

Limited Intra-Medullary Debridement With Medulloscopy And Irrigation-Drainage System for Management of Chronic Osteomyelitis Of Long Bones

Anurag singh¹, anand singh², nikhil oza³, aniruddh dash^{4*}, a. Ganesh⁵, deepak verma⁶

^{1,2,3,4,5,6}Department of Orthopaedics, IMS and SUM hospital, Siksha "O" Anusandhan University (Deemed to be), K8, Kalinga nagar, Bhubaneswar-751003, Odisha, India.

⁴Anirortho@gmail.com

Abstract:

Introduction-Chronic osteomyelitis is a therapeutic challenge and even with proper management it is seldom cured. The usual surgical management involves extensive surgery and prolonged hospitalisation. In cases where only intramedullary variety of infection is present, we can proceed with a less debilitating procedure. In this study our aim is to prove the efficacy of limited intramedullary reaming and medulloscopy with post operative suction-irrigation for managing this kind of osteomyelitis.

Methods and Materials - This study was conducted since June 2018 to May 2020 in which we operated nine patients of medullary chronic osteomyelitis with our technique. The inclusion criteria is Patients with Radiographic / MRI proven Chronic osteomyelitis of medullary variety of Femur or Tibia. Entry points were made at proximal and distal ends of lesion in the bone. The medullary cavity was reamed from proximal and distal points using hand reamers. An arthroscope was used to visualise the medullary cavity for remaining infectious nidus. Post operatively a continuous suction-irrigation system was placed.

Results- Eight patients were followed up for a mean duration of 13 months. At final follow up all the patients were free of symptoms without any pain and discharging sinus. The mean ESR and CRP levels at the time of presentation was 28 and 5.67 respectively and at the final followup was 12 and 0.60 respectively.

Conclusion- Intramedullary debridement using a reamer and arthroscope gives good results as a single staged procedure. With addition of suction-irrigation system it clears off any remaining nidus of infection.

Keywords- Osteomyelitis, Intramedullary, Debridement, Medulloscopy, Continuous suction irrigation

1. INTRODUCTION:

An inflammation of the bone or 'Osteomyelitis' can be acute, subacute or chronic, and is a therapeutic challenge. According to Cierney and Mader, Chronic Osteomyelitis can be of four types namely, medullary, superficial, localised and diffused. Intramedullary osteomyelitis is infection of Large bones medulla diaphysis of the cavity 1 Hematogenous spreading, open injury and surgical operation can be caused. Presence of a sequestrum or dead bone can be considered as a hallmark of chronic osteomyelitis.1-3 It is a major cause of morbidity for the patient as it usually leads to poor functional outcomes.4-8 While for the orthopaedic Ans, It is a therapeutic challenge and has significant economic and health effects with respect to the use of medications, hospital visit and theater time..4,9-11

Medical treatment is administered for at least six weeks with high dose intravenous antibiotics followed by oral antibiotics. A relatively simple of post-operative intravenous antibiotics followed by oral antibiotics was also observed for six weeks. It is difficult to select antibiotics as superficial and sinus cultures have a poor correlation. Emerging resistance to antibiotics complicates clinical therapy.¹² In chronic osteomyelitis The poor perfusion, sequestration and biofilm local condition prevents traditional systemic antibiotics from working.⁵

In an otherwise healthy patient, surgical management is combined with antibiotic therapy. Treatment goal is to debride all dead bone and surrounding soft tissues followed by prolonged antibiotic therapy. Current techniques of debridement are saucerisation of cortical bone and reaming of the medullary canal. To achieve adequate visualisation we may jeopardise structural integrity of the bone which can necessitate prolonged immobilisation, non weight bearing or stabilisation with an external fixator. Identification of causative microbe along with antibiotic sensitivity is the backbone in prevention of recurrence after surgical debridement. There is a consensus among various authors that to achieve desired result an intramedullary tissue sample along with extensive debridement and irrigation is required.¹³⁻¹⁷

