ORIGINAL ARTICLE

EFFICACY OF PROPHYLACTIC INTRAWOUND APPLICATION OF VANCOMYCIN POWDER IN PREVENTING SURGICAL SITE INFECTIONS IN SPINAL INSTRUMENTATION SURGERY

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Background: Surgical site infection (SSI) is always a matter of utmost concern in cases of spinal instrumentation in low-income countries. This study was conducted to determine the efficacy of local intrawound application of vancomycin powder in reducing postoperative SSI following Thoracolumbar-Sacral spinal instrumentation. **Methods:** This randomized controlled trial was done in the Department of Neurosurgery, Ayub Teaching Hospital Abbottabad from 1st July 2019 to 31st December 2021. Seventy-eight patients of either gender with an age range from 15 to 65 years, who were planned for posterior spinal instrumentation surgery (transpedicular screw fixation), were included in the study. Patients were divided into two equal groups, A (Vanco group) and B (control group). In addition to standard systemic prophylaxis, 1 gm of Vancomycin powder was applied over the implant in Group A patients. **Results:** The mean age of the patients in Group A was 36±16.6 while the mean age of patients in the group was 33.7±15.9 years. A statistically significant reduction of surgical site infection was observed in those who received a prophylactic intra-wound application of vancomycin powder (Vanco group) (5.2%) compared to the control group (20.5%). **Conclusion:** Intrawound vancomycin powder administration significantly decreases SSI following spinal instrumentation surgeries. Patients at high risk of infection are highly recommended as a candidate for this technique.

Keywords: SSI; Incidence; Risk factors; Prevention

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INTRODUCTION

Postoperative wound infection after spinal surgeries is a potentially devastating complication with higher morbidity, mortality and healthcare cost.[1] Despite the use of prophylactic systemic antibiotics and improved surgical techniques, it is still a serious challenging postoperative complication of spinal instrumentation surgeries. Such an infection increases hospital stay, delayed rehabilitation, loss of instrumentation and often required additional surgeries with prolonged use of systemic antibiotics.[2] The reported incidence varies from 0.5 to 15% with a higher rate for instrumented spinal surgeries and deformity correction.[3] *Staphylococcus aureus* and epidermis are the two most common pathogens with increasing incidence of methicillin-resistant S. Aureus.[4] Pre-existing Diabetes, smoking, obesity, insufficient irrigation and a history of previous spinal surgeries further increase the risk.[5] The local ischemia, hematoma and seroma of the surgical site impair the intravenous delivery of systemic antibiotics leading to inadequate local concentration with an increased risk of surgical site infection.[6] Prevention of surgical site infection is one of the main requirements of high-standard medical care. Local application of antibiotics is an attractive option to reduce the incidence of surgical site infection because high concentrations are achieved directly at these sites with limited systemic toxicity.[7,8] The addition of local intrawound application of vancomycin powder to standard systemic prophylaxis in elective spine surgeries reduces infection rate from 2.6 to 0.29%with no specific adverse events and no difference in the radiographic outcome.[9] The fact Because *Staphylococcus aureus* and epidermis are the main pathogens in SSI, local intrawound application of vancomycin can eliminate both with a significant reduction in postoperative wound infection after spinal surgery.[10] Numerous studies have been done in the past to determine the role of the intrawound application of vancomycin powder in preventing postoperative surgical site infection, but the results of these studies are controversial. The aim of this study is to determine the efficacy

of local intrawound application of vancomycin powder in reducing postoperative SSI following thoracolumbar-sacral spinal instrumentation, by comparing patients who did and who did not receive a local intrawound application of vancomycin powder, in addition to standard intravenous antibiotics.

