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RADIOLOGICAL SPECTRUM OF OSTEOMYELITIS.

Radiology

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ABSTRACT

Osteomyelitis remains a vexing illness and the outcome is often unsatisfactory despite major advances in surgery and antimicrobial therapy. Clinical experience is the guidebook for management as there is a paucity of controlled clinical trials and a lack of long term follow up in most published reports. The term "Osteomyelitis" taken implies inflammation of the bone and its marrow regardless of whether it is due to pyogenic organisms, tuberculosis, Syphilis, a specific virus or the presence of a foreign body such as shrapnel. Osteomyelitis affects the metaphysic of long bones commonly out of which the bone ends in small children are most susceptible sites. Osteomyelitis in drug addicts may occur in unusual locations, such as clavicle and sternum. Axial involvement appears to be more prevalent than long bone involvement. Post-traumatic and postoperative osteomyelitis develops after treatment for compound fractures, prosthetic replacement and pin-track fixation. Radiologically the acute and subacute osteomyelitis pose a diagnostic problem due to very little or absent radiological evidence. Chronic osteomyelitis is more a disease of chronic ischemia than of chronic sepsis

KEYWORDS

INTRODUCTION:

Osteomyelitis remains a vexing illness and the outcome is often unsatisfactory despite major advances in surgery and antimicrobial therapy. Clinical experience is the guidebook for management as there is a paucity of controlled clinical trials and a lack of long term follow up in most published reports. The term "Osteomyelitis" taken implies inflammation of the bone and its marrow regardless of whether it is due to pyogenic organisms, tuberculosis, Syphilis, a specific virus or the presence of a foreign body such as shrapnel. However, universal acceptance of the term is applied only to infection by pyogenic bacteria less commonly to the granulomatous inflammation of Tuberculosis and Syphilis.

Osteomyelitis affects the metaphysic of long bones commonly out of which the bone ends in small children are most susceptible sites. Osteomyelitis in drug addicts may occur in unusual locations, such as clavicle and sternum. Axial involvement appears to be more prevalent than long bone involvement. Post-traumatic and postoperative osteomyelitis develops after treatment for compound fractures, prosthetic replacement and pin-track fixation. Radiologically the acute and subacute osteomyelitis pose a diagnostic problem due to very little or absent radiological evidence. Chronic osteomyelitis is more a disease of chronic ischemia than of chronic sepsis. Bacterial characteristics, site of primary localization, age of the patient, vascular supply, immune mechanism, physiotherapy and refractive status of the host are all involved in determining the spectrum of osteomyelitis. Despite the availability of tomography, isotope bone scanning, CT scanning and MRI having their advantages and disadvantages, plain radiography is still the most acceptable cheap and commonly available tool of investigation.

The study aimed to study various sites of involvement and variable presentation of diseases, the incidence of osteomyelitis in a compound fracture and the incidence and radiological presentation in post-operative cases of osteomyelitis in closed fracture (iatrogenic).

MATERIAL METHODS:

The study was carried out in the department of radiodiagnosis of MLN Medical College, Prayagraj. Those cases attending the Radio diagnosis, Orthopaedics, surgery and Paediatrics outpatient departments from 01/01/2019 to 01/01/2020 were included in this study. Selection criteria include patients presenting as the fresh case with pain and redness or swelling at any bony site with or without pyrexia, patients having pus discharging sinus, patients treated previously for osteomyelitis by conservative or operative methods like incision and drainage, sequestrectomy and saucerization etc.

All the cases were thoroughly interrogated for detailed clinical history and relevant general examination with local examination were done to assess the mode of infection. Investigations included Blood routine: Hb%, TLC, DLC, ESR; Urine routine: Albumin, Sugar, microscopic examination; Blood Sugar: Fasting and Postprandial or random; Blood Urea. The selected cases were put to radiological examination by X-ray machines available in the radio diagnosis department and also available X-ray films, X-Ray developer, Fixer and other darkroom accessories, Cassettes and grid, illuminating viewing box were used for the study.

