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Research Article

ROLE OF ANTIBIOTIC BEADS IN MANAGEMENT OF COMPOUND FRACTURE LONG BONES

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ABSTRACT

Objective: The aim of the study was to assess role of antibiotic beads in the management of compound fracture long bone.

Methods: Twenty-four patients with compound long bone fracture (Grade II, IIIA, and IIIB) operated with initial debridement, fracture stabilization, and antibiotic coated beads. All patients were followed-up till at least 6 months. All patients were evaluated clinically and radiologically for functional outcome.

Results: Seventeen patients (71%) were male while 7 patients (29%) were female. Mean age at the time of surgery was 34.5 years (Range: 20–70 years). Sixteen patients had fracture on the right side while the eight patients had on the left side. Sixteen patients had Type II compound injury (67%), five patients had Type IIIA (21%), and three patients had Type IIIB compound injury (12%). The average time of union was 16 weeks in 6 patients (26.06%), 12–14 weeks in 8 patients (34.78%) and 18–22 weeks in 9 patients (39.14%). Out of 24 cases, only one case had superficial infection, one case has deep infection, three patients had raw skin area, one patient developed post-operative knee stiffness, and another had 1 cm limb shortening. Functional outcome is seen as six patients with excellent outcome, eight patients with fair outcome, nine patients with good outcome, and one patient had poor outcome.

Conclusion: The study concludes the use of antibiotic coated beads in compound fracture significantly reduces the infection in compound fracture of Grade II, Grade IIIA, and IIIB. Antibiotic impregnated beads delivers higher concentration of local antibiotics to wound site which helps in hastening recovery of wound. This reduces hospital stay and morbidity.

Keywords: Antibiotic beads, Compound fracture, Long bones.

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INTRODUCTION

As industrialization and urbanization are progressing every year, with rapid increase in traffic, incidence of high energy trauma are increasing with the same pace. Compound fractures of long bones are the most common long bone fractures encountered by most orthopedic surgeons. Compound fractures are injuries in which the skin and soft-tissue integument are disrupted and the underlying bone is exposed to the external environment [1,2]. This communication results in contamination by microorganisms that can cause deep and superficial infection [3].

Impaired vascularity, devitalized tissue, and loss of skeletal stability are all factors leading to increased susceptibility to infection after compound fracture of long bones [4]. One of the most feared and challenging complication in the management of compound fracture is infection, which can delay healing, lead to permanent functional loss, or even amputation of affected limb [5]. Antibiotic impregnated beads are a method used to deliver higher concentration of local antibiotics to treat bone infections, which may help in hastening recovery of wound. This reduces hospital stay, morbidity, and cost-effective [6].

Most of the antibiotic when mixed with bone cement have been shown to maintain efficacy. However, the main requirement of the antibiotics is that they should be heat stable and hydrophilic. Most commonly preferred antibiotics include gentamycin, tobramycin, and vancomycin. Gentamycin sulfate, an aminoglycoside acts as an excellent additive to bone cement due to its broad spectrum of action, its bactericidal characteristics, low rate of primarily resistant pathogens, and good thermos stability [7].

Objective

The aim of the study was to assess role of antibiotic beads in management of compound fracture long bone.

METHODS

This is a hospital-based and prospective study, is conducted in the Department of Orthopaedic, Government Medical College and Associated group of hospitals, Kota, during the September 2019–December 2021. All fresh cases of compound fracture of long bones will be included in this study (Type II, IIIA, and IIIB). Compound fracture Grade 2 and 3A and 3B based on Gustilo and Anderson classification, both sex and age above 15 years were included in the study. Closed fractures, Grade 1 and Grade 3c, pathological fractures, known hypersensitive to antibiotics, patients who are medically unstable, and at extremely poor anesthesia risk were excluded from the study. All cases were subjected to detailed history with emphasis on age, sex, mode of injury, duration of reporting after injury, and time interval between injury and treatment. Clinical examination will include general examination, local examination, neurovascular status, systemic examination, and for associated injuries such as head, chest- visceral injuries, and other associated skeletal injuries.

Preparation of the bone cement

To mix, empty the contents of the packet containing the powder into a sterile inert mixing device. The liquid from the ampoule is added to the powder. Stirring is done until a dough like mass is formed. The dough like mass is ready for manipulation. The mixing and manipulation process should be at least 4 min. The completion of polymerization occurs with an exothermic reaction with considerable liberation of heat. Temperature occurring during polymerization has been reported as high as 110°C. From the start of mixing, the final hardening occurs in standard viscosity bone cement € 7.5–8.5 min. Low viscosity bone cement € 9.5–10.5 min.

