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Three months study of orthopaedic surgical site infections in an Egyptian University hospital

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Abstract
A 3-month prospective study, with 30 days follow up after surgery, or to the end of the study for patients with implant, was conducted on 121 patients undergoing surgery and completed their follow up visits at Orthopaedic department, Tanta University hospital. SSI was revealed in 10 patients with overall cumulative incidence rate of 8.264 % for which bacteriological culture and sensitivity was done. Descriptive and logistic regression analyses were performed to determine risk factors for such infections. Univariate analysis showed that SSI was significantly associated with age more than 50 years, diabetes mellitus, ASA score more than 2, duration of surgery more than 2 hours and use of drains. While binary logistic regression analysis showed that use of drains is the only independent risk factor in our cases. The most commonly isolated organisms were *Staphylococcus aureus, Pseudomonas* spp. and *E. coli* (20% each). The high incidence of SSI in our hospital in comparison with developed countries and some studies done in Egypt has encouraged the development of recommendations for prevention of such infections in university hospitals.

Key words
Surgical site infections, orthopaedic, Incidence

Introduction
Surgical site infections (SSI) are the most common nosocomial infections in surgical patients and lead to prolonged hospital stay, readmissions to the hospital, and increased morbidity and mortality.[1] It accounts for 14 %-16% of all infections among hospital inpatients. This is a major health problem and orthopaedic surgery is no exception, for which SSI is the second most common complication often resulting in the need to remove the prosthesis. [2]

As regards to orthopaedic SSI, it prolongs total hospital stays by a median of 2 weeks per patient, approximately double re-hospitalization rates, and increase healthcare

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costs by more than 300%. Moreover, patients with orthopaedic SSIs have substantially greater physical limitations and significant reductions in their health-related quality of life.[3]

As we have been confronted to frequent SSIs and because of the scarcity of studies about this subject in Tanta University hospital, a prospective study was conducted in order to determine the incidence, the causative organisms and the main risk factors of SSI in orthopaedic department Tanta University hospital.

Materials and methods

This prospective analytical study included all patients undergoing surgical operations at orthopaedic department, Tanta University Hospital over a period of three months from first of January to the end of March 2008. Emergency cases were excluded.

Place of study

Orthopaedic department in Tanta University Hospital which contains 83 beds distributed in 5 wards (3 for males containing 48 beds & 2 for females containing 35 beds). There are 3 operation theatres. Medical care is offered by 42 staff members (9 residents, 9 assistant lectures, 8 lectures, 3 assistant professors and 13 professors), 9 chief nurses, 93 nurses (28 for male wards, 32 for female wards and 33 for operation theatres). Cleaning of the department is done by 14 workers (5 for male wards, 5 for female wards and 4 for operation rooms).

Data collection

A modified checklist from the NOSOMED protocol is constructed including the demographic characteristics of patients, the surgical procedure, possible risk factors, occurrence of SSI, and follow up data.

Clinical and bacteriological follow up

Operated patients during the period of study were monitored three times a week during their post-operative stay in hospital for signs and symptoms of SSI which met standard internationally recognized definitions of the CDC.

After discharge, patients were observed during follow up visits in outpatient clinic. These visits were organized to be every week in the first month postoperatively. Patients were instructed to return to the hospital for re-examination, regardless of the time of follow up visit, when any of the symptoms of wound infection develop (pain, tenderness, localized swelling, redness or heat) When SSI was recorded, whether during hospitalization or follow up visits, a swab was taken from the wound for microbiological culture in Microbiology department, Tanta Faculty of Medicine to detect the causative microorganisms.

Statistical analysis

Results were expressed as a percentage or as mean ± standard deviation. Univariate analyses of the development of surgical site infection and each individual associated factor were conducted. Variables associated with surgical site infection in the univariate analysis were introduced to binary multivariate logistic regression analysis. The significance of the variables in the model was assessed by the Wald χ^2 test and P value. The level of statistical significance was set at $P<0.05$. Analyses were performed using SPSS version 8.0 computer programs.

Results

During the study period, there were 213 admissions and among these patients, 158 were treated by operation, whereas 55 patients were treated by conservative means. One hundred twenty one cases were included in the study cohort as there come to follow up visits in outpatient clinic while the remaining 37 cases were missed. Ten, out of 121 patients who complete their follow up visits, developed infection; with higher incidence in knee arthroplasty (33.33%) (Table I). The majority of patients developed deep infection (70%) (Fig.1). The cumulative incidence rate of SSI was 8.264%.

As regards to major risk factors in the study patients most of them (90.51%) were not diabetic and the majority had wound class I (87.97%). Data on preoperative showers of patients shows that 18.99 % of the study patients had showers before operation. While, preoperative hair removal was done by shaving in 60.76%. As regards to preoperative hospital stay it was more than 3 days in 58.23% of patients. ASA score were more than 2 in 15.82% of the study patients. Duration of surgery was less than 2 hours in 77.22% of patients.

