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ORIGINAL STUDY

Chronic osteomyelitis of the pelvis

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The aim of this study was to examine the aetiology and response to treatment of a series of patients with pelvic osteomyelitis.

Criteria for selection were multiple positive intra-operative cultures and/or a positive radiological diagnosis. Twenty patients met these criteria (age range : 21-78 years, mean = 46). Data was recorded on host status using the Cierny-Mader classification, neurological status, causative organisms ; sensitivities were recorded and the treatment and its outcome.

Pelvic osteomyelitis was frequently caused by unusual organisms ; a high incidence (45%) of neurologically compromised patients was noted. There were important differences in infective organisms, treatment and outcome in the paraplegic and non-paraplegic population. A high mortality and a high incidence of squamous cell carcinoma was observed.

Pelvic osteomyelitis should be managed differently to long bone osteomyelitis as far as the antibiotic therapy is concerned, with a greater need for broad spectrum antibiotics in pelvic osteomyelitis. The response to surgical resection was similar to long bone osteomyelitis with a high chance of success with marginal resection in type A hosts and with wide resection in type B hosts.

Keywords : pelvis ; osteomyelitis.

INTRODUCTION

Osteomyelitis is a serious and potentially life-threatening condition (*10*). It can present acutely over a few days or chronically over months or years with low-grade inflammation (*17*). Previous reports of bone infection have concentrated on long bone osteomyelitis. The most common pathogen described in these studies is *Staphylococcus aureus*, which expresses adhesion molecules that are able to adhere to the bone matrix (*2*). Less commonly, other Gram-positive organisms such as coagulase negative *Staphylococcus* and *Streptococcus* are also described in previous reports on osteomyelitis (*2*).

The Cierny-Mader classification is useful in helping to assess the transverse extent of the disease and gauge the host status of the patient. In type 1 or intra-medullary osteomyelitis, the infection is confined to the medulla of the bone and the endosteal surface. In type 2 the infection does not involve the full thickness of the cortex but resides in the external surface of the cortical bone. In type 3 and type 4 osteomyelitis, the entire thickness of the bone is involved. In type 3 there is still skeletal integrity,

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whereas in type 4 there is loss of integrity after debridement has been carried out (*5*).

The host status has also been demonstrated to affect the outcomes (*4*) : class "A" patients have no systemic or local risk factors, those graded as "B" hosts either have a systemic (Bs) or local (Bl) risk factor or both. In grade "C" hosts, the morbidity of the surgery exceeds the morbidity of the disease. Therefore patients can be categorised as "C" hosts either because they would require very extensive surgery which could cause considerable morbidity or because even though their surgery would be relatively minor, they have minimal symptoms with very infrequent flares of osteomyelitis (*5*).

The Cierny-Mader classification of the extent of disease and host status is of value in guiding treatment. However it is designed for long bone peripheral osteomyelitis and it is not known whether it is suitable for pelvic osteomyelitis.

Acute pelvic osteomyelitis is relatively common, accounting for 1-11% cases of haematogenous osteomyelitis (*6*). It can mimic other conditions making diagnosis difficult, even with modern imaging tools (*15*). The iliac bone is the most commonly affected bone, possibly due to its extensive blood supply (*14*).

Chronic pelvic osteomyelitis on the other hand is relatively rare with few cases reported in the literature. The purpose of this study is to assess the aetiology and the response to treatment of a series of patients with pelvic chronic osteomyelitis in order to determine whether patients with pelvic chronic osteomyelitis should be treated in the same way as patients with long bone chronic osteomyelitis.

