Eur J Pediatr (1991) 150:166–169
0340619991000070

European Journal of
Pediatrics

Radionuclide bone imaging in toddler's fracture

K. De Boeck[1], S. Van Eldere[1], P. De Vos[2], L. Mortelmans[2], and M. Casteels-Van Daele[1]

Departments of [1]Paediatrics and [2] Nuclear Medicine, University Hospital Gasthuisberg, Herestraat 49, B-3000 Leuven, Belgium

Received November 14, 1989 / Accepted May 13, 1990

Abstract. Seven cases of toddler's fracture are reported. The value of radionuclide bone imaging in helping to establish this diagnosis is discussed.

Key words: Toddler's fracture – Radionuclide bone imaging

Introduction

Toddler's fracture was first described by Dunbar et al. [3]. It is a fracture of a long bone in a young child in which X-ray films initially show no abnormalities. Only some weeks later periosteal new bone formation is visible. Treatment consists of immobilisation. In children, a history of trauma is not always present and fever due to a concomittant infection frequently obscures the clinical picture. Therefore, the diagnosis of toddler's fracture is not always clearcut. The aetiology of limping in a child varies among other possibilities from trauma to infections and malignancies. Diagnostic clues are provided by historical, laboratory and radiographic data. Unfortunately, these investigations are not always helpful.

We report on seven cases of acute onset of limping in children, which proved to be toddler's fractures. The usual investigations were inconclusive. Bone scintigraphy enabled localisation of the injury and clearly differed from bone scintigraphic findings in cases of acute osteomyelitis encountered over the same time period. Two case reports are presented in detail; data on all seven cases are shown in Table 1.

Case reports

Case 1

A 14-month-old boy had refused to walk for 3 days. He woke up at night crying. There was no history of trauma or fever. Discrete tenderness over the right distal tibia was the only abnormal finding. Erythrocyte sedimentation rate was 32 mm after 1 h. White blood cell count was 9900/mm^3 with a normal differential count. X-ray films including lateral oblique views of the long bones, were normal. Bone scintigraphy showed an intense and diffuse accumulation of technetium tracer over the entire right tibia (Fig. 1). Treatment consisted of relative rest. The child's symptoms subsided after 5 days. Two weeks after the initial hospital visit, the child presented with a temperature of 39°C. Rhinitis was the only finding on physical examination. Erythrocyte sedimentation rate was 90 mm after 1 h. WBC was 9000/mm^3 with lymphocytic predominance. X-ray films showed a periosteal reaction over the right tibial diaphysis (Fig. 1). As there was no definite diagnosis, a bone biopsy was performed and showed only fibrous periosteal reaction. The diagnosis of toddler's fracture with intercurrent respiratory tract infection was made. The child's leg was immobilised for 2 weeks. He was afebrile after 1 week. X-ray films and bone scan remained abnormal at 2 weeks follow up. Both examinations were normal at 6 months follow-up.

Case 7

A 14-month-old baby boy was admitted to hospital because of fever and limping of 1 day's duration. Physical examination revealed a temperature of 38.5°C, a purulent rhinitis and right sided acute otitis media. There was pinpoint tenderness over the right distal tibia. X-ray films were normal. Bone scintigraphy revealed marked increased uptake over the lower two thirds of the tibia. The diagnosis of toddler's fracture was made. The leg was immobilised in a cast for 4 weeks. Follow up roentgenograms showed a marked periosteal reaction along the tibia and a discrete spiral fracture line. Healing was uneventfull. The child remains well after 12 months follow up.

Discussion

Toddler's fracture is a difficult diagnosis and is sometimes made only in retrospect. In the classic case, the child presents with limping after a trauma. Roentgenograms are negative and only follow up X-ray films prove the previously existing fracture. At the onset, no anamnestic, clinical or laboratory clues reliably differentiate trauma from osteomyelitis or other causes of limping. In the case of a traumatic lesion, there often is no clearcut

Offprint requests to: K. De Boeck

Table 1. Clinical data in individual patients

	Sex	Age (months)	Complaint	Trauma	Physical examination	Initial X-ray film	Bone scintigraphy	Treatment	Follow-up X-ray	Additional investigations
1	M	14	Refusal to walk (3 days)	No	Tender right distal tibia	Negative	Increased uptake over the entire tibia	Immobilisation	Periosteal reaction, tibia	Bone biopsy
2	M	34	Limping (14 days)	No	Negative	Negative	Increased uptake over most of the tibia	None	Periosteal reaction, fracture line	None
3	M	23	Refusal to walk (3 days)	Yes	Bruises lower legs	Negative	Increased uptake over most of the tibia	None	Periosteal reaction	None
4	M	35	Limping (21 days)	Yes	Fever 39°C; tender swollen right ankle	Negative	Increased uptake over most of the tibia	Immobilisation	Periosteal reaction spiral fracture	None
5	M	22	Limping (1 month)	No	Distal tibia swollen and tender (Fig. 2)	Negative	Increased uptake over most of the tibia	Immobilisation	Periosteal reaction callus (Fig. 2)	Bone biopsy; magnetic resonance imaging
6	M	24	Refusal to walk (3 days)	Yes	Negative	Negative	Increased uptake over most of the tibia	None	Spiral fracture	None
7	M	14	Limping (1 day)	Yes	Swollen right ankle fever 38°C; acute otitis media	Negative	Increased uptake over most of the tibia	Immobilisation	Periosteal reaction, spiral fracture	None

history of trauma; on the other hand, trauma is a confounding variable in many patients with limping due to osteomyelitis or transient synovitis of the hip [8]. To further confuse the issue, during the course of a toddler's fracture, fever may be caused by an intercurrent viral infection. Besides, it is known that fever is not a reliable factor to differentiate trauma from bone infection. Fever was absent in four out of seven patients with osteomyelitis of the leg treated at our hospital from 1985 to 1987 and this has also been the finding at other centres [8]. Physical findings in patients with limping can be absent or may be limited to areas of localised tenderness, not differentiating between trauma and bone infection. Erythrocyte sedimentation rate is usually raised in osteomyelitis or arthritis [8] but it can be elevated for other reasons such as illustrated by case 1. Finally, although soft tissue signs on roentgenograms can point to lesions of the underlying bones, they do not allow differentiation between trauma and infection. Skeletal X-ray films typically do not show bony changes during the first 10–14 days in children with osteomyelitis; but even detailed X-ray films in case of a bone fracture can be negative early on.

More recently bone scintigraphic findings in toddler's fracture have been published [1]: a diffuse increase in uptake of the tracer over the affected bone resulting in the picture of a black tibia. The increased uptake is not only due to increased vascularisation of the bone since also late bone images show impressive accumulation of technetium diphosphonate. Probably remodelling of the bone's Haversian systems, distorted due to fracture, and periosteal new bone formation result in an increased metabolic activity in most of the long bone. In all our patients with toddler's fracture, the bone scintigraphy showed this picture of "black tibia". From May 1985 till May 1987, 92 patients with acute limping consulted our hospital. Osteomyelitis was diagnosed in seven patient; septic arthritis was present in two patients. The nine patients with bone infection only had a discrete 'hot spot' on bone scintigraphy as illustrated in Fig. 2. Bone scintigraphy thus reliably differentiates between the two conditions. Miller and Sandeson [5] published similar findings: patients with toddler's fracture had a markedly positive 'hot' area on bone scintigraphy running obliquely across the involved tibial diaphysis, quite different from the metaphyseal and juxta-articular increased activity seen in inflammatory bone or joint disease.

