



## Osteoarticular infections in Belgian children : A survey of clinical, biological, radiological and microbiological data

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The aim of this study is to report the pathogens which were found most frequently to be responsible for osteo-articular infections in infants and children in Belgium, and to propose an appropriate empirical antibiotic therapy applicable before identification of the responsible pathogen. Clinical presentation, imaging and blood biology are also reviewed and analysed.

Fifty-six cases of osteo-articular infections (acute/sub-acute osteomyelitis, osteo-arthritis, septic arthritis, spondylodiscitis, sacro-iliitis) treated between 2001 and 2007 were retrospectively reviewed, focusing on clinical, biological, microbiological and radiological data.

Septic arthritis, acute osteomyelitis, septic osteo-arthritis and sacro-iliitis often have a loud clinical (fever, pain, inflammatory signs) and biological presentation. Subacute osteomyelitis and spondylodiscitis are almost asymptomatic, but for functional impairment. The responsible pathogen was isolated in 38% of the cases. The most frequent pathogen was *Staphylococcus Aureus*, followed by *Pneumococcus*, *Streptococcus A* and *B*, *Kingella Kingae*, and *Haemophilus*. None of them were resistant to usual antibiotics.

Functional impairment is the only constant symptom of osteo-articular infections. Other clinical and biological symptoms may be absent, making diagnosis often difficult. We recommend oxacillin (> 5 years) or a combination of oxacillin with cefotaxime (< 5 years) in the empirical treatment of osteo-articular infection, and a total of 4 weeks of treatment.

**Keywords :** osteo-articular infection ; children ; pathogens ; antibiotic therapy.

## INTRODUCTION

Acute haematogenous osteo-articular infections are common in paediatrics, occurring at a rate of 5.5 to 12/100,000 children (7). The most commonly identified pathogen in acute osteo-articular infections is *Staphylococcus aureus* (S. Aureus), which represents 25% to 60% of identified pathogens (6,9, 10,13,23). Other pathogens include group A *Streptococcus* (Strepto A), group B *Streptococcus* (Strepto B), *Streptococcus pneumoniae* (Pneumococcus), *Salmonella*, *Haemophilus influenzae* type B (HIB) has been replaced by *Kingella Kingae* (K. Kingae) (31) since vaccination has resulted in a significant fall in the incidence of HIB septic arthritis in children (36).

Recently, infections caused by Methicillin-resistant *S. Aureus* (MRSA) in patients without

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established risk factors for MRSA (21) have been increasingly reported (3,14,20,26,32) in American and British hospitals. These have been termed community-associated MRSA (CA-MRSA) infections. The aim of this study was to determine the frequency with which the various osteo-articular pathogens were encountered in our institution, and to propose an appropriate empirical antibiotic therapy to cover the first 24 to 48 hours before the results of cultures become available.

### PATIENTS AND METHODS

Cases of haematogenous osteo-articular infections encountered between 2001 and 2007 in children less than 15 years of age were retrospectively reviewed. We excluded from this series all cases of chronic osteomyelitis (OM, chronic recurrent multifocal OM), inflammatory mono- or polyarthritis, reactive arthritis and osteitis occurring by contiguity from a bedsore or another wound. The records of 56 cases (26 female and 30 male children) were retrospectively reviewed with focus on clinical, biological, microbiological and radiological data. There were 25 children with septic arthritis (SA), 7 with osteomyelitis (OM), 5 with septic osteoarthritis (SA associated with OM), 8 with subacute OM, 3 with sacro-iliitis (SI) and 8 with spondylodiscitis (SD). All data are summarised in table I.

The mean age at admission was 4.2 years (range, 2 weeks to 14.3 years).

To compare subgroups of children, Fisher's exact tests were performed for qualitative variables, and non parametric Mann-Whitney tests were performed for continuous numerical variables. P values less than 0.05 were considered as significant.

### RESULTS

#### Sites of infections (fig 1)

Among the 21 children with OM (7 with acute OM including 1 bilateral case, 5 with osteo-arthritis, 8 with subacute OM), the site of infection was the metaphysis of the proximal femur (5 cases), of the distal femur (3 cases), of the proximal tibia (3 cases), of the distal tibia (2 cases), of the distal fibula (1 case) and of the proximal humerus (1 case). The infection site was the calcaneus in 2 cases, the cuboid bone and the acetabulum in one case each; two other cases were multifocal (meningococcaemia). Septic arthritis (SA) occurred in the knee (15 cases), the hip (9 cases), the shoulder (4 cases), the ankle (1 case), the elbow (1 case) and in a chondro-sternal joint (1 case). There were 3 cases of sacro-iliitis (SI). The infections were on

Table I. — Clinical and biological data of the 56 cases of osteo-articular infections. The patients were distributed into two groups : group 1 includes osteomyelitis, septic osteoarthritis, septic arthritis and sacroiliitis ; group 2 includes subacute osteomyelitis and spondylodiscitis. The two groups were significantly different with respect to fever, redness, warmth and swelling, CRP and WBC (CRP = C-reactive protein; WBC = white blood cell)

	Group 1				Group 2		Fisher's test
	Osteomyelitis (OM)	Osteoarthritis (OM + SA)	Septic arthritis (SA)	Sacroileitis (SI)	Subacute OM	Spondylo-discitis (SD)	p value
Number of cases	7	5	25	3	8	8	
Sex ratio (F/M)	3/4	3/2	10/15	3/0	4/4	3/5	NS
Mean age at diagnosis (years)	7.0	2.5	4.1	1.3	5.3	3.0	NS
Side : Left/Right/Bilateral	4/1/2	2/1/2	12/12/1	2/1	5/3	–	NS
Fever	57% (4/7)	80% (4/5)	80% (20/25)	100% (3/3)	12.5% (1/8)	0% (0/8)	p < 0.001
Redness, warmth, swelling	57% (4/7)	60% (3/5)	68% (17/25)	0% (0/3)	0% (0/8)	0% (0/8)	p < 0.001
Functional impairment	100%	100%	96% (24/25)	100%	100%	100%	NS
Abnormal CRP	71% ( 5/7)	80% (4/5)	92% (23/25)	100% (3/3)	0% (0/8)	25% (2/8)	p < 0.001
Abnormal WBC count	57% (4/7)	80% (4/5)	96% (24/25)	67% ( 2/3)	12.5% (1/8)	37.5% (3/8)	p < 0.001

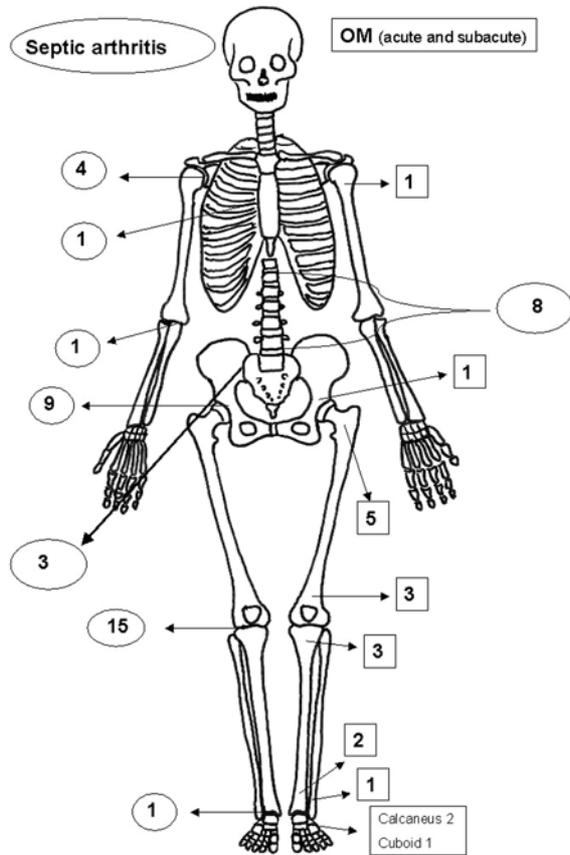


Fig. 1. — Infection localisations in the series.

the left side in 24 cases, on the right side in 18 and bilateral in 5 cases. Spondylodiscitis occurred at L1-L2 (2 cases), L2-L3 (3 cases), L4-L5 (1 case) and L5-S1 (2 cases).

### History

A history of trauma was noted in 8 patients (15%). The expected entry point for bacteraemia was an infected ingrown toe nail (2 cases), a concomitant otitis (2 cases), an upper respiratory tract infection (3 cases) or a pneumonia (2 cases). Three children had clinical meningococcaemia with septic shock, multiple skin necrosis and multiple osteo-articular involvement.

### Symptoms (table I)

Fever was present on admission in 32 children (58%) while 24 were afebrile (42%). Children with acute OM, SA, septic OA and SI were generally febrile (57%, 80%, 80% and 100% febrile respectively) while those with subacute OM or SD were generally afebrile (87.5% and 100% respectively). Comparing these two groups, the difference was statistically significant ( $p < 0.001$ ) (table I).

The classical symptoms of redness, swelling and warmth (*rubor, tumor, calor*) were present in the majority of the children with SA (68%) except in 4 cases located at the hip, 1 case at the elbow and 1 case at the shoulder. All knee and ankle SA's were clinically obvious (pain, swelling, warmth, redness). Among children with acute and subacute OM, the diagnosis was clinically obvious in 71%, while septic OA located at the hip was not clinically detectable in two children. All cases of SI, SD and subacute OM had no signs of swelling or redness. Functional impairment was present in 55 of 56 children (96%), sometimes only characterized by a limp. Only the child with chondro-sternal septic arthritis had no evidence of functional impairment.

### Blood parameters (table I)

Blood biology showed abnormal values for at least one inflammatory marker in 80% of patients (CRP or leucocytes count). C-reactive protein (CRP) (normal value  $< 1$  mg/dl) was normal in 19 cases (34%) and was elevated in the others (66%). White blood cells count (WBC) was normal in 18 cases (32%) and elevated in the others (68%). Both markers were normal in 11 cases (20%). None of the children with OM, septic OA or SI had normal inflammatory markers. Seven of the eight children with subacute OM (88%) had normal blood tests, and 4 with SD (50%) had normal CRP and WBC count while the others only had a slight disturbance.

### Imaging (table II)

Sonography and radiographs were performed in all cases except in spondylodiscitis where only

Table II. — Percentage of cases in which the various imaging modalities contributed to the diagnosis (echography, radiograph, MRI, bone scan)

	Osteomyelitis (OM)	Osteoarthritis (OM + SA)	Septic arthritis (SA)	Subacute OM	Spondylodiscitis (SD)	Sacroileitis (SI)
Number of cases	7	5	25	8	8	3
Positive echography	5/7 (71%)	3/5 (60%)	24/25 (96%)	3/8 (37.5%)	–	1/3 (33%)
Positive radiograph	5/7 (71%)	4/5 (80%)	1/25 (4%)	6/8 (75%)	8/8 (100%)	0/3 (0%)
Percentage of clear diagnosis made by echo or radiograph	5/7 (71%)	100%	24/25 (96%)	6/8 (75%)	100%	0/3 (0%)
Imaging giving the diagnosis in the other cases	2/7 (29%) MRI +, bone scan +	–	1/24 (4%) bone scan +	2/8 (25%) MRI +, bone scan +	–	3/3 (100%) bone scan +

radiographs were made, and in two cases of meningococcaemia in which the diagnosis of SA was obvious without sonography.

Sonography was positive in 63% of all cases (presence of excessive joint fluid and/or synovial tissue thickening). SA was clearly diagnosed by sonography in all but one case (in which technetium bone scan was positive and joint aspiration permitted to identify the pathogen). Sonography often helped in acute OM (5/7) (soft tissue swelling, subperiosteal abscess); it was less useful for osteoarthritis, subacute OM and SI (60%, 37.5% and 33%).

Plain radiographs were positive in 43% of all the cases. Radiological diagnosis was considered positive when either osteolysis or periosteal apposition was present. The diagnosis was made on plain radiographs in 71% of the children with OM and 75% of those with subacute OM; it was provided by MRI in the others. SD was detected on radiographs and MRI in all cases.

SI was diagnosed by technetium bone scan in all cases; only one had a positive sonography (sacroiliac joint swelling), and all had negative initial radiographs.

### Bacteriology (table III)

Haemocultures were systematically performed when fever was present. In children with SA, joint aspiration was done in all cases, except in 5 cases in which only a very small effusion was present. Arthroscopy was performed in 6 cases of knee SA to achieve a more efficient joint drainage. In case of

acute OM, osseous biopsy was performed in all but three cases: two cases with negative radiographs and a positive bone scan and another case in which antibiotic treatment had been initiated two days before admission.

None of the SD and of the SI were punctured, considering the reportedly low rate of successful puncture. Two children with subacute OM were surgically treated due to the presence of a sequestrum on MRI or CT-Scan. In the absence of a sequestrum, the other subacute OM were not punctured.

In total, 32 patients out of 56 (57%) were punctured or biopsied. All but 9 (24%) children with acute OM, osteoarthritis or SA were punctured but 16 out of 19 (84%) with subacute OM, SD and SI were not. The pathogen could be identified in 38% of the cases in total. Considering only the punctured or biopsied patients, the success rate was 66%.

The pathogen was cultured from haemocultures in 8 cases, from aspirated joint fluid in 11 cases, from osseous biopsy in 5 cases and from pleural fluid in one case. The mean age of the children affected by *S. Aureus* (7.7 years) was significantly older than in those affected by *Kingella Kingae* or *Hemophilus Influenzae* (1.4 year) ( $p = 0.04$ ). For OM and SA, isolated or associated, the cultures were positive in 20 cases out of 37 (54%).

Out of the 13 OM, the pathogen was isolated in 4 osseous biopsies, 3 haemocultures, and one joint aspiration (septic OA). The responsible pathogen was *S. Aureus* in 6 cases, *Streptococcus A* in 1 case and probably *Neisseria meningitidis* in 2 cases (clinical evidence of meningococcaemia but without positive bacteriological culture).

Table III. — Type of sampling performed (haemoculture, joint fluid puncture, osseous biopsy), percentage of positive culture and identified pathogens

	Osteomyelitis (OM)	Osteoarthritis (OM + SA)	Septic arthritis (SA)	Subacute OM	Spondylo-discitis (SD)	Sacroileitis (SI)
Number of cases	7	5	25	8	8	3
Osteoarticular prelevement realised	4	5	20	2	0	0
Positive prelevement	4/4 (100%) osseous biopsy	1/5 (20%) articular fluid	10/20 (50%) articular fluid	1/2 (50%) osseous biopsy	–	–
Hemoculture realised	4	4	20	–	–	3
Positive hemoculture	2/4 (50%)	1/5 (20%)	5/20 (25%)	–	–	0/3 (0%)
Other positive prelevement	–	–	pleural fluid (1)	–	–	–
No germ cultured	1/7 (14%)	4/5 (80%)	12/25 (48%)	7/8 (88%)	8/8 (100%)	3/3 (100%)
Identified germs	6/7 (86%)	1/5 (20%)	13/25 (52%)	1/8 (12.5%)	0/8 (0%)	0/3 (0%)
	S. Aureus (5)	Neisseria meningitidis (2) (clinical evidence)	Pneumococcus (4)	S. Aureus (1)		
	Strepto A (1)	S. Aureus (1)	Kingella Kingae (3)			
			Strepto B (2)			
			S. Aureus (2)			
			Hemophilus Influenzae (1)			
			Strepto A (1)			

Out of the 25 cases with SA, 13 pathogens could be isolated (52%) thanks to haemocultures (5 cases), joint aspiration (10 cases), and pleural fluid aspiration (pneumonia complicated with pleuresis). The responsible pathogen was *Pneumococcus* in 4 cases, *Kingella Kingae* in 3 cases, *S. Aureus* in 2 cases, *Streptococcus B* in 2 cases, *Hemophilus Influenzae* in 1 case and *Streptococcus A* in 1 case.

Only one case of subacute OM had a positive culture on osseous biopsy with *S. Aureus*.

The pathogen was cultured in no case of SI and SD, in which no needle aspiration had been attempted.

## DISCUSSION

### Sites of infections

Osteo-articular infections predominantly occur in the lower limbs (38). In this series, 46 infections were in the lower limbs, 9 were in the trunk and

6 in the upper limb. In the lower limbs, the most frequent locations were near the knee (21 cases) and the shoulder was the predominant location in the upper limb.

### History

Out of our 56 cases, 12 had a probable entry point. This is helpful information when no pathogens can be isolated. For example, a history of otitis, pneumonia, and meningitis is helpful, as it gives a clue to the nature of the responsible pathogen (*Pneumococcus*, *Neisseria meningitidis*). Possible entry points like ingrown toenails or cutaneous lesions in healthy patients give the indication of a possible *S. Aureus*.

### Symptoms

Classically, the presentation of osteo-articular infection combines pain about the affected joint or bone and the other aspecific signs of infection :

redness, swelling, warmth and fever. Infants and young children are unable to clearly locate the pain. Moreover, these signs are sometimes absent. The only constant sign is functional impairment (for example a limp or denial of limb use). This clue added to local pain represented the most typical presentation of the disease. The only patient who was not impaired was young (22 month-old). He had an obvious abscess in a chondro-sternal joint but he was moving the upper arms normally.

Only 58% of our patients were febrile (table I). Only 57% of children with OM had fever, which is similar to the Faden and Grossi study (17) in which fever was absent in 30% of the cases. The majority of children with SA or SI were febrile. All children with SD and most of those with subacute OM were afebrile.

### Imaging

The diagnostic strategy in imaging osteo-articular infections is currently well codified (4). Radiographs, always available in an emergency situation, are systematically taken. They can be usefully complemented with sonography in accessible superficial locations, when looking for a puncturable abscess. MRI is not systematic but can be used when OM is suspected with a normal radiograph, when looking for an abscess (pelvis, spinal cord), to evaluate the risk of epiphysiodesis when a physis is involved, or when there is resistance to treatment. CT scan has limited indications : it is performed when looking for a bone sequestrum. Bone scan is currently only performed when radiographs are normal and there are no clinical warning signs.

### Bacteriology

A pathogen could be identified in only 38% of our cultures, similar to the rate reported in literature (24,38). In order to improve the pathogen identification, each SA should be punctured, and if deemed appropriate, be drained. Joint fluid should be collected in a heparinized syringe so that the large clot that would otherwise form in the fluid will not preclude leukocytes count. Fluid should be

Table IV. — Summary of identified pathogens classified by frequency and antibiotic susceptibility

Germ	Number of cases	Susceptibility
Staph Aureus	9	oxacilline (9)
Pneumococcus	4	penicilline (4)
Kingella Kingae	3	ampicilline (3)
Strepto A	2	ampicilline (2)
Strepto B	2	ampicilline (2)
Hemophilus Influenzae	1	ampicilline (1)

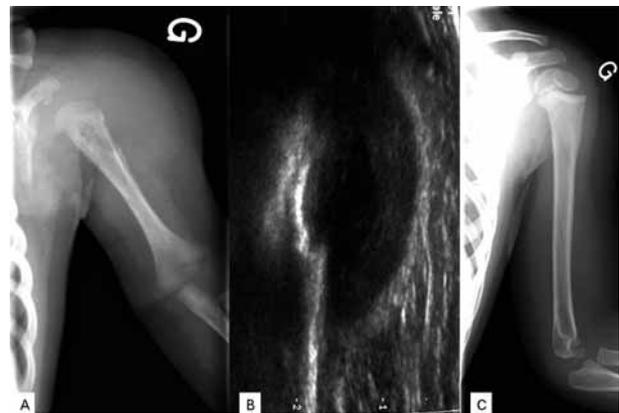


Fig. 2. — Acute osteomyelitis of the proximal humeral metaphysis-diaphysis with *Staphylococcus Aureus*. A. Radiograph showing osteolysis and periosteal apposition. B. Sonography showing cortical rupture and an abscess under the deltoid muscle. C. After 22 months of evolution : complete healing.

sent for culture in haemoculture flasks (Bactec®) and also in a normal flask for direct WBC count and a direct examination with Gram stain. Patients with OM should, inasmuch as possible, have osseous biopsy as its success rate was high in our series. Identification of the responsible pathogen decreases the duration of treatment and its potential complications as well as emergence of resistant strains.

Despite the recent increase in the incidence of infections caused by MRSA in patients without established risk factors for MRSA (21) in American and British hospitals, we did not observe such an evolution. It was not observed in France either (19). All the pathogens encountered were susceptible to classical antibiotics (table IV).



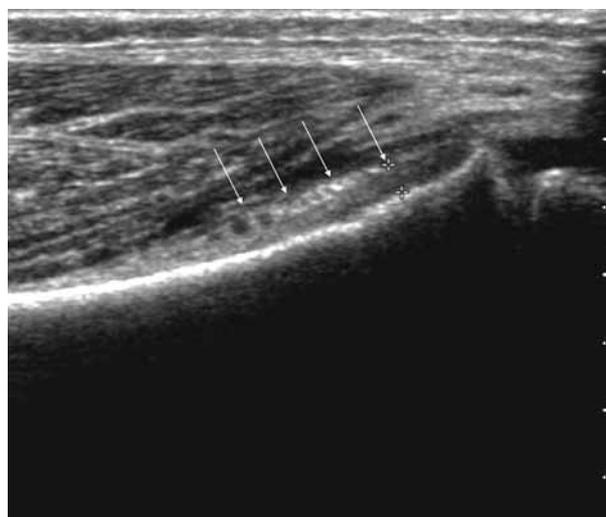
**Fig. 3.** — Septic arthritis of the hip in a 1-year-old girl. She presented 12 days after onset of fever. Radiographs showed osteolysis in the superior femoral epiphysis. Arthrotomy was performed with drainage tube insertion. After 1 year, the child was asymptomatic and radiographs showed healing of the femoral head with only a slight head enlargement.

#### Acute OM (fig 2)

Acute haematogenous OM is frequently located in a metaphysis, as blood flow markedly slows down at the tips of the metaphyseal vessels (2). The presence of transphyseal blood vessels in the long bones of infants and children was described by Trueta (39) and Ogden (34) and may explain the possible spread of infection from the bone to the adjacent joint (osteo-arthritis) or vice versa. In infants, Ogden mentioned multiple bone involvement and secondary sepsis in joints adjacent to osteomyelitic foci (34). Bone scan can be helpful to detect all the foci in infants. Blood culture should be performed in all cases (19). Local biopsy is recommended when possible : simple aspiration seems to be less efficient for bacterial diagnosis, compared with trocar-biopsy (35). The rate of positive culture resulting from bone biopsies is low (34%) (19,42). Aspirating 2 ml or more purulent fluid is associated with a significantly higher rate of positive cultures (42). A systematic bacteriological protocol with cultures on aerobic and anaