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Comparative Study on the Use of Vancomycin Powder in Spine Fixation Surgery for Prevention of Post-Operative Infection

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KEYWORDS

Vancomycin powder, Spine fixation surgery, Post-operative infection prevention and Surgical site infection (SSI).

ABSTRACT:

Introduction: Spine surgery is associated with a wide range of com-plications. Surgical site infections are the most devastating complications because they are associated with low postoperative recovery, low patient satisfaction, and high patient morbidity and mortality. In the literature, infection rates of spine surgeries range from 0.7% to 11.9%.

Aims: To study the difference in the rate of post-operative infections with and without the use of Vancomycin powder in spine fixation surgery.

Materials and Methods: It was a Comparative study between the In Risk group and In Risk with Vancomycin group.Each group had 25 patients each as per simple randomization. This study was conducted from February 2024- August 2024 at the department of Neurosurgery, KPC Medical College.

Result: In Risk with control, 3(12%) patients had SSIs, 4(16%)patients had Superficial SSIs, 2(8%)patients had Deep SSIs, 3(12%)patients had Dose of 1 g, 1(4%)patient had Dose of 2 g, 2(8%)patients had Dose between 0.5 –and 2 g, 3(12%)patients had Cervical, 2(8%)patients had Thoracolumbar, 1(4%)patient had Infectious bacteria, 1(4%)patient had MRSA, 2(8%) patients had Gram-positive bacteria and 1(4%) patient had Gram-negative bacteria.In Risk with vancomycin, 4(16%)patients had SSIs, 2(8%)patients had Superficial SSIs, 1(4%)patient had Deep SSIs, 2(8%) patients had Dose of 1 g, 3(12%) patients had Dose of 2 g, 1(4%)patient had Dose between 0.5 –and 2 g, 2(8%)patients had Cervical, 2(8%)patients had Thoracolumbar, 1(4%)patient had Infectious bacteria, 3(12%)patient had MRSA, 1(4%)patient had Gram-positive bacteria and 3(12%)patient had Gram-negative bacteria. Association of Outcomes with Group was not statistically significant (p=0.92059).

Conclusion: There was no statistically significant difference in the rate of infections post spinal surgery, in the In Risk group without the use of Vancomycin powder and the In Risk group with vancomycin powder.

INTRODUCTION

Spine surgery is associated with a wide range of com-plications [1]. Because surgical site infections are linked to poor postoperative recovery, low patient satisfaction, and high patient morbidity and death, they are the most severe consequences. The literature reports spine surgery infection rates ranging from 0.7% to 11.9%. [2,3] Specifically, compared to decompression procedures,

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instrumented surgeries had increased infection rates. [4] This significant range of surgical site infections following spine operations is caused by multiple variables. One of the factors is the patients' socioeconomic position. It has been discovered that industrialized countries have far lower rates of surgical site infections than do developing and underdeveloped nations. [5,6].

Several patient and procedure-related factors, such as advanced age, diabetes, smoking, obesity, prolonged surgical length, higher blood loss, and revision operations, are risk factors linked to surgical site infections. [7,8,9]. It is advised to employ sterile technique, properly prepare the skin, and administer prophylactic antibiotics prior to surgery in order to lower the risk of infection.

A new trend that has emerged in the last ten years is the topical application of powdered vancomycin to the surgical bed. Numerous studies have demonstrated that, despite some divergent opinions, pre-emptive administration of vancomycin powder in addition to routine systemic antibiotic prophylaxis reduces the risk of surgical site infections following spinal surgeries. [10,11] Nonetheless, the majority of these investigations were conducted in affluent nations with lower rates of first infection. The purpose of this study was to ascertain the frequencies of early postoperative infection as well as the benefits and drawbacks of topical vancomycin treatment during posterior instrumentation spinal procedures carried out on patients with diseases that increase their risk.

MATERIALS AND METHODS

Study Type: Comparative study

Place Of Study: The present study was a comparative study. At the department of Neurosurgery, KPC Medical College. This Study was conducted from February 2024-July 2024.

Period Of Study: 6 Months

Study Population: Patients attending neurosurgery Outpatients department.

Sample Size/Design: Total 50 patients were included in this study.

Inclusion criteria:

Patients undergoing elective or emergency spinal fixation surgeries (e.g., for deformity correction, degenerative spine disease).Patients eligible for intraoperative vancomycin powder application during spine fixation.

Exclusion criteria:

Patients with known hypersensitivity or allergy to vancomycin or its components. Pregnant or breastfeeding women due to potential risks to the fetus or infant. Patients with active systemic or local infections (non-spine related) at the time of surgery. Patients receiving intraoperative antibiotic powders other than vancomycin. Patients with a history of surgical site infection (SSI) within the past year.Patients with factors such as open spinal trauma, overt uncontrolled diabetes, immunocompromised state, or previous spinal surgeries.