PATIENTS AND METHODS

A consecutive series of 20 adult patients presenting with pelvic chronic osteomyelitis were identified by searching hospital admission codes from over a 10-year period. The diagnosis of chronic osteomyelitis required multiple positive cultures of the affected area of bone obtained operatively. A diagnosis was also made if there was positive confirmation on MRI or CT in the absence of positive culture. This was the case for two patients. The age, sex and site of infection were recorded, as was the relevant past medical history, including the neurological status in particular whether partial or complete paralysis was present. The Cierny-Mader host status was determined for each patient based on the medical history. At the time of surgery multiple specimens were harvested for microbiology and histology as described by Atkins *et al* (*1*). The range of organisms and their antibiotic sensitivities were recorded. The surgical and antibiotic treatment was recorded. For the purposes of this study, a marginal clearance was defined as a dissection down to bleeding bone and a wide resection was a clearance of > 5 mm beyond the extent of infection. These results were tabulated against the outcome. Recurrence was defined as a re-infection of the site by the same organism during the follow-up period, while clearance was defined as the absence of reinfection during the follow-up period. The minimum length of follow-up was 12 months, with the mean follow-up of 4.7 years (range : 12 months – 10 yrs).

RESULTS

Host status

A total of 20 patients were identified with an age range of 21 to 78 years, with an average age at diagnosis of 46 years. There were 11 male and nine female patients. Nine patients (45%) had some form of neurological deficit, including spinal cord injuries (SCI), multiple sclerosis and spina bifida. Of these nine, eight were completely paraplegic. Nine of the 20 were classified as having an "A" host status on the Cierney-Mader system and eleven were classified as having "B" status. Four patients had bowel pathology including intestinal fistulas, colostomies and perforations as well as urological pathologies such as recurrent urinary tract infections and urostomies. The majority (75%) of paraplegics had significant co-morbidities and were Cierny-Mader "B" hosts. Conversely, the majority of non-paraplegics (66%) were Cierny-Mader "A" host status.

Outcome of Final Surgical Resection

Of the 20 patients, five had died. The causes of death included sepsis, squamous cell carcinoma and upper GI haemorrhage. Two deaths were due directly to sepsis but the chronic infection indirectly caused the death secondary to the squamous cell

carcinoma in two cases. Overall two (18%) of the neurologically intact patients and two (22%) of the neurologically impaired patients had recurrent infection. When the extent of surgical resection was taken into account for the neurologically intact patients two (29%) undergoing an initial marginal resection recurred and none undergoing a wide resection. For the neurologically impaired group, three (75%) undergoing an initial marginal resection recurred compared to none undergoing a wide resection. Three patients were not managed surgically. In one of these, the patient died before surgical intervention could take place, one had tuberculosis and one was managed with long term antibiotics. There were five instances of the infection recurring after marginal resection – three in the neurologically compromised group and two in the neurologically intact group. Two patients from the compromised group underwent further wide resection and were cleared (Fig. 1 & 2).

Microbiology

In nine cases the chronic osteomyelitis was due to a single organism and in eleven cases multiple organisms were grown. In the 20 patients, the numbers of organisms grown ranged from 1 to 6 (mean 2.4). The most common pathogen was *Staphylococcus aureus* (Methicillin sensitive), which was present in 40% of patients, coagulase negative *Staphylococcus* negative was found in 30%. Methicillin resistant strains (MRSA) were cultured in 20% of cases. A high incidence of *Coliforms* was also noted – Gram negative bacilli were found in seven (35%) patients. *Enterobacteria* and *Pseudomonas* were cultured in 25%. Two patients grew *Candida albicans* and *Proteus*. Other rarer causes were *Fusobacteria*, *alpha haemolytic Streptococcus*, *Mycobacterium tuberculosis* and yeasts.

Influence of neurological status

In the paraplegic patients, *Coliforms* were the joint highest causative organism along with *Staphylococcus Aureus*. *Pseudomonas*, *Enterococcus*, *Candida albicans* and Coagulase-negative *Staphylococci* were all found in greater proportion in the paraplegic cohort compared with the non-paraplegic cohort. Hence, the paraplegic cohort had a greater incidence of Gram negative bacterial infections than their non-paraplegic counterparts. They were also more likely to have multiple organisms. There were seven cases of coliforms in our series of 20 : all but one were found in the neurologically compromised group.

