Section: Orthopedics

Original Research Article

TO INVESTIGATE THE FACTORS AFFECTING SURGICAL SITE INFECTION IN PATIENT WHO UNDERWENT ORTHOPEDICS SURGERY AT ERA'S LUCKNOW MEDICAL COLLEGE AND HOSPITAL

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ABSTRACT

Background: Surgical site infections post orthopedic surgeries is a common and troublesome problem that is often common and results in added cost of treatment and prolonged hospitalization. **Aim:** We aimed to investigate the factors affecting surgical site infection in patient who underwent orthopedics surgery at Era's Lucknow Medical College and Hospital. **Result:** Mean age of the patients was 39.00±16.42 and ranged between 6 to 87 years. Majority of the patients were Males (69.7%).Hair removal was required in 81.5% of the patients and Drain was placed in 27.5%. Vacuum assisted closure (VAC) was applied in only 8 cases (4.5%). At first month follow-up, C-Reactive Protein (CRP), Hemoglobin and Total leucocyte count (TLC) were 15.25±16.02 mg/dL, 10.28±1.22 g/dL and 9127.07±1984.0 cell/mm3. Surgical Site Infection (SSI) was seen in 4 (2.2%) cases and significantly higher CRP, HbA1c and TLC were found in cases with SSI as compared to no-SSI patients. Among perioperative factors, a significant association was found between SSI incidence with Alcohol consumption, Smoking, elevated CRP at 1st, 3rd and 6th month follow- up and elevated HbA1c levels. **Conclusion:** Apart from older age, smoking and alcohol consumption are important risk factors for development of SSI. Further, HbA1c and CRP levels should be closely observed and might help in predicting development of SSI. VAC was demonstrated as the protective factor for wound healing.

INTRODUCTION

Surgical site infection (SSI) poses a significant challenge to national health, manifesting either at the incision site (superficial incisional SSI (SSSI) or deep incisional SSI (DSSI)) or as an organ or space infection (OS-SSI). This pervasive issue impacts approximately 500,000 individuals in the United States annually, making it the second most common nosocomial infection. SSI represents 40% of all healthcare-related infections in surgical patients.[1,2,3,4] The repercussions of SSI are profound, extending beyond the immediate health implications. Patients affected by SSI often experience prolonged hospital stays, elevated readmission rates, diminished quality of life, and substantial healthcare costs. As a result, SSI stands as a crucial parameter in the evaluation of medical safety.[5,6]

A surgical incision, an inherent component of all surgical procedures, introduces a vital element into healthcare scenarios. Despite the complexity of surgical interventions, a substantial portion of associated risks for patients is intrinsically tied to the healthcare environment. A staggering 77% of surgical patient deaths are attributed to infections, with a direct correlation to open surgical wounds.[7]

Surgical site infection (SSI) stands out as the predominant healthcare-associated infection among surgical patients. It serves as the primary catalyst for one-third of post-operative deaths, contributing to 8% of all fatalities resulting from nosocomial infections.[8,9,10] The spectrum of complications stemming from SSI varies from mild cases necessitating local wound care and antibiotics to severe instances requiring multiple reoperations and exhibiting a high mortality rate. These complications frequently lead to prolonged hospitalization, significantly escalating the overall cost of patient care.[11,12]

Surgical site infection (SSI) assumes a particularly dire significance in orthopedic practice due to the inherent challenges in eradicating infections from bones and joints, often resulting in prolonged delays in the return to normal functional levels. Despite notable advancements in surgical techniques, the integration of modern technologies in the operating

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room, and the implementation of precautions such as perioperative intravenous antibiotics and pre-surgery skin antisepsis, orthopedic surgeries remain susceptible to SSI.

The Center for Disease Control and Prevention defines Surgical site infection as a "wound infection that occurs within 30 days of an operative procedure or a year if an implant is left in place, and the infection is thought to be secondary to surgery".[13] While many surgical site infections are preventable through these advanced measures, they persist as the most common healthcare-associated infections, arising in 1%-3% of all surgical procedures.[14] Despite their preventable nature, surgical site infections contribute significantly to patient discomfort, morbidity, and cost. They constitute over one-sixth of total hospital-acquired or nosocomial infections, imposing a substantial physical, psychological, and financial burden on both patients and healthcare systems.