Technique:

The views by which the skiagrams were taken, were mainly Anteroposterior view and lateral views. Where necessary, oblique views, sagittal views and axial views are taken. The Skiagrams were done under low mAs so that soft tissue could also be visualised well. The Skiagrams were examined by illuminating view box for the evidence of soft tissue changes, presence of periostitis, density changes and radiological evidence of changes in vascularity. Two Radiologist's with 8 years of experience agreed on a common radiological finding.

Observations:

A total of 32 cases were studied ranging from 6 years to 42 years. The mean age of the patients was 21.34 years and 31.25% of patients were from the second decade. Duration of illness ranged from 1.5months to 8years. Male predominance was observed as 21 (65.6%) were males and 11 (34.4%) patients were female. Duration of illness in cases of the present study was quite variable ranging from 1.5months to 8 years. The average duration of involvement was 16.75 months. Out of 32 cases, bones of upper extremities were involved in 11 (34.37%) cases, while the bone of lower limbs was involved in 20 (62.5%) cases (Table1).

Table-1: Age & Sex Distribution

Age groups	Number of cases	Percentage (%)
0-10Yrs	9	28.12
10-20Yrs	10	31.25
20-30Yrs	6	18.75
30-40Yrs	4	12.50
40Yrs&above	3	9.38
Sex	**Number of cases**	**Percentage (%)**
Male	21	65.6
Female	11	34.4
Upper Limb	11	34.37
Lower Limb	20	62.50

The mean age of the patients was 21.34years and 31.25% of patients were from second decade. Male predominance was observed as 21(65.6%) were males and 11 (34.4%) patients were female. Bones of lower extremities were more commonly (62.5%) involved.

In the present study out of 32 patients, the mode of spread was haematogenous in 24(75%) cases. In the rest 9 (28.12%) cases the spread was non-haematogenous. In cases of non-haematogenous mode, post-traumatic infection resulted in 6 (18.75 %) cases; simple fracture-4(12.5%) cases; Compound fracture-2(6.25%) cases; infection in postoperative period-2(6.25%) cases (Table 2).

Table-2: Mode of spread of osteomyelitis

Spread of Osteomyelitis	No. of Cases	Percentage (%)
Hematogenous	24	75
Non-Hematogenous	8	25
In simple fracture	4	12.5
In compound Fracture	2	6.25
Post-operative	2	6.25
Total	32	100

In majority (75%) patients, the mode of spread was haematogenous.

In 32 cases a total of 46 sites of bone involvement were observed and 12 patients had 2 or more involved sites. Femur was involved in maximum number 12 (37.5%), followed by Tibia in 7 (21.87%) cases; humerus in 5 (15.62%); Radius in 2 (6.25%) cases; Ulna in 1 (3.12%); and Fibula in 5(15.62%) cases (table3).

Table-3: Number of Sites and bones involved

Number of cases	Names of Bones invoved	Number of sites of involvement
7	Tibia	11
10	Femur	15
4	Humerus	6
2	Radius	3
2	Ulna	2
5	Fibula	8
2	Tarsal bones	2

Twelve patients had 2 or more number of involved sites. Femur was involved in maximum (37.5%) number of cases followed by Tibia (21.87%).

Radiological presentations included metaphysis involvement in 15 (46.87%) cases; Periosteitis or periosteal elevation in 25 (78.12%) cases; Soft tissue shadow and smudging of fascial planes in 15(46.8%) cases; Sequestrum in 20 (62.5%) cases; Sclerosis and destruction in 18 (56.25%) cases; Involucrum and periosteal reaction in 22 (68.75%) cases; Cloacae and sinus in 18 (56.25%) cases; post-operative and posttraumatic features like radio-lucency in 9 (28.12%) cases (Table 4).

Table-4: Radiological features

Radiological features	Number of cases	Percentage (%)
Metaphysis involvement	**15**	**46.87**
Periosteal elevation or Periosteites	**25**	**78.12**
Soft tissue shadow or Separation of fascial planes	**15**	**46.87**
Sequestration	**20**	**62.50**
Destruction or Sclerosis	**18**	**56.25**
Involucrum and Periosteal reaction	**22**	**68.75**
Cloacae and Sinus	**18**	**56.25**
Post-operative and post-traumatic features as Radiolucencies	**9**	**28.12**

Most common radiological features were Periosteal elevation or Periosteites (78.12%) followed by Involucrum and periosteal reaction(68.75%) and Sequestration(62.5%).

