

INCIDENCE AND RISK FACTORS FOR EARLY SURGICAL SITE INFECTION IN ELECTIVE ORTHOPAEDIC IMPLANT SURGERIES: A PROSPECTIVE STUDYSuneet Tandon¹, Abhishek Pathak², Santosh Kumar Mishra³, Mayank Vijayvargiya⁴**HOW TO CITE THIS ARTICLE:**

Suneet Tandon, Abhishek Pathak, Santosh Kumar Mishra, Mayank Vijayvargiya. "Incidence and Risk Factors for Early Surgical Site Infection in Elective Orthopaedic Implant Surgeries: A Prospective Study". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 15, February 19; Page: 2525-2531, DOI: 10.14260/jemds/2015/364

ABSTRACT: BACKGROUND: Surgical site infections in orthopaedic implant surgery is devastating complication range from 1-2% to 22%. It leads to increase case cost, prolongs antibiotic use/abuse, increases morbidity and rehabilitation. **METHOD:** This prospective cross sectional study was conducted on 624 patients with closed fracture cases undergoing clean and elective orthopaedic implant surgeries admitted at Gandhi Medical College and Hamidia Hospital, Bhopal (Madhya Pradesh), India between '1st November 2013 to 31st October 2014'. **RESULTS:** The surgical site infection was diagnosed in 43 (6.89%) patients within 30 days after surgery. Klebsiella was most common infective organism isolated in 39.53% cases. On data analysis SSI was significantly associated with increasing age, duration of hospital stay more than 7 days, duration of surgery more than 120 minutes, pre-operative Hb less than 12 gm%, diabetes mellitus, use of intra-operative negative suction and tourniquet. **CONCLUSION:** Incidence of SSI in implants surgeries are quite high, proper measure are needed to control it. In this study gram negative organism has emerged as major threat in contrast to staphylococcus aureus.

KEYWORDS: Surgical site infection, orthopaedic surgery, risk factors.

INTRODUCTION: Surgical site infection is an infection that develops within 30 days after an operation or within one year if an implant was placed and infection appears to be related to the surgery.⁽¹⁾ Surgical site infection in orthopaedic implant surgery is devastating complication for both patient and surgeon. Infection is a common post-operative event with incidence ranging from 1-2% to 22 % after orthopaedic implant surgeries.⁽²⁻⁴⁾ Infection in orthopaedics increase case cost by 300% prolongs antibiotic use, increases morbidity and rehabilitation.⁽⁵⁾ Infection in implant surgeries is very difficult to eradicate, because implants provide surfaces for bacterial adherence & formation of biofilm that inhibits penetration of antibiotics.⁽⁶⁾ Main risk factors for occurrence of infection are advanced age, diabetes, smoking, malnutrition, obesity, immune impairment, rheumatoid arthritis, infection in other part of body and anemia.⁽⁷⁾

An early SSI present within 30 days of surgical procedure, where as an infection is described as intermediate if it occurs between one and three months and late if it develops more than three month after surgery.⁽⁸⁾ Early infections are mainly caused by highly virulent microorganisms eg. Staphylococcus aureus and gram negative bacilli, while delayed and late SSI are caused by low virulence microorganism like coagulase-negative staphylococci.⁽⁹⁾ The purpose of this study to evaluate incidence of post-operative wound infection, to evaluate risk factor associated with SSI, to know spectrum of organism in clean orthopaedic implant surgeries.

MATERIAL AND METHODS: This prospective study was conducted at Gandhi Medical College and Hamidia Hospital, Bhopal (Madhya Pradesh), India between '1st November 2013 to 31st October

ORIGINAL ARTICLE

2014'. 624 patients with closed fracture cases undergoing elective orthopaedic implant surgery were included in this study. Patient undergoing soft tissue surgeries, cases with compound injury planned for external or internal fixation, non-implant surgeries and cases operated in emergency were excluded. Predesigned patient proforma was used for recording patients information. All surgeries were performed in well-equipped operation theatre using autoclaved surgical instruments, implants and drapes, gowns.

A standard pre-operative preparation and institute antibiotic protocol was followed for all patients. For each patient 3rd generation cephalosporin was given 30 minute prior to surgical incision. If procedure was lasted for more than two hours antibiotic dose was repeated. Post-operatively if any wound was found to be infected discharge was collected in sterile container and immediately sent for bacteriological culture and antibiotic sensitivity. All patients were followed up to 30 days after surgery for evaluation of post-operative wound and any evidence of infection.

