

Utility of Positive Suction Drain Tip Culture in Early Detection of Infection After Total Knee Replacement

Ammar Hafeez,¹ Hamza Fareed,² Nadia Atiq,³ Inamullah Shah,³

1.Deptt of Orthopaedics, Ghurki Trust Hospital, Lahore; 2.Deptt of Surgery, Fauji Foundation Hospital

Abstract

Introduction: To compare the frequency of wound infection in positive and negative drain tip culture in patients after primary total knee replacement.

Methods: In this descriptive study patients undergoing primary total knee replacement for osteoarthritis were included. Early postoperative wound infection was defined as patient developing redness, pain, heat or swelling at surgical site; or drainage of pus within 7 postoperative days. Positive culture was considered as bacterial growth within 48 hours after suction drain tip was cultured on media. Negative culture was defined as no bacterial growth in 48 hours after placing the suction drain tip on culture media. Closed suction drain tips were sent for culture and sensitivity on 3rd postoperative day. Patients were followed for 7 days for any signs of infection. Effect modification was catered to by stratification for malnutrition defined as serum albumin less than 3.5g/dl; and obesity that was considered when BMI was equal to or more than 30kg/m².

Results: The mean age of patients was 57.28±7.37 years. Positive suction drain was found in 9.17% , while 6.67% had infection among all cases. Among 8 cases with infection there were 6(75%) who were positive on suction drain tip and among 112 non-infected cases there were 5(4.5%) who had positive suction drain tip. There was significant association between infection and suction drain tip positivity, p-value being < 0.001.

Conclusion: Suction drain tip culture analysis can predict infection after primary total knee replacement.

Key Words: Total knee arthroplasty, Surgical site infection, Drain tip culture;

Introduction

Primary total knee replacement (TKR) is becoming popular in our population. Joint infections after arthroplasty are disastrous complications. Their management is difficult and costly. Keeping in view

the morbidity and mortality of these infections, considerable stress is placed on strategies to minimize infections in joint arthroplasties including total knee replacement.^{1,2} Malnutrition, obesity, diabetes mellitus and rheumatoid arthritis are factors that are associated with increased risk of infection after arthroplasty. Attempts have been made to reduce the infection rate by using laminar flow in operating rooms and limiting movement of personnel in the procedure area. Thorough cleansing of skin by antiseptic scrubs has been used in many centers whereas others have employed different techniques for wound closure.¹ Limiting postoperative transfusion of blood, early removal of indwelling urinary catheter and use of suction drainage have all been experimented with in an attempt to reduce the factors that may cause infection.³

As drains are placed in close proximity to the implant in total knee arthroplasty, suction drain tip culture can be used to predict infection in cases of primary total knee replacement. An ongoing debate on utility of this method of early detection of postoperative infection necessitated this study to put forward South Asian perspective on the subject. The importance of early recognition or prediction of patients who may develop post-arthroplasty infection cannot be overstated as early therapeutic measures can reduce calamitous morbidity. Claims have been made by various studies about the utility of three phase radioisotope bone scans, estimation of interleukin-6 (IL-6), levels of C reactive protein (CRP) and ESR, but unfortunately no single investigation can be relied upon for early detection of periprosthetic infection. None of them, individually or in combination, has sufficiently high sensitivity and specificity to be relied upon for early detection of infection or in predicting impending infection.⁴

A closed system of suction drainage is commonly employed after arthroplasty.⁵ Drain tip cultures have been used for early detection or prediction of infection after orthopedic and spine surgery and has been reported to have a sensitivity of 60% and specificity of 66%.⁶ Very few studies can be found in literature that

have explored the predictive value of drain tip culture in postoperative infection in patients who have undergone total joint replacement. No study on the topic has been performed in South Asia where a low cost diagnostic tool like drain tip culture may be vital in predicting and managing infections that may cause debilitating disability if not treated promptly. The objective of this study is to compare the frequency of wound infection in positive and negative drain tip culture in patients after primary total knee replacement.

Patients and Methods

In this descriptive study, carried out at Department of Orthopaedics in Ghurki Trust Hospital, Lahore, from January 2016 to December 2017, 120 patients were included. All patients between 40 to 70 years of age, undergoing primary total knee replacement for osteoarthritis were included. Osteoarthritis was diagnosed when patient had knee pain along with at least five of the nine criteria including crepitus; morning stiffness less than 30 minutes; bone tenderness; bone enlargement; no palpable warmth; ESR levels less than 40 mm/hour; Rheumatoid Factor (RF) levels less than 1.4; synovial fluid signs of osteoarthritis; or age more than 50 years. Alternatively, osteoarthritis was diagnosed when patient had knee pain and radiographic osteophytes along with one of the three criteria including crepitus; stiffness less than 30 minutes; or age more than 50 years.⁷ Patients with history of previous surgery around knee joint, diabetics and those with history of steroid intake for more than two weeks in previous six months, were excluded. Early postoperative wound infection was defined as patient developing redness, pain, heat or swelling at surgical site; or drainage of pus within 7 postoperative days. Positive culture was considered as bacterial growth within 48 hours after suction drain tip was cultured on media. Negative culture was defined as no bacterial growth in 48 hours after placing the suction drain tip on culture media. Closed suction drain tips were sent to laboratory of Lahore Medical and Dental College for culture and sensitivity on 3rd postoperative day. Patients were followed for 7 days for any signs of infection. Effect modification was catered to by stratification for malnutrition defined as serum albumin less than 3.5g/dl; and obesity that was considered when BMI was equal to or more than 30kg/m². Descriptive statistics were used to project results of continuous variables; frequencies and percentages in case of categorical variables like gender, culture and sensitivity, early postoperative

