative staphylococci "CoNS" and Enterococci were detected in 10.6% and 6.4% of isolates respectively. *K. pneumonia, P. aeruginosa, K. oxytoca, E. coli and A. baumannii* were detected in percentages of 14.9%, 10.6%, 4.3%, 4.3% and 2.1% of isolates respectively. *Candida albicans* was also detected in 4.3% of isolates. Antimicrobial susceptibility testing of isolates detected Oxacillin resistant S.aureus (ORSA) in 65% of *S. aureus* isolates. Enterococcus species resistance to vancomycin (VA) was 33.4%, and that to ampicillin (AMP) was 66.7%. Fluoroquinolones (FQs) resistance was detected in 20% of *P. aeruginosa* isolates. Extended-spectrum cephalosporin resistance (ESBLs) was detected in 50% of *K. oxytoca* isolates, 40% of *P. aeruginosa* and 28.6% of *K. pneumonia* isolates. Carbapenem resistance was detected only in *K. pneumonia* isolates (14.2%). **Conclusion:**We concluded that incidence of SSIs in orthopedic patients in Egypt is higher than that reported in some developing countries. *S. aureus* is the most common pathogens associated with orthopedic SSIs. ORSA, VA-resistant Enterococcus species, ESBLs producing *Klebsiellae* species and *P. aeruginosa,* as well as FQs resistant *P. aeruginosa and* carbapenem resistance *K. pneumonia* pose an ongoing and increasing challenge to the antimicrobial policy in our hospital. In orthopedic surgery unit risk factors for SSIs that may represent points of intervention including; limiting the number of personnel entering the operating room, improving NNIS risk index of patients and reduction of duration of surgery. In the era of restricted hospital budgets and increased bacterial resistance, long-term surveillance of SSIs rates and follow-up of compliance may provide a way to improve performance at low costs. [Journal of American Science 2010;6(7):272-280]. (ISSN: 1545-1003).

Key words; Surgical site infections (SSIs); Risk factors of SSIs; *S. aureus*, Oxacillin resistant S. aureus (ORSA); Extended-spectrum cephalosporin resistance (ESBLs); Carbapenem resistance**.**

1-Introduction

Surgical site infections (SSIs) were the most common procedure-associated Health care associated infections (HAIs) CDC(2007). SSIs were identified on inpatient surgical wards, and most were associated with cardiac, abdominal, orthopedic surgery and neurosurgery, Alicia et al.,(2008). SSIs increase morbidity and mortality and can bring considerable costs to an already overwhelmed health care system, Green and Wenzel(1977) and Taylor et al.,(1990).

Antimicrobial-resistant pathogens that cause healthcare-associated infections (HAIs) pose an ongoing and increasing challenge to hospitals, both in the clinical treatment of patients and in the prevention of the cross-transmission of these problematic pathogens, Esposito and Leone(2007); Schwaber and Carmeli (2007). Surveillance for SSI is a standard procedure in many hospitals, CDC(1996) has stated that United States has a countrywide surveillance system . Surgical site infection rates are an established measure of quality of clinical care,Wenzel(1985); Haley(1985), and reliable surveillance data are the foundation of effective infection control programs,CDC(1996).

Unfortunately, Surveillance of SSIs is a persistent problem in orthopedic surgery, M'-Irrazi(2005). Despite the fact that, infection control program has been introduced to every hospital in Egypt few years ago, yet its implementation was questionable. In Egypt, Surveillance of SSIs -particularly in orthopedic surgery- has not been well known and was thus investigated in this study aiming to define the level of risk for our patients, and to recognize a trend within our department that may allow for targeted prevention measures.

Aim of the work

This study was conducted to estimate the risk factors and major pathogens involved in surgical site infections in orthopedic ward in a public hospital in Cairo, Egypt

2-Materials and Methods

2.1.Materials:

This single institution study was conducted at the department of orthopedic surgery, Mobarak hospital (which is a public hospital (< 200 beds) in Cairo, Egypt). During the 9-months period from March through December 2009. Operating rooms in the hospital were built in new modern way maintained at positive pressure with respect to corridors and adjacent areas. All ventilation and air conditioning systems in operating rooms have two filter beds in series. Surgical instruments were sterilized by autoclaving (monitoring of steam autoclave performance is satisfactory). Surgical attire and drapes –scrub suits, caps/hoods, shoe covers, masks, gloves, and gowns were used properly. Adherence to the principles of asepsis by all scrubbed personnel, excellent surgical technique, post-operative incision care, and discharge planning with optimum protocols for home incision care have been perfectly implemented.

