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INFECTION AFTER TOTAL KNEE ARTHROPLASTY.

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Abstract:

Background: *Surgical site infection (SSI) after total knee replacement (TKR) is a devastating complication. We performed a retrospective study of all consecutive TKRs performed during a two years period. Surgical site infection (SSI) was defined by standard criteria.*

Method and Results *All patients were examined 1 year following surgery. Of 180 patients undergoing TKR, 10 (5.6%) developed a superficial (3, 1.7%) or deep (7, 3.9%) SSI. Two independent risk factors for SSI were detected: left knees became infected more often (9/ 92, 9.8%) than right knees (1/88, 1.1%) (Relative Risk 6.7995% CI 1.726.8); and 7/72 (9.7%) patients receiving a type-1 prosthesis developed infection versus 3/104 (3.1%) receiving a type-2 prosthesis (RR 4.7, 95% CI 1.1818.4).*

Conclusion: *patients undergoing total knee replacement during a 2-year period and related epidemiological investigation led to detection of several distinct risk factors which, upon correction, resulted in a significant decrease in wound infection rate.*

Key words: *knee replacement, infection, total knee arthroplasty*.

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INTRODUCTION:

Hospital acquired infections in general are a challenging problem in all health care systems. They require broad-spectrum antibiotic treatment, lead to additional suffering and prolonged hospitalization and increased mortality. Most of the patients admitted to orthopaedic departments undergo surgical treatment, which usually includes internal fixations and prostheses. An infected foreign body often requires removal in a second operation, prolonged immobilization and antibiotic treatment and a subsequent third operation. [1,3] Infection is a frequent reason for failure after total knee arthroplasty [4,5]. The prevalence of infection after primary total knee arthroplasty has been reported to range from 0.5 to 5 percent in series ranging in size from 821 to 13,478 arthroplasties [6,7]. The rate of infection is higher among patients managed with revision total knee arthroplasty and those who have rheumatoid arthritis [6,8]. Several systems have been proposed for the classification and staging of infection [6,9] but none of these systems have been shown to be particularly useful as guides to treatment, especially with regard to whether the prosthesis should be removed or retained. In a previous study 36, we proposed a classification system that was based on the clinical presentation of infection after a total hip arthroplasty; the four types of infections included early postoperative infections, late chronic infections, acute hematogenous infections, and clinically inapparent infections associated with positive cultures of specimens obtained at the time of a revision operation. Infection is one of the most devastating and dreaded complications of total knee arthroplasty.

During past decades, surgeons have attempted to identify associated predisposing risk factors to help guide clinical practice in the treatment and prevention of deep, periprosthetic infections. [10,11,12] As a result, many steps have been taken to eliminate environmental airborne pathogens and contamination by surgical personnel during the surgical procedure. Although the prevalence of wound infection after total joint arthroplasty has decreased during this time, treatment of a patient with an infection often requires costly, prolonged hospital stays, weeks or months of intravenous antibiotic therapy, and multiple additional surgical procedures.

METHOD:

In this study we collected data by reviewed the charts of all consecutive patients who underwent total knee replacement (TKR) at Fatima Memorial Hospital during 2 years (2016 and 2017), and retrieved the following information: 1) pre-operative factors, including age, gender, underlying diseases and comorbidities, medications, American Society of Anesthesiologists (ASA) score, status of the knee joint (previous operations or infections), and indication for total knee replacement; 2) intra-operative factors, including name and seniority of the operating surgeon, those of surgical assistants, anaesthesiologists and nurses, side of surgery, the surgeon's position to the right or left of the patient, right- or left-handedness of the surgeon, size and type of prosthesis, duration of surgery and usage of tourniquet; 3) post-operative factors, including use of a closed-suction drainage system and the drainage volume, range of motion achieved at discharge from the hospital, any concomitant infection other then surgical site infection (SSI), presence or absence of redness, swelling or secretion from the wound and its duration, positive cultures obtained from the joint, body temperature, white blood count, sedimentation rate, C-reactive protein, plasma biochemistry results, each before and after operation until discharge from hospital.