MATERIAL AND METHODS

This randomized controlled trial was conducted in the Department of Neurosurgery, Ayub Teaching Hospital Abbottabad from 1st July 2019 to 31st December 2021. Approval was taken from Hospital's ethical committee. 78 patients of either gender with an age range from 15 to 65 years with a traumatic thoracolumbar spine fracture, spinal metastasis, spine tuberculosis and degenerative spinal disease, which were planned for posterior spinal instrumentation surgery (Rods and screws), were included in the study. Those with a previous history of spinal instrumentation surgery whether clean or infected were excluded from the study. Informed written consent was taken from all patients who were randomly divided into two equal groups, A (Vanco group) & B (control group), each consisting of 39 patients. Preoperative preparation with alcohol followed by povidone-iodine solution was done in all patients. All patients received standard systemic antibiotic prophylaxis consisting of 2gm IV cefoperazon+sulbactum within 30 minutes of surgical incision followed by 1 gm IV cefoperazone+sulbactum every 12 hours for 3 days. After passing pedicle screws and rod fixation, the wound was thoroughly washed with normal saline and povidone-iodine solution. Additionally, 1gm of vancomycin powder was applied over the implant and in the deep subcutaneous tissue prior to wound closure in Group A patients. Wound was closed, cleaned with normal saline and a sterile dressing was applied. Basic demographics (age and gender), presence of comorbidities (diabetes, hypertension, tuberculosis, epilepsy, hepatitis-C), operative time, estimated blood loss, history of blood transfusion during or after surgery, history of tobacco use, body mass index, haemoglobin level, ASA grade, level and cause of pathology and extant of instrumentation (short or long segment) were recorded on predesigned proforma. All the patients were followed for a period of three months with regular wound examinations for evidence of SSI. We defined SSI as an infection occurring within 3 months following surgery, requiring additional operation and antibiotic treatment. It was further subdivided into superficial (occurring above lumbosacral fascia) or deep (beneath lumbosacral fascia) on the basis of wound examination and operative findings. The microbiological culture was taken from all patients who developed SSI, to determine the causative organisms. The data was analyzed using SPSS version 20. Descriptive statistics were used to calculate means ± standard deviation. Frequencies with percentages were calculated for gender and treatment efficacy. The chi-square test was used to compare the efficacy of treatment in both groups. *p*-value <0.05 was considered significant.

RESULTS

This study included 78 patients divided into two equal groups, A (Vanco group) and B (control group). The overall mean age of these patients was 35.3±16.2 years. The mean age of the patients in Group A was 36±16.6 while the mean age of patients in Group was 33.7±15.9 years. In group A there were 21 (53.8%) male and 18 (46.2%), female patients, while in group B there were 23 (58.9%) male and 16 (41.1%)) female patients. Pre-existing comorbidities in group A (vancomycin group) in decreasing order of frequency were tuberculosis (9 patients) (11.5%), diabetes mellitus (4 patients) (5.1%), hypertension (3 patients) (3.8%), hepatitis C (1) (1.3%) and epilepsy (1) (1.3%), while in group B 2 (5.1%) patients were diabetic, 2 (5.1%) were hypertensive, 1 (2.6%) was epileptic and 6 (66.7%) patients have a history of spine tuberculosis. Only 1 patient in each group has a history of tobacco use. The mean ASA grade in group A was 1.18±0.41, while in group B mean ASA grade was 1.18±0.45 with no statistically significant difference between the two groups (p=1.0). The mean difference in haemoglobin level between the two groups was 0.6±1.2 which was statistically significant ($p \leq 0.05$). The difference in BMI was not statistically significant (p=0.74) (Table-1). The extent of instrumentations was limited to 3 levels in 27 (69.2%) of group A patients and 37 (94.8%) of group B patients. 12 (30.2%) of group A and 2 (5.2%) of group B patients underwent long segment (>3 levels) instrumentations. The difference in mean operative time and estimated blood loss was 7±13 minutes (p=0.46) and 25±44 ml (p=0.07) respectively. 17 (43.6%) patients in group A and 18 (46.2%) patients in group B received intraoperative or postoperative blood transfusion (Table-2).

