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CLINICAL AUDIT OF IMPLANT-ASSOCIATED SURGICAL SITE INFECTIONS, BACTERIAL ISOLATES, ANTIBIOTIC SUSCEPTIBILITY, AND ASSOCIATED RISK FACTORS IN POSTOPERATIVE ORTHOPEDIC PATIENTS AT A TERTIARY CARE HOSPITAL, NEPAL

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Abstract

Background: Implant-associated surgical site infections (SSI) are important complications of orthopedic surgery influenced by multiple host-related and external risk factors. This study aimed to identify clinical features, bacterial pathogens, and their antimicrobial susceptibility patterns. **Methods:** A prospective descriptive observational study was conducted in the Orthopedic Department of Janaki Medical College, Ramdaiya, Dhanusha, Nepal. A total of 74 operated patients were included. Clinical features and potential risk factors were documented. Samples from infected implant surgical sites were cultured on MacConkey and blood agar. Bacterial isolates were identified using Gram staining and biochemical tests. Antimicrobial susceptibility was assessed using the Kirby–Bauer disc diffusion method. Data were analyzed using frequencies and percentages. **Results:** Among 74 participants, eight (10.8%) had positive bacterial cultures. Gram-negative organisms accounted for 6/8 (75%), while Gram-positive organisms accounted for 2/8 (25%). *Escherichia coli* was the predominant pathogen (75%). *E. coli* showed 100% sensitivity to piperacillin-tazobactam, cefoperazone, and levofloxacin, and 75% sensitivity to amikacin and ofloxacin. Pain (91.9%), tenderness (91.9%), redness (75.7%), and swelling (59.5%) were the predominant clinical features. Older age, diabetes, smoking, alcohol consumption, and socioeconomic factors were among the potential risk factors. **Conclusion:** Implant-associated SSI remains an important complication of orthopedic surgery. Clinical assessment, appropriate wound care, microbiological investigation, and culture-guided antibiotic therapy are essential for effective management. Strict aseptic surgical techniques and rational antibiotic use may reduce infection rates and hospital stays. Findings should be interpreted cautiously because of the limited number of positive cultures and single-centre design.

Keywords: *Implant associsted surgical site infections, Orthopedic Surgeries, antibiotics susceptibility test, anti-bacterial agents, Bacterial classification.*

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INTRODUCTION

Pin site infection is the most common complication and often a limiting factor associated with external fixators [1]. Risk factors associated with pin site infection are poorly understood but most certainly multifactorial [2]. Intrinsic (host, age, smoking etc.) as well as extrinsic (construct of fixators, duration of an applied external fixators pin placement etc.) factors seem to affect the risk of pin site infection in a complex way3. Several authors states that prevention starts in the operating theater with proper surgical technique [1,4]. Aseptic no touch wire handling, irrigation of pilot holes to remove debris, no wire or pin drilling through soft tissue, use of soft tissue

protection sleeves when drilling, proper skin incisions and heat prevention by continuous saline cooling, no use of tourniquet , predrilling, stop and start drilling, and pin insertion by hand have all been proposed as techniques to lower the risk of pin site infection [3-5]. Most Pin site infections are treatable with improved wound care and a short course of oral antibiotics6. Surgical site infection(SSI) appear in the postoperative period that occurs within 90 days of post operative procedure in case of metallic implant insertion [7]. The aim of this study was to find out reliable clinical tools, identification and anti- bacterial sensitivity pattern and risk factors. Thus, this study is necessary to conduct in context of local region in Dhanusha district, Nepal.

METHODS

Study type and site

Prospective descriptive observational study was conducted in Orthopedic department of Janaki Medical College, Ramdaiya, Dhanusha, a Tertiary Care Hospital of Nepal. All operated cases in orthopedic department from 2nd day of stay were included in the study.

Sample size determination:

Sample size(S) = z2xpxq/d2
Where q=1-p
P=0.05
Z2= 3.84
d= 5%
S= 73

Inclusion criteria

Any patients from 2nd day of admission

Exclusion criteria

Patients clinically viral and fungal infected and not giving either verbal or written consent.

METHODOLOGY

Clinical symptoms and signs were collected. Each implant associsted surgical site was first washed with sterile gauze piece soaked with sterile normal saline gently. Sterile swab was either rubbed on apparently healthy wound or of infected wound from the previous healthy living tissues and immediately transferred to nutrient broth. The swab was kept for at least 3 hours at 370C. Sub-culture was done on Blood and MacConkey Agar plates and incubated at 370C over 48 hours. Gram stain was done and bacteria were classified. Further identification of bacteria was made with biochemical methods from isolated colonies. Anti-bacterial sensitivity test was done. Antibiotic susceptibility testing of bacterial isolates was done by Kirby Bauer disc diffusion method by Microbiologist. Data of clinical profiles was collected and analysed. Statistical analysis was done by using SPSS version 25. Frequency and percentages were calculated.

Ethical Consideration: Ethical approval was obtained from the Ethical Review Committee of Janaki Medical College, Ramdaiya, Dhanusha, Nepal, before commencement of the Study (Ref. 024/IRC-JMC/2024/018).

Study duration: The Study was conducted over 1 and half year from 26th Nov. 2024 to 10th May 2026.

Consent: Verbal and or written consent was taken from all eligible patients.

RESULTS

Table 01: Socio-demographic features of participants (n=74)

Characters		Frequency	Percent
Gender	Female	25	33.8
	Male	49	66.2
Age	<15	15	20.3
	15-35	25	33.8
	35-55	17	22.9
	55-75	14	18.9
	>75	3	4.1
District	Dhanusha	58	78.4
	Mahottari	10	13.5
	Sarlahi	4	5.4
	Siraha	2	2.7
Marital status	Married	56	75.7
	unmarried	18	24.3
religion	Hindu	72	97.3
Caste	Chhetri	4	5.4
	Dalit	8	10.8

	Janjati	32	43.2
	Muslim	4	5.4
	Tharu	2	2.7
	TMOC	24	32.4
Co-morbidity	Bronchiectesis	2	2.7
	Bronchitis	2	2.7
	DM-II	8	10.8
	HTN	2	2.7
	None	60	81.1
Education	Bachelor	4	5.4
	Intermediate	6	8.1
	None	30	40.5
	play group	6	8.1
	Primary	16	21.6
	Secondary	12	16.2
Occupation	bussiness	6	8.1
	carpenter	4	5.4
	Farmer	24	32.4
	general worker	2	2.7
	housewife	8	10.8
	Job	4	5.4
	mason labour	2	2.7
	Mason	2	2.7
	play group	4	5.4
	Retired	10	13.5
	Student	6	8.1
	Teacher	2	2.7
Injury Site	Femur	11	14.9
	Iliotibial band	5	6.8
	Tendon	5	6.8
	Forearm	4	5.4
	Humerus	13	17.5
	Tibia	6	8.1
	Clavicle	4	5.4
	Metacarpal	6	8.1
	Tibio-fibula	4	5.4
	Radio-ulna	1	1.3
	Hipbone	2	2.7
	Implant removal	5	6.8
	Knee joint	4	5.4
	Foot injury	4	5.4
Socio-economic Status	Low	10	13.5
	middle class	64	86.5
Anti-biotic use	None	4	5.4
	Yes	70	94.6
OTC drugs	None	16	21.6
	Yes	58	78.4
Alcohol	None	64	86.5
	Yes	10	13.5
Smoking	None	58	78.4
	Yes	16	21.6
Economic source	Enough	58	78.4
	Poor	16	21.6
Residency	Concrete	50	67.6
	non-concrete	24	32.4
Traditional healer	None	42	56.8
	Yes	32	43.2
Vaccination	None	44	59.5
	Yes	30	40.5

Vehicle use	ambulance	12	16.2
	Bike	20	27.0
	Bus	18	24.3
	Jeep	2	2.7
	None	6	8.1
	Tempoo	16	21.6
Lab test interest	None	12	16.2
	Yes	62	83.8
Vector/carrier (mosquito/flies)	Both	74	100.0
Disease concept	None	28	37.8
	Yes	46	62.2
Site of injury	Soft tissue injury	2	2.7
	Femur	22	29.7
	Foot	8	10.8
	Hand	4	5.4
	Hip	2	2.7
	Humerus	12	16.2
	Radio-ulnar	2	2.7
	Shoulder	4	5.4
	Tendon	6	8.1
	Tibia	8	10.8
	Tibio-fibular joint	4	5.4
Drinking water	handpump	56	75.7
	tap water	4	5.4
	Well	14	18.9
Washing water	handpump	56	75.7
	tap water	4	5.4
	Well	14	18.9
Sanitary latrine	None	8	10.8
	Yes	66	89.2
Sanitary barrier	None	24	32.4
	Yes	50	67.6
Waste disposal	None	20	27.0
	Yes	54	73.0
Air pollution	None	24	32.4
	Yes	50	67.6
Diet pattern	non-veg	70	94.6
	Veg	4	5.4
Milk/Meat	Both	70	94.6
	Milk	4	5.4
Preservative food	None	16	21.6
	Yes	58	78.4
Roasted Food	None	12	16.2
	Yes	62	83.8
Food adulteration	None	14	18.9
	Yes	60	81.1
Balanced Diet	None	6	8.1
	Yes	68	91.9
Domestic sanitation	None	8	10.8
	Yes	66	89.2
Garbage disposal	None	10	13.5
	Yes	64	86.5
Safe Kitchen	No	4	5.4
	Yes	70	94.6
Personal Hygiene	None	2	2.7
	Yes	72	97.3
Pet animals	None	32	43.2
	Yes	42	56.8

Cooking methods	Gas	30	40.5
	Wood	10	13.5
	wood/gas	34	45.9
Immunosuppression	None	74	100.0
Herd Immunity	None	4	5.4
	Yes	70	94.6
Familial Co-morbidity	Bronchitis	2	2.7
	DM II	8	10.8
	HTN	4	5.4
	None	60	81.1
Malnutrition	None	74	100.0
Obesity	None	74	100.0
Pre-op infection	None	74	100.0
Blood transfusion	None	60	81.1
	Yes	14	18.9
Hypoxia	None	70	94.6
	Yes	4	5.4
Peri-op hyperthermia	None	74	100.0
Anti-coagulants	None	74	100.0
Post-OP hyperglycemia	None	74	100.0
Total		74	100.0

Table 01 presents the socio-demographic, behavioral, environmental, dietary, and selected clinical characteristics of the 74 study participants. Of the total participants, 49(66.2%) were male and 25 (33.8%) were female. Most occurrence age group falls under 15-35 class interval. The average duration of surgery was approximately 2 hours. Most participants were from Dhanusha district (78.4%), followed by Mahottari (13.5%). The majority were married (75.7%), Hindu (97.3%), and belonged to the Janajati group (43.2%). Regarding education, 40.5% had no formal education, while 21.6% had primary and 16.2% had secondary education. Farming was the most common occupation (32.4%), and 86.5% belonged to the middle socioeconomic class.

Regarding comorbidities, most participants (81.1%) had no reported comorbidity, while diabetes mellitus type II was present in 10.8%. A large proportion reported prior antibiotic use (94.6%) and over-the-counter drug use (78.4%). Most participants did not report alcohol consumption (86.5%) or smoking (78.4%).

Most participants had concrete residences (67.6%), used hand-pump water for drinking and washing (75.7%), and had sanitary latrines (89.2%). Traditional healer use was reported by 43.2% of participants. Mosquitoes or flies were reported as potential vectors/carriers by all participants (100%).

Regarding dietary characteristics, 94.6% followed a non-vegetarian diet, 78.4% reported consumption of preserved foods, 83.8% consumed roasted foods, and 81.1% reported exposure to food adulteration. A balanced diet was reported by 91.9% of participants. Most participants also reported good personal hygiene (97.3%), safe kitchen practices (94.6%), and adequate domestic sanitation (89.2%).

The most frequent sites of injury were the femur (29.7%), followed by the humerus (16.2%), foot and tibia (10.8%) each, and tendon injuries (8.1%). Regarding transportation to the hospital, motorcycles (27.0%) and buses (24.3%) were the most commonly used means.

With respect to perioperative characteristics, 18.9% of participants received blood transfusion, while hypoxia was reported in 5.4%. None of the participants had documented immunosuppression, malnutrition, obesity, preoperative infection, perioperative hyperthermia, anticoagulant use, or postoperative hyperglycemia.

Several features of this population plausibly contributed to infection risk. Oder age, diabetes, smoking , alcohol consumption ,gender, education, low socioeconomic status ,roasted food, food adulteration, prior antibiotic use, high OTC drug consumption, and substantial reliance on traditional healers (43.2%)

Table 02: Systemic Features of participants with implant site infection (n=74)

Systemic features		**Frequency**	**Percent**
Fever	none	64	86.5
	yes	10	13.5
Headache	none	70	94.6
	yes	4	5.4
Vomiting	none	74	100.0
nausea	none	74	100.0
Malaise	none	72	97.3
	yes	2	2.7

Anorexia	none	72	97.3
	yes	2	2.7
Delirium	none	74	100.0
Pain	Yes	68	91.9
	No	6	8.1
	Total	74	100.0

Table 02 presents the systemic features observed among the 74 study participants with respect to implant-site infection. Pain (91.9%) was the most frequently reported systemic feature, then after occurring fever in 10 (13.5%) participants. Headache was reported in 4 (5.4%) participants. Malaise and anorexia were each reported in 2 (2.7%) participants. No participants reported vomiting, nausea, or delirium. Overall, systemic manifestations were relatively uncommon in the study population, suggesting that most participants with implant associated surgical site infection had localized rather than systemic clinical features.

Table 03: Local clinical signs in the site (n=74)

Local site features		n	%
Redness	none	18	24.3
	yes	56	75.7
Tenderness	none	6	8.1
	yes	68	91.9
Swelling	none	30	40.5
	yes	44	59.5
Itching	none	62	83.8
	yes	12	16.2
Discharge	none	52	70.3
	yes	22	29.7
Smell	none	64	86.5
	yes	10	13.5
	Total	74	100.0

Table 03 shows the local clinical signs of implant-site infection among the 74 study participants. Tenderness was the most common local feature, reported in 68 (91.9%) participants, followed by redness in 56 (75.7%) and swelling in 44 (59.5%). Discharge from the implant site was observed in 22 (29.7%) participants.

Less frequent findings included itching in 12 (16.2%) participants and an unpleasant smell in 10 (13.5%) participants. Overall, systemic features includes pain, fever and headache while tenderness, redness, and swelling were the predominant local manifestations. Itching and foul smell were less commonly reported. These findings indicate that localized inflammatory signs were more prominent than systemic manifestations among the study participants.

Table 04: bacterial isolates distribution in implant associsted surgical site samples (n=74)

		Frequency	Percent
Bacterial Culture	No growth	66	89.2
	E. coli	6	8.1
	Staph. aureus	2	2.7
	Total	74	100.0

Table 04 presents the distribution of bacterial isolates identified from implant-site samples among the 74 study participants. Bacterial growth was detected in 8 (10.8%) samples, while 66 (89.2%) samples showed no bacterial growth. Among the positive cultures, Escherichia coli was the predominant isolate, identified in 6 (8.1%) participants, followed by Staphylococcus aureus in 2 (2.7%) participants.

All Antibiotics are equipotent in Staph. aureus except AK while CXM is sensitive. Overall, the findings indicate that bacterial culture positivity was relatively low, with E. coli accounting for the majority (75.0%) of the positive bacterial isolates.

Table 05: Anti-biotic susceptibility pattern in positive isolate cultures (n=8)

Antibiotic	Positive cultures	Sensitivity
Amikacin	6	75
Ofloxacin	6	75
Levofloxacin	8	100
Ceftriaxone	4	50
Piperacillin-Tazobactam	8	100
Cefoperazone	8	100
Cefuroxime	2	25
Clindamycin	2	25
Linezolid	4	50
Amoxicillin-Clavulanic acid	2	25

Table 05 demonstrates the antibacterial susceptibility pattern of the bacterial isolates obtained from implant-site samples. Among the tested antibiotics, Levofloxacin (LE), Piperacillin-Tazobactam (PIP-T), and Cefoperazone (CPZ) showed the highest sensitivity with 100% of tested isolates being susceptible.

Moderate sensitivity was observed with Amikacin (AK) and Ofloxacin (OF), each showing 75% sensitivity. Ceftriaxone (CTR) and Linezolid (LZ) demonstrated 50% sensitivity. The lowest sensitivity was observed with Cefuroxime (CXM), Clindamycin (CD), and Amoxicillin-Clavulanate (AMXC), each showing only 25% sensitivity but 2 cases of Staph. aureus shows similar antibacterial activities except Cefuroxime which is found sensitive to them

Overall, the isolates demonstrated relatively higher susceptibility to Levofloxacin, Piperacillin-Tazobactam, and Cefoperazone, whereas susceptibility to cefuroxime, Clindamycin, and Amoxicillin-Clavulanate was comparatively low. These findings emphasize the importance of culture-based antibacterial susceptibility testing to guide appropriate antibiotic therapy in implant associated surgical site infections. Several features of this population plausibly contributed to infection risk. Oder age, diabetes, smoking , alcohol consumption ,gender, education, low socioeconomic status ,roasted food, food adulteration, prior antibiotic use, high OTC drug consumption, and substantial reliance on traditional healers (43.2%).

DISCUSSION

This descriptive study characterized the demographic, clinical, and microbiological profile of implant associated surgical site/post-operative wound infection among 74 orthopedic patients at a tertiary hospital in Dhanusha, Nepal.

This study deals the majority of the patients falls in the class interval of 15-35 yrs of age. The male covers 66.2% while female comprised of 33.8 i.e. nearly doubles the population of female and roughly one in ten patients had diabetes mellitus as co-morbidity. Overall, tenderness, redness, and swelling were the predominant local manifestations, This pattern mirrors the risk-factor profiles reported for surgical site infection (SSI) worldwide: older age, diabetes, and smoking are consistently identified as independent predictors of SSI after orthopaedic surgery, alongside prolonged operative time and emergency presentation8,9. A hospital-based Italian case–control study found diabetes similarly, smoking, and age to correlate with SSI development10. The femoral injury (29.7%) as the commonest [1].

This study deals the local signs as tenderness (91.9%),redness (75.7%) and swelling (59.5%) were most common, whereas systemic features like Pain(91.9%),fever (13.5%) and headache (5.4%) were comparatively usual, and features such as vomiting, delirium and anorexia were absent. The natural history of pin-tract/wound infection is also similar, in which most cases remain localised and only a minority progress to systemic or bone involvement [6].

This study deals only 10.8% of samples yielded bacterial growth (E. coli 8.1%, S. aureus 2.7%), while 89.2% were culture-negative. It contrasts with several other Nepalese studies, a tertiary-centre study of suspected orthopaedic infections in Lalitpur found a substantially higher culture-positivity rate at 47.7% [12]. and a retrospective cohort at Kathmandu's National Trauma Centre reported an orthopaedic SSI prevalence of 31.2%, with Staphylococcus aureus and Escherichia coli as the leading gram-positive and gram-negative isolates respectively [13]. The comparatively low yield in the present study may reflect empirical antibiotic exposure, as 94.6% of patients reported prior antibiotic use and 78.4% reported over-the-counter drug use, both of which can suppress culture positivity.

Usually Staphylococcus aureus (including S. epidermidis) is the leading pathogen, followed by Gram-negative organisms such as E. coli, Pseudomonas aeruginosa and Klebsiella species in pin-site infection [1,11,14]. In this study though, E. coli was more frequently isolated than S. aureus, a pattern that has been reported elsewhere in Nepal and resource-limited settings, where Enterobacterales frequently rival or exceed staphylococci as causes of orthopaedic wound infection [15,16]. This gram-negative predisposition can be linked to environmental and hygiene-related exposure, contaminated open wounds, poor perioperative asepsis, and/or community water/sanitation practices.

Isolates in this study showed most sensitivity to Piperacillin-Tazobactam, Cefoperazone and Levofloxacin (100%), moderate sensitivity to Amikacin and Ofloxacin (75%), and poor sensitivity to Cefuroxime, Clindamycin and Amoxicillin-Clavulanate (25%). This mirrors the broader regional picture of declining efficacy of older Penicillins and first/second-generation Cephalosporins against orthopaedic pathogens: the Kathmandu trauma-centre study reported Penicillin (29.8%-74.5%) and Cephalosporin(48.3%-57.1%) resistance across bacterial groups, with Fluorquinolones (25.7%-40.5%) and Aminoglycosides(17.3%-43.2%) comparatively more effective.16 Other Nepalese wound-infection studies have similarly documented high rates of methicillin resistance among S. aureus isolates and extended-spectrum β-lactamase production among Enterobacterales [17,18], reinforcing that empirical prophylaxis based on penicillins or first-generation Cephalosporins alone may be inadequate in this setting, and that local antibiograms should guide surgical antibiotic prophylaxis, with WHO guidance since that SSI prevalence in low- and middle-income countries runs several-fold higher than in high-income countries [19].

Several features of this population plausibly contributed to infection risk. Oder age, diabetes, smoking, alcohol consumption ,gender, education, low socioeconomic status ,roasted food, food adulteration, prior antibiotic use, high OTC drug consumption, and substantial reliance on traditional healers (43.2%) before presentation might have affected the overall outcome of patients as risk factors.These patterns are consistent with the broader literature on antibacterial stewardship gaps in South Asian community settings, where unsupervised or incomplete antibiotic courses are recognised drivers of resistant Enterobacterales and staphylococci [16,18].

LIMITATION OF THE STUDY

Small number culture-positive isolates (n=8), a single center study, patients mostly from Dhanusha district, Nepal, limit the data for generalization.

STRENGTH OF THE STUDY

The study identified the clinical features of implant associated surgical site infections, classification of bacteria and their antibacterial sensitivity pattern.

CONCLUSION

Implant associated Surgical site infection is one of the consequences of surgery, with bacteria playing major role in resulting systemic symptoms and local signs . Systemic symptoms include pain, fever and headache while tenderness, redness and swelling were local signs. E. coli (6/8)was more frequently isolated, and the isolates retained good in-vitro sensitivity to Levofloxacin, Piperacillin-Tazobactam, Cefoperazone, Ofloxacin and Amikacin, but poor sensitivity to

ceftriaxone and Linezolid acid. After that Staph. aureus(2/8) was isolated and found sensitive to similar Antibiotics except Amiikacin in place of which Cefuroxime was found sensitive.

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CONFLICT OF INTEREST

None of conflict of interest declared

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