



Role of local installation of Vancomycin powder for Prophylaxis against Infection in open fracture

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Abstract

Open fractures are known to be high risk for infection, even when treated with thorough debridement, stabilization, and appropriate systemic antibiotic therapy. Infection rates can be divided on the basis of Gustilo-Anderson fracture type-1, although there is variation in the literature, with rates of 0% to 6% for type-I fractures, rates of 2% to 6% for type-II fractures, and rates of 5% to 50% for type-III fractures Systemic antibiotics substantially lower infection rates in open fractures. Wound cavities are avascular; therefore, systemically administered antibiotics only achieve low concentrations in the fluids that collect in the cavity The purpose of this study was to determine the efficacy of local wound cavity installation of Vancomycin in conjunction with systemic antibiotics, to lower the prevalence of infection in patients with open fractures. This study suggests that local installation of Vancomycin administration as an adjunct to systemic antibiotics may be effective in lowering infection rates in open fractures; further research with higher-level research designs is needed.

Keywords

Gustilo-Anderson fracture, infection, local installation, Vancomycin

Introduction

Musculoskeletal infection is a challenging complication for both orthopaedic surgeons and patients. Open fractures are known to be high risk for infection, even when treated with thorough debridement, stabilization, and appropriate systemic antibiotic therapy. Infection rates on the basis of Gustilo-Anderson fracture type are of 0% to 6% for type-I fractures, rates of 2% to 6% for type-II fractures, and rates of 5% to 50% for type-III fractures¹. Wound cavities are usually avascular, systemically administered antibiotics only achieve low concentrations

Need of Local Antibiotics: Tissue-implant interface is especially prone to contamination. Impaired local blood supply due to surgical trauma, hematoma, and oedema may affect the delivery of the antibiotic when administered systemically and moreover Systemic side effects of the antibiotic can be avoided and higher local drug levels can be achieved by local antibiotics.

Delivery vehicles: Various delivery systems are available for antibiotics delivery at site of infection

- a. Antibiotic loaded Bone Cement most common: Bone cement Being Non-absorbable carriers require a second surgical procedure for removal, adding cost to the health-care system as well as additional morbidity to the patient.



- b. Biodegradable carrier such as calcium sulphate, calcium hydroxyapatites, calcium phosphate, bioactive glasses, and demineralised bone
- c. Natural polymers such as collagen, fibrin and thrombin as well as synthetic polymers, such as polyanhydrides, poly (lactic acid) and polylactides-coglycolides (PLGA). Cost of these combination products is a concern and no proper evidence available

Antibiotics Option: Essential properties of the selected antibiotic(s) should have activity against the causative organism. Antibiotics should be broad spectrum of efficacy and have extremely low rates of anaphylaxis. Locally deliverable antibiotics such as Aminoglycosides, such as tobramycin and gentamicin, are bactericidal and active against aerobic gram-negative bacilli. Vancomycin is a glycopeptide that is active against gram- positive bacteria including methicillin-resistant Staphylococcus aureus

Local Installation: The use of local antibiotics as an adjunct to perioperative antibiotics has gained significant attention over the past 5 years the addition of prophylactic intra- wound vancomycin to standard systemic prophylaxis in elective spine surgery was shown to reduce infection rates from 2.6% to 0.2%.

Material and Method

Prospective study from January 2017 to December 2019 at Government Medical college hospital, Rajnandgaon. All Open fracture admitted in department of orthopaedics were included. Fractures which were not operated were excluded, Fracture in younger than 8 years age group were excluded. Patients with pre-existing infection at the operative site were excluded. Patients with known major systemic infection at the time of injury were excluded. Outcomes were measured as occurrence of Surgical Site Infection (SSI) within post- operative 90 days and SSI that required return to the operating theatre. All patients received initial debridement in Emergency department and received systemic broad-spectrum antibiotics. In intervention group (118 fractures) in addition also received local installation of 1gm Vancomycin powder

Figure 1 Open fracture grade I Tibia, Local installation of Vancomycin powder after internal fixation.