Only 1 (2.54%) patient in Group A developed SSI, whereas 5 (12.82%) patients in Group B developed SSI, the difference being statistically significant (p <005). The patient with

SS1 in Group A was diabetic, developed a superficial wound infection and culture revealed *E. coli*. Whereas among the patients with SSI in group B, 2 patients have the growth of *Staphylococcus aureus* and one each showed growth of *Staphylococcus epidermidis*, pseudomonas aeruginosa and *E. coli*. Deep infection was observed in 3 of 5 cases. And among these cases with deep SSI one had diabetes and two had tuberculosis. Our study also assessed the contribution of low haemoglobin levels to increase the risk of SSI. We found that low preoperative haemoglobin level (<11.8g/dl) significantly increases the risk of SSI (Table-3).

Table-1: Demographic characteristics of patients with or without intrawound vancomycin powder

Characteristics	Total (n=78)	Vancomycin group n=39)	Control group (n=39)	*p*-value
Age (years) (mean±SD)	35.3±16.2	36.90±16.6	33.72±15.9	0.391
Gender male	44 (56.4%)	21 (53.8%)	23 (58.9%)/	0.64
female	34 (43.6%)	18 (46.2%)	16 (41.1%)	
Comorbidities Diabetes mellitus	4 (5.1%)	2 (5.1%)	2 (5.1%)	0.742
Hypertension	3 (3.8%)	2 (5.1%)	1 (2.6%)	
Tuberculosis	9 (11.5%)	6 (66.7%)	3 (33.3%)	
Hepatitis C	1 (1.3%)	0 (0%)	1 (1.3%)	
Epilepsy	1 (1.3%)	1 (2.6%)	0 (0%)	
Tobacco uses Yes	2 (2.6%)	1 (2.6%)	1 (2.6%)	0.8
No	76 (97.4%)	38 (97.4%)	38 (97.4%)	
ASA (mean±SD)	1.18±0.41	1.18±0.38	1.18±0.45	1.0
BMI (mean±SD)	22.19±1.61	22.13±1.75	22.25±1.48	0.74
Haemoglobin level (mg\dl)	12.1±1.2	11.8±1.22	12.4±1.2	0.05

ASA: American Society of Anaesthesiology, BMI; Body Mass Index.

Table-2: Operative characteristics of patients with or without intrawound vancomycin (Vanco) powder

Characteristics	Total (n=78)	Group- A (n=39)	Group B (n=39)	*p*-value
Level Thoracic	15 (19.2%)	8 (20.5%)	7 (17.9%)	0.80
Thoracolumbar	39 (50%)	19 (48.7%)	20 (51.2%)	
Lumbar	18 (23.1%)	8 (20.5%)	10 (25.6%)	
Lumbosacral	6 (7.7%)	4 (10.2%)	2 (5.2%)	
Disease Metastatic	1 (1.3%)	1 (2.6%)	0 (0%)	0.20
Traumatic fracture	63 (80.8%)	28 (71.7%)	35 (89.7%)	
Degenerative disease	5 (6.4%)	4 (10.2%)	1 (2.6%)	
Potts disease	9 (11.5%)	6 (15.3%)	3 (7.69%)	
Instrumentation Short segment	64 (82.1%)	27 (69.2%)	37 (94.8%)	0.003
Long segment	14 (17.9%)	12 (30.8%)	2 (5.2%)	
Operative time (minutes)	124±41.4	127±47	120±34	0.46
Estimated blood loss (ml)	108.9±60	121±76	96±32	0.07
Transfusion Yes	35 (44.9%)	17 (43.6%)	18 (46.2%)	0.82
No	43 (55.1%)	22 (56.4%)	21 (53.8%)	

DISCUSSION

Postoperative surgical site infection is gradually decreasing with the advent of the aseptic surgical technique; however, it is still one of the most common complications of spinal instrumentation surgery.[10] It increases the morbidity and mortality of patients and also causes severe burdens to the patients and their families.[11] It also increases the risk of pseudoarthrosis with subsequent development of spinal instability and requires repeated wound debridement and irrigation with prolonged antibiotic treatment.[12,13] This study was designed to determine the incidence and risk factors for surgical site infection as well as to determine the effect of local intrawound application of vancomycin powder in reducing surgical site infection following thoracolumbar-sacral spine instrumentation surgery.