2**.1.1.Subjects**:

-A total of 93 consecutive orthopedic surgery procedures were performed. Those patients were followed prospectively for 30 days after surgery,according to (Mangram et al., (1999). Wounds were inspected for signs of sepsis at the 3^{rd}, 5^{th}, 7^{th}, and 14^{th} postoperative day or whenever there was clinical suspicious of wound infection. Patients were taught to return to the hospital for reexamination whenever any signs or symptoms of woundinfections,pain,tenderness,localized swelling, or fever- were developed afterdischarging from the hospital.

- Pretested questionnaire was collected included: social data (Age, Gender, Body mass index (BMI), Diabetes, Nicotine abuse, Chronic diseases) , and surgical details (Type of operation "elective or emergency", Duration of operation, Wound class**,** Surgical drains, Number of persons attending the operation, length of stay in hospital (LOS), and Preoperative skin preparation including shaving with razor) , according to Mangram et al., (1999).

-Each patient was classified according to American Society of Anesthesiologists (ASA) score , and National Nosocomial infections surveillance (NNIS) risk index which was calculated by assigning one point for a contaminated wound, an ASA score >3, and surgical procedures lasting longer than NNIS-derived 75th percentile for the duration of procedure, Edwards etal.,(2008).

2.2. Methods:

2.2.1.Bacteriological study

Swabs from infected surgical wound were transported to the Microbiology laboratory, Faculty of medicine, Cairo University to be inoculated (within 2 h of collection) and inoculated onto sheep blood (5 %), chocolate and MacConkey agar plates (Oxoid, Basingstoke, United Kingdom). Plates were incubated at 37°C aerobically (MacConkey & blood) and in 5% carbon dioxide (chocolate).Plates were examined after 24 and/or 48 h. Isolates were identified to genus level by conventional methods, Murrayet al., (1995).

Staphulococcusaureus(S.aureus) identification was based upon colony morphologies , Gram stain and positive catalase reaction. Tube coagulase test for the detection of free coagulase activity on rabbit plasma (bio-Me´rieux, Marcy l'Etoile, France), and rapid slide latex agglutination tests (Slidex Staph Plus; bioMe´rieux) were performed for definitive identification of *S.aureus*. Slidex Staph Plus (bioMe´rieux); is a slide agglutination test based on latex particles sensitized with human fibrinogen and monoclonal antibodies for the simultaneous detection of clumping factor, staphylococcal protein A, and group-specific antigens on the *S.aureus* cell surface. The test was performed according to the manufacturers' instructions. positive tube coagulase test and latex agglutination test indicated *S.aureus*.

Gram negative isolates were identified to the species level by API 20E kit (bio-Me´rieux, Marcy l'Etoile, France).

Antimicrobial susceptibility testing (agar disk diffusion methods) using Mueller-Hinton BBL II agar (Becton Dickinson, Heidelberg, Germany), and antibiotic disks (Oxoid, Basingstoke, United Kingdom) were performed. The choice of antibiotic and interpretation of inhibition zones were done according to guidelines of CLSI (M100-S18) **(**Clinical and Laboratory Standards Institute,2008)· Multidrug resistant, including Oxacillin resistant *S.aureus* (ORSA), vancomycin-resisant VA)Enterococcus(,extendedspectrumcephalospori-resistant (ESBLs) *Klesiella pneumonia*(*K.pneumonia),Pseudomonas aeruginosa (P. aeruginosa)* and *Escherichia coli (E. coli),* as well as carbapenem-resistant *P. aeruginosa,Acinetobacterbaumanni(A. baumannii), K. pneumoniae, K. oxytoca, and E. coli* were investigated among studied isolates. This classification was based on the recognition that the mechanisms of resistance in these phenotypes confered resistance to multiple classes of antimicrobial agents, Alicia et al.,(2008).

Oxacillin resistant *S.aureus* (ORSA) was identified as specified in M100-S15, Clinical and Laboratory Standards Institute(2005) using 30µg cefoxitin disks. *S. aureus* with a zone diameter of ≤ 19mm were scored as resistant and those with a zone diameter of ≥ 20mm were reported as susceptible. *S. aureus* strains ATCC 29213 and ATCC 25923 were included for quality control.