Figure 2: compound fracture medial Malleoli, local installation of antibiotics after internal fixation



Observation & results

Total 329 patient with compound fracture were treated during January 2017 to December 2019. Two hundred and fifty-one were included in study after excluding as per exclusion criteria. All patients received initial debridement in Emergency department and received systemic broad-spectrum antibiotics. Control group (133 Fractures) didn't receive local installation of antibiotics during surgery. In intervention group (118 fractures) received local installation of 1gm Vancomycin powder.

Table 1: Age, sex, diabetic status, Limb involve 7 Fixation type in observation and control group

		Control group (133)	Intervention group (118)	P value
Age		35.4+/- 17.1	37.9+/_17	0.2475
Sex	Female	34.58%	32.20%	
	Male	64.42%	68.8%	
Diabetic		6.7% (9)	10.16%(12)	
Fixation Location	Upper limb	51	46	0.9176
	lower limb	82	72	



		Control group (133)	Intervention group (118)	P value
Fixation type	Minimally invasive	60	54	0.9178
	ORIF	73	64	

Table 2 Gustilo-Anderson Fracture type in control group and observation group and their mean follow up

Gustilo-Anderson Fracture type	Control group (133)	Intervention group (118)	P value
I	28	26	
II	49	45	
IIIA	32	29	
IIIB	14	18	
IIIC	0	0	
Follow-up	8.4+/_ 5.5	9.2+/_ 5.2	0.8522

Results: The deep and superficial infection rate in the control group was 32.33.7% but it was significantly lower in the intervention group at 20.33%. When comparing only the deep infections, the infection rate in the control group was 19.54% (twenty-six of 183 fractures) compared with 7.62% in the intervention group.

Discussion

Jenson and colleagues (1939)³ showed no infections in 39 open fractures treated with debridement and sulphanilamide powder placed into the wounds. Earliest report of local application of Vancomycin was in cardiothoracic patients in 1989, mixed in a haemostatic paste of topical thrombin was applied to the cut sternal edges The authors found a sternal infection rate of 0.45% compared with 3.6% in a historical control group

A recent meta-analysis (2014)⁵ showed that local application of Vancomycin powder protected against surgical site infections, deep incisional surgical site infections and surgical site infections caused by S. aureus. A study by Penn-Barwell et al. (2014) showed superior infection control when a gel containing



gentamicin and vancomycin was utilized compared with conventional antibiotic loaded PMMA beads in a rat model of open fracture.

A study (2015)⁶ showed that foot and ankle surgical patients had an overall likelihood of SSI decrease by 73% in patients who received topical vancomycin compared with patients that did not receive topical vancomycin. A study by O'Neill et⁷ al. evaluated the use of intra-site vancomycin after spine trauma and found a reduction in SSI rate compared with historical controls (0% and 13%, respectively).

Reported Side Effects

Reported or potential side effects are very few included tissue-irritation, resulting in neuritis or seroma formation, development of vancomycin-resistant organisms, inhibition of osteoblasts with resultant pseudoarthrosis, renal toxicity, and anaphylactic reaction.

Newer Technique

MR compatible carbon fibre nails coated with antibiotic impregnated cement in the setting of long bone infections. Schmidmaier et al.⁸ used titanium rods coated with poly (D, L-lactide) (PDLLA) loaded with gentamicin in rats with inoculation of *S. aureus* in their medullary canal. The rats were able to clear 80–90% of the infections

Limitations

This study was Nonrandomized study. Confounding factors such as ASA grading, hospital stay, polytrauma, smoking was not assessed. The impact of intrawound vancomycin on 1-year SSI was not analysed. The rate of SSI is high within 90 days postoperatively and decreases subsequently; therefore, this time point was chosen

Conclusions

This study suggests that local installation of Vancomycin administration as an adjunct to systemic antibiotics may be effective in lowering infection rates in open fractures. Further research with higher-level research designs is needed.

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