In two cases the bone scintigraphy was compatible with toddler's fracture but the history and clinical evolution were confusing. Therefore additional investigations were carried out to further substantiate the diagnosis of toddler's fracture. In case 1 the high temperature and sedimentation rate prompted the decision to perform a bone biopsy. This only revealed fibrous periosteal reaction. Infection could be ruled out. In case 5, the limping was protracted. History, physical examination and bone scintigraphy (Fig. 3) were compatible with the diagnosis of toddler's fracture and the child was put on relative rest. The limping subsided after a few days but recurred after the child resumed walking. At that time the child's leg was swollen, warm and ecchymotic. X-ray films

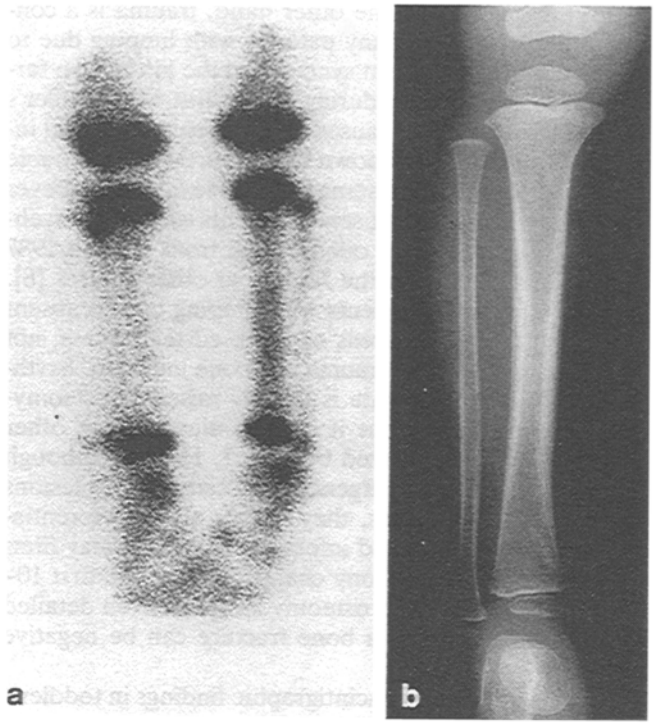

Fig. 1. a Increased uptake of tracer over the entire right tibia. **b** Periosteal reaction along the tibial diaphysis 1 month after the positive bone scintigraphy findings

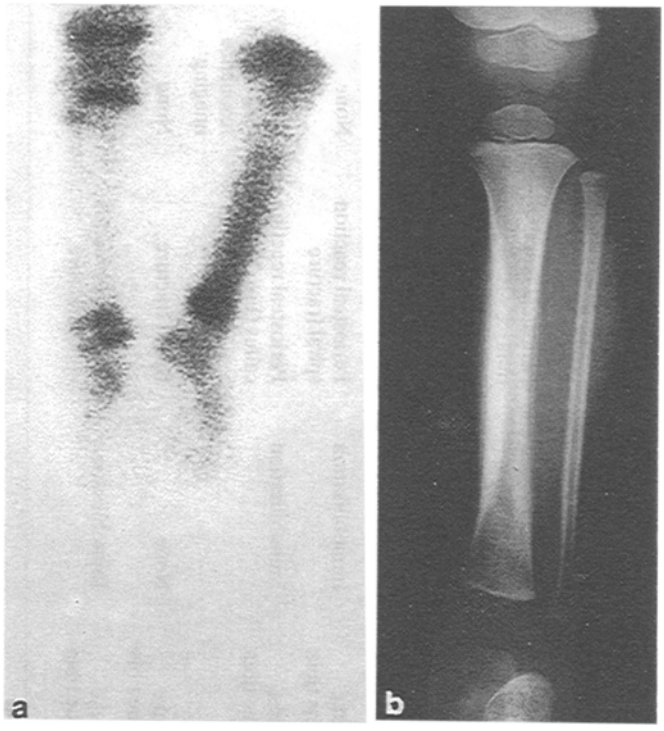

Fig. 3. a Positive bone scintigraphy showing increased uptake to tracer over the right tibia. **b** X-ray film 1 month after the onset of limping showing marked endosteal and periosteal reaction