RESULT AND ANALYSIS

Table: 1 Association between Age in Group: Group

	Risk with control		Risk with vancomycin		P value
Age in Group	**Number**	**%**	**Number**	**%**	**0.9485**
21-30	5	**20**	6	**24**	
31-40	8	**32**	7	**28**	
41-50	9	**36**	8	**32**	
51-60	3	12	4	16	
Total	25	100	25	100	

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Table: 2 Association between Age in Group: Group

	Risk with control		Risk with vancomycin		P value
Gender	**Number**	**%**	**Number**	**%**	**0.7707**
Male	15	60	16	64	
Female	10	40	9	36	
Total	25	100	25	100	

Table: 3. Grading of Recommendations Assessment, Developing, and Evaluation used to assess the systematic review outcomes. Vancomycin was compared to control for patients with posterior spine surgery

	Risk with control		Risk with vancomycin		P value
Outcomes	**Number**	**%**	**Number**	**%**	**0.92059**
SSIs	3	12	4	16	
Superficial SSIs	4	16	2	8	
Deep SSIs	2	8	1	4	
Dose of 1 g	3	12	2	8	
Dose of 2 g	1	4	3	12	
Dose between 0.5 –and 2 g	2	8	1	4	
Cervical	3	12	2	8	
Thoracolumbar	2	8	2	8	
Infectious bacteria	1	4	1	4	
MRSA	1	4	3	12	
Gram-positive bacteria	2	8	1	4	
Gram-negative bacteria	1	4	3	12	
Total	25	100	25	100	

Table:4. Distribution of Case

Case	Frequency	Percent
C4 C5 disc prolapse	1	2.0%
C4 canal stenosis	1	2.0%
C4 IDEM	1	2.0%
C4 to C6 canal stenosis	1	2.0%
C4 to C6 canal stenosis with Cord compression	1	2.0%
C4C5, C5C6 disc prolapse with Cord compression	1	2.0%
C5 C6 disc prolapse	1	2.0%
C5 canal stenosis	2	4.0%
Cervical myelopathy	1	2.0%
L1 burst fracture	1	2.0%
L1 compression	1	2.0%
L2 fracture	1	2.0%
L2 to S1 canal stenosis	1	2.0%

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L3 L4 grade 1 listhesis, L3-L4, L4-L5 canal stenosis	1	2.0%
L3-L4 grade1 listhesis with LCS	1	2.0%
L3L4L5 SCS	1	2.0%
L4 L5 Canal stenosis, L3 L4 Lateral recess stenosis	1	2.0%
L4 L5 disc prolapse	1	2.0%
L4 L5 gr 2 listhesis	1	2.0%
L4 L5 Grade 1 listhesis with canal stenosis	1	2.0%
L4 L5 stenosis	1	2.0%
L4 L5 stenosis with grade 1 listhesis	1	2.0%
L4 L5, L5 S1 canal stenosis	1	2.0%
L4L5 canal stenosis	2	4.0%
L4-L5 canal stenosis	1	2.0%
L4L5 discitis	1	2.0%
L4L5 extruded disc	1	2.0%
L4L5 Grade 1 listhesis with canal stenosis	1	2.0%
L4L5 Grade 1 listhesis, L5S1 lat recess stenosis	1	2.0%
L4L5 left disc prolapse	1	2.0%
L4L5S1 stenosis	1	2.0%
L5 - S1 disc prolapse	1	2.0%
L5 S1 Canal stenosis	1	2.0%
L5 S1 gr 2 listhesis, LCS	1	2.0%
L5 S1 gr II listhesis	1	2.0%
L5 S1 grade II listhesis	1	2.0%
L5S1 recurrent disc prolapse	1	2.0%
LCS	1	2.0%
LCS, L3L4, L4L5	1	2.0%
Lt P EDH	1	2.0%
T 10 burst	1	2.0%
T11 burst fracture	1	2.0%
T11 compression	2	4.0%
T12 compression	2	4.0%
T5,T6 fracture	1	2.0%
T7 T8 IDEM	1	2.0%
Total	50	100.0%

Table:5. Distribution of Surgery

Surgery	Frequency	Percent
C3 to C6 laminectomy with lateral mass fixation	1	2.0%
C4 C5 ACDF	1	2.0%
C4 corpectomy, C3C5 cage plate fixation	1	2.0%
C4C5C6 laminectomy, lateral mass fixation	2	4.0%
C5 C6 ACDF	1	2.0%
C5 corpectomy with C4C6 fixation	1	2.0%
C5 corpectomy, C4,C6 cage fixation	2	4.0%
Decompression and L4L5S1 TPF	1	2.0%
Disectomy with L4L5 TPF	1	2.0%