In our study, the overall incidence of surgical site infection following spine instrumentation surgery was 7.69%. This incidence is similar to other studies which reported an incidence of 0.7–11.9%.[14] Some literature reported an incidence of 4.3% which is much lower than those observed in our study.[15] such high incidence of SSI in our study may be due to relatively poor operating room conditions, comorbidities like Diabetes, tuberculosis, anaemia etc. many studies identified risk factors for surgical site infection including advanced age, smoking, steroid use, medical comorbidities, larger estimated blood loss, longer duration of surgery etc.[16] Our study assessed much of the previously mentioned risk factors. We found Diabetes and tuberculosis to be the most common condition associated with increased risk of SSI. Out of 9 cases of spine tuberculosis in this study, 2 patients developed SSI. Four patients in our study

were diabetic and only 2 of them developed deep SSI. Our study also assessed the contribution of low haemoglobin levels to increase the risk of SSI. We found that low preoperative haemoglobin level (<11.8g/dl) significantly increases the risk of SSI. We did not notice an increased risk of infection with prolonged duration of surgery, increased amount of blood loss during surgery, or increasing extent of instrumentations or blood transfusion during or after surgery. Though steroid is commonly used in neurosurgical practices, our study did not evaluate them to be a risk factor for increasing SSI.

Staphylococcus aureus and epidermis are the two most common pathogens causing SSI with increasing incidence of methicillin-resistant *S. aureus*.[4] Jabbar *et al*, also reported staphylococcus Aureus as a major causative organism of SSI (45.2%), followed by staph epidermis (31.4%) and MRSA (34.3%).[17] Our study revealed the growth of *Staphylococcus aureus* and epidermidis, *E coli* and *Pseudomonas aerogenosa*.

One of the main aims of our study was to determine the efficacy of prophylactic intrawound application of vancomycin powder in preventing surgical site infection following thoracolumbar-sacral spinal instrumentation surgery. Numerous studies have been done in the past but the results of these studies are controversial. We observed a statistically significant reduction of surgical site infection in those who received a prophylactic intra-wound application of vancomycin powder compared to the non-Vanco group. Prophylactic local intrawound application of vancomycin has become a routine practice following its use by Sweet *et al*.[9] it enables the surgeon to achieve high local concentration and avoid systemic toxicity.[18,19] It is not absorbed into the systemic circulation, stays in the wound and acts locally to prevent the SSI.[9] It is glycopeptide and is widely used for the treatment of gram-positive bacterial infections. Prophylactic local application of vancomycin at the incision site can effectively prevent staphylococcal infection with very low side effects.[20] Local intrawound vancomycin administration can generate a concentration nearly 1000-fold higher than the minimum inhibitory concentration for MRSA and coagulase-negative staphylococcus, thereby reducing the risk of antibiotic resistance.[9, 21] No local or systemic side effect was observed in this study.

Our study supports the judgments of previously mentioned studies because a significant reduction of surgical site infection was achieved and no local or systemic side effect due to local intrawound application of vancomycin was observed.

The main limitations of this study are the small sample size, the inability to assess the steroids as a risk factor for SSI and the inability to evaluate and document the standard of sterilization techniques in the operating room.

CONCLUSION

Prophylactic Intrawound vancomycin powder administration significantly decreases SSI following spinal instrumentation surgeries. Patients at high risk of infection are highly recommended as a candidate for this technique.

AUTHORS' CONTRIBUTION

SK: data collection, paper writing. SAK: data analysis, results interpretation. AN, GM, Faiza: Statistical analysis. ZJ, AM, AA: Literature review.

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