Promoting appropriate wound care and expediting the wound healing process emerges as a crucial strategy in mitigating surgical site infections and their associated complications, thereby facilitating early recovery and reducing hospitalization duration.[15] Local and systemic factors contribute to this dynamic, encompassing both modifiable and non-modifiable elements.

Local factors, including hypothermia, pain, infection, radiation, and tissue oxygen tension, play a pivotal role in shaping the wound characteristics. The good news is that these local factors are amenable to modification through appropriate interventions and preventive strategies. Addressing issues such as hypothermia, managing pain effectively, preventing infections, and optimizing tissue oxygen tension can significantly influence the healing process.[16]

Moreover, the interplay of these local factors with systemic elements and other conditions such as nutritional status, age, and deficiencies in proteins, vitamins, and minerals collectively influences the overall healing ability. By recognizing and addressing both local and systemic factors through comprehensive interventions, healthcare professionals can enhance wound care, expedite healing, and ultimately reduce the risk of surgical site infections and related complications.

MATERIALS AND METHODS

All the patients fulfilling the inclusion criteria (Patients of all age groups, Patients who agreed to participate in this study, Patients who give consent) and exclusion criteria (All non-operative patients, Patients who underwent revision surgery, Already Infected patients, Patients lost to follow up, Individuals unwilling or unstable to give informed consent or withdrawal of consent, Patients with bone tumor and osteomyelitis), who underwent orthopedics surgery between January 2020 and January 2022 at Department of Orthopaedics, Era's Lucknow Medical College and Hospital, were included in the study after obtaining written and informed consent.

Study Participants - Patients who underwent orthopedic surgery between 1st January 2020 to 1st January 2022 after fulfilling the inclusion and exclusion criteria were included in the study.

Type of Study - Cross-Sectional Study.

Place of Study - Department of Orthopaedics, Era's Lucknow Medical College and Hospital Lucknow.

Period of study - 24 months.

Total Sample Size- 178

The sample size is calculated based on the Odds ratio of the risk factor with having maximum and minimum significant risk.

Research Question

What are the Predictors of postoperative infection in patients who underwent orthopedics surgery in ELMCH?

Objectives

Primary objectives

1. To determine the distribution of the predictors of surgical site infections (SSI) amongst patients undergoing Orthopedic surgery.
2. To determine the univariate and multivariate magnitude of the association of determinants of SSI infection and their confidence intervals.

Secondary objectives

1. To Highlight modifiable factors which decrease the risk of SSI and recommend including them in the management strategy.

Analysis

Demographic, clinical, radiological, preoperative, intraoperative, and postoperative data of patients were recorded in standardized proforma. All of these patients were followed up for 12 months and all necessary assessments were done and recorded on an Excel sheet. Univariate logistic regression analysis was used to evaluate the association between independent variables and the risk of SSI. Factors that were found to be significant ($p<0.05$) in the univariate analyses were entered into the multivariate logistic regression model to find out the adjusted association between risk factors and the risk of SSI. Odd ratio and 95% confidence interval were used to determine the association magnitude between each variable and the risk of SSI adjusted for confounding factors.

RESULTS

In the present study, we found that the majority of the patients were aged from 21 to 60 years. Age ranged from 6 to 87 years. Mean age was 39.00±16.42 years. The majority of the patients were males (69.7%). These findings of the present study present an interesting picture regarding the OPD at our tertiary center. SSIs were more common in the older age group. Table 1 and Table 9 demonstrate the demographic distribution and association between age and SSI status.

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Table 1: Demographic distribution of the study population (N=178)

Gender ratio (M:F): 2.3

SN	Age Group	No. of Patients	Percentage (%)
1	≤20 yrs	15	8.4
2	21-40 yrs	86	48.3
3	41-60 yrs	56	31.5
4	61-80 yrs	19	10.7
5	≥81 yrs	2	1.1
	Mean Age in years ±SD (Range): 39.00±16.42 (6.0-87.0)		
	Gender	No. of Patients	Percentage (%)
	Female	54	30.3
	Male	124	69.7

Age of the patients ranged from 6 to 87 years. Mean age was 39.00±16.42 years. Majority of the patients were Males (69.7%). The gender ratio was 2.3.