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Excision and T6T7T8 Fixation	1	2.0%
Excision of IDEM, C4,C5,C6 Lateral mass fixation	1	2.0%
L2 to S1 laminectomy, TPF	1	2.0%
L2 vertibroplasty	1	2.0%
L3 L4 S1 TPF, L4L5 Disc biopsy	1	2.0%
L3 laminectomy, L3 L4 TPF	1	2.0%
L3,L4 Laminectomy, L3 to L5 TPF	1	2.0%
L3,L4 Laminectomy, L3L4L5 TPF	1	2.0%
L3,L4,L5 TPF	1	2.0%
L3L4 discectomy, L4 L5 foraminotomy	1	2.0%
L4 L5 TPF, decompression	1	2.0%
L4 Laminectomy L4 L5 TPF	1	2.0%
L4 laminectomy, L3,L4,L5 TPF	1	2.0%
L4 laminectomy, L4 L5 TPF	1	2.0%
L4 Laminectomy, L4-L5 TPF	1	2.0%
L4,L5 Laminectomy, L4 L5 S1 TPF	1	2.0%
L4,L5 laminectomy, L4L5 TLIF, L4L5S1 TPF	1	2.0%
L4L5 decompression, L4L5 TPF, TLIF	1	2.0%
L4L5 discectomy with TPF	1	2.0%
L4L5 Laminectomy, L5S1 left discectomy, L4L5S1 TPF	1	2.0%
L4L5 TPF, TLIF	2	4.0%
L4L5S1 TPF	1	2.0%
L4L5S1 TPF, L4L5 TLIF	1	2.0%
L5 laminectomy, L5S1 TPF	1	2.0%
L5 S1 disectomy with TPF	1	2.0%
L5 S1 TPF	1	2.0%
L5S1 disectomy with TPF	1	2.0%
L5S1 TPF	1	2.0%
Lt decompressive craniotomy	1	2.0%
T10 to L2 TPF	1	2.0%
T11 vertibroplasty	1	2.0%
T12 Vertibroplasty	1	2.0%
T12, L2 TPF	1	2.0%
T12,L2L3 TPF	1	2.0%
T4 to T8 fixation, decompression	1	2.0%
T8-L1 TPF, T10 laminectomy	1	2.0%
T9 to L1 TPF	2	4.0%
Total	50	100.0%

In Risk with control, 5 (20%) patients were 21-30 years of age, 8 (32%) patients were 31-40 years of age, 9 (36%) patient were 41-50 years of age and 3 (12%) patients were 51-60 years of age. In Risk with vancomycin, 5 (20%) patients were 21-30 years of age, 8 (32%)patients were 31-40 years of age, 9 (36%)patient were 41-50 years of age and 3 (12%) patients were 51-60 years of age. Association of Age in Group with Group was not statistically significant (p=0.9485). Risk with control, 15 (60%) patients were male and 10 (40%) patients were Female. In Risk with vancomycin, 16 (64%) patients were male and 9 (36%) patients were Female.

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Association of Gender with Group was not statistically significant (p=0.7707).In Risk with control, 3(12%) patients had SSIs, 4(16%)patients had Superficial SSIs, 2(8%)patients had Deep SSIs, 3(12%)patients had Dose of 1 g, 1(4%)patient had Dose of 2 g, 2(8%)patients had Dose between 0.5 –and 2 g, 3(12%)patients had Cervical, 2(8%)patients had Thoracolumbar, 1(4%)patient had Infectious bacteria, 1(4%)patient had MRSA, 2(8%) patients had Gram-positive bacteria and 1(4%) patient had Gram-negative bacteria.

In Risk with vancomycin, 4(16%)patients had SSIs, 2(8%)patients had Superficial SSIs, 1(4%)patient had Deep SSIs, 2(8%) patients had Dose of 1 g, 3(12%) patients had Dose of 2 g, 1(4%)patient had Dose between 0.5 –and 2 g, 2(8%)patients had Cervical, 2(8%)patients had Thoracolumbar, 1(4%)patient had Infectious bacteria, 3(12%)patient had MRSA, 1(4%)patient had Gram-positive bacteria and 3(12%)patient had Gram-negative bacteria. Association of Outcomes with Group was not statistically significant (p=0.92059).

The cases in our study included 1 (2.0%) patient with C4 C5 disc prolapse, 1 (2.0%) patient with C4 canal stenosis, 1 (2.0%) patient with C4 IDEM, 1 (2.0%) patient with C4 to C6 canal stenosis, and so on. Each condition was represented by 1 or 2 (2.0% or 4.0%) patients.