Double-disk diffusion test was done to confirm ESBLs activity; 30µg antibiotic disks of cefotaxime, ceftazidime, cefpodoxime and cefepime (Oxoid, Basingstoke, United Kingdom) were placed around an amoxicillin/clavulanic acid disk (20µg/10µg, respectively) at a distance of 25 mm. A clear extension of the edge of the inhibition zone of any of these disks toward the disk containing clavulanate (Keyhole effect) was interpreted as synergy, indicating the presence of an ESBLs, Tzelepi et al., (2000).

2.2.2.Statistically analysis:

Analysis was conducted for qualitative data using number, percent and Chi-square test, for numeric data using mean, standard deviation and analysis of variance test, and for ASA and NNSI scores using proportional trend test with significant level at P-value < 0.05

3-Results

Table1: Characteristics of operated patients

Characteristics of patient	No. (%)
Gender:	
Males	66 (71%)
Females	27 (29%)
Age group (years):	
16 - 40	20 (21.5%)
>40 - 60	41 (44.1%)
>60ys	32 (34.4%)
Nicotine abuse	
Smoker	68 (73.1%)
Non smoker	25 (26.9%)
Body mass index (BMI)	
BMI < 25	43 (46.2%)
BMI > 25	50 (53.8%)
Diabetes mellitus	
Diabetics	13 (14%)
Non Diabetics	80 (86%)
ASA score[a]:	
< 3	64 (68.9%)
≥ 3	29 (31.1%)
Class of wound	
Clean	49 (52.7%)
Contaminated	35 (37.6%)
Dirty/infected	9 (9.7%)
Type of operation	
Emergency procedures	52 (55.9%)
Open reduction and internal fixation	41 (44.1%)

a; American Society of Anesthesiologists, Mangram et al., (1999)

Table (2): Incidences of surgical site infections (SSI)

	No. of SSI	**No. of operated patients**	**Incidence rate**	***P* value**
Total SSI	24	93	25.8%	
SSI rate stratified by NNIS risk index[a] score:				0.000
0	2	42	4.7%	
1	7	26	26.9%	
2	13	23	56.5%	
3	2	2	100%	
SSI rate stratified by Class of wound:				0.000
Clean	2	49	4.08%	
Contaminated	16	35	45.7%	
Infected/dirty	6	9	66.6%	

a; NNIS (National Nosocomial infections surveillance) risk index score was calculated for each patient by assigning one point each for a contaminated wound, an ASA (American Society of Anesthesiologists) score >3, and surgical procedures lasting longer than the NNIS-derived 75th percentile for the duration of the procedure, Edwards etal.,(2008).

Table (3): Association between investigated risk factors and surgical site infections

Variable	No. of patients with SSI	without SSI	P value[d]
Incidence of SSI	24	69	
Age group:			
16 - 60ys	9	52	**0.000**
>60ys	15	17	
Gender			
Males	16	50	**0.58**
Females	8	19	
BMI[a] >25	23	27	**0.000**
Nicotine abuse			
Smoker	21	47	**0.02**
Non smoker	3	28	
Diabetes mellitus	5	8	**0.48**
ASA score[b]<3	14	64	**0.33**
ASA score ≥3	10	29	
NNIS risk index[c] > 2	15	10	0.000
Class of wound			
Clean	2	49	
Contaminated	16	35	**0.000**
Dirty/infected	6	9	
Length of stay in hospital (Mean ± SD)	13±1.6	7±1.4	**0.000**
Type of operation			
Emergency procedures	16	42	**0.61**
Open reduction fracture	8	27	
Duration of surgery			
>75[th] percentile for the duration of the procedure	13	20	**0.02**
Presence of drain tube	14	37	**0.4**
No. of persons in the operating room (mean ± DS)	6.6±1.5	5±1.5	**0.000**
Preoperative shaving with razor	8	20	**0.44**

a; Body mass index
b; American Society of Anesthesiologists score[13]
c; NNIS (National Nosocomial infections surveillance) risk index score was calculated for each patient by assigning one point each for a contaminated wound, an ASA (American Society of Anesthesiologists) score >3, and surgical procedures lasting longer than the NNIS-derived 75th percentile for the duration of procedure[18].
d; Significant level at P-value < 0.05

