USE OF ANTIBIOTIC CEMENT SPACERS/BEADS IN TREATMENT OF MUSCULOSKELETAL INFECTIONS AT A.I.C. KIJABE HOSPITAL

G.C. Mwangi, MBChB, COSECSA Resident Orthopaedics, A.I.C. Kijabe Hospital, P.O. Box 20-0220, Kijabe, Kenya and **J.T Macharia**, MBChB, MMed (Orthop), FCS Ortho[ECSA], Cure Children's International Hospital, P.O. Box 52, Kijabe 0220, Kenya

Correspondence to: Dr. G.C. Mwangi, A.I.C. Kijabe Hospital, P.O. Box 20-0220, Kijabe, Kenya
Email: chegemwas@yahoo.com

ABSTRACT

Background: Chronic musculoskeletal infection involving bone present a big challenge to orthopaedic surgeons. These include chronic osteomyelitis, septic non union and open fractures of long bones.
Objective: The study was done to determine outcome of treatment of chronic musculoskeletal infections involving bone after use of local antibiotic impregnated cement and report the microbiological patterns of these infections in our hospital.
Setting: A.I.C. Kijabe Hospital, Kenya.
Patients and methods: The medical charts of all patients treated with antibiotic cement were reviewed over the period of one year [September 2012 to September 2013]. The cohort consisted of 80% males and 20% females. The patterns of cultures for infections were reviewed and the procedure of antibiotic impregnated cement placement described.
Results*:* Twenty patients charts were reviewed, 4 (20%) were females and 16 (80%) males with ages ranging between 4 years and 62 years. Of these 40% had infected non unions of tibiae and femur, 25% open fractures, 25% chronic osteomyelitis. Culture results revealed 25% mixed infections, 20% *staphylococcus aureus*. All patients had initial debridement and antibiotic impregnated bone cement. Infection was cleared in 95% of the patients with 75% having radiological evidence of healing. Forty percent had bone transport of between 4 and 6 cm. A 100% of the patients had negative cultures at the time of antibiotic cement spacers removal.
Conclusions: Use of antibiotic impregnated bone cement could be used in treating chronic musculoskeletal infections.

INTRODUCTION

Musculoskeletal infections include infected non union, chronic osteomyelitis, and infected Gustillo 3 open fractures. This may also involve bone loss either from initial injury or from debridements (sequestrectomy).

Segmental bone defects resulting from traumatic injuries or chronic osteomyelitis are complicated problems with significant long-term morbidity. Historically, due to the difficulty in managing segmental long bone defects, amputation was the preferred treatment. More recently, the use of an antibiotic cement spacer followed by grafting within this space confirmed by an induced biomembrane has been described as a potential treatment strategy (1).

In cases with infected non-union, the primary step is eradication of the infection before attempting to achieve union. Release of antibiotics from the bone cement at a high concentration and its penetration to the surrounding tissues, including cortical and cancellous bone, prompted the use of antibiotic cement in the control of bone infection (2,3).

Treatment of patients with posttraumatic infected nonunions or highly contaminated open fractures with segmental bone loss of the long bones of the lower extremity is demanding. The use of a 2-stage reconstruction technique, the first stage characterized by thorough debridement, copious lavage, soft tissue coverage, and placement of a cement spacer with antibiotics at the infected site, and the second stage by cement spacer removal, internal fixation, and placement of bone graft with local antibiotics is worth consideration (2).

Recently, Masquelet proposed a procedure combining induced membranes and cancellous autografts like has been used in some of our patients. However, predicting the outcome of reconstruction of bone defects remains difficult; and the patient should always be informed that, although potential complications are mostly predictable, in most of the cases the reconstruction process is long and difficult (4,5).

Current data has demonstrated that the use of antibiotic-impregnated cement spacers has improved the outcome of the treatment of infection associated with total joint arthroplasty. These spacers provide direct local delivery of antibiotics while preserving patient mobility and facilitating reimplantation surgery (6). This concept can also be employed in treatment

of musculoskeletal infections and open fractures with bone loss. Ununited fracture of the tibia or femur complicated by infection is not only a complex surgical problem but also a chronic and at times debilitating condition to the patient and therefore a big challenge to the orthopaedic surgeon (7).