In the present study, according to the distribution on the basis of BMI, the higher incidence of SSI were among patients with BMI>30 kg/m^2. Table 2 and Table 9 demonstrate the demographic distribution and association between BMI and SSI status.

Table 2: Distribution of Nutritional Status (N=178)

SN	Nutritional Status (BMI)	No. of Patients	Percentage (%)
1	Underweight (≤18.5 kg/m^2)	12	6.7
2	Normal Weight (18.5-24.9 kg/m^2)	115	64.6
3	Overweight (25-29.9 kg/m^2)	41	23.0
4	Obese (≥30 kg/m^2)	10	5.6

Abbreviation: BMI (body mass index)

Mean BMI ±SD (Range) kg/m2: 23.25±3.68 (16.0-34.0)

BMI ranged from 16 to 30 kg/m2,mean BMI was 23.25±3.68 kg/m2. Majority of the patients were Normo weighted (64.6%), followed by Overweight (23.0%).

Among the patients 20.2% were Smokers, 20.0% consumed Alcohol and 12.3% had H/o Co-morbidities (12.3%).

In the present study, Mean HbA1c was 5.79±1.10 %. HbA1c ranged from 4 to 12%. Mean Hemoglobin was 11.56±1.33 g/dl. Mean TLC were 9308.12±2553.85. The higher incidence of SSI were found in patients with elevated HbA1C and TLC at early follow up and elevated HbA1C alone at late follow up. Table 9, Table 11, Table 13 and Table 14

Table 3: Distribution of Pre-op Laboratory Parameters (N=178)

SN	Laboratory Parameters	Min.	Max.	Mean	SD
1	HbA1c	4.0	12.0	5.79	1.10
2	Hemoglobin	7.8	16.1	11.56	1.33
3	Total Leucocyte count	1125.0	15800	9308.12	2553.85

In the present study, majority of the patients presented with RTA injuries (89.9%), had Lower Limb injury (65.2%) and had injured the Diaphysis (53.3%). Table 4 demonstrate the demographic distribution of cause and site of injury.

Table 4: Distribution of Diagnosis

SN		No. of Patients	Percentage (%)
1	**Limb affected**		
	Upper Limb	62	34.8
	Lower limb	116	65.2
2	**Cause**		
	Pathological	1810.1	
	Road Traffic Accident	160	89.9
3	**Site**		
	Diaphysis	95	53.37
	Epiphysis	14	7.9
	Metaphysis	69	38.8

In the present study, VAC was applied in 8 patients (4.5%) to clean the area of involvement and maintain the surgical site in patients with SSI and patients with unhealthy wound with serosanguinous discharge. At 1 year follow up two patients developed SSI, while 6 patients showed no sign of SSI and promote good

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wound healing, which gives 'P' value 0.001. Table 5 and Table 9

Table 5: Distribution of VAC applied (N=178)

SN	Discharge	No. of Patients	Percentage (%)
1	No	170	95.5
2	Yes	8	4.5

VAC: Vacuum assisted closure

In the present study, Majority of the patients underwent CRIF surgery (62.9%), followed by CREF (30.9%). Titanium implant (50.6%) was only marginally more common than stainless steel (49.4%). Hair removal was done in 81.5%, while Drain was placed in 27.5%. Surgery duration ranged from 35 to 360 minutes. Mean Surgery duration was 105.53±68.27 minutes. No significant association of type of surgery, implant type, removal of hair, drain placement and duration of surgery with SSI rate was observed. Table 6 demonstrate the demographic distribution of surgical parameters.

Table 6: Distribution of Surgical Parameters (N=178)

SN	Parameters	No. of Patients	Percentage (%)
1	Type of Surgery		
	ORIF	10	5.62
	CRIF	112	62.9
	CREF	56	31.4
2	Implant		
	Titanium	90	50.56
	Stainless Steel	88	49.44
3	Hair Removal	145	81.5
4	Drain Placement	49	27.5
5	Mean Surgery Duration ± SD (Range) in minutes	105.53±68.27 (35-360)	

Abbreviations: ORIF: Open reduction internal fixation, CRIF- Closed reduction and internal fixation, CREF- Closed reduction external fixation.