Table4: Frequency of different isolated organisms

Organism	Frequency No (%)
Gram positive cocci	**28 (59.6)**
- *S.aureus*	20 (42.6)
- *Coagulase negative staphylococci*	5 (10.6)
- *Enterococcus spp.*	3 (6.4)
Gram negative bacilli	**17 (36.1)**
- *Klebsiella pneumonia* - *Klebsiella oxytoca*	7 (14.9) 2 (4.2)
- *Pseudomonas aeruginosa*	5 (10.6)
- *E. coli*	2 (4.3)
- *Acinetobacter baumannii*	1 (2.1)
Candida albicans	**2 (4.3)**

Table5: Resistance patterns of isolated organisms

Type of resistant organism	Total number of isolates	% of Resistant isolates
S.aureus ORSA[a]	20	 65%
Enterococci VA resistant AMP resistant	3	 33.4% 66.7%
Pseudomonas aeruginosa FQs resistant PIP resistant ESBLs[b] "CTR, TAZ, or CPM" resistant Carbapenem "IMI or MERO" resistant	5	 20% 20% 40% NR[c]
Klebsiella pneumoniae ESBLs "CTR or TAZ" resistant Carbapenem"IMI, or MERO"resistant	7	 28.6% 14.2%
Klebsiella oxytoca ESBLs "CTR or TAZ" resistant Carbapenem"IMI, or MER(resistant	2	 50% NR

a; Oxacillin resistant S.aureus, b; Extended-spectrum cephalosporin-resistant, c; Not reported
AMP, ampicillin; CPM, cefepime; CTR, ceftriaxone; FQs, fluoroquinolones (ciprofloxacin, levofloxacin, moxifloxacin, or ofloxacin); IMI, imipenem; MERO, meropenem;; PIP, piperacillin; TAZ, ceftazidime; VN, vancomycin.

4-Discussion:

Surveillance of SSIs detected an overall SSIs incidence rate of 25.8% (from 4.1% in clean wound to 66.7% in dirty contaminated wounds). Maksimovic et al.,(2008) and Graf et al.,(2009), detected an overall SSIs incidence of 22.7% and 22.5% respectively. SSIs rates from 13.2% in clean wound to 70% in dirty contaminated wounds were also reported by Maksimovic et al.,(2008)which are comparable results to ours. Meanwhile, lower incidence rates were detected in some developing countries, Kasatpibal et al.,(2004);Thu et al.,(2005); Gastmeier et al.,(2005);Alicia et al.,(2008).

The present study defined age older than 60 years as significant risk factors for SSIs development (P value= 0.000), and no specific gender was significantly associated with SSIs. A recent study reported that age older than median age of 68 years was significant risk factor for SSI development Eli et al.,(2003); Maksimovic et al.,(2008) and Graf et al., (2009) reported that no significant differences in age or gender between case-patients and matched controls were noted.

The present study pointed to obesity **(**BMI > 25**)** as a significant risk factor for SSIs (P value = 0.000). Similar results have been reported by many researchers,He et al.,(1994)and Barber et al.,(1995). Maksimovic et al.,(2008) defined obesity as a non significant factor in SSIs development

The contribution of diabetes to SSI risk is controversial, Nagachinta et al.,(1987);Lilienfeld et al.,(1988). While our study found that Diabetes was not associated with increased SSI risk.Recent studies defined diabetes and high intraoperative blood glucose level as significant risk factors for SSI development, Estrada et al.,(2003)and Graf et al.,(2009). More studies are needed to assess the efficacy of pri-operative blood glucose control as a prevention measure for SSIs, Mangram et al.,(1999).

As reported by many researchers, Jones and Triplett(1992)and Holley et al.,(1995) and results of our study; smoking was corroborated as significant SSI risk factor, nevertheless. In addition, Maksimovic et al.,(2008), denied that association.

As reported by Graf et al., (2009) and Maksimovic et al.,(2008)and the present study;it was found that length of stay in hospital was significantly longer for SSIs case patients (P value = 0.000). Prolonged preoperative hospital stay was frequently suggested as a patient characteristic associated with increased SSI risk, Mangram et al.,(1999) . Taylor et al.,(2003)and Graf et al., (2009) , could not get significance in this respect because they cannot show clearly if a longer stay is due to an infection or if the infection causes a longer stay. In our hospital, there was increasing tendency towards short-stay hospitalization policy due to lake of resources, and thus the majority of SSIs in the present study occurred after discharging from hospital .