The value of z is 0.5862. The value of p is .5552. The result is not significant at $p < .05$.

The surgeries in our study included 1 (2.0%) patient who underwent C3 to C6 laminectomy with lateral mass fixation, 1 (2.0%) patient who had C4 C5 ACDF, 1 (2.0%) patient who had C4 corpectomy C3C5 cage plate fixation, 2 (4.0%) patients who had C4C5C6 laminectomy lateral mass fixation, and so on. Each surgical procedure was performed on 1 or 2 (2.0% or 4.0%) patients,

The value of z is 0.5862. The value of p is .5552. The result is not significant at $p < .05$.

In above table showed that the mean Age (mean±s.d.) of patients was 53.7200 ± 14.8476

DISCUSSION

The present study was a comparative study at the department of Neurosurgery, KPC Medical College. This a single centre study with a single surgeon having operated on all the cases. This Study was conducted from February 2024- August 2024. Total 50 patients were included in this study. This study synthesizes the most recent research findings published in the literature, performs a comparative analysis based on various surgical sites, vancomycin doses, and infection types, and delves deeper into the effects of intraoperative local application of VP on SSIs following posterior spinal surgery. Infections on the surface lacked statistical significance. There was no statistically significant incidence of adverse events with or without the use of vancomycin in our study (p 0.92).

In our study, out of 50 patients most of the patients were 41-50 years old in [9 (36%)] in Risk with control Group Compared Risk with vancomycin Group 8 (32.0%) to and this was not statistically significant (p=0.9485).

Meta analysis of several studies worldwide have discovered that local VP spraying can lower the overall incidence of SSIs following spine surgery, primarily to lower the rate of deep SSIs following posterior spinal surgery.Furthermore, according to two studies, vancomycin can also have negative side effects such as impeding natural healing and resistant organisms[13,14].

Khalid S, et al [12] (2023) examined that 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. They concluded that high risk individuals may be recommended for vancomycin powder administration in spinal surgeries.

Research has indicated that the variation in SSIs may be associated with various sections of spine surgery. In order to find out whether vancomycin can effectively reduce spinal SSIs following thoracolumbar and cervical spine surgery, we performed a subgroup study depending on the operation area (cervical spine, thoracolumbar spine) without any statistically significant difference.

The majority of research has used 1 or 2 grams of vancomycin topically. Research conducted on animals

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and in vitro has revealed that topical vancomycin administration can suppress osteoblast activity, which in turn impacts bone mending. Vancomycin can prevent osteoblasts from proliferating and migrating when the dose is higher than 3 mg/cm2. [15] Codschmidt [16] et al.'s in vitro study on the concentration-dependent effect of vancomycin showed that when the concentration of vancomycin was greater than 4000 μg/mL, it inhibited the growth of fibroblasts. At present, there is no uniform standard for the safety of the dosage of vancomycin.

Our study comprised 1 (2.0%) patient with C4-C5 disc prolapse, 1 (2.0%) patient with C4 canal stenosis, 1 (2.0%) patient with C4 IDEM, and 1 (2.0%) patient with C4-C6 canal stenosis, among other things. Each disease was represented by 1 or 2 patients (2.0% or 4.0% respectively). The area of operative intervention did not affect the SSI rates. Result was not statistically significant (p=.5552), (z=0.5862)

Our study includes 1 (2.0%) patient who received C3 to C6 laminectomy with lateral mass fixation, 1 (2.0%) patient who had C4 C5 ACDF, 1 (2.0%) patient who had C4 corpectomy C3C5 cage plate fixation, and 2 (4.0%) patients who had C4C5C6 laminectomy lateral mass fixation, and so forth. Each surgical procedure was performed on one or two individuals (2.0% or 4.0%). It was not statistically significant (p=.5552), (z=0.5862)

Chiang HY et al 2020 [17] Consistently higher SSI rates have been reported in instrumentation-augmented spinal fusion compared to laminectomy, and the incidence is also elevated after the resection of spinal metastases in contrast to simple laminectomy. None of our patients had spinal metastases.

CONCLUSION

The clinical evidence that exists for prophylactic use of vancomycin powder in non-trauma spinal surgeries has multiple confounders. The type of neurosurgical intervention,the number of surgeons operating and related adjuncts may impact the exposure risk. Larger studies with more homogeneous samples are essential to illustrate the difference, if any, in the risk of postoperative infections with or without the use of vancomycin powder. We need to fully understand the long-term effects and potential risks of prophylactic vancomycin powder use, such as antibiotic resistance before making it a standard recommendation.

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