The minimal follow-up was 1 y after the operation: the patients' hospital and outpatient clinics charts were reviewed and, We used the case definition criteria for surgical site infection (SSI) as published by the Centers for Disease Control (CDC) because of their widespread acceptance and reproducibility [6. Briefly, superficial SSI involves only skin and subcutaneous tissue; deep SSI involves fascial and muscle layers; and organ/space SSI involves any part of the anatomy other than the incision, opened or manipulated during the operative procedure. SSI must meet at least 1 of the following criteria: the infection occurred within 30 d (superficial incisional SSI) or within 1 y after the operation; an organism was isolated from an aseptically obtained culture of fluid or tissue from the incision, deliberately opened by the surgeon; an abscess or other evidence of infection was detected on direct examination, during reoperation, or by histopathological or radiographic examination; or SSI was diagnosed by a surgeon or attending physician. Controls consisted of the remainder of the patients.

Data analysis:

Data were entered, processed and analysed using Epi Info 6.04d software (CDC, Atlanta, USA). Proportions were compared using the x2 or 2-tailed Fisher's exact test, where appropriate. Continuous variables were compared by the Student's t-test. All p-values were 2-tailed, and a p-value of <0.05 was considered statistically significant. Logistic regression analysis was performed using EpiInfo 2000 (CDC, Atlanta, USA) and SPSS version 16.0, to

identify factors independently associated with the development of infection following total knee arthroplasty. We included in the logistic regression models selected variables having p values <0.08 in the bivariate analysis, as well as several central variables regardless of their p-value.

RESULTS:

During the year 2016 and 2017, 181 consecutive total knee arthroplasties (TKR) were performed. None of the patients received an operation of both knees during the study period. The preoperative factors are shown in Table I. All patients were admitted to the department on the day of the surgery. Each patient received preoperative antimicrobial prophylaxis (i.e. within 1 h prior to surgery) with cefonicid or, in case of penicillin allergy, vancomycin. Early range-ofmotion exercises and early ambulation were the standard treatment protocol. The minimal follow up was 1 year.

The analysed study group therefore consisted of 180 patients, of whom 10 (5.6%) developed infection 3(1.7%) superficial and 7 (3.9%) organ space infections. Table II shows the factors that were significantly associated with SSI. Two risk factors were independently associated with SSI on multivariate analysis: first, left knees were infected 4 times more often than right knees and, second, use of the Johnson & Johnson prosthesis was associated with infection 4 times more often than that of the Biomet prosthesis. In addition, if the first surgeon was positioned on the left side of the operated patient, there was an increase in the infection rate. Finally, as the number of surgeons and/or anaesthesiologists increased, the rate of wound infection was also higher. However, the latter factors closely approached but did not reach statistical significance. 100% of patients received antibiotic prophylaxis, consisting of 1 dose of 1 g cefonicid, provided within 1 h prior to surgery. Exact timing of prophylaxis was recorded in a minority of patients only, but was observed in a previous study and found to be given at the appropriate time in 100% of patients. Use of tourniquet, suction drainage and peri-operative use of low molecular weight heparin (enoxapirin) was recorded for all patients, i.e. for all those with and without subsequent SSI. A relatively higher preoperative leukocyte count was associated with a higher rate of SSI upon bivariate analysis (=0.056), as was a past history of a cerebrovascular accident or cellulitis involving the operated leg (p <0.05); none of these factors was found to be significant in the multivariate models. Additional variables, which upon bivariate analysis were not found to be significant risk factors for surgical site infection (SSI), included: the preoperative glucose level and the preoperative erythrocyte sedimentation rate; the preoperative ASA score and NNIS index; the duration of operation; presence of haematomas; and development of a post-operative infection other than a SSI.

Table I. Demographic and clinical characteristics of 180 patients

Characteristics	n (%)
Gender:	
Male	61 (34)
Female	119 (66)
Age, in y9SD (range) Comorbid factors:	72.497.4 (4194)
Ischaemic heart disease	41 (23)
Congestive heart failure	18 (10)
Chronic lung disease	32 (18)
Diabetes mellitus	37 (21)
Obesity	34 (19)
First versus repeat knee surgery:	
First	158 (88)
Repeat	22 (12)
Indications for TKR:	
Osteoarthritis	162 (90)
Rheumatoid arthritis	5 (3)
Avascular necrosis	2 (1)
Psoriatic arthritis	1 (1)
Aseptic loosening	5 (3)

Infected loosening Pre-operative ASA score*	5 (3)
02	158 (94)
35	11 (6)
Total NNIS index*	
0	128 (80)
1	25 (15)
2	6 (4)
3	2 (1)
Pre-operative glucose, in mg/dl (range) Operative factors:	118938 (58304)
Drain volume, in ml9SD	4429295
Duration, in h9SD (range)	1.790.6 (15.2)
Prolonged operation Post-surgical factors:	15 (9 %)
Any infection, except SSI:	31 (17)
Bacteraemia/sepsis	3 (2)
Pneumonia	3 (2)
Urinary tract infection	25 (14)
One-y follow-up	
Outpatient clinic	150 (83)
Telephone callvisit	30 (17)

TKR: total knee replacement; SSI: surgical site infection. *Data were not available for all patients

Table II. Factors associated with developing wound infection after total knee replacement.

