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Role of Intraoperative local vancomycin in preventing surgical site infections

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Abstract
Background: Surgical site infections following spinal surgeries are a big menace to operating surgeons as well as the patients. It causes increased morbidity and health care costs. Multiple treatment methods and prophylactic measures have been tried to reduce the rates of surgical site infections.
Materials and methods: The study was conducted in our institute from June 2012 to May 2017 for a period of 5 years in a prospective manner. Surgeries were performed by multiple surgeons belonging to different units of the Institute. A total of 200 patients were included in the study and they were categorized into two groups. In first group, intra operative vancomycin was not used (control group) which included 100 patients and second group comprised of another patients in whom prophylactic vancomycin was used intra operatively (antibiotic group).
Results and analysis: Infection rate in the vancomycin group was 3% (3 out of 100 patients). On the contrary infection rate was on higher side in the control group with 8 out of 100 (8%) patients getting infected. There was statistically significant decrease in the rate of infection in vancomycin used group when compared to control group with a 'p' value of 0.001.
Conclusion: There was a clear reduction in the rates of surgical site of infections in the antibiotic group. However, further randomized double blind studies with larger patient base and a larger surgical subpopulation is necessary to confirm the efficacy of vancomycin in reducing the rates of surgical site infections.

Keywords: Vancomycin, surgical site infections, spinal surgeries

1. Introduction
Surgical site infections following spinal surgeries is one of the most common complications [1]. Occurrence of these complications results in increased morbidity and increase the cost associated with surgeries. And also there will be increased duration of hospitalization and requirement of revision surgeries following surgical site infections [2]. The incidence of surgical site infections following spinal surgeries without instrumentation reported in the literature is 0.7 to 2.3% and that following spinal instrumentation is 0.3 to 20% [3-5]. Thus there is a raise in the incidence of infection when instrumentation is used in spinal surgeries. The most common organism isolated from surgical site infections is staphylococcus aureus. It could be either methicillin-sensitive or methicillin-resistant [6, 7]. It is the responsibility of the operating surgeons to reduce the rates of incidence of infection. Several risk factors have been explained as contributing factors to surgical site infections. Common ones being diabetes, low immunity status, smoking, long operating hours, increased blood loss, instrumentation and revision surgeries [8, 9]. Numerous preventive stratergies have been used by spinal surgeons to reduce the infection rates. Most common methods used are preoperative intravenous antibiotic prophylaxis, diluted povidone-iodine wash, skin antisepsis, silver impregnated dressings. Recently the use of powdered forms of antibiotic in the operative site before wound closure has been found to lower the rates of surgical site infections. Theory behind this is that local application of antibiotic helps in achieving highest levels of antibiotic concentrations at the operative site for a prolonged period. Most commonly used antibiotic is vancomycin. The aim of this study is to assess the role of vancomycin as a prophylaxis method in reducing the rates of surgical site infections following spinal surgeries.

2. Materials and methods
The study was conducted in our institute from June 2012 to May 2017 for a period of 5 years in a prospective manner.

Surgeries were performed by multiple surgeons belonging to different units of the Institute. A total of 200 patients were included in the study and they were categorized into two groups. In first group, intra operative vancomycin was not used (control group) which included 100 patients and second group comprised of another patients in whom prophylactic vancomycin was used intra operatively (antibiotic group). One gram of vancomycin powder was used intra operatively before wound closure below the level of fascia after thorough wound was. Pre operative antibiotic prophylaxis was given in all cases as it is done universally. Ceftriaxone with Sulbactum was the intravenous antibiotic used for prophylaxis in all cases. Following patients were included in the study:

- Laminectomy – both single and multiple levels
- Discectomy – both single and multiple levels.
- Trauma cases which required instrumentation
- Spondylolisthesis cases with or without instrumentation
- Cervical spine cases
- Deformity corrections
- Tuberculosis of spine

Paediartic spinal surgeries and revision spinal surgeries were excluded from the study.

Drain was not used in any of the cases, compression dressings were used instead. Both superficial and deep infections were included in the study. Patients were examined for wound gaping, serous discharge, any pus discharge, and fever and evaluated for signs of infections by laboratory investigations, gram stain and culture reports. After confirming the presence of infection, wound debridement and irrigation was done in the cases in which the infection was not controlled by intravenous antibiotics.

After completion of surgeries, a total of one gram of vancomycin was sprayed in the surgical wound after closing muscle layer, below the fascial plane. Post operatively intravenous antibiotics were used for a period of 72 hours, followed by oral antibiotics for another 5 days. Surgical site infections occurring up to period of 6 months were considered for the study, those occurring after 90 days were considered as late infections. For all the patients diagnosed with surgical site infection, additional operations required, vacuum assisted wound closures and number of additional hospitalization days required were recorded. Then the rates of surgical site infections were compared between the two groups.

Following were the different surgical procedures performed: 52 laminectomies, 68 laminectomy and discectomies, 36 cases of post traumatic instrumentations, 24 cases of spondylolisthesis, 7 cases of cervical spine, 4 deformity corrections and 9 cases of tuberculosis of spine (Table 1).

Table 1: Different surgical procedures included in the study.

Serial No.	Type of surgical procedures	Total numbers
1.	Laminectomy alone	52
2.	Laminectomy and discectomy	68
3.	Post traumatic instrumentation	36
4.	Spondylolisthesis	24
5.	Cervical spine surgeries	07
6.	Deformity corrections	04
7.	Tuberculosis of spine	09

3. Results and analysis

A total of 200 consecutive patients who met with the inclusion criteria were included in this prospective study. 100 of them were belonged to antibiotic group in whom intra operative vancomycin was used and another was control group in whom no local vancomycin was used. Mean age of the patients was 50.28 years; the mean follow up period was 10 months with range from 6 to 16 months. There was no statistical difference between the two groups when following variables were compared between two groups: sex (females 50.65% and males 49.02%), mean operating time was 121 minutes, and mean blood loss was 433ml. Diagnosis of infection was done when patients were either in the hospital or after discharging from the hospital. Comparison of variables between two groups is shown in Table 2. The distribution of different operative procedures between two groups is shown in Table 3.