infection, malnutrition (serum albumin less than 3.5g/dl) and obesity. Data was stratified for malnutrition, obesity, age and gender for effect modification. Post-stratification chi square test was used as test of significance with a 95% confidence interval.

Results

The mean age of patients included in the study was 57.28±7.37 years with minimum 43 and maximum age of 70 years. 35.83% (n=43) cases were 40 to 55 years old whereas 64.17% (n=77) cases were in 56 to 70 year old bracket. 38.33% (n=46) patients were male and 61.67% (n=74) were female. As measured by BMI, 29.17% (n=35) patients were malnourished whereas 21.67% (n=26) patients were in the obese category. All patients with positive drain tip cultures and those who developed infection yielded growth of Staphylococcus aureus. Positive suction drain was found in 9.17% , while 6.67% had infection among all cases. Among 8 cases with infection there were 6(75%) who were positive on suction drain tip and among 112 non-infected cases there were 5(4.5%) who had positive suction drain tip. There was significant association between infection and suction drain tip positivity, p-value being < 0.001 (table 1). .Data was stratified for age, gender, malnutrition and obesity. These parameters were found to have no effect on infection in postoperative patients, despite showing a significant association between infection and suction drain tip positivity.

Table 1: Comparison of infection and suction drain tip findings

Culture		Infection		Total
		Yes	No	
Suction drain tip	Positive	5% (n=6)	4.2% (n=5)	9.2% (n=11)
	Negative	1.7% (n=2)	89.1% (n=107)	90.8% (n=109)
Total		6.7% (n=8)	93.3% (n=112)	100.0% (n=120)

*p-value < 0.001

Discussion

Suction drains tubing is placed in close association to the implants. This proximity means that they would be contaminated with the infective organisms that may be present around the implant. Tube tips may be used as

culture specimens for early detection of infective organisms. Considerable debate is going on over the benefit of using suction drains in orthopaedic surgery in general and after total joint arthroplasty in particular.⁸Wound haematoma is considered by some surgeons as the medium for bacterial colonisation that leads to postoperative infection. This group of surgeons deems suction drainage as the ideal method to eliminate any blood that may act as the nidus for bacterial proliferation. The practice in our department is to place suction drains as a routine after total knee arthroplasty.

Infection rate in total knee arthroplasty (TKA) has been reported to range from 1.93% to 2.20%.^{9,10}Although this incidence is relatively low, infections are the bane of arthroplastic surgery as they frequently require reoperation. A review of 60,355 revision TKA cases from the National Inpatient Sample database published a review of 60,355 TKA cases, revealing that infection was the major cause for revision arthroplasty performed after TKA (25.2%).¹¹In our study the rate of infection was 6.67% that is three times higher. The reasons may be multifactorial including difference in antibiotic prophylaxis, surgical techniques, mode of fixation and operating room configurations, in addition to patient factors.

According to the findings in our study, there were 11(9.17%) cases with positive suction drain tip culture. This is higher as compared to a recent study by Aski et al that reported on results of 546 drains used in 352 patients who had undergone either unilateral or bilateral TKA. They reported positive drain tip culture in 3.39%.¹² This rate of positive drain tip culture in our study correlates positively with the rate of infection in our patients, giving an indirect clue to the positive predictive value of drain tip cultures.

The paramount finding of our study is a statistically significant association ($p < .001$) between positive suction drain tip culture and surgical site infection (Table 1). 75% ($n=6$) of the patients who developed infection had positive drain tip cultures. Conversely in those patients who did not develop infection, only 4.5% had positive drain tip cultures. Our objective was not to find diagnostic accuracy so we didn't calculate sensitivity and specificity of drain tip culture. Findings of our study are in agreement with Aski et al that reported a positive drain tip culture in 3.39% with an infection of 2.26% of wounds. They reported 91.66% sensitivity and 98.64% specificity for drain tip culture, with a positive predictive value of 61.11% and a negative predictive value of 99.8%.¹² On the other hand, our study is in disagreement with an

observational study by Lazureanu V et al that reported none of the 6.69% positive suction drain tip cultures developed clinical signs of infection.¹³ In their study, 2.46% ($n=7$) cases developed infection but none of them had positive suction drain tip cultures. A cohort study by Sankar et al reported significant statistical correlation between positive culture of drain tips and wound infection, concluding that while a positive culture result may predict wound infection in only 50% cases, a negative culture definitely excludes the presence of infection.¹⁴

Stratification of our data with reference to age, gender, malnutrition and obesity showed that these patient related factors had no bearing on the development of infection in our patients. Therefore, the association of positive suction drain tip cultures with wound infection in relation to these parameters stayed statistically significant with p values of $<.001$, $.001$, $.002$ and $.001$ respectively. This is not in agreement with a study by Wagner ER et al and Ahmad et al, that reported increased rates of wound infection with increasing BMI ($p < 0.001$).^{15,16}

This study is significant in that it contributes to the ongoing debate on the value of positive suction drain tip culture in detection of early infection. The South Asian perspective is important in a debate of this nature because the local circumstances in terms of resources and surgical practice are different from the developed countries. Our study had a relatively smaller sample size but this was effectively overcome by the rigorous methodology and strict inclusion criteria. Further research is needed to find out a more reliable indicator of early infection after total arthroplastic procedures.