There was variability in the location of the infection, and in seven patients (35%) more than one site in the pelvis was infected. The commonest site was the ilium. This bone was infected in seven patients (35%). The peri-acetabular region was the next most common site with five cases. The ischium and sacro-iliac joint were the next most common sites of infection with three patients (15%) having infections in both those regions.

DISCUSSION

The results of this study show that there are important differences in the aetiology of pelvic chronic osteomyelitis and long bone chronic osteomyelitis, which have implications for management. However the outcomes following surgery show similarities between pelvic and long bone disease. We found that type "A" hosts had a good response with wide or marginal resection, whereas type "B" hosts had a high recurrence rate with marginal resection. This pattern is in agreement with the pattern reported previously in long bone chronic osteomyelitis (*3*). Where the extent of the chronic osteomyelitis necessitated hindquarter amputation, this was effective in controlling the pelvic osteomyelitis. This concurs with the findings of Ziran *et al* (*19*). Interestingly, in our series, hemipelvectomy in paraplegic patients did not result in seating problems and simply required adjustment of the wheelchair seating cushions. Furthermore, the final outcomes between the neurologically intact group (78% recovery) and the neurologically compromised group (88% recovery) were similar although a high rate of recurrence following marginal resection was observed in the neurologically compromised cohort.

In a previous report of long bone osteomyelitis, 12% of cases occurred as spread from a contiguous