MATERIALS AND METHODS

We retrospectively reviewed charts for 20 patients covering the period from September 2012 to September 2013. Their ages ranged from 4 years to 62 years. The study included all patients with chronic musculoskeletal infections and open tibia and femur fractures treated with antibiotic impregnated cement spacers or beads at A.I.C. Kijabe Hospital. We excluded patients with musculoskeletal infections or open long bone fractures that were not treated with antibiotic impregnated bone cement.

Surgical procedures: During the first stage, the operative extremity was prepared and draped in the usual sterile fashion. The area of bone loss was carefully debrided and irrigated. Debris and nonviable tissues were removed. 'External fixators were applied after which antibiotic impregnated cement spacers or beads were inserted. Material for cultures and sensitivity was taken for all patients. Each satchet of antibiotic cement was 40 grams and was already impregnated with gentamycin by the manufacturer. Intraoperatively, 2 grams of vancomycin was added to the cement for all the patients.

The spacers were left *in situ* for a period ranging from 6 weeks to 7 months. The definitive procedures that were done after the removal of bone cement included bone transport, bone grafting using the Masquelet technique, intramedullary nails, girdlestone, below knee amputation and knee fusion.

RESULTS

Of all the 20 patients whose charts were reviewed, four were females and 16 were males with ages ranging between 4 and 62 years.

Table 1

Distribution of patients according to their ages

Age (years)	Frequency
0-10	1
11-20	3
21-30	7
31-40	4
51-60	4
61-70	1
Total	20

Table 2

Distribution of disease according to the bone affected

Disease	Bone involved	Frequency	(%)
Infected non union	Tibia	6	30
	Femur	2	10
Open fractures	Tibia	4	20
	Femur	1	5
Infected pseudoarthrosis	Tibia	1	5
Chronic osteomyelitis	Tibia	3	15
	Femur	2	10
Infected THR	Femur	1	5
	Tibia	14	70
	Femur	6	30
Total		20	100

Figure 1

Distribution of disease according to the bone affected

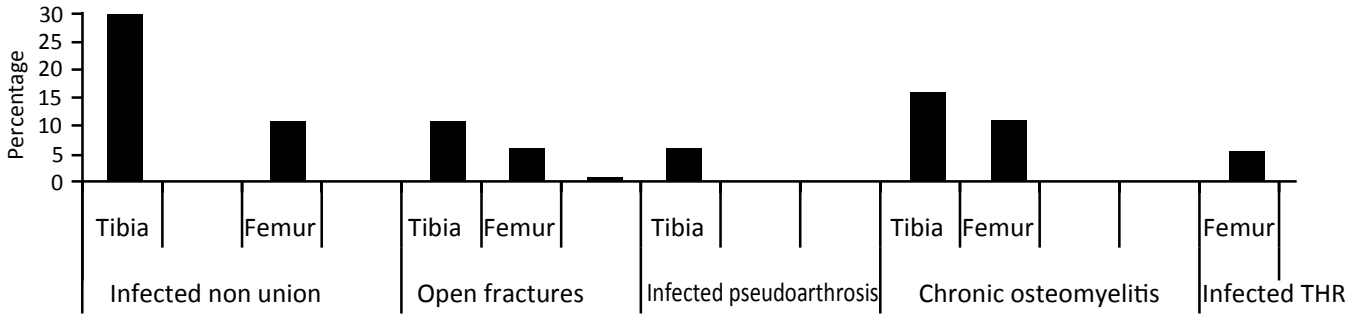


Table 3

Bacterial pattern according to type of disease and duration of illness

Disease	Duration of illness	Bacterial pattern
Infected non union	3 months to 3 years	Pseudomonas aeruginosa, proteus, S. aureus, MRSA
Open fractures	1 day to 30 days	S. aureus
Infected pseudoarthrosis	4 months	Negative cultures
Chronic osteomyelitis	1 month to 3 years	S. aureus, GNR enterobacter clocae, proteus mirabilis
Infected total hip replacement	5 months	GNR enterobacter clocae, S. aureus