At one month follow up CRP ranged from 2 to 90 ng/ml. Mean CRP was 15.25±16.02 ng/ml. Hemoglobin ranged from 8 to 14.7 g/dl. Mean Hemoglobin level was 10.28±1.22 g/dl. Mean Total Leucocytes was 9127.07±1984.09, and ranged from 4500 to 15000. The higher incidence of SSI were found in patients with elevated CRP ('P' value 0.005) and TLC('P' value 0.003) at one month follow up. Table 7, Table 9, and Table 13.

Table 7: Distribution of Laboratory Parameters at 1st Month Follow-up (N=178)

SN	Parameter	Min	Max	Mean	SD
1	C Reactive Protein	2.0	90.0	15.25	16.02
2	Hemoglobin	8.0	14.7	10.28	1.22
3	Total Leucocyte count	4500.0	15000.0	9127.07	1984.09

In the present study, at Early follow-up 2.2% of the patient developed SSI. There was a significant association of BMI, Smoking, Alcohol, and elevated levels of CRP (1st follow up), TLC(1st follow up) and HbA1c with incidence of early SSI (Table 9 and Table 13). Table 8 demonstrate the demographic distribution of SSI at 1 month follow up.

Table 8: Distribution of SSI (Surgical Site Infection) at 1st Month Follow-up (Early) (N=178)

SN	SSI	No. of Patients	Percentage (%)
1	No	174	97.8
2	Yes	4	2.2

In Univariate analysis at one month follow up, there was a significant association of BMI, Smoking, Alcohol, and elevated levels of CRP (1st follow up), TLC(1st follow up) and HbA1c with incidence of early SSI. Table 9

Perioperative data have shown a high degree of accuracy in predicting post operative SSI at early follow up using prediction model. Table 15.

Table 9: Association of Surgical Site Infections with Perioperative Risk factors at 1st month Follow-up (Early): Univariate logistic regression analysis

SN	Risk Factor	No SSI (n=	174)	SSI (n=4)		OR	Co	'p'
				No.	% No.	%		
1	**Age Group**							
	≤20 yrs	15	8.6	0	0.0			
	21-40 yrs	85	48.9	1	25.0			

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	41-60 yrs	54	31.0	2	50.0	1.03	0.03	0.28
	61-80 yrs	18	10.3	1	25.0			
	≥81 yrs	2	1.1	0	0.0			
2	**Gender**							
	Female	54	31.0	0	0.0	2449.2	1.000	0.98
	Male	120	69.0	4	100.0			
	Nutritional Status							
3	Underweight (≤18.5 kg/m)	12	6.9	0	0.0	1.396	0.338	0.001
	Normal Weight (18.5-24.9 kg/m^2)	114	65.5	1	25.0			
	Overweight (25-29.9 kg/m^2)	40	23.0	1	25.0			
	Obese (≥30 kg/m2)	8	4.6	2	50.0			
4	**Smoking status**							
	No	141	81.0	1	25.0	12.83	2.55	0.02
	Yes	33	19.0	3	75.0			
5	**Alcohol Status**							
	No	156	89.7	2	50.0	8.66	2.16	0.03
	Yes	18	10.3	2	50.0			
6	**VAC Applied**							
	No	168	96.6	2	50.0	13.824	2.626 0.001	
	Yes	6	3.4	2	50.0			
		Mean	SD	Mean	SD	OR	Co	'p'
7	C Reactive Protein (1st Follow-up)	14.62	15.60	42.50	9.57	1.06	1.10	0.005
8	Total Leucocyte count	9046.66	1924.93	12625.0	1376.89	1.01	0.001	0.003
9	HbA1c	5.74	0.99	8.05	2.78	2.02	0.70	0.002

There was a Significant association of Smoking, Alcohol, BMI, HbA1c and elevated TLC and CRP at 1st month follow up with development of SSI at early interval

In the present study, at 1 year follow up we found that 6 patients (3.4%) developed SSIs. Table 10 demonstrate the demographic distribution of SSIs at 1 year follow up.