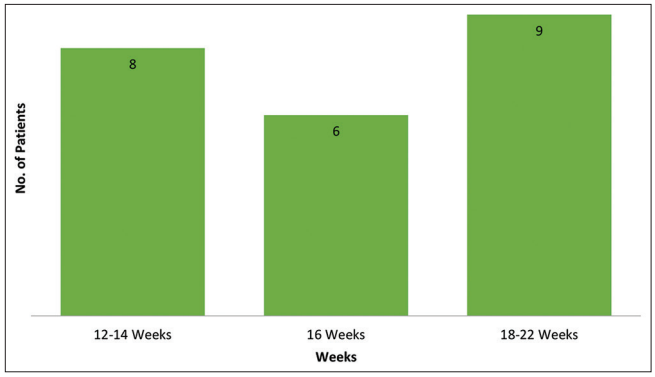

Fig. 1: Union time

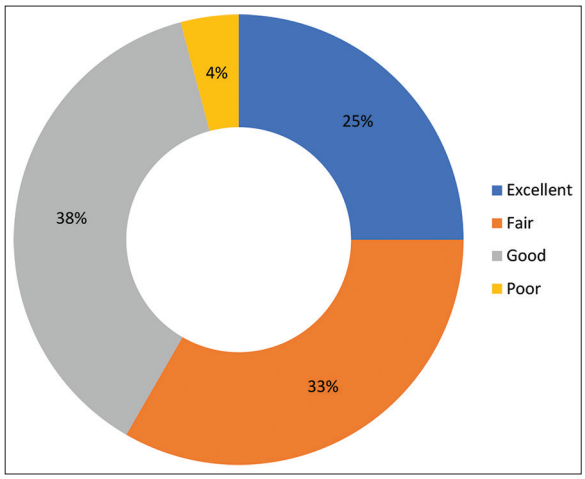

Fig. 2: Functional outcome

Table 1: Sociodemographic profile of study subjects

Age group	No. of patients	Percentage
20–30 years	7	29.1
30–40 years	9	37.5
40–50 years	3	12.5
50–60 years	4	16.6
>60 years	1	4.7
Sex		
Male	17	70.80
Female	7	29.20

Table 2: Fracture type, pattern, site

Garden type of fracture	No. of patients	Percentage
Garden type II	16	67
Garden type III a	5	21
Garden type III b	3	12
Fracture pattern		
Comminuted	11	46
Oblique	8	33
Transverse	4	17
Segmental	1	4
Fracture site		
Distal Femur	9	39
Proximal tibia	2	9
Middle tibia	8	30
Distal Tibia	5	22

Store in dark below 25°C. Mechanical testing of the antibiotic impregnated bone cement confirmed that the antibiotic when incorporated in the amounts usually used for clinical purposes had no significant influence as the strength of the bone cement both in comparison and tension.

Preparation of antibiotic loaded cement beads

When the Vancomycin mixed PMMA bone cement attains its doughy consistency, it is rolled over manually into balls of 6 mm to 7 mm diameter. A string of approx. 20–25 beads is made over 20 or 22 gauze stainless steel wire. They are allowed to get set and thus beads are made ready for implantation. The prepared beads are folded and packed within the soft tissue. Primary wound closure is done. The antibiotic is leached from the PMMA beads and rod into the post-operative wound hematoma and secretion, which acts as a transport medium. The use of suction drains is debatable, because their presence may diminish the concentration of antibiotic in the wound hematoma.

Placement of the implants

In compound fractures of long bone, first patient undergoes a through debridement. This was followed by copious irrigation of the fracture site with hydrogen peroxide, povidone iodine solution, and copious amount of normal saline. The fracture was then reduced and stabilized with plate, interlocking nail, or external fixator. One packet of bone cement is taken and 2 g of teicoplanin and 2 g of vancomycin added to it and cement mixing is started and placed in mould with stainless steel wire in between for the required number of beads and allowed to set. After setting of the cement, the ends of the stainless wire are made into a knot as the beads do not slip during removal. Wound closure done with simple sutures. Betadine dressing done and pop slab applied to affected limb.