RESULTS: Out of total 624 patients, 43 (6.89%) patients developed SSI within 30 days of surgery. Out of these infected patients, 38 (88.37%) were male and 5 (11.63%) female. In this study klebsiella was most commonly isolated organism in 39.53% cases followed by e. coli in 18.60% cases. staphylococcs aureus was most common gram positive organism isolated causing SSI. Staphylococcus aureus was isolated in 16.28% infected cases. Pseudomonas (13.95%), proteus (2.33%), group D streptococci (2.33%) and non-lactose fermenting gram negative organism (2.33%) were also isolated. On univariate analysis statistically significant association of surgical site infection was found with age more than 60 years (P=0.019), duration of hospital stay more than 7 days (P=0.007), duration of surgery more than 120 minutes (P=0.001), pre-operative Hb less than 12 gm% (P=0.001), diabetes mellitus (P=0.032), intra-operative use of negative suction (P=0.047) and use of tourniquet (P=0.0008). In this study use of diathermy (P=0.032) and negative suction drain (P=0.034) was associated with reduction in infection rate.

DISCUSSION: Of the 624 patients in this study, the overall incidence of surgical site infection was 6.89%, similar result was found in study by K. S. Dhillon et al⁽¹⁰⁾ they found infection rate 6.8% while I. Onche et al⁽¹¹⁾ found 7.5 % and N. E. Ngim et al⁽¹²⁾ found 9.38% infection rate. In this study gram negative organism was most commonly isolated in infected cases. Klebsiella was most commonly isolated organism in 39.53% cases followed by E coli in 18.60% cases. Staphylococcs aureus was isolated in 16.28% infected cases. I. Onche et al,⁽¹¹⁾ B. K. Das et al,⁽¹³⁾ Khan MS et al⁽¹⁴⁾ and C. Edwards⁽¹⁵⁾ found staphylococcus aureus as main infecting organism in clean orthopaedic surgeries. While L. T. A Thu et al⁽¹⁶⁾ isolated gram negative organism in 79.1% cases and Patkar R et al⁽¹⁷⁾ isolated gram negative organism in 70.27% cases. This result may be fact that in healthy humans, klebsiella is a commensal in the colonic flora. Gram negative bacteria only transiently colonize the oropharynx and skin of healthy individuals. In contrast, in hospital settings, these bacteria become dominant flora of both mucosal and skin surfaces, particularly in association with antimicrobial use, severe illness, and extended length of stay. This colonization may lead to subsequent infection.

In this study significant (p=0.019) increase in incidence of SSI with advancing age was observed. Patients aged more than 60 years most commonly developed SSI. UOE Ikeanyi et al⁽¹⁸⁾ reported that increasing age greater than 60 years was a significant risk factor for surgical site infection. Stephen Apanga et al,⁽¹⁹⁾ Aikaterini Masagala et al,⁽²⁰⁾ Ibtesam K Afifi et al,⁽²¹⁾ A.L. Akinyoola

ORIGINAL ARTICLE

et al⁽²²⁾ and Khan MS et al⁽¹⁴⁾ also reported that SSI is common in old aged patient. It may be because of low immunity, increasing catabolism, increasing co-morbidities and low wound healing rates in old age patients.

Statistically significant association of diabetes mellitus (p value-0.032) was found with SSI. Yang K et al,⁽²³⁾ Ibtesam K Afifi et al,⁽²¹⁾ Aikaterini Masgala et al⁽²⁰⁾ and Guo-qing et al⁽²⁴⁾ found that diabetes mellitus as independent risk factor with significant increase in the development of SSI. Delayed wound healing and neutrophil dysfunction (median threshold for neutrophil dysfunction-at blood sugar level 200mg/dl) may be the cause of increasing SSI among diabetics.⁽²⁴⁾ Incidence of SSI was more common among patients having Hb less than 12gm% (p value-0.001). Similar result was found by Dunne JR et al.⁽²⁵⁾ In this study statistically significant (p value-0.007) association was seen between increased incidence of SSI & longer duration of hospital stay. Patients with pre-operative hospital stay more than 7 days have developed SSI in 9.68% cases. UOE Ikeanyi et al⁽¹⁸⁾ reported that prolong duration of hospital stay greater than 13 days was associated with 21% infection rate. Stephen Apanga et al,⁽¹⁹⁾ Aikaterini Masgala et al,⁽²⁰⁾ A. L. Akinyoola et al,⁽²²⁾ C. Edwards et al⁽²⁶⁾ and Otieno et al⁽²⁷⁾ noted that longer pre-operative hospital stay adversely affect the surgical wound outcome. It is due to longer pre-operative hospital stay causes colonization of multidrug resistant micro-organism over patient's skin.

In this study highly statistically significant association was found between duration of surgery and surgical site infection. There is gradual increase in incidence of SSI in patients operated for longer duration. Guo-qing et al⁽²⁴⁾ found that duration of surgery longer than 3 hours was crucial risk factor in development of surgical site infection. Ibtesam K Afifi et al⁽²¹⁾ reported SSI was significantly associated with duration of surgery more than 2 hours. Similarly A. L. Akinyoola et al,⁽²²⁾ Muhammad Shoaib Khan et al,⁽²⁸⁾ Khan MS,⁽¹⁴⁾ L. T. A. Thu et al⁽¹⁶⁾ and Otieno et al⁽²⁷⁾ found that post-operative surgical site infection was more common in patients with prolong surgery time.

This study shows that use of urinary catheter & development of SSI has no statistical significance correlation (p value-0.132). Similar result was found with study by Colin Haines et al.⁽²⁹⁾

In this study intra-operative use of negative suction was important risk factor for SSI. Panagiotis Givissis et al⁽³⁰⁾ reported that intra-operative use of negative suction may be source of infection and suction catheter tip contamination can occur due to airborne and directly by members of the operation theatre. In present study statistically significant (p value-0.034) decrease in incidence of SSI with use of negative suction drain was found. This result may be due to use of negative suction drain reduces hematoma formation at surgical site and thus inhibiting fibrosis and reducing risk of SSI.⁽³¹⁾

In this study intra-operatively use of tourniquet was a risk factor to develop SSI. It was seen that 10.88% patients in whom intra-operative tourniquet was used developed SSI, in comparison to 5.10% patients developing SSI on whom no tourniquet was used. Infecting micro-organism which resides in tourniquet may be associated with SSI in patients in whom intra-operative tourniquet was used.⁽³²⁾ In this study statistically significant association (p value-0.032) was found with use of diathermy & reduction of SSI. This may be because of use of diathermy intra-operatively reduces blood loss, post-operative wound ooze and thus reduces infection rate⁽³³⁾. There were some limitations in our study. We have followed post-operative patients for only 30 days, but in implant surgeries infection can develop 1year long after surgery.

ORIGINAL ARTICLE

CONCLUSION: Surgical site infection is inevitable in orthopaedic procedures in spite of use of broad spectrum antibiotic, well sterilized operation theater. The possible risk factors are age more than 60 years, longer duration of pre-operative hospital stay, longer duration of surgery, anemia, diabetes mellitus, use of intra-operative negative suction and tourniquet. In this study gram negative organism has emerged as major threat in contrast to staphylococcus aureus. Point of intervention could be pre-operative correction of anemia, control of blood sugar level, reduction in pre-operative hospital stay and duration of surgery.

REFERENCES:

1. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. *Infect Control Hosp Epidemiol.* 1992 Oct; 13 (10): 606-8.
2. Kathryn B. Kirkland, Jane P. Briggs, Sharon L. Trivette, William E. Wilkinson, Daniel J. Sexton. The Impact of Surgical-Site Infections in the 1990s: Attributable Mortality, Excess Length of Hospitalization, and Extra Costs. *Infect Control Hosp Epidemiol* 1999; 20: 725-730.
3. Elie F. Berbari, Arlen D. Hanssen, Mary C. Duffy, James M. Steckelberg, Duane M. Ilstrup, William S. Harmsen, and Douglas R. Osmon. Risk Factors for Prosthetic Joint Infection: Case-Control Study. *Clinical Infectious Diseases* 1998; 27: 1247-54.
4. Jadranka Maksimovic, Ljiljana Marković-Denić, Marko Bumbaširević, Jelena Marinković, Hristina Vlajinac. Surgical Site Infections in Orthopedic Patients: Prospective Cohort Study. *Croat Med J.* 2008; 49: 58-65.
5. Knobben BAS, Van Horn Jr, Van Der Mei HC, Busscher HJ. Evaluation of measure to decrease intra-operative bacterial contamination in orthopaedic implant surgeries. *J Hosp infect.* 2006; 62 (2): 74-80.
6. Trampuz A, Osmon DR, Hanssen AD, et al. Molecular and antibiofilm approaches to prosthetic joint infection. *Clin Orthop* 2003; 414:69-88.
7. Moucha CS, Clyburn T, Evan RP, Prokuski L. modifiable risk factors for surgical site infection. *J Bone Joint Surg Am.* 2011; 93 (4): 398-404.
8. Peel ALG. Definition of infection. In: Taylor EW, editor. *Infection in surgical Practice.* Oxford: Oxford University Press, 1992; 82-87.
9. Willenegger H, Roth B, Treatment tactics and late results in early infection following osteosynthesis. *Unfallchirurgie* 1986; 12: 241-246.
10. K S Dhillon, C S Kok. The incidence of post-operative wound infection in orthopaedic surgery. *Med. J. Malaysia* 1995 Sep; 50 (3): 237-40.
11. I. Onche and O. Adedeji. Microbiology of post-operative wound infection in implant surgery. *Nigerian Journal of Surgical Research* Vol. 6, No. 1 - 2, 2004: 37 - 40.
12. N. E. Ngim, A. J. Etokidem, I. A. ikpeme, A. M. Udosen. Surgical site infection in clean orthopaedic operations: experience from the third world. *Asian J Med Cli Sci* Jan -Apr 2013 Vol-2 Issue- 1.
13. B.K. Das & Arti Kapil. Bacteriology of orthopaedic wound infections in Indian Tertiary Care Hospital. *Indian J Med Res* 121, June 2005, pp 784-785.
14. Khan MS, Rehman S, Ali MA, Sultan B, Sultan S. J. Infection in orthopedic implant surgery, its risk factors and outcome. *J Ayub Med Coll Abbottabad*, 2008 Jan-Mar; 20 (1): 23-5.

ORIGINAL ARTICLE

15. C. Edwards, A. Counsell, C. Boulton, C. G. Moran. Early infection after hip fracture surgery. *Journal of Bone and Joint Surgery - Series B*, Jun 1 2008.
16. L.T.A. Thu, M.J. Dibley, B. Ewald, N.P. Tien, L.D. Lam. Incidence of surgical site infections and accompanying risk factors in Vietnamese orthopaedic patients. *Journal of Hospital Infection* (2005) 60, 360–367.
17. Patkar R, Kishore A, Baveja S, De A. Study of surgical site infection amongst orthopedic patients in a tertiary care hospital. RP 1176; 5 October 2013, page 1-4.
18. UOE Ikeanyi, CN Chukwuka, TOG Chukwuanukwu. Risk factors for surgical site infections following clean orthopaedic operations. *Nigerian Journal of Clinical Practice* Oct-Dec 2013 Vol. 16 Issue 4.
19. Stephen Apanga¹, Jerome Adda¹, Mustapha Issahaku, Jacob Amofa, Kuewu Rita Ama, Mawufemor, Sam Bugr. Post-Operative Surgical Site Infection in a Surgical Ward of a Tertiary Care Hospital in Northern Ghana. *Int J Res Health Sci*. 2014 Jan 31; 2(1): 207-12.
20. Aikaterini Masgala, Efstathios Chronopoulos, Georgios Nikolopoulos, John Sourlas, Stergios Lallos, Emmanuel Brilakis, John Lazarettos, Nikolaos Efstathopoulos. Risk Factors Affecting The Incidence Of Infection After Orthopaedic Surgery: The Role Of Chemoprophylaxis. *Cent Eur J Public Health* 2012; 20 (4): 252–256.
21. Ibtesam K Afifi, Ehssan A Baghagho. Three months study of orthopaedic surgical site infections in an Egyptian University hospital. *International Journal of Infection Control*, 2010, v6:i1.
22. A.L. Akinyoola, O.O. Adegbehingbe And O.J. Ogundele. Factors influencing the outcome of elective paediatric orthopaedic operations in Ile-Ife, Nigeria. *Tanzan J Health Res* 2008 Apr; 10 (2): 68-72.
23. Yang K, Yeo SJ, Lee BPH, Lo NN. Total Knee Replacements In Diabetic Patients, A Study Of 109 Consecutive Cases. *J arthroplasty*, 2001; 16: 102-106.
24. Guo-qing Li, Fang-fang Guo, Yang Ou, Guang-wei Dong, Wen Zhou. Epidemiology and outcomes of surgical site infections following orthopedic surgery. *AJIC*. December 2013 Volume 41, Issue 12, Pages 1268–1271.
25. Dunne JR, Malone D, Tracy JK, Gannon C, Napolitano LM. Perioperative anemia: an independent risk factor for infection, mortality, and resource utilization in surgery. *J Surg Res*. 2002 Feb; 102 (2): 237-44.
26. C. Edwards, A. Counsell, C. Boulton, C. G. Moran. Early infection after hip fracture surgery. *Journal of Bone and Joint Surgery - Series B*, Jun 1 2008.
27. Otieno, Oliver Soren (URI: <http://hdl.handle.net/10570/239>).
28. Muhammad Shoaib Khan, Saif ur Rehman, Mian Amjad Ali, Babar Sultan, Shahid Sultan. Infection In Orthopedic Implant Surgery, Its Risk Factors And Outcome. *J Ayub Med Coll Abbottabad* 2008; 20(1).
29. Colin Haines, Zachary Na Pier, Aaron Roberts, Kathleen Boyle, Warren Yu and Joseph O'Brien. A Comparison of Urinary Tract and Surgical Site Infection Rates in Anterior Cervical Discectomy and Fusion with and without Urinary Catheterization. *JSM Neurosurg Spine* 2(4): 1031 (2014).

ORIGINAL ARTICLE

30. Panagiotis GIVISSIS, Dimitrios KARATAGLIS, Petros ANTONARAKOS, Panagiotis D. SYMEONIDIS, Anastasios CHRISTODOULOU. Suction during orthopaedic surgery. How safe is the suction tip?. *Acta Orthop. Belg.*, 2008, 74, 531-533.
31. Waugh T.R. Stinchfield F.E. suction and drainage in orthopaedic wounds. *J.Bone Joint surg*; 1961, 43-A, 939-946.
32. Stephen A Brennan, Raymond J Walls, Elizabeth Smyth, Talal Al Mulla, and John M O'Byrne. Tourniquets and exsanguinators: a potential source of infection in the orthopedic operating theater. *Acta Orthopaedica* 2009; 80 (2): 251–255 251.
33. Kearns SR, M Gilmore, JP McCabe, K Kaar and W Curtin. Diathermy versus Scalpel Incisions for Hemiarthroplasty: A Randomized Prospective Trial. *J Bone Joint Surg Br* 2004 vol. 86-B no. SUPP II 129.

Risk factors	Number of patients with SSI	Number of patients without SSI	P value
Age >60 years	14(12.38%)	99(87.61%)	0.019
Male	38(7.7%)	451(92.22%)	0.099
Female	5(3.7%)	130(96.29%)	0.099
Duration of hospital stay more than 7 days	31(9.68%)	289(90.31%)	0.007
Duration of surgery more than 120 minutes	10(21.73%)	36(78.26%)	0.001
Pre-operative Hb less than 12 gm%	35(11.67%)	265(88.33%)	0.001
Diabetes Mellitus	4(22.22%)	14(77.78%)	0.032
Pre-operative urinary catheterization	30(6.02%)	468(93.97%)	0.132
Negative suction used	23(9.66%)	215(90.33%)	0.047
Negative suction drain	12(4.31%)	266(95.68%)	0.034
Diathermy	12(4.3%)	267(95.69%)	0.032
Tourniquet	21(10.88%)	172(89.11%)	0.0008

Table 1: Association of risk factors and surgical site infection

ORIGINAL ARTICLE

AUTHORS:

1. Suneet Tandon
2. Abhishek Pathak
3. Santosh Kumar Mishra
4. Mayank Vijayvargiya

PARTICULARS OF CONTRIBUTORS:

1. Associate professor, Department of Orthopaedics, AOAIISM.
2. Associate Professor, Department of Orthopaedics, Gandhi Medical College and Hospital, Bhopal, Madhya Pradesh, India.
3. Resident, Department of Orthopaedics, Gandhi Medical College and Hospital, Bhopal, Madhya Pradesh, India.

FINANCIAL OR OTHER

COMPETING INTERESTS: None

4. Resident, Department of Orthopaedics, Gandhi Medical College and Hospital, Bhopal, Madhya Pradesh, India.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Suneet Tandon,
Department of Orthopedics,
Gandhi Medical College,
Bhopal, Madhya Pradesh-462001, India.
E-mail: doctorskmishra@gmail.com

Date of Submission: 04/02/2015.

Date of Peer Review: 05/02/2015.

Date of Acceptance: 12/02/2015.

Date of Publishing: 18/02/2015.