Many different methods have been described by various authors like Belfast technique and Modified Papineau technique, etc that involved two staged treatment i.e. radical debridement with dead space management by gentamicin impregnated beads which after three to six weeks is removed and further debridement with bone graft is done.^{13,18-19} The success rate varied from 62 to 92 % in various studies.^{9,19} A system that offers a drainage port allows a greater flexibility as the antibiotics can be changed as opposed to a system with antibiotic laden bone cement where mostly Gentamicin is used.²⁰ A few other authors described a method in which a closed double lumen tube (Modified Lautenbach System) was used for antibiotic delivery and suction with good success rates.^{21,22} However, these techniques can push the sequestrum deeper into the medullary canal as the point of irrigation and suction is same. In this study, we have made two different portals with minimally invasive procedure to allow reaming followed by irrigation and suction. In this we created a separate drainage channel with negative suction to facilitate removal of debris and microorganisms. We also used Vacuum Assisted Closure for wound management as the closure is difficult post extensive soft tissue debridement.

2. MATERIALS AND METHODS

This research was conducted since June 2018 to May 2020 in which we operated nine patients of medullary chronic osteomyelitis with our technique. The patients were selected on the inclusion criteria i.e. Patients with Radiographic / MRI proven Chronic osteomyelitis of medullary variety (according to Cierny and Mader Classification) of Femur or Tibia. The exclusion criteria were, a) Patients who were not followed up for a minimum of six months, b) Patients who refused surgery, c) Involvement of multiple bones and d) Age < 18 years. Prior institutional ethical committee clearance was obtained along with patient's informed written consent. The statistical analysis of data was performed using the computer program, Statistical Package for Social Sciences (SPSS for Windows, version 20.0. Chicago, SPSS Inc.) and Microsoft Excel 2010.

The selected patients were admitted and routine blood investigations along with ESR and CRP were sent. Plain radiographs and sinogram (if discharging sinus present) were taken. Pus samples for culture and sensitivity from discharging sinus were sent. No pre-operative antibiotics were started. The patients were taken to the operation theatre upon anaesthetic fitness. Under Spinal anaesthesia and without tourniquet use the sinus tract excision and soft

tissue debridement was done till fresh bleeding margins were visible. The sinus tract was sent for histopathological analysis, culture and antibiotic sensitivity along with evacuated pus as separate samples in 0.9% Normal Saline. All the internal fixation device (if present) were removed. Two slanting entry points were made at distal ends and proximal of lesion in the maxilla. The medullary cavity was reamed from proximal and distal points using hand reamers of increasing size. An 8mm arthroscope was used to visualise the medullary cavity for remaining infectious nidus. The end point of reaming was removal of all infective material and appearance of pin point bleeding (Paprika sign) throughout the whole length. A thorough lavage was given from both the entry points till all the debris were removed. Two sterile tubes were inserted, one tube through each entry point and the other ends were taken out from healthy skin away from the wound by making a tunnel. The wound was then thoroughly washed with normal saline, 5% povidone iodine and closed with the help of a Vacuum Assisted Closure device. Sterile well padded compressive dressing is given after surgery. The proximal tube is then connected to intravenous drug delivery system and a third generation cephalosporin or other drug based on previous culture and sensitivity reports is started through this channel. The drug is given till it fills up the medulla while the distal tube is clamped and connected to a negative suction device. After every four hours the distal tube is opened for 30 minutes and the fluid is allowed to drain through negative suction. The irrigating antibiotic is later changed according to intraoperative culture and sensitivity reports. This suction and irrigation system is continued for at least 3 weeks. At every 7-day interval one litre of The solution of Hartmann is filled with a negative suction for 1 hour by proximal drain and the effluent is collected in a container and sent for culture and sensitivity. The suction and irrigation system was removed after a minimum of 3 weeks or till the culture becomes negative. ESR and CRP are sent weekly for monitoring efficacy of the therapy. Removal of VAC and definitive wound management is done whenever the wound surface looks healthy. The wound can be closed by secondary suturing or Split thickness Skin Graft (STSG). The patients were discharged after removal of suction and irrigation system on oral antibiotics.

The patients were followed up for a minimum of six months at weekly interval for 1st month then at monthly intervals thereafter.