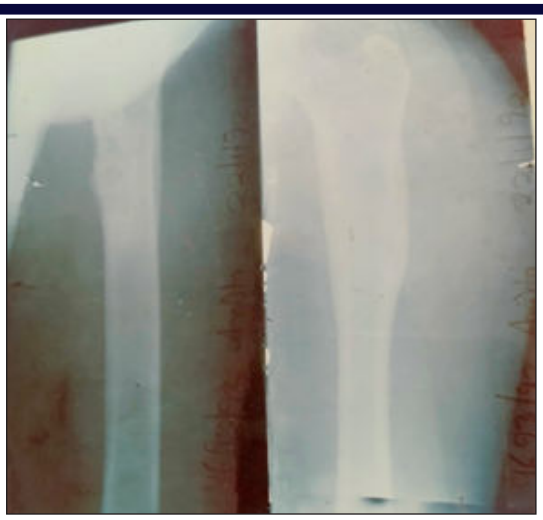

Image 1: Chronic osteomyelitis upper shaft femur with huge soft tissue swelling with loss of fascial planes

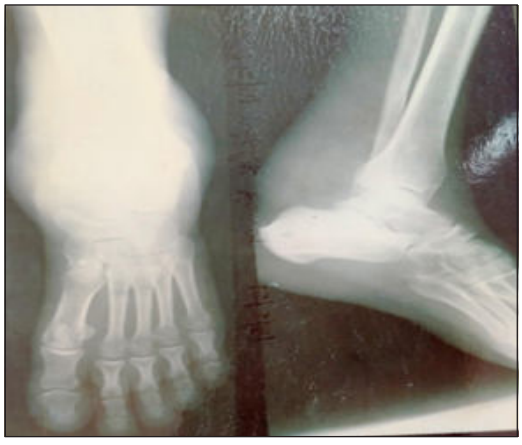

Image 2: Sclerosis, irregular outline, resence of cloacae and soft tissue swelling in the ankle: Chronic Osteomyelitis

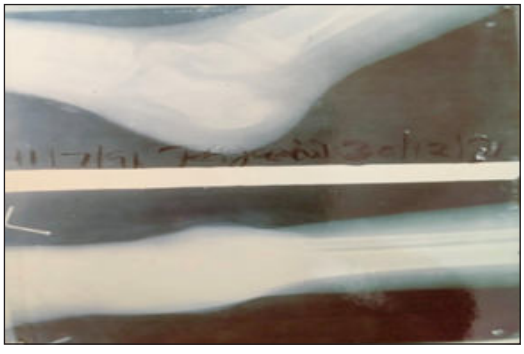

Image-3: There is periosteitis, destruction, erosion with irregular outline calcaneum.

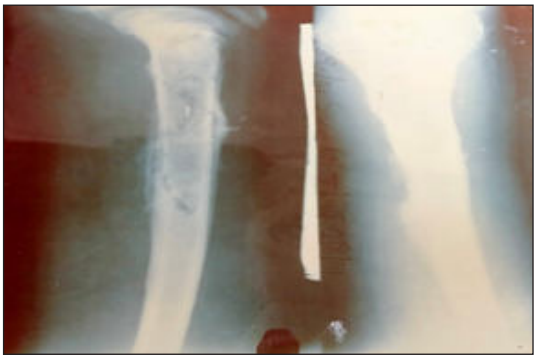

Image-4: Thickening,sclerosis, deformed outline with peristeitis and multiple seqestrum seen in the lower shaft femur.