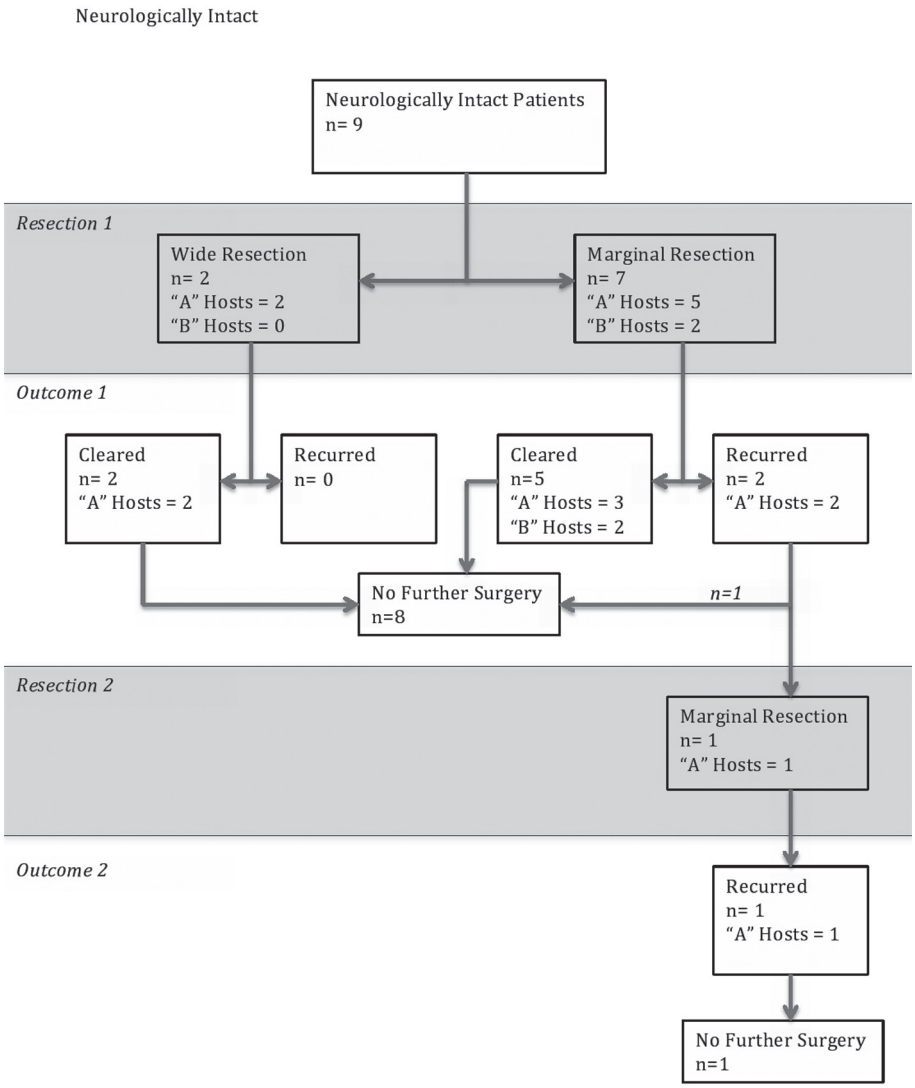

Fig. 1. — Management of neurologically intact patients

site such as full thickness ulceration down to bone (*18*). In this study of pelvic chronic osteomyelitis, 35% of cases arose from a contiguous source. All of these patients were neurologically impaired. This underlines the importance of trying to prevent full thickness ulceration in neurologically impaired patients. In this study of chronic pelvic osteomyelitis, 6 (30%) patients were secondary to acute osteomyelitis. This compares to a 20% recurrence rate in long bone acute osteomyelitis (*8*). Pelvic acute osteomyelitis often masquerades as other conditions and may present late. However, with treatment with early antibiotics there is a low chance of progressing to chronic osteomyelitis (*16*).

Long bone osteomyelitis has been reported to be polymicrobial in 6 to 38% of cases (*15*). In comparison, we found that 50% of pelvic osteomyelitis had multiple bacteria. For both this series of pelvic osteomyelitis and three previous reports (*9,11,12*) on long bone osteomyelitis, the commonest organism was *Staphylococcus Aureus* : it was found in 11 (55%) patients in this study of pelvic infections