Table I: Incidence SSI according to type of intervention

Type of intervention	Total number of patients	Number of SSI patients	Incidence rate (%)
Hip arthroplasty	13	4	30.77
Knee arthroplasty	3	1	33.33
Internal fixation of long bones	57	4	7.02
Internal fixation of spine	5	1	20
Arthroscopy	24	0	0
Others*	56	0	0

* Others includes repair of congenital deformities, excision of tumours, grafts, external fixation, operations for tendons, nerves, diseases and removal of implant.

Staphylococcus aureus, *Pseudomonas* and *E. coli* were the most commonly isolated organisms (20% each). One (10%) out of two isolated *Staphylococcus aureus* was methicillin resistant (MRSA**).** Coagulase negative staphylococci, *Klebsiella*, *Acinetobacter* were also isolated (Fig 2).

Univariate analysis showed that SSI in the present study was significantly associated with age more than 50 years (P=0.001), diabetes mellitus (P=0.009), ASA score more than 2 (P=0.001), duration of surgery more than 2 hours (P=0.001) and use of drains (P=0.001) (Table II).

According to binary logistic regression analysis, use of drains alone was the only independent risk factor in patients with SSI in the present study (P=0.003) (Table III).

Discussion

The cumulative incidence rate of SSI in the present study was 8.264% which was remarkably higher than that in orthopaedic patients from two studies in Egypt with recorded incidence rates of 2.7% out of 112 patients and 4.02% out of 199 patients.[4] On the other hand, the incidence rate in the present study was lower

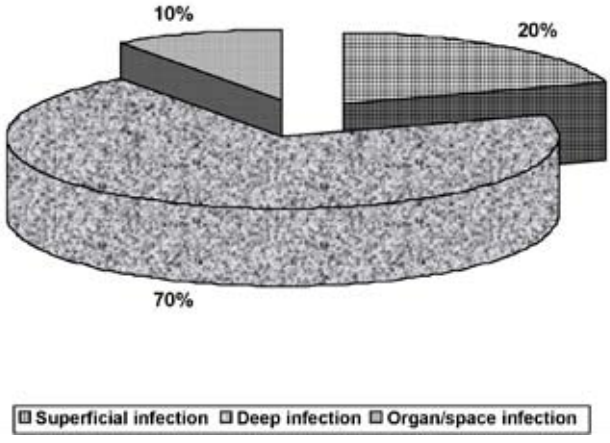

Figure 1. Distribution of infected patients according to type of SSI

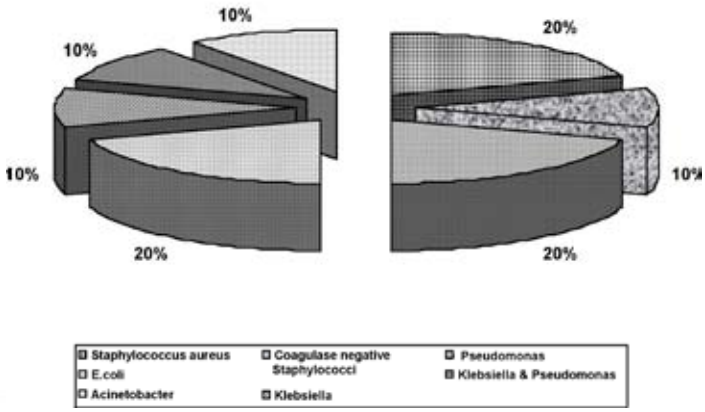

Figure 2. Organisms isolated from SSI patients

Table II: Association between surgical site infections and investigated factors according to univariate logistic regression

Risk factor	Number of patients Without SSI (No. 111) (%)	Number of patients With SSI (No.10) (%)	OR(95%CI)	P value
Age in years >50	28 (25.22)	8 (80)	11.86(2.13-42.31)	0.001*
Sex Males	68 (61.26)	3 (30)	0.27(0.05-1.25)	0.090
Diabetes Mellitus	8 (7.2)	4 (40)	8.85(1.61-45.83)	0.009*
Wound class IV	14 (12.61)	1 (10)	0.77 (-)	1.0
No Preoperative Showers	89 (80.18)	9 (90)	2.22 (0.26-49.32)	0.69
Preoperative Hair removal	66 (59.46)	8 (80)	2.73 (0.50-19.57)	0.31
Preoperative hospital stay >3days	63 (56.76)	8 (80)	3.05(0.56-21.84)	0.19
ASA score ≥ 2	21 (18.91)	7 (70)	10.0(2.07-54.06)	0.001*
Duration of Surgery > 2 hours	20 (18.02)	9 (90)	40.79(4.79-913)	0.001*
Grade of surgeon				
Lecturer	36 (32.44)	4 (40)	1.56(0.27-9.52)	0.70
Ass. lecturer	33 (29.72)	3 (30)	1.27(0.19-8.61)	1.0
Use of drains	24 (21.62)	8 (80)	14.5(2.58-106)	0.001*
No Antibioprophylaxis	1 (0.9)	0(0)	-	1.0

**Significant*

Table III: Risk factors for SSI according to binary logistic regression analysis

Variables	Wald	P Value (Significance)
Age	0.033	0.86
Diabetes	0.287	0.53
ASA	3.822	0.05
Duration of surgery	3.139	0.08
Use of drains	8.657	0.003*

**Significant*

than that detected in Bangui (18%) between May 2003 to April 2004 on 278 cases[5] and in Serbia (22.7%) on 227 cases between February to July 2002.[6]

The high incidence rate of SSI in the present study in comparison of others may be explained by the difference in number of cases studied, lack of financial resources and outdated equipment, limited ventilation in the operating theatre, as well as limited application of infection control measures.

On calculating rates of SSI in different types of intervention, the present study showed that it was higher in knee arthroplasty (33.33%). This supports the study done by Hussein which showed the same percentage (33.33%).[4] This is partly explained by the fact that patients undergoing these procedures tend to have a longer post-operative stay in hospital, and so increasing the chance that SSIs will be detected. The percentage in the present study is remarkably higher than previously published results of other study done by Gastmeier *et al.*,[7] where it was 1% out of 9,011 total patients undergoing knee arthroplasty, this may be attributed to the fact that number of patients in the present study is much lower than their study.

Hip arthroplasty SSI rate was the second most common infection detected in the present study in a percentage of 30.77%. This supports the work of Ridgeway *et al.*,[8] and Health protection agency[9] where arthroplasty procedure was also the second infection detected in their studies. They reported that the hip arthroplasty procedure is commonly carried out on elderly patients with underlying illness that affects their susceptibility to infection. In addition, these more vulnerable patients tend to stay longer in hospital postoperatively increasing the chance to detect SSI.

There was no significant difference in the SSI rate between procedures carried out by different surgeon grades in the study and this is in line with finding from study done by NPHS Communicable Disease Surveillance Centre.[10]

ASA score more than 2, duration of surgery more than 2 hours are considered as an important predictor of surgical site infection, and its relationship with the development of infection in orthopedic ward in the present study is in agreement with findings from studies performed in a public hospital in Santa Cruz, Bolivia and in a university hospital in southern Brazil.[11-12]

Additionally, it was found that patient age more than 50 years, diabetes mellitus and use of drains were associated with a significant risk of SSI These items are among those listed by Mangram *et al.*,[13] as important risk factors of SSI.

Binary logistic regression analysis showed that use of drains is the only independent risk factor in the present study occurring in 8 out of 10 infected patients with the same operators dealt with both groups of patients.; this supports the data reported by Kirkland *et al.*,[14] that drains are associated with higher rates of infection and pressure necrosis in surrounding structures. Bratzler *et al.*,[15] added that necessity of drains for total joint arthroplasty is controversial and that over time, there is increased bacterial colonization of the drain tip and migration of skin organisms into the wound.

Staphylococcus, Pseudomonas spp. and *E. coli* were the predominant causative organisms in the present study as in study done by Bercion *et al*.[5] between May 2003 to April 2004 on orthopaedic patients with SSI.

Antibiotic most commonly used in the present work was cefotaxime, this is consistent with previous report of Bratzler *et al.,*[15] that the preferred antimicrobials prophylaxis in orthopaedic total joint arthoplasty is cefazolin (first generation cephalosporin) and cefuoxime (second generation cephalosporin). But its use in Tanta University hospital as prophylactic was for prolonged period which is inappropriate. Guidelines state that prophylaxis end within 24 hours after the operation and prolonged use of prophylactic antibiotics is associated with emergence of resistant bacterial stains.

In conclusion, surgical site infection is a considerable problem in orthopaedic wards in Tanta University Hospital. Identification of risk factors for surgical site infections has encouraged the development of recommendations for prevention of such infections in university hospitals.

Recommendations

- Good performance of preoperative preparations for orthopaedic patients as regards to preoperative showers and hair removal.
- Establishment of antibiotic policy in orthopaedic Department, Tanta university Hospital
- Drain should be used only when necessary with nursing measures in caring patients as good site care, careful monitoring for infection, and adequate stabilization of drains.
- Surveillance system for SSI should be developed for university hospitals to monitor incidence of SSI, evaluate local practice and improve quality of health care.

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