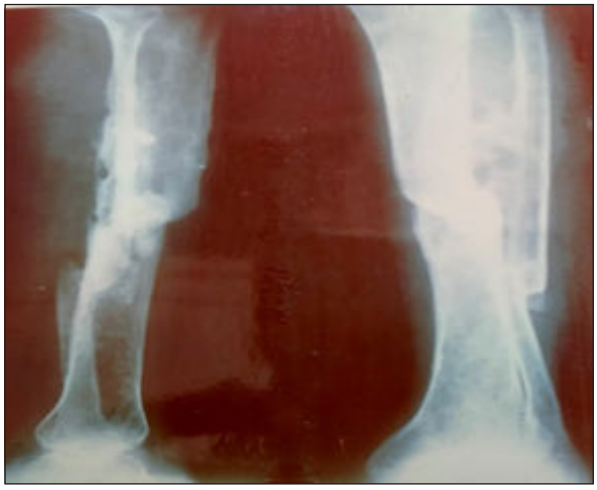

Image 5: Old case of fracture tibia and fibula with changes of osteomyelitis and non-union.

One or more discharging sinuses were seen in 15 (46.8%) cases while 17 (53.12%) cases were devoid of any discharging sinus, More than half (53.12%) cases were free of discharging sinuses (table5).

Table-5: Incidence of discharging Sinus

Discharging sinus	Number of cases	Percentage
Present	15	46.8%
Absent	17	53.12%
Total	32	100

Various treatment modalities included Chemotherapy in 8 (25%) cases; incision and drainage 12 (37.5%) cases and Saucerization and or Sequestrectomy 18 (25%) cases. Twenty eight (87.5%) of patients received previous treatment (Table 6).

Table-6: Previous treatment

Type of Previous treatment	Number of cases	Percentage
Chemotherapy	8	25%
Incision and drainage	12	37.5%
Saucerization and or Sequestrectomy	18	25%

In this study involvement of joints was detected by clinical examination and radiological evidence. Joints were involved in 8(25%) of cases while the rest 24 (75%) cases did not have any joint involvement (table 7)

Table-7: Incidence of Joint involvement

Joint involvement	Number of cases	Percentage
Present	8	25
Absent	24	75

DISCUSSION:

The present study shows that osteomyelitis is common in Young patients ranging from 6-42 years (mean age-21.34yrs) with the majority in the second decade (31.25%). In western countries, Osteomyelitis affects primarily young children, with half of all paediatric cases in children younger than 5 years of age (1). Boys are affected twice as often as girls, and this difference has been ascribed to greater exposure to microtrauma (2). Acute haematogenous osteomyelitis is an infection that usually affects the growing skeleton, involving primarily the most vascularized regions of the bone. It is considered an acute process if the symptoms have lasted less than 2 weeks (1,3). Children with Panton-Valentine Leucocidin (PVL)-positive staphylococcal infections are more likely to have multifocal osteomyelitis, large subperiosteal abscesses, multiple bony abscesses, deep venous thrombosis, and associated myositis and pyomyositis (4). PVL gene encodes for a toxin that produces tissue necrosis and destruction of neutrophils (5) and is associated with a higher rate of septic shock and greater need for surgical interventions and prolonged hospitalization (6). Metaphyseal spongiosa contains abundant blood vessels with leaky endothelium and sluggish flow that end in capillary loops (7). These vessels are terminal and that bacteria lodge at the junction between the physis and the metaphysis (8). The periosteum also is highly vascular in the child, but it is unclear whether it can be the site of origin of infection (9). Osteomyelitis can be difficult to detect clinically as symptoms, physical examination, and laboratory findings can be deceptive at presentation, variable, and nonspecific (10). The main questions addressed by imaging include confirming the presence of infection, site of infection and also assessing drainable collections. Hematogenous Osteomyelitis was most often seen (13) in childhood. Osteomyelitis is most common in the long bones, particularly lower extremities (75%) in children (2). In the present study, bones of lower extremities were involved in 20 Cases (62.5%) with the commonest being Femur (15 cases), followed by Tibia in 7 patients. Post-traumatic and post-operative Osteomyelitis develop after treatment for fractures, Prosthetic replacement and pin track fixation. After prosthetic replacement, a zone of radiolucency at the metal cement or bone cement interface raises the possibility of loosening and/or infection. A zone of radiolucency greater than 2mm or increasing over time suggests infection as does scalloped irregularity of the lucent Zone or cortex and periosteal reaction. Fixation pin tract may be diagnosed by the presence of a characteristic ring sequestrum at the pin tract site over time. In our study, radiolucent zones were seen postoperatively in 2 cases, who had undergone surgery and prosthetic replacement. Radiolucencies were also seen in 6 other cases of post-traumatic affection, 4 cases were of a simple fracture, while 2 cases were treated for compound fractures. In our study duration of illness ranged from1.5months to 8 years (Average16.75months).