The results of our study supported the previously published data that the duration of surgery was significantly longer for SSI patients, Eli et al.,(2003). Maksimovic et al.,(2008) and Graf et al.,(2009) reported that duration of operation ($\geq 75^{th}$ percentiles) was not significantly associated with SSIs.

As reported by Eli et al.,(2003), no significant differences in surgery type between case-patients and matched controls were noted in our study. On the other hand, Maksimovic (2008) reported that open reduction fracture is a risk factor associated with SSIs, while emergency procedures were not significantly associated with SSIs.

As reported by others, Scherrer(2003); Devaney and Rowell(2004)and Maksimovic et al.,(2008); our study showed that the number of persons in operating room had a significant risk factor for SSIs (p value = 0.000). In our hospital a lot of house officers and residents tended to attend orthopedic operations because the orthopedic unit invited a lot of famous Egyptian and foreign orthopedic surgeons and the operation rooms were not designed as a teaching setting. Reduction of number of persons in the operating room, may reduce the incidence of SSIs, Scherrer (2003).

Although the ASA score predicts surgical site infection, Cullen et al.,(1994);Soleto et al., (2003)and Maksimovic et al.,(2008) noted that length of hospital stay, and risk for death was limited as a risk adjustment measure because of its subjectivity and poor inter-rater reliability. Our results showed that ASA score was not significantly associated with SSIs. Because of the fact that a good percentage of our patients were HCV positive with no or mild symptoms, that might affect the significance of ASA as predictor of SSIs in this study.

The present study confirmed the well known fact that the NNIS index was found to be a good predictor of SSIs **,**Thu et al.,(2005); Hernandez et al.,(2005)and Maksimovic et al.,(2008) (P value = 0.000).

Although the usefulness of wound classification is doubtful, Ferrraz et al.,(1992), the present study supported the previously published data of Mangram et al.,(1999);Soleto et al.,(2003) and Maksimovic et al.,(2009) that contaminated or dirty wounds were independent risk factor of SSIs (P value = 0.000).

It was well known that shaving with razor Mangram et al.,(1999) and Maksimovic et al., (2008) or hair removal by any means Winston (1992)and Moro et al., (1996) increases the risk of SSIs. The present study detected no significant association between shaving with razor and SSIs.Probably due to the fact that most of the patients involved in the present study underwent emergency procedures (55.9%) without proper preoperative preparations including shaving and if shaving is a must it is done immediately before surgery.

The present study showed no significant association between the presence of drain tube and SSIs. Results that fit in between data reported by Maksimovic et al.,(2009), and Graf et al.,(2009).

Bacteriological study of infected surgical sites detected 47 pathogens out of 24 SSIs cases cultured. Polymicrobial infections were detected in some cases .

As reported by others, Madsen et al.,(1996);Thu et al.,(2005);Maksimovic et al.,(2008)and Markovic et al.,(2009). The present study showed that ***S. aureus***; Coagulase-negative ***staphylococci*** (CoNS); Gram negative bacilli were the most common pathogens associated with cases of surgical site infection in orthopedic surgery units. ***S. aureus*** were isolated most frequently (42.6%), Coagulase negative staphylococci (CoNS) and Enterococci were detected in 10.6% and 6.4% of isolates respectively. *K. pneumoniae, P. aeruginosa , K. oxytoca, , E. coli and A. baumannii* were detected in percentages of 14.9%, 10.6%, 4.3%, 4.3% and 2.1% of isolates respectively. *Candida albicans* were detected in 4.3% of isolates. Alicia et al.,(2008), reported that the most common pathogens associated with cases of surgical site infection in orthopedic surgery units were as follows; ***S. aureus*** (48.6%), CoNS (15.3%), Enterococcus species (3 – 5 %), ***P. aeruginosa*** (3.4%), ***K. pneumoniae*** (1.2%), ***A. baumannii*** (0.9%), ***K. oxytoca*** (0.4%), and ***Candida albicans*** (0.2%). ***S. aureus*** is the most common pathogen causing SSIs in orthopedic surgery Maksimovic et al.,(2008); Saadatian-Elahi et al.,(2008)and Markovic et al.,(2009).

Antimicrobial-resistant pathogens that cause healthcare-associated infections included ORSA, VA-resistant Enterococcus species, ESBLs producing *E. coli* and *Klebsiella* species, as well as fluoroquinolone- or carbapenem-resistant Enterobacteriaceae or *P. aeruginosa* Chambers (2005)and Deshpande et al.,(2007). Describing the magnitude of the problem with respect to these antimicrobial-resistant pathogens is challenging, because the levels of antimicrobial resistance vary for different types of healthcare facilities and for different geographic areas, and some resistance phenotypes were difficult for laboratories to detect, Alicia et al.,(2008). In the present study, the most common resistance patterns associated with isolated organisms were as follows; ORSA was reported in (65%) of isolated *S. aureus. Enterococcus* species resistance to VA was

(33.4%), and that of AMP was (66.7%). Alicia et al.(2008) reported ORSA in (49.2%) of *S. aureus* isolates. Enterococcus species resistance to VA was up to (33%), and that of AMP was up to (71.0%). Graf et al.,(2009) reported ORSA in 52% of S. aureus isolates. Markovic et al.,(2009) reported that 79.2% of *S.aureus* isolates were ORSA. ORSA isolates have been detected in percentages as low as 20% -reported from Canada,Jones et al.,(2004) and as high as 80% reported from southern European countries, Vincent et al., (1995)

In the present study FQs resistance were detected in 20% of *P. aeruginosa* isolates. ESBLs was detected in 50% of *K. oxytoca* isolates, 40% of *P. aeruginosa* isolates and 28.6% of *K. pneumonia* isolates. Carbapenem resistance were detected only in *K. pneumonia* (14.2% of *klebsiellae* isolates). Alicia et al.,(2008) reported that FQs resistance were detected in 15.9% of *P. aeruginosa* isolates while ESBLs, and PIP resistant *P. aeruginosa* were detected in 5.7 – 7.3%, and 7.9% of *P. aeruginosa isolates* respectively. The percentage of ESBLs resistance among *K. pneumonia* was 29% of pathogenic isolates and that of *K. oxytoca* was 15% and no carbapenem-resistant *K. oxytoca* pathogenic isolates were reported by Jones et al.,(2004).The first reports of carbapenem resistance among *Klebsiella* species (21% of pathogenic isolates) started to appear from New York hospitals around 2004(Bradford et al., (2004)and Streit et al., (2004). In Europe the prevalence of ESBLs in *klebsiellae* ranged from as low as 3% in Sweden to as high as 34% in Portugal, Hanberger et al.,(1999). Rates of ESBL production by *K. pneumoniae* have been as low as 5% in Japan, Lewis et al.,(1999) and 20 to 50% elsewhere in Asia, Bell et al., (2002); Du et al., (2002)and Yu et al., (2002). ESBLs have also been documented in Israel, Borer et al., (2002), Saudi Arabia El-Karsh et al., (1995) and a variety of North African countries AitMhand et al., (2002) and Neuhauser et al., (2003).

Risk factors for acquisition of ESBLs including; recent surgery, De Chambers (2005) and Heavy antibiotic use Lautenbach et al.,(2001). Several studies have found a relationship between third-generation cephalosporin use and acquisition of a ESBLs-producing strain**,**Lautenbach et al.,(2001);Du et al.,(2002)and Lee et al.,(2004).The present study reported an overall high incidence of antimicrobial resistance in our department, probably due to inappropriate scheme of antimicrobial usage in our hospital.

Although we have some limitations in this study such as small sample size and incomplete post discharge surveillance (patients have difficulty assessing their own wounds for infection). this study was considered one of the few studies that survey SSIs in orthopedic department in Egypt.

We concluded that incidence of SSIs in orthopedic patients in Egypt is higher than that reported in some developing countries. *S. aureus* is the most common pathogens associated with orthopedic SSIs. ORSA, VA-resistant Enterococcus species, ESBLs producing *Klebsiella* species and *P. aeruginosa*, as well as fluoroquinolone resistant *P. aeruginosa* and carbapenem resistant *K. pneumonia* posed an ongoing and increasing challenge to the antimicrobial policy in our hospital. In orthopedic department risk factors for SSIs that may represent points of intervention including; Limiting the number of personnel entering the operating room, Improving NNIS index of patients by proper management of surgical wound to prevent contamination, identifying and treating all infections remote to the surgical site before operation. Also, adherence to excellent surgical technique through proper training of surgeons and nurses may reduce duration of surgery. In the era of restricted hospital budgets and increased bacterial resistance, long-term surveillance of SSIs rates and follow-up of compliance may provide a way to improve performance at low costs.

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