3. RESULTS

A total of eight patient's data is considered for this study as one patient's follow up is for three months, therefore, has been excluded. Out of the 8 patients, 7 were males and 1 female. The presenting complain was pain in 5 cases while a discharging sinus was there in 3 cases. In all cases the minimum duration of symptoms was 14 months with mean duration being 21 months. History of trauma and previous surgery was present in 4 cases. Two patients had metallic implants in-situ which was removed prior to debridement. The mean ESR and CRP levels at the time of presentation was 28 and 5.67 respectively. The pre and intraoperative culture reports suggested presence of *Staphylococcus aureus* in 4 cases, *Pseudomonas aeruginosa* in 2 cases and no growth in another 2 cases had gram negative aerobes. Post operatively all the cultures were negative within 3 weeks of surgery except one patient with *Staphylococcus aureus* for whom re-debridement was done at 3 weeks and the cultures were negative after 3 weeks of second surgery. In 6 cases Cefuroxime along with Lizolid was given while in 2 cases a combination of Piperacillin and Tazobactam along with Lizolid was given in the irrigation fluid. Intravenous antibiotics were also given based on sensitivity. After 10 days of VAC therapy wound closure was done with secondary closure while in another 2 patients Split Thickness Skin Graft (STSG) was done. The grafts incorporated well and no complications were noted. All the patients were followed up for a mean duration of 13

months. At final follow up all the patients were free of symptoms without any pain and discharging sinus. The ESR and CRP values were 12 and 0.60 respectively at the final follow-up.

4. DISCUSSION

Tibia and femur are one of the commonest sites for posttraumatic osteomyelitis.^{23,24} Clinical suspicion of chronic osteomyelitis should prompt further investigations with consideration of the entire clinical picture.²⁵ Histopathology of the bone aids in confirmation of the diagnosis and identification of an organism. Therefore it can be considered as the gold standard investigation.

Imaging studies like MRI are very important adjunct in assessing the extent and soft tissue status, which helps in surgical planning.^{26,27} MRI characteristics of active osteomyelitis include Reduced stimulus for T1-weighted pictures and decreased signal in images with a weight of T2 due to edema, exudates, hyperemia and ischemia replacement of marrow fat.²⁸ Metallic implants and other post operative changes may obscure the osteomyelitic changes. The size and intensity of fragile artifacts arising from magnetic field distortion is reduced by a metal-artifact reduced series (MARS).²⁹

Technetium (Tc)-99m bone scintigraphy may be performed in cases with lower clinical suspicion, as reported sensitivities for detection of osteomyelitis are highly variable but up to 100% in some studies.³⁰

After confirming the diagnosis we should attempt to classify the disease according to Cierny and Mader (1985) classification which can help us determine the appropriate line of management.³¹ The health status of the patient is more important than the type of infection, and every effort should be made to optimize the physiologic state of the patient to eradicate infection.³¹

Extremely cautious bone and soft tissue deterioration is considered the gold standard for the prevention of infection. To eradicate the infection one often requires radical debridement which causes large bone and soft-tissue defects. Treatment of these defects may require complicated reconstruction with external fixation, vascularized bone-grafting, or distraction osteogenesis. Stabilization methods after these procedures may cause prolonged disability and immobilization. The impregnated cement beads were found to promote the production of resistant strains, in particular small colony variants of staphylococci, that are difficult to detect and are characteristically thymine or menadione based. The empirical selection or use of systemic antibiotics was shown to be of great importance.³²

Our method of minimally invasive intraosseous debridement with continuous suction and irrigation eliminates the above problem. However, it should be limited to patients classified as Cierny-Mader Type 1-3. Patients with ranged widely of bone and soft tissue need more thorough debridging, with resection of additional cortical bone and need for stabilization.

High success rate has been described by other authors by using a similar technique but with single portal for suction and irrigation was.^{4,21} There is only one single staged surgery required in our technique as the tubes can be later removed in ward without any need for anaesthesia. Only one patient required resurgery. This finding is similar to another study.⁴ This helps in reduction of overall treatment cost and anaesthesia exposure. Our technique does not require any bone grafting thus it decreases morbidity related to donor site and prolonged non weight bearing. The use of arthroscope to visualise and illuminate the medullary canal helps in better identification of infected bone and helps in removing them precisely.³³ By providing continuous irrigation and suction through different portals any remaining debris and micro-organisms can be removed. Local antibiotic delivered through

this system helps reaching high MIC without any systemic adverse reactions. The system should also be able to recover additional organisms from injured tissue.