Of all radiological features, periostitis or periosteal elevation was seen in the maximum number of cases (15,78.12%). This is due to the subperiosteal spread of infection which elevates the periosteum. The inflammatory process progresses across the cortex by enlarging the normal Haversian canals. Abscesses develop that lift the periosteum and disrupt the periosteal blood supply. This is particularly prominent in the immature skeleton owing to the relatively loose attachment of the periosteum to bone. In our study, most of the patients were from the young age group, therefore Periosteitis is seen most. Smudging of fascial planes was seen in 15 (46.87%) cases. Focal deep soft tissue swelling is related to vascular changes and oedema occurring within the bone and subsequently, muscle swelling and obliteration of soft tissue planes occurred.

The first definitive radiological change noted is small local deep soft tissue swelling in the region of metaphysics. The deep soft tissue swelling is continuous with the adjacent bone and is apparent on roentgenograms by displacement of the lucent deep muscle plane away from the bone. The second change in the soft tissue is manifested by swelling of the muscles and obliteration of the lucent planes between the muscles. The deep muscles and lucent planes are the first to be altered followed later by the involvement of the more superficial muscles and lucent planes. Superficial subcutaneous soft tissue oedema is the last soft tissue change to be observed (15). The roentgen observation of the metaphyseal deep soft tissue swelling correlates well with the time that the vascular changes are occurring during the early events of the inflammatory response. The early stage of osteomyelitis before the accumulation of exudates is referred to as metaphysis (15). Metaphysis involvement was seen in 15 (46.87%) cases in our study. Sequestration was seen in 20(62.5%) cases. Deprivation of blood supply leads to cortical necrosis. A segment of necrotic bone that is separated from living bone by granulation tissue is known as sequestrum. Radiologically dense bony spicules may be identified in the medullary aspect of the involved bone. The increased density of the sequestrated bone results from its lack of blood supply. The sequestrum is often sharply marginated and may vary in size from minute fragment to long necrotic segment. These may eventually extrude into adjacent soft tissues and be discharged through the draining sinus tract. Periosteal new bone usually appears after 3-6 weeks and is the first evidence of involucrum formation. In our study, Involucrum and the periosteal reaction was seen in 22(68.75%) cases. The extent of periosteal reaction along the shaft is proportional to the extent of the subperiosteal abscess, it may be limited to a small area or may encompass the entire shaft. The periosteal new bone continues to be laid down and eventually, a large area of new bone (Involucrum) appears around the cortex. The contour of the involucrum become irregular and wavy until the affected segment of bone is enveloped in a thick bony sleeve. Internal defects in the involucrum (Cloacae) are the result of local periosteal necrosis and these channels allow the drainage of pus and small sequestra.

A sinus tract is a channel lined with granulation tissue that allows the pus to drain from the infected bone to the skin surface (14) and in our study,15 cases (46.8%)were having one or more discharging sinuses out of 20 known cases of known chronic osteomyelitis.

Conventional radiographs should be the first step in the imaging evaluation. Although radiographs are diagnostic in less than 20% of cases of acute staphylococcal osteomyelitis of childhood (11,12) they may help direct the subsequent imaging evaluation and, more importantly, show whether symptoms are the result of a different condition such as trauma or tumour. Other lesions that can resemble osteomyelitis include Osteoid Osteoma, repeated trauma and septic embolic lesion. The majority (87.5%) of patients received previous treatment and 25% of patients had joint involvement.

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