Risk factor	Total n (%)	Infected n (%)	p (2-tailed) bivariate RR (95% CI)	p multivariate RR (95% CI)
Gender			NS (0.09)	NS
Male	61 (34)	6 (9.8)	1.07 (0.981.17)	
Female	119 (66)	4 (3.4)		
CHF			NS (0.6)	NI
Yes	18 (10)	0	1.07 (1.021.11)	
No	162 (90)	10 (6.1)		
Diabetes mellitus			NS (0.69)	NI
Yes	37 (21)	1 (2.7)	1.04 (0.971.11)	
No	143 (79)	9 (6.3)		
First vs repeat* surgery			NS (0.35)	NI
First	158 (88)	8 (5.1)	0.53 (0.105.53)	
Repeat	22 (12)	2 (9.1)		
Knee operated			0.01	B0.01
Left	92 (51)	9 (9.8)	9.01 (1.2203)	6.69 (1.726.8)
Right	88 (49)	1 (1.1)		
Prosthesis type			0.056	0.03
Johnson & Johnson	72 (40)	7 (10)	3.6 (0.818.4)	4.7 (1.1818.4)
Biomet	104 (58)	3 (3)		
Revision of TKR	4 (2)	0 (0)		
No. of surgeons			NS (0.32)	NS
Two	72 (40)	2 (2.8)	1.05 (0.981.12)	
Three	108 (60)	8 (7.4)		
No. of TKR/surgeon			0.045	NS
114 (n9)	40 (22)	5 (12.5)	3.86 (0.8317.6)	
]15 (n4)	140 (78)	5 (3.6)		
Preoperative ASA score			NS (1.0)	NI
02	158 (94)	10 (6.3)		

35	11 (6)	0		
Prolonged operation			NS (1.0)	NI
Yes	15 (8)	0		
No	165 (92)	10 (6)		
Presence of urinary catheter			NS (1.0)	NI
Yes	8 (4)	0		
No	172 (96)	10 (5.8)		

RR: relative risk; 95% CI: confidence interval; NS: non-significant; WBC: white blood count; the x2 calculation of the prosthesis type was done omitting the 'revision surgery' cases. *Repeat indicates any kind of previous surgery of the knee subsequently undergoing TKR; NS: not significant; NI: not included in the multivariate model due to high p -value in the bivariate model.

DISCUSSION:

This study of 180 patients undergoing total knee replacement during 2 years (2016 and 2017) revealed 3 superficial wound infections (1.7%) and 7 deep infections requiring re-operation (3.9%), out of a total of 10 surgical site infections (SSI) (5.6%). These figures are within the range of published data (0.5-5%), although at the upper limit of the spectrum, justifying the conduct of this survey. Two independent risk factors for wound infection were detected, in addition to several factors that nearly reached statistical significance. The independent risk factors were the operation involving the left rather than the right knee and the kind of prosthesis used. Subsequently we will discuss the major findings of this study. In the operating room, patients were always placed in the same position with their left side to the described, main entrance. Sterile surgical instruments were laid out on trays on the right side of the operating table.. Bacteria shed from the surgical team could have been carried by the airflow onto the patient's wound. Salvati et al.reported an increased incidence of post-operative organ space SSI from 1.9% to 3.9% while comparing total knee replacements performed in rooms ventilated by conventional air-conditioning system and in rooms with horizontal unidirectional filtered airflow. They found that during total knee replacement (TKR), team members were periodically required to stand between the source of the horizontal air stream and the exposed wound. Our infection-rate pattern (Table II) confirms these observations. The use of the Johnson & Johnson prosthesis was associated with an infection rate that, at 11%, was 4 times higher than that of use of the Biomet prosthesis (3%).

CONCLUSION:

In conclusion, this retrospective study of 180 patients undergoing total knee replacement during a 2-year period and related epidemiological investigation led to detection of several distinct risk factors which, upon correction, resulted in a significant decrease in wound infection rate.

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