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Transdiaphyseal osteomyelitis: Review of literature and our experience at a tertiary care center

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Abstract

Chronic haematogenous osteomyelitis persists to be a key reason of musculoskeletal morbidity globally. It has remained a perennial dilemma for the orthopedic surgeon which levies a considerable healthcare burden. With regards to the treatment of chronic transdiaphyseal osteomyelitis numerous issues still remain unresolved. This was a retrospective study at a tertiary care centre from May 2015 to July 2019, analysing 13 patients (9 males and 4 females, mean age 21 years) who were diagnosed with chronic transdiaphyseal osteomyelitis. The clinical records of all patient were retrospectively evaluated and the data recorded. Osseous stabilizations in the form of intramedullary nails or external fixators were essential in 4 cases and plastic surgery reconstructions were required in 9 cases. Our objective in this article was to study the magnitude of the problem and to emphasize areas wherein optimum research might enhance the management of this condition. We have also reviewed the literature to summarise the existing research. We would like to report our experiences in the treatment of transdiaphyseal osteomyelitis patients admitted to our hospital.

Keywords: Transdiaphyseal osteomyelitis, osseous stabilizations

1. Introduction

Requisite primary healthcare is inaccessible to around 50% of world's inhabitants, and orthopaedic facilities are unavailable to around 2/3rds of these [1]. Chronic haematogenous Osteomyelitis persists to be a key reason of musculoskeletal morbidity globally. It has remained a perennial dilemma for the orthopedic surgeon which levies a considerable healthcare burden.

With regards to the treatment of chronic transdiaphyseal osteomyelitis numerous issues still remain unresolved. Although there are several retrospective series reported from developed and developing countries, there are few reports of prospective or comparative research.

Our objective in this article was to study the magnitude of the problem and to emphasize areas wherein optimum research might enhance the management of this condition. We have also reviewed the literature to summarise the existing research. We would like to report our experiences in the treatment of transdiaphyseal osteomyelitis patients admitted to our hospital.

2. Material and Methods

This was a retrospective study at a tertiary care centre started after taking appropriate ethics committee approval and requisite informed consent and done from May 2015 to July 2019, analysing 13 patients (9 males and 4 females, mean age 21 years) who were diagnosed with chronic transdiaphyseal osteomyelitis.

The clinical records of all patient were retrospectively evaluated and the data recorded included age, sex, localization to specific bone, duration of the disorder, spectrum of organisms cultured, number of surgical procedures patient had to undergo and duration of hospital stay. The functional outcome was recorded in the form of restriction of the ROM of affected joints and the recurrence rate.

Records of supplementary diagnostic procedures including serological investigations (ESR, CRP) and radiological investigations using radiographs and magnetic resonance imaging (MRI) [2, 3, 4] were also reviewed. No statistical tests were used.

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3. Results

The mean duration of the disease was 16 months. On average, 3(range 1-9) surgical procedures were performed. The affected bones were: Tibia in 3, femur in 5, forearm in 2 cases, and humerus in 3 cases. The mean hospital stay lasted 12 (range, 3-18) weeks. Multiple blood transfusions were necessary for patients during their hospital stay owing to low haemoglobin values.

3.1. Surgical Results

Osseous stabilizations in the form of intramedullary nails or external fixators were essential in 4 cases and plastic surgery reconstructions were required in 9 cases. The frequently performed procedures included bony debridement, curettage and intramedullary reaming. The most commonly affected bone was the femur (n = 5) followed by the tibia & humerus (n = 3). Discharging sinuses were observed in 7 cases. In 4 cases, there existed a solitary sinus; in 2 cases two sinuses each and in 1 case multiple draining sinuses were observed. The management of the sinuses and soft tissue cavities was performed using a vacuum-assisted closure (VAC) system. In 4 cases, all that the wound required for closure were simple secondary sutures. Various plastic-surgery procedures were obligatory for nine patients to cover the huge soft tissue defect. local skin flaps were adequate in 2 patients, local muscle flaps were utilised in 3 patients, while split-thickness skin grafting was performed in 4 cases.

3.2. Microbiological results

Staphylococcus aureus was the culprit bacteria in 7/13 cases (69.2%) of which 4/7(57.14%) could be identified as methicillin-resistant *S. aureus* (MRSA). The other cultured pathogenic microorganisms included: Salmonella in 1 and Gram-negative organisms (*Pseudomonas* & *Escherichia coli*) in 2 cases. 2 cases (15.3%) were polymicrobial; the cultures revealed no growth in 1 patient (7.6%).