Table 4

Results for culture and sensitivity patterns

Bacteria	Frequency	Sensitivity
Staphylococcus aureus	5	Cefazolin, Chloramphenicol, vancomycin, erythromycin, azithromycin, doxycycline,
MRSA	1	Chloramphenicol, tetracycline, cotrimoxazole
Pseudomonas aeruginosa	1	Meropenem, ciprofloxacin, septrin
Enterobacter clocae	4	Meropenem, ciprofloxacin, ceftriaxone gentamycin, meropenem, tazobacterm
*Mixed infection	5	
Negative cultures	4	
Not taken	1	
Total	20	
*Mixed infections		
Proteus mirabilis/ Staphylococcus aureus	P. mirabilis	Chloramphenical, meropenem, ciprofloxacin, cefazolin
	S. aureus	Chloramphenicol, Cefazolin
Enterobacter clocae/ Staphylococcus aureus	E. clocae	Meropenem, cefepime, ciprofloxacin
	S. aureus	Erythromycin, chloramphenicol, cefazolin
Staphylococcus aureus/ Proteus mirabilis	S. aureus	Erythromycin, septrin, chloramphenicol, cefazolin
	P. mirabilis	Meropenem, chloramphenicol, ampicillin/sulbactum
Eschelichia coli/Proteus mirabilis	E. coli	Meropenem, chloramphenicol
	P. mirabilis	Ciprofloxacin, meropenem
Pseudomonas aeruginosa/ enterobacter clocae	P. aeruginosa	Ciprofloxacin, meropenem, septrin
	E. coli	Ciprofloxacin, meropenem, septrin

Table 5
Surgical procedures performed

Procedure	Frequency	(%)
Debridement	20	100
Ex fix	17	85
Antibiotic cement spacer/beads	20	100
Masquelet technique	5	25
Bone transport	6	30
IM Nail	3	15
Girdle stone	1	5
BKA	1	5
Knee fusion	1	5

Figure 2
Surgical procedures performed

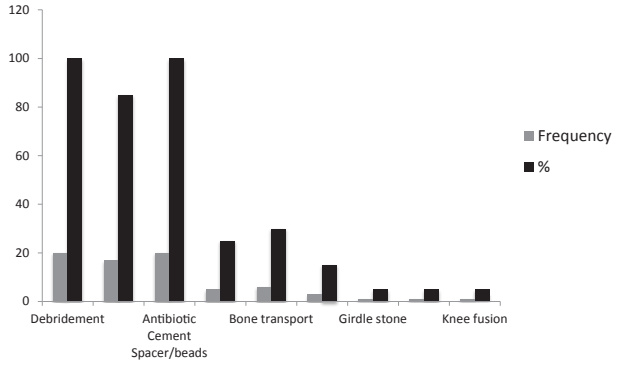


Table 6
Outcomes after removal of antibiotic spacer/beads

Outcome	Frequency (Cultures negative)	(%)
Infection cleared/ no further drainage (cultures-negative)	19	95
Minimal discharge (culture negative)	1	5

Figure 3
Outcomes after removal of antibiotic spacer/beads

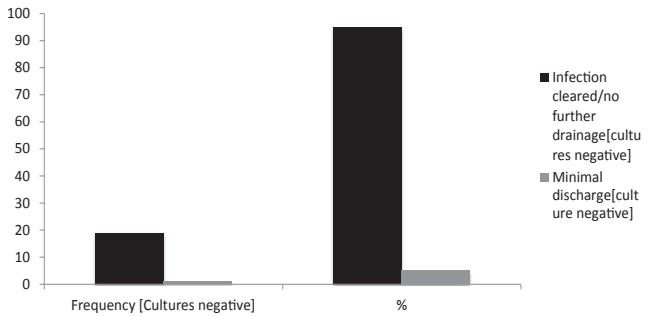
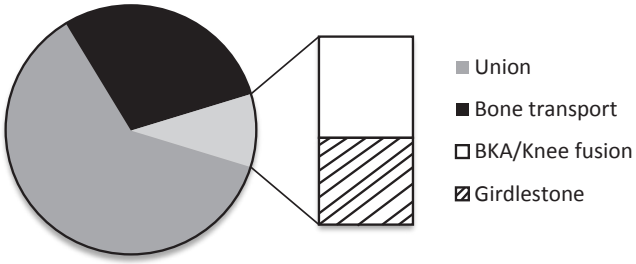


Table 7
Showing other outcomes

Masquelet technique done	17
Knee fusion/ Below knee amputation	2
Girdle stone resection arthroplasty	1
Bone transport	8
Total	28

Figure 4
Other outcomes



The total above for the other outcomes is 28 because all patients who had bone transport done also went to complete bone union.

Follow up: Patients were followed up for a period of between 4.5 and 9 months after the last surgical treatment and no reactivation of infection was noted during the period. During this period, negative cultures had been obtained for all the patients under investigation.

Of the twenty patients included in the study, 17 of them went to complete bone union with one achieving successful knee fusion, one getting a below knee amputation and one getting a successful girdlestone resection arthroplasty.

DISCUSSION

Our study revealed high rates of infection clearing (95%), minimal discharge in one patient (5%) and high bone healing (union) rates (90%). The cultures revealed multiple/mixed bacterial infections in single individuals. The long durations of hospital stay was necesitated by culture results with bacterial growths that required prolonged intravenous antibiotic administration. A number of patients presented with chronic discharging sinuses, as late as 3 years and others being referred from other hospitals. Treatment resulted with good results with only one patient having chronic discharge after treatment and with all patients having negative culture results at the time of removal of the antibiotic cement spacers or beads. Vancomycin was added to the bone cement because it is a heat stable antibiotic. Most patients with chronic musculoskeletal infections in our set up would have received gentamycin at some point during their treatment and thus use of vancomycin as the alternative was considered.

It is also evident that Masquelet technique is being embraced (25%) in treament of complicated/ chronic infections and bone loss. In the use of Masquelet technique, the cement delivers high-dose local concentrations of antibiotics while filling the dead space. The cement spacer also fills a potential space, induces the formation of a biomembrane, and prevents the involution of the surrounding soft tissue (8). Masquelet and Begue proposed that the membrane prevents graft resorption and improves vascularity and corticalization hence increasing bone union (1).

Reconstruction of diaphyseal bone defects due to infections or fractures still represents a major clinical challenge in our set up. Several approaches are used with the common objective to regenerate bone loss and restore function. The methods most commonly used are the vascularised fibula autograft and the Ilizarov bone transport technique. Most centres in our set up may lack the capacity to carry out procedures like use of vascularised fibula autograft and thus use of cement implegnated bone cement may be used as an alternative to treat chronic musculoskeletal infections.

Limitations in this study include incomplete documentaton for example amount of bone loss intraoperatively. Other factors that would influence healing for example immunosuppresion status for example HIV and albumin levels were not investigated.

CONCLUSION

Complicated musculoskeletal infection and bone loss after open long bone fractures poses a threat to limbs. Antibiotic spacers are effective and add value in the treament of such infections and bone loss.

REFERENCES

1. Tak, M.W., Tak W.L., Xin L., *et al*. Masquelet technique for treatment of posttraumatic bone defects. *The Scien World J*. 2014; **2014**: 1-5.
2. Allende, C. Cement spacers with antibiotics for the treatment of posttraumatic infected nonunions and bone defects of the upper extremity. *Tech Hand UP Extrem Surg*. 2010; **14**(4):241-247.
3. Pelissier, P.H., Masquelet A.C., Bareille R., *et al.* Induced membrane secrete growth factors including vascular and osteoconductive factors could stimulate bone regeneration. *J Orthop Res*. 2004; **22**: 73 – 79.
4. Giannoudis, P.V., Faour, O., *et al*. Masquelet technique for the treatment of bone defects: tips-tricks and future directions. 2011 Jun;42(**6**):591-8. doi: 10.1016/j.injury.2011.03.036. Epub 2011 May 4.
5. Romana, M.C. and Masquelet, A.C. Vascularized periosteum associated with cancellous bonegraft: an experimental study. *Plastic Reconst Surg*. 1990; **85** (4): 587-592.
6. Motsitsi, N.S., Masquelet's technique for management of long bone defects: From experiment to clinical application. ISSN 2073-9990. *East Cent Afr J Surg*. 2012; **17**(2): 43-46.
7. Quanjun, C., William, M. Mihalko, *et al.* Antibiotic-impregnated cement spacers for the treatment of infection associated with total hip or knee arthroplasty. (C) *JBJS*. 2007; **89** (4): 871-882.
8. Ashok, K.S., Parag, K.S., Salim, K., *et al*. Use of antibiotic cement-impregnated intramedullary nail in treatment of infected non-union of long bones. *Indian J Orthop*. 2009; **43**(4): 396–402.