Follow-up

Follow-up was done as regularly every month till 6 months and then every two months. The minimum follow-up in our study was 6 months and during the follow-up period, functional outcome was assessed clinically and after radiological union.

RESULTS

In our study, majority patients were in the age group of 20–50 years with mean age of 34.5 years. The youngest was 21 years old and the oldest was 62 years old. The total number of male patients were 17 (70.80%) and female patients were 7 (29.20%), 16 patients had fracture on the right side while the remaining eight had on the left side, mode of injury was RTA in 21 patients (87%) and fall from height in 3 patients (13%) (Table 1).

We followed Gustilo Anderson classification system for classifying the compound fracture. In our study, 16 patients had Type II compound injury (67%), 5 patients had Type IIIA (21%) and three patients had Type IIIB compound injury (12%). Maximum 45.83% were operated between 24 and 72 h of admission to trauma center. In 54% cases, i/l tibia nail was used followed by 38% DFLCP and in 8% LHBP were used as implant (Table 2).

On analyzing the post-operative X-rays of patients, fracture union was seen in two patients and non-union was seen in one patient (due to infection). The average time of union was 16 weeks in 6 patients (26.06%), 12–14 weeks in 8 patients (34.78%) and 18–22 weeks in 9 patients (39.14%) (Figs. 1 and 2).

In our study, out of 24 cases, only two cases developed infection, out of two cases, one case had superficial infection and one case has deep infection. Superficial infection settled with regular dressing and sensitive systemic antibiotics. Non-union developed in patient with deep infection. Three patients had raw skin area, one patient developed post-operative knee stiffness, another had 1 cm limb shortening. In eight patients wound heal by primary intention and in 15 patients wound heal by secondary intention.

DISCUSSION

The increasing incidence of open fracture has led to higher infection rates leading to higher incidence of non-union and morbidity.

In our study, we used antibiotic impregnated beads to deliver higher concentration of local antibiotics. We aimed for preventing infection by local antibiotic delivery and bony union by definitive stabilization of fracture. Use of antibiotic coated beads with primary fixation of fracture is a definitive single stage procedure, risk of multiple surgeries is avoided and prolonged duration of systemic antibiotics can be minimized.

In 2018 Amarnath *et al*. conducted similar study in 40 patients for evaluation of role of antibiotic impregnated beads in compound fractures (Grade II, IIIA, and IIIB). This study was undertaken to share our experience on role of antibiotic beads in compound fractures [8].

In our study, we analyzed the following parameters – age, fracture pattern, grade of compounding, timing of surgery, intraoperative and post-operative complications, wound healing, and fracture union.

Most common age group involved in our study with road traffic accidents was between 20 and 50 years. Similar results were found in study conducted by Amarnath *et al*. [8]. This may be due to that this age group which went out mostly due to active, enthusiastic, or employment.

In our study, male patients were 17 and female patients were seven thus male-female ratio was 2.4:1.

In study by Amarnath *et al*. [8], 10 patients (25%) had Type II fracture, 16 patients (40%) had Type IIIA and 14 patients (35%) had Type IIIB fracture. Twenty-seven patients (67.5%) had tibia fracture and 13 patients (32.5%) had femur fracture. Out of 40 patients, four patients developed wound infection (10%).

Similar results were shown by Henry *et al*. [7], in their study, the overall infection rate was 12% in Group 1 (treated without antibiotic beads) and 3.7% in Group 2 (treated with antibiotic beads). This difference is highly significant ($p<0.001$).

In our study, out of 24 patients (16 patients of Type II compound injury, five patients of Type IIIA, and three patients of Type IIIB compound injury), 1 patient (4.16%) developed superficial wound infection, and 1 patient (4.16%) developed deep infection.

Irrespective of the usage of antibiotic bone cement in compound fractures, primary extensive wound debridement always plays a vital role in reducing the chance of infection.

CONCLUSION

Our experience of this study denotes final outcome of compound fracture of long bone depends on many factors related to the patient, surgical procedure, timing, fracture pattern, type of compound fracture, etc. However, it is certain that antibiotic coated beads around the fracture site will help in preventing infection to a large extent. However, one should try to follow good surgical principles, for example Thorough wound wash, thorough wound debridement, and definitive stabilization of fracture along with antibiotic coated beads to achieve satisfactory outcome. Although our series showed good outcome in large number of patients but more number of patients and longer follow-up will help in arrive at a conclusion.

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AUTHORS' CONTRIBUTION

All the authors have contributed equally.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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