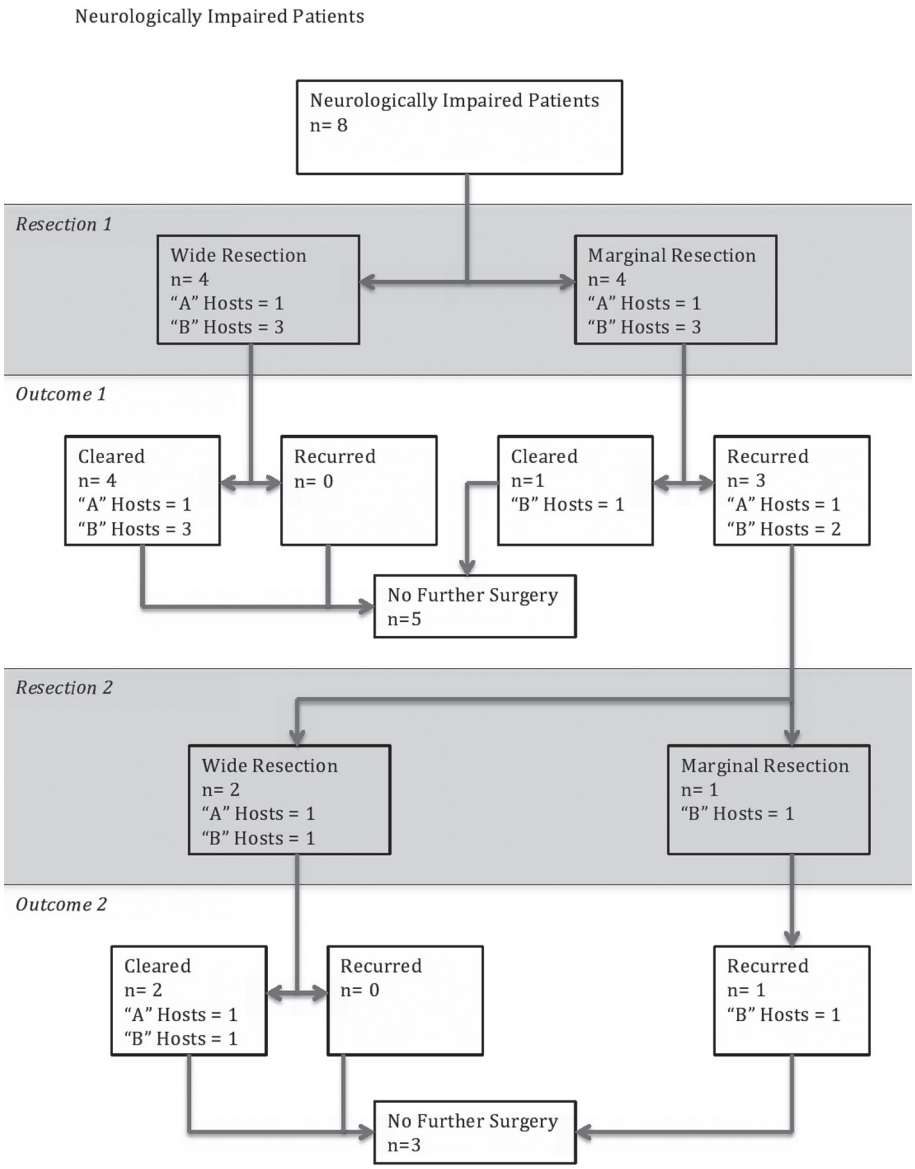

Fig. 2. — Management of neurologically impaired patients

compared to percentages of 42% and 66% in 2 series of long bone osteomyelitis (*13,20*). In the neurologically intact patients in this series, 11 (64%) cases grew *Staphylococcus aureus* which was the commonest organism. However, there was also a greater range of organisms including a number of organisms rarely found in osteomyelitis such as *Candida*, *Proteus*, *Pseudomonas* and *M. tuberculosis*. Of particular note was the large percentage of patients who grew *Coliforms*. This group included *Enterobacter*, *Klebsiella* and *Escherichia coli* which were found in 35% of pelvic osteomyelitis, but 66% of the neurologically compromised patients. In a case series of 38 patients with long bone osteomyelitis, Majid *et al* only report one case (2%) of coliform infection (*Klebsiella*) (*13*), demonstrating the differences in infective organisms between long bone and pelvic osteomyelitis, and also the difference with neurologically compromised patients. This is of great importance in considering the initial empiric

Table I. — Outcome of final surgical resection

Surgical Resection	Host Status	Cleared	Recurred
Wide	"A" host	3	0
	"B" host	5	0
Marginal	"A" host	3	2
	"B" host	3	1

antibiotic cover in patients with systemic sepsis associated with chronic osteomyelitis, in whom antibiotics effective against *Staphylococcus aureus* are recommended. Our findings indicate that although *Staphylococcus aureus* should be covered, *Coliforms* should also be covered and antibiotics active against Gram negative as well as Gram positive organisms.

Another important difference between long bone and pelvic osteomyelitis is the relative absence of neurologically impaired patients in the former group. We found that in pelvic osteomyelitis 45% had neurological deficits compared to 2% in a series 50 patients with long bone osteomyelitis (unpublished data).

The high incidence of squamous cell carcinoma (10%) is also noteworthy. Two patients developed squamous cell carcinoma as a consequence of ulcers that transformed into malignant disease over the course of two years. The average survival following diagnosis of SCC was 9 months. This incidence is much higher than previously reported (0.2-1.7%) in long bone osteomyelitis (*7*).

The Cierny-Mader anatomical grading was designed for long bone chronic osteomyelitis. In this series of pelvic chronic osteomyelitis, the distinction between intramedullary (type 1), extramedullary (type 2) and full thickness (types 3 or 4) was not feasible, and therefore did not predict outcome.

Pelvic osteomyelitis is an uncommon condition and as such the number of patients in the study was limited to twenty. However, this study is the largest retrospective study of this important condition.

In conclusion, chronic osteomyelitis is a serious life-threatening condition. It is significantly different in the microbiological profile, the source of the infection and the mortality compared to long bone osteomyelitis ; this has implications for antibiotic treatment and prognosis. However the control of the disease has a similar dependence on surgical resection to that of long bone osteomyelitis (*3*).

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