Table 10: Distribution of SSI at 1 year Follow-up (Late) (N=171)

SN	SSI	No. of Patients	Percentage (%)
1	No	165	96.6
2	Yes	6	3.50

Total number of patients were 171 at the end of 1 year Patients who already got infected at 1st month follow up (4 patients) were no included at the end of the year Three patients lost to follow up.

In Univariate analysis at 1 year follow up, there was a significant association of Alcohol, Smoking, Age group and elevated level of CRP and HbA1c, at one

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year follow up with development of SSI at late interval. Table 11.

Perioperative data have shown a high degree of accuracy in predicting post operative SSI at late follow up using prediction model. Table 16.

Table 11: Association of Surgical Site Infections with Perioperative Risk factors at 1 year follow up (Late) : Univariate logistic regression analysis

SN	Variables	No SSI (n=165)		SSI (n=6)		Odds Ratio	Coefficient	p value
1	**Alcohol Status**	No.	%	No.	%	19.4842	2.9696	0.001
	No	147	86.9	2	33.3			
	Yes	16	9.3	4	66.7			
2	**Smoking status**	No.	%	No.	%	8.7526	2.1694	0.014
	Yes	140	81.	2	33.3			
	No	4		4	66.7			
		32	18.					
		6						
3	Age Group (20-90 yrs)	165	96.5	6	3.5	1.0548	0.0534	0.027
4	CRP (1st follow up)	14.67	15.74	31.55	16.79	1.0409	0.0400	0.022
5	CRP (2nd follow up)	7.84	5.81	13.67	7.45	1.2877	0.2528	0.023
6	CRP (6th Month Follow-up)	5.31	2.71	27.67	29.55	1.2560	0.2280	0.002
7	HBA1C	5.71	0.95	8.05	2.28	1.0456	0.7803	0.001
8	**Gender**	No.	%	No.	%	0.1234	12.4312	0.9672
	Female	54	31.	0	0.0			
	Male	4		6	100.0			
		111	67.					
		6						

There was a significant association of Alcohol, Smoking, Age group and elevated level of CRP and HbA1c, at one year follow up with development of SSI at late interval.

In the present study, the cost was significantly higher in patients who developed SSI as compared to those who did not develop SSI. Table 12 demonstrate the association of SSI and total cost, taking Ayushman Bharat Scheme in consideration.

Table 12: Association of SSI and Total cost

	No SSI		SSI		Student's t-test	
	Mean	**SD**	**Mean**	**SD**	**'t'**	**'p'**
Mean Cost of Treatment ±SD	34475	3940.2	54500	6033.5	-0.845	0.001

The cost was significantly higher in patients who developed SSI as compared to those who did not develop SSI (54500±6033.5 vs. 34475±39402 Rupees INR).

On multivariate analysis, at 1st month follow up, Smoking, BMI and elevated TLC and CRP showed an independent significant association with early SSI after adjusting for pre-operative TLC and HbA1c. Table 13 demonstrate the multivariable logistic regression analysis of factors associated with SSI at 1st month follow up (EARLY).

Table 13: Multivariable logistic regression analysis of factors associated with SSI at 1st month follow up (EARLY)

SN	Variables	Odds ratio	p value
1	TLC (1st follow up)	1.001	0.009
2	Smoking status	45.86	0.03
3	CRP (1st follow up)	1.098	0.03
4	BMI	1.606	0.05
5	HbA1c	0.701	0.152
6	TLC (pre-op)	0.999	0.302

On multivariate analysis, Smoking, BMI and elevated TLC (1st follow up) and CRP showed an independent significant association with early SSI after adjusting for pre-operative TLC and HbA1c.

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On multivariate analysis, only HbA1c and CRP were found to be significantly associated as independent factors for late SSI. Table 14 demonstrate the multivariable logistic regression analysis of factors associated with SSI at 1 year follow up (LATE).

Table 14: Multivariable logistic regression analysis of factors associated with SSI at 1 year follow up (LATE)

SN	Variables	Odds ratio	p value
1	HbA1c	0.758	0.017
2	CRP (at 6th Month follow up)	0.169	0.025

On multivariate analysis, only HbA1c and CRP (at 6th month follow up) were found to be significantly associated as independent factors for late SSI.
This study also showed that perioperative data could be effectively used in identifying SSI using prediction model. The results of our study are useful in advancing current and future efforts to use perioperative data for patient safety surveillance and improvement. Table 9 and Table 13.
Table 15 demonstrate the predicted sensitivity of the projected model for 1 month of SSI.