Conclusion

Suction drain tip culture analysis can predict or detect early infection after primary total knee replacement. Routine use of a drain tip culture is recommended to prevent the devastating consequences of a full-blown infection.

References

1. Daines BK, Dennis DA, Amann S. Infection prevention in total knee arthroplasty. *The Journal of the American Academy of Orthopaedic Surgeons* 2015;23(6):356-64.
2. Thomassen BJ, den Hollander PH, Kaptijn HH, Nelissen RG, Pilot P. Autologous wound drains have no effect on allogeneic blood transfusions in primary total hip and knee replacement: a three-arm randomised trial. *The bone & joint journal* 2014;96-b(6):765-71.
3. Adelani MA, Johnson SR, Keeney JA, Nunley RM, Barrack RL. Clinical outcomes following re-admission for non-infectious

- wound complications after primary total knee replacement. *The bone & joint journal* 2014;96-b(5):619-21.
4. Tande AJ, Patel R. Prosthetic joint infection. *Clin Microbiol Rev.* 2014;27(2):302-45.
 5. Childers CP, Siletz AE, Singer ES. Surgical Technical Evidence Review for Elective Total Joint Replacement Conducted for the AHRQ Safety Program for Improving Surgical Care and Recovery. *Geriatr Orthop Surg Rehabil.* 2018;9:2151458518754451. Published 2018 Feb 12.
 6. Ahn JS, Lee HJ, Park E, Park IY, Lee JW. Suction Drain Tip Culture after Spine Surgery: Can It Predict a Surgical Site Infection?. *Asian Spine J.* 2015;9(6):863-68.
 7. Altman R, Asch E, Bloch D. Diagnostic and Therapeutic Criteria Committee of the American Rheumatism Association. Development of criteria for the classification and reporting of osteoarthritis: classification of osteoarthritis of the knee. *Arthritis Rheum.* 1986;29:1039-49
 8. Chen ZY, Gao Y, Chen W, Li X, Zhang YZ. Is wound drainage necessary in hip arthroplasty? A meta-analysis of randomized controlled trials. *Eur J Orthop Surg Traumatol.* 2014;24(6):939-46.
 9. Wang FD, Wang YP, Chen CF, Chen HP. The incidence rate, trend and microbiological aetiology of prosthetic joint infection after total knee arthroplasty: A 13 years' experience from a tertiary medical center in Taiwan. *J Microbiol Immunol Infect.* 2018 ;51(6):717-22
 10. Kane P, Chen C, Post Z, Radcliff K, Orozco F, Ong Seasonality of infection rates after total joint arthroplasty. *Orthopedics.* 2014;37(2):e182-86.
 11. Bozic KJ, Kurtz SM, Lau E, Ong K, Chiu V. The epidemiology of revision total knee arthroplasty in the United States. *Clin Orthop Relat Res* 2010;468(1):45-51.
 12. Aski B, Vaidya N, Patil R, Pinto N. Drain tip culture following total knee arthroplasty. *Int J Res Med Sci* 2015;3(2):409-11.
 13. Lazureanu V, Radu D, Vermesan D, Prejbeanu R, Florescu S. Drain tip cultures do not predict infections in primary total knee arthroplasty. *La Clinica terapeutica* 2014;166(3):e153-57.
 14. Sankar B, Ray P, Rai J. Suction drain tip culture in orthopaedic surgery: a prospective study of 214 clean operations. *Int Orthop* 2004;28(5):311-14.
 15. Wagner ER, Kamath AF, Fruth K, Harmsen WS, Berry DJ. Effect of Body Mass Index on Reoperation and Complications After Total Knee Arthroplasty. *J Bone Joint Surg Am.* 2016;98(24):2052-60.
 16. Ahmed W, Lakdawala RH, Mohib Y, Qureshi A, Rashid RH. Does obesity affect early infection after total knee arthroplasty? A comparison of obese vs non obese patients. *J Pak Med Assoc.* 2016 ;66(Suppl 3)(10):S96-S98.

Contribution of Authors: Ammar HAfeez=A,B,D,F;Hamza Fareed = C,E; Nadia Atiq=C,D,E; Inamullah Shah=C,D,E

Key for Contribution of Authors : A= Conception/ Study/ Designing /Planning; B= Experimentation/Study conduction;C=Analysis/Interpretation/ Discussion; D= Manuscript writing;E= Critical review;F= Facilitated for reagents/Material/Analysis