Fig. 2. Bone scintigraphy findings in a case of osteomyelitis: a juxta-articular 'hot spot' is noted

showed marked periosteal and endosteal reaction (Fig. 3). To exclude osteomyelitis, a bone biopsy and magnetic resonance imaging were performed. Bone biopsy revealed fibrous periosteal reaction. Magnetic resonance imaging revealed a large spiral fracture of the tibia.

It can reasonably be assumed that the usual wear and tear of life is not sufficient to cause a positive bone scan [4]. On the other hand, a bone scintigraphy in a toddler with a greenstick fracture referred to our hospital because of suspicion of child abuse showed the same "black tibia". Indeed the scintigraphic findings of toddler's fracture resemble those of fractures of the long bone [4]. Bone scintigraphy can provide the diagnosis a few hours after the trauma [4]. Because of the increased sensitivity of scintigraphy over roentgenography in detecting bone fractures, it has been claimed as the method of choice to evaluate cases of possible child abuse [7].

Toddler's fracture has been initially reported as a fracture of the tibia. More recently, Starshak et al. [6] reported toddler's fracture of the calcaneous.

The accurate diagnosis of toddler's fracture is important since several of these fractures only heal after correct immobilisation, as illustrated by cases 1 and 5. In addition, several toddler's fractures were not merely greenstick fractures but spiral fractures of the tibia.

In conclusion, limping in a child often places the clinician in a tight spot. It is not always possible to differentiate fracture and bone infection on clinical or X-ray films only. In case of doubt, bone scintigraphy is a non-invasive diagnostic tool that helps to differentiate between minor fracture and early osteomyelitis. In cases of toddler's fracture, the scintigraphy shows a marked increased uptake over most of the tibia. In contrast, in all 7 cases of early osteomyelitis amongst 92 limping children, the bone scan showed only a small area of increased uptake adjacent to the metaphysis.

References

1. Conway JJ (1986) Radionuclide bone scintigraphy in pediatric orthopedics. Pediatr Clin North Am 33:1313–1334
2. Dich VQ, Nelson JD, Haltakin KC (1975) Osteomyelitis in infants and children. Am J Dis Child 129:1273–1281
3. Dunbar JS, Owen HF, Nogrady MB (1964) Obscure tibial fracture of infants – the toddler's fracture. J Can Assoc Radiol 15: 136–144
4. Kim HR, Thrall JH, Keyes JW (1979) Skeletal scintigraphy following incidental trauma. Radiology 130:447–451
5. Miller JH, Sandeson RA (1988) Scintigraphy of toddler's fracture. J Nucl Med 29:2001–2003
6. Starshak RJ, Simons GW, Sty JR (1984) Occult fracture of the calcaneus – another toddler's fracture. Pediatr Radiol 14:37–40
7. Sty JR, Starshak RJ (1983) The role of bone scintigraphy in the evaluation of suspected abused child. Radiology 146:369–375
8. Waldvogel FA, Medoff G, Swartz MN (1970) Osteomyelitis: a review of clinical features, therapeutic considerations and unusual aspects. N Engl J Med 282:198–206

THE ART OF MEDICINE

Medicine – however much it develops – must always remain an "applied science," and one differing from all the rest in that the application is to man himself. Were there no sick persons there would be no need for Medicine, either the Science or the Art. So long as there are, both will be necessary. The application of its Science, to be of value, must be made in such a way that it will produce the maximum of relief to the sick man. This calls for certain qualities in the practising physician which differ entirely from anything required in the practice of the other applied sciences. Herein lies the Art of Medicine. The need for it is as great today as it ever was, or ever will be, so long as human sickness continues.

Sir Arthur Hall, Practitioner, 1941