Table 15: Observed and predicted probability of SSI up to 1 month of follow up (EARLY)

After Univariate and Multivariate analysis, the coefficient of the age-independent variable was taken out to calculate the Log of Odd, which found 10 is the cut-off value		
Predicted Value	Observed Value	
	9	46
	1	122
Sensitivity = 0.9 And Specificity = 0.7		

The predicted sensitivity of the projected model for 1 month of SSI prediction was 90% and the specificity was 72.6%.
This study also showed that perioperative data could be effectively used in identifying SSI using prediction model. The results of our study are useful in advancing current and future efforts to use perioperative data for patient safety surveillance and improvement. Table 11 and Table 14.
Table 16 demonstrate the predicted sensitivity of projected model for 1 year SSI.

Table 16: Observed and predicted probability of SSI up to 1 year of follow up (Late)

After Univariate and Multivariate analysis, coefficient of the age-independent variable was taken out to calculate the Log of Odd, which found 10 is the cut off value		
Predicted Value	Observed Value	
	8	56
	2	105
Sensitivity = 0.9 And Specificity = 0.7		

The predicted sensitivity of projected model for 1 year SSI prediction was 80% and specificity was 65.2%.

DISCUSSION

SSIs are a significant complication of orthopedic surgeries, affecting patient morbidity and mortality rates. Several risk factors are associated with the development of SSIs, including patient-related, surgery-related, and healthcare-related factors. Patient-related risk factors include age, obesity, smoking, and diabetes, while surgery-related risk factors include surgical technique, duration of surgery, type of surgery, and antibiotic prophylaxis. Healthcare-related risk factors include the hospital environment and healthcare worker hygiene. To reduce the incidence of SSIs in orthopedic surgeries, it is important to identify and address these risk factors through the implementation of evidence-based infection control strategies. This includes proper patient selection, optimization of co-morbidities, use of minimally invasive surgical techniques, appropriate antibiotic prophylaxis, and adherence to hand hygiene and environmental cleaning protocols.

In the present study, we found that the majority of the patients were aged from 21 to 60 years. Age ranged from 6 to 87 years. The mean age was 39.00±16.42 years. The majority of the patients were males (69.7%). These findings of the present study present an interesting picture regarding the OPD at our tertiary center. The center caters to patients presenting with orthopedic injuries due to falls, RTA, and other causes, but also caters to complex surgeries including the likes of Spinal surgery, Total Knee Arthroplasty, and Total Hip Arthroplasty. It is therefore imperative that due to this wide range of services that have been branching from the department of orthopedic surgery patients from very wide age groups have been reported in the present study.
In the present study, we found that the majority of the patients were Normal weight (64.6%), followed by Over weighted (23.0%). The mean BMI was 23.25±3.68 years and ranged from 16 to 34 years. We also found that the prevalence of Smoking (20.2%) and Alcohol consumption (11.2%) were much lower

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than in most literature, however, it was one of the limitations of the study that Smoking and Alcohol consumption status were recorded based on the patients' or his attendants' response. The prevalence of Co-morbidities was also low (12.4%), but it can be confounded to the rather smaller and younger sample size of the population.

In the present study, the majority of the patients presented with RTA injuries (89.9%), had Lower Limb injuries (65.2%), and had injured the Diaphysis (53.3%). We also found that in the majority of the patients CRIF surgery was performed (62.9%) and Titanium alloy was used (50.6%). These findings are common from an orthopedic surgeon's point of view, as the majority of the patients were injured during RTA and had affected Diaphysis, Titanium alloy is more suitable due to its flexibility and more conducive fracture healing in areas where more strain is required for a healing response to develop is preferred. Additionally, titanium alloy is more resistant to cyclic load and notch sensitivity.[17]

In the present study, the mean Surgery Duration was 105.53±68.27 minutes and ranged from 35 to 360 minutes. These findings are very diverging because we had included various surgeries ranging from simpler closed reduction using external fixators to more complex ones like open surgery with internal fixators.