Three weeks' simple drainage indicates good granulation

It's shaped tissue. When cloudy drainage continues, further debriding can be carried out early during the same admission and thus allow for a proactive rather than a delayed reactive activity to be cumulative.

We used Vacuum Assisted Closure (VAC) for management of soft tissue loss and dead space management. Its use helps in rapid granulation tissue formation along with removing exudate and bacterial load from the soft tissue.

In our study we obtained low initial failure rates along with high patient satisfaction which is consistent with other authors.4,22

5. CONCLUSION

Intraosseous debridement utilizing an arthroscope and arthroscopic tools along with continuous suction and irrigation with local antibiotics provided a potent method for curbing chronic osteomyelitis. This is a simple technique which can be used by other Orthopaedicians in treating these infections in a single staged surgery which decreases morbidity and economic burden to the patient.

REFERENCE

- [1] Caesar BC, Morgan-Jones RL, Warren RE, et al. Closed double-lumen suction irrigation in the management of chronic diaphyseal osteomyelitis: long-term follow-up. *J Bone Joint Surg Br* 2009;91(9):1243-1248.
- [2] Patzakis MJ, Zalavras CG. Chronic posttraumatic osteomyelitis and infected nonunion of the tibia: current management concepts. *J Am Acad Orthop Surg* 2005;13(6):417-427.
- [3] Esterhai JL Jr, Sennett B, Gelb H, et al. Treatment of chronic osteomyelitis complicating nonunion and segmental defects of the tibia with open cancellous bone graft, posterolateral bone graft, and soft-tissue transfer. *J Trauma* 1990;30:49-54.
- [4] Gilbert DN, Dworkin RJ, Raber SR, Leggett JE. Outpatient parenteral antimicrobial drug therapy. *N Engl J Med* 1997;337:829-38.
- [5] Plowman R. The socioeconomic burden of hospital acquired infection. *Euro Surveill* 2000;5:49-50.
- [6] Khatri G, Wagner DK, Sohnle PG. Effect of bone biopsy in guiding antimicrobial therapy for osteomyelitis complicating open wounds. *Am J Med Sci* 2001;321:367-71.
- [7] Patzakis MJ, Abdollahi K, Sherman R, Holtom PD, Wilkins J. Treatment of chronic osteomyelitis with muscle flaps. *Orthop Clin North Am.* 1993 Jul;24(3):505-9.
- [8] Patzakis MJ, Wilkins J. Factors influencing infection rate in open fracture wounds. *Clin Orthop Relat Res.* 1989 Jun;243:36-40.
- [9] Walenkamp GH. Chronic osteomyelitis. *Acta Orthop Scand.* 1997 Oct;68(5):497-506.
- [10] Bucholz RW, Heckman JD, Court-Brown CM, Tornetta P III. Rockwood and Green's fractures in adults. 7th ed. Philadelphia: Lippincott Williams & Wilkins; 2010.
- [11] Olsen RV, Munk PL, Lee MJ, Janzen DL, MacKay AL, Xiang QS, Masri B. Metal artifact reduction sequence: early clinical applications. *Radiographics.* 2000 MayJun;20(3):699-712.
- [12] Schauwecker DS, Braunstein EM, Wheat LJ. Diagnostic imaging of osteomyelitis. *Infect Dis Clin North Am.* 1990 Sep;4(3):441-63.
- [13] Cierny G III, Mader JT, Penninck JJ. A clinical staging system for adult osteomyelitis. *Contemp Orthop.* 1985;10:17-37.

Legend-

Figure 1- Instruments required for drilling, reaming and medulloscopy

Figure 2- Drilling with a power drill to make and opening in the cortex

Figure 3- Reaming the medullary canal using a hand reamer of progressively increasing diameter

Figure 4- Reaming done from proximal as well as distal portal

Figure 5- Insertion of 8mmarthroscope to check for 'Paprika Sign' and any residual infective focus