The antibiotics were modified according to the resistance of the cultured microorganism on culture sensitivity reports. Linezolid was administered in cases of MRSA detection. The intravenous antibiotics were given for 3 weeks. Thereafter oral antibiotics were administered for another 3 weeks. Serological investigations in the form of ESR & CRP were serially observed to record the trend and as an indirect marker of disease activity.

3.3. Complications

Local recurrences were observed in 8/13 cases which were managed with a variable combination of surgical debridement & antibiotics. Surgical revision included local debridement, thorough wash, and local instillation of antibiotic-impregnated absorbable calcium sulfate granules. Few patients required a VAC system, which had to be maintained for multiple days until the wound could be secondarily closed. There was one case of a 35yrs old male with femur diaphyseal osteomyelitis who was operated with osseous debridement in the form of saucerization, intramedullary reaming, and local instillation of antibiotic-impregnated absorbable calcium sulphate granules. After 6 weeks of antibiotics (3 weeks iv and 3 weeks oral) patient remained symptom free until 8 weeks post-surgery wherein he suffered a trivial fall leading to fracture shaft of femur. This was managed with closed intramedullary femur interlock nailing.

3.4. Outcome

Substantial functional inhibitions were noted in 9 patients Due

to cicatrisation and adhesion of skin and underlying muscles, ROM of knee and elbow joints were notably reduced in majority of patients. Most of them had loss of occupation and social as well as economic implications of prolonged treatment.

4. Discussion

Chronic OM has been traditionally defined as long-lasting infection that progresses over months or years, characterized by the microorganisms' persistence, low-grade inflammation, sequestrum with fistulous tracts^[5, 6]. Despite several years of its existence even today it is challenging to define specific criteria allowing a consistent diagnosis. It is therefore very tough to relate diverse investigation and treatment methods, and consequently evidence-based results are few. The underlying cause for this is the most pertinent characteristic of the disorder: the diverse variety of symptoms manifested in chronic osteomyelitis which makes a systematic description hard^[7, 9]. Haematogenous osteomyelitis tends to manifest as chronic due to the lack/inadequate antibiotic treatment^[3, 4].

Literature review reveals that the most recurrently affected localizations are tibia and femur which tend to be the involved bone in about 80% of all cases^[1, 2, 10, 11] In our case series also, femur was the most commonly involved bone.

Staphylococcus aureus is reported to be the most common responsible germ of the osteomyelitis in the developing as well as in the industrialized countries, with a frequency of 70-80%.

4.1. Antibiotics: When, which & for how long?

There exist conflicting statements in the literature about the period of the essential antibiotic treatment^[1, 2, 12, 13]. It is recommended that in cases of negative cultures, antibiotics sensitive to staphylococcus should be administered owing to its common incidence. The physiological and anatomical features of bone prevent replicating the enormous success rates of antibiotics in other infectious diseases.

Since antibiotics fail to penetrate devitalised tissue treatment with antibiotic alone is fruitless^[4]. Osteomyelitis tends to be persistent due to the presence of sequestrum. Pre-operative antibiotics tend to promote resistance. Research is needed to determine whether routine post-operative systemic antibiotics enhance the outcome following sequestrectomy and curettage. Reasonable outcomes have been reported when surgical treatment was done in absence of antibiotics, 15 and where antibiotics were used selectively^[13].

Patients with immunocompromised status may benefit from post-operative antibiotics, either until their immune status is reestablished or at least until the wounds have healed and the involucrum has matured. Another group are those who have an involucrum which appears sclerotic on the radiographs, with possible microsequestra within it (B-3 sequestrum with sclerotic involucrum). There is at present no literature upon which to base a treatment regimen for the use of systemic antibiotics in chronic osteomyelitis.

Antibiotics can also be delivered locally, using an antibiotic-loaded methylmethacrylate cement spacer or beads inserted after sequestrectomy. The rationale for this is that high concentrations of antibiotics are released locally, with the aim of sterilising the surgical field. Several series have reported the successful use of antibiotic loaded beads or spacers inserted at the time of sequestrectomy, prior to bone grafting in children^[16] and adults^[17, 18].

The use of antibiotic-impregnated collagen^[19] and plaster^[20] implants have also been described. So far there have been no

controlled trials of these techniques.

4.2. How to deal with bone defects?

Lautenbach ^[21, 22] described his surgical technique of irrigation and suction. Papineau *et al.* ^[23] presented their two-stage procedure consisting osseous debridement, irrigation and secondary cancellous bone graft ^[1]. This technique has not been used too often recently.