In the present study, we only found SSI in 4 cases (2.2%) at Early follow-up (Table 9). On univariate analysis, BMI, Smoking Status, Alcohol Use, and elevated levels of CRP (1st follow-up), TLC (1st follow-up), and HbA1c were significantly associated with the incidence of SSI. In the present study, at late follow-up (Table 11), we found that 6 patients (3.4%) developed SSI. On univariate analysis, Age, Alcohol use, Smoking, elevated CRP (1st 2nd follow up and at 6 months follow up), and HbA1c were significantly associated with the incidence of SSI. However, on multivariate analysis, TLC (1st follow up), Smoking Status, CRP(1st follow up), BMI, and HbA1c were significantly associated with Early SSI (Table 13), while HbA1c and CRP (at 6- month follow up) were significantly associated with Late SSI (Table 14).

Vacuum-assisted closure (VAC) therapy is a system that promotes wound healing through negative pressure, especially in infected tissues. In the present study, VAC was applied in 8 patients (4.5%) to clean the area of involvement and maintain the surgical site in patients with SSI and patients with unhealthy wounds with serosanguinous discharge. At 1 year follow up two patients developed SSI, while 6 patients showed no sign of SSI and promote good wound healing, which gives a 'P' value of 0.001. In our study, Coagulase negative staphylococcus was the most common causative pathogen. The most common discharge from the wound was Serosanguineous (19.1%), followed by Sanguineous (13.5%), Serous (8.4%), and Purulent (2.2%), while in the remaining 56.7% No Discharge was found.

Previous research has demonstrated that SSI rates were significantly higher in the spine and lower extremities than in the upper limb.[10] However, this current study showed that after removing other confounding factors, the risk of infection was higher in the lower limb, especially the Tibia bone. This might have been due to inadequate coverage in the medial surface, poor blood supply (an especially inferior third of the tibia) and decrease muscle mass.

Findings of the study conducted by Hubneret al,[18] reported that in univariate analysis male sex, age, ASA score, contamination class, operation duration, and emergency procedures were significantly associated with the incidence of SSI. Andejumoet al,[19] reported that on multivariate analysis, anemia, contaminated and dirty wounds, retroviral disease status, physiological status (ASA scores IV and V), prolonged surgery time, a cadre of the surgeon, emergency surgeries, and use of drains were found to be significant risk factors for SSIs. Kumar and Rai,[20] reported from India that SSI was 12.5% in elective and 17.7% in emergency surgeries, further they reported that prophylactic antibiotic use and avoidance of drain use were associated with significantly lower rates of SSI. Bhatta et al. [21] found a significant association between the duration of surgery and surgical site infection rate. However, no significant association of gender with surgical site infection rate was observed. Ansari et al,[22] reported additionally, SSI infections are more common in elderly patients, patients undergoing emergency surgeries, those with longer preoperative hospital stays and longer surgical duration, and patients with a high ASA index. Surgical site infections comprise more than one-sixth of total hospital-acquired or nosocomial infections and carry a heavy physical, psychological, and financial burden.[23]

CONCLUSION

At Early follow-up, 2.2% of the patient developed SSI. There was a significant association of BMI, Smoking, Alcohol, and elevated levels of CRP (1st follow-up), TLC (1st follow-up), and HbA1c with the incidence of early SSI. While at late follow up 3.4% of the patient developed Further, SSI. Age, Alcohol use, Smoking, and elevated CRP (1st,2nd follow up and at 6 months follow-up), and HbA1c were significantly associated with the incidence of SSI. The overall cost of treatment was significantly higher in patients with SSI as compared to those who did not have SSI (54500±6033.5 vs. 34475±3940.2 Rupees). VAC was demonstrated as the protective factor for wound healing. The lower percentage of SSI in our study compared with other developing countries might be due to the use of modern equipment, operating rooms, and adequately trained healthcare professionals.

This study also showed that perioperative data could be effectively used in identifying SSIs (Table 15 and Table 16). Perioperative data have shown a high degree of accuracy in predicting post-operative SSIs at early and late follow up (Fig 1 and 2). The results

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of our study are useful in advancing current and future efforts to use perioperative data for patient safety surveillance and improvement.

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