Table 2: Comparison of variables between two groups.

Parameter	Total	Antibiotic group	Control group	P value
Age (years)	50.28	49	51	0.0078
Females	86	48%	55%	0.0127
Mean OT time	121 min	127min	119 min	0.0027
Amount of bleeding	433ml	430ml	435ml	0.0009

Table 3: Distribution of different procedures in two groups.

Procedure	Control group N=100	Antibiotic group N=100
Laminectomy	24	28
Laminectomy and discectomy	36	32
Post traumatic instrumentation	20	16
Spondylolisthesis	11	13
Cervical spine surgeries	03	04
Deformity correction surgeries	02	02
Tuberculosis of spine	04	05

Infection rate in the vancomycin group was 3% (3 out of 100 patients). One of these patients was methicillin resistant staphylococcus aureus and other two were klebsiella. On the contrary infection rate was on higher side in the control group with 8 out of 100 (8%) patients getting infected. Most common organism isolated in the control group was methicillin resistant staphylococcus aureus, 5 patients. 2 were methicilin sensitive staphylococcus aureus and another one was klebsiella. There was statistically significant decrease in the rate of infection in vancomycin used group when compared to control group with a 'p' value of 0.001.

One interesting aspect noted in the study was that there was increase in the rates of infection when instrumentation was done. Out of total 11 cases of infections, 7 were instrumentation cases. Here also, there was a significant difference in the instrumented cases infected in two groups. In the control group, 5 out of 37 instrumentation cases were infected (13.51%) and 2 out of 36 instrumented cases in the antibiotic group (5.56%) got infected. Rate of infection in non instrumentation cases was 4.76% in control group and 1% in antibiotic group.

7 of the total 11 cases which got infected had risk factors such as age above 60 years, diabetes, and smoking which gives an indication of the role of these risk factors in contributing for infection.

4. Discussion

Surgical site infections following spinal surgery is a great menace to both operating surgeons and for the patients as well. For the patients it greatly increases the morbidity and mortality and for the operating surgeons it's a great headache in the treatment of such patients. The reported incidence of surgical site infections in the literature ranges from 0.3 to 20%. Studies

have reported an estimated fourfold increase in the health care costs when patients develop surgical site infections following spinal surgeries [10]. Hence, prophylactic measures taken to reduce the surgical site infections will have a positive impact on the outcome and reduces the health care costs.

Many risk factors have been proposed in the literatures that have been expected to increase the rates of infections. Some of them are non modifiable and some are modifiable. It's the responsibility of the surgeon to minimize the risk factors before performing surgeries. Advanced patient's age, malnutrition, obesity, diabetes, smokings are some of the patient related risk factors. Common surgery related risk factors increased blood loss during surgery, prolonged operative time, revision surgeries, instrumented surgeries and multi level surgeries. There is no concrete evidence in the existing literature to suggest these risk factors are the causative factors for increased rates of surgical site infections.

Pre operative administration of intravenous antibiotics is one of the conventional prophylactic methods followed since decades to reduce the rates of surgical site infections. Lonstein *et al*. [11] showed that contamination of wound is an important cause for surgical site infections. The use of crystalloid solutions and povidone iodine, debridement of devitalized tissues are few of the techniques commonly used worldwide to reduce the burden of post operative infections [12, 13]. However the level of evidence to support these studies is very low.

Reports in the literature regarding the effectiveness of topical antibiotic use are contradictory. Maguire [14] demonstrated that the use of neomycin powder and found reduced infection rates. On the other hand Nachamie *et al*. [15] investigated the use of dilute neomycin and found the technique to be ineffective. To date, the literature remains unclear on the effectiveness of these techniques. Use of suction drainage system has not been shown to reduce the rates of infection as per the literature [16].

Powdered form of antibiotics used intra operatively before the closure of wounds has been shown to reduce the rates of post operative infections [17]. It is theoretically known to achieve high levels of antibiotic concentration in the surgical wound. Vancomycin is the most commonly used powdered antibiotic for surgical wounds, because it is cheap, effective against methicillin resistant staphylococcus Aureus, has got very good diffusion and concentration properties when compared to other antibiotics.

O' Neil *et al*. [18] and Sweet *et al*. [19] showed that the use of powdered antibiotic before wound closures reduces the rate of surgical site infections significantly. However, these studies dint had a control group. Our study had a control group. We have tried to allocate equal distribution of different procedures in both the categories. There was a clear reduction in the rates of surgical site infections in the vancomycin used group when compared to control group. There were no systemic complications following the use of vancomycin in our study.

Limitations of our study were that there was no randomization. And also the results cannot be entirely attributed to vancomycin, because there are so many other risk factors which can contribute for surgical site infections. Also, surgeries were performed by multiple surgeons which can lead to variation in surgical timing and techniques. However, we have tried to allocate the patients uniformly into both the groups.

5. Conclusion

In this study comprising of 200 patients, divided into antibiotic and control groups of 100 patients each, one gram of vancomycin was used in antibiotic group intra operatively before the closure of wound below fascia level. There was a clear reduction in the rates of surgical site of infections in the antibiotic group. However, further randomized double blind studies with larger patient base and a larger surgical subpopulation is necessary to confirm the efficacy of vancomycin in reducing the rates of surgical site infections.

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7. Conflicts of interest: None

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