In chronic osteomyelitis, however, the most significant and effective procedure is still acceptable surgical debridement ^[1, 2]. In bone defect <2 cm with good periosteal blood supply a cancellous bone graft is considered suitable. In cases of larger and full-thickness defects, distraction osteogenesis described by Ilizarov ^[24] is known to be effective for good results. But the Ilizarov-method is fraught with high complications, is time consuming & requires high compliance of patient. Cure has been achieved in many cases due to improvement in osseous blood supply ^[24].

Other surgical options include non-vascularised fibular strut grafts ^[25, 26] and vascularised structural grafts (usually the fibula) ^[27], or bone transport ^[28].

Others have reported acceptable results using fibular strut grafts in particular cases ^[29, 30, 31] and local vascularised fibular strut grafts for tibial defects ^[32]. The femur presents specific difficulties. Monolateral fixators and Ilizarov frames have compliance issues. The most frequently used structural graft i.e, the fibula is too weak and too small.

Besides the osseous reconstruction, the soft tissue coverage is of specific relevance. In our patients, different plastic surgery operations were necessary to manage the soft tissue defect. There exist only scarce reports in published literature about role of VAC management of osteomyelitis ^[33]. We have promising experiences with regards to the soft tissue conditioning. The negative pressure generated assists in the removal of fluids and increases the granulation tissue formation.

According to literature, about 10-30% of patients revert with recurrence of osteomyelitis after the assumed cure ^[1, 2]. In our series, local recurrence that required repeat surgical intervention was noted in 4 patients.

4.3. When to operate? Controversies regarding the Timing of Surgery

Controversy exists as regards to the timing of sequestrectomy and debridement. The oft-quoted recommendation of waiting until a sufficient involucrum has formed before performing a sequestrectomy has the rationale of minimising the risk of complications such as fracture, nonunion, deformity and segmental bone loss, which may ensue if surgery is performed early ^[34, 35, 36]. Some reports have supported delaying surgery on the basis that the sequestrum may be absorbed while the involucrum is developing ^[29, 30].

Other authors endorse early sequestrectomy to eradicate infection and deliver a congenial environment for the periosteum to respond, and to minimise harm to the adjacent soft tissues ^[19, 33, 35]. Thomas *et al.* ^[29] reported in patients whose acute osteomyelitis became chronic that if an involucrum had not become visible on a plain radiograph by three months, it would not form, and recommended sequestrectomy at this stage to prevent further morbidity.

Either way, it is very important to preserve the periosteum, as this generates the involucrum that creates skeletal stability. Some patients who initially appear to have severe bone loss, with a massive structural deficit, can regenerate almost an entire diaphysis, provided infection is controlled and stability

maintained ^[37]. In other cases the periosteum appears to die, fails to generate an involucrum, and surgical reconstruction is required. The cause of this is uncertain. It may be an ischaemic phenomenon or due to bacterial toxins.

5. Conclusion

Because of the daunting and difficult to manage complications there lies the challenge in guaranteeing permanent cure. The surgical treatment of chronic osteomyelitis requires a radical osseous debridement. The knowledge of varied plastic-surgical procedures is essential to rebuild soft tissue defects

Radical osseous debridement is the most pertinent aspect of treatment. Different reconstructive procedures and osseous stabilizations maybe required depending on the ensuing size and localisation of the defect. The knowledge of varied plastic-reconstructive procedures to attain acceptable soft tissue coverage is vital. The VAC system can play a critical role.

Interdisciplinary treatment with close collaboration between trauma surgeons/orthopedists, plastic surgeons, radiologists, microbiologists, and anesthetists is indispensable for successful management of chronic osteomyelitis.

Although chronic osteomyelitis is recognized as a very old disease, it still poses arduous challenges despite the enhancement of chemotherapy and surgical treatment. Any treatment instituted cannot guarantee permanent cure because of its tendency to recurrence.

5.1. Take-home message

Diaphyseal osteomyelitis lingers to be a challenging condition to diagnose and treat. Further research should be focused at a classification system that can direct treatment, diagnostic methods with high specificity and treatment algorithms based on individual patients' expectations.

The field of chronic osteomyelitis lags behind the other disciplines of orthopedic literature by several years. The orthopedic trauma community needs to start collaborating to increase the power of the data that we currently have and develop more robust treatment algorithms. The idea of global expert consensus with universal future directions for research should also be explored.

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7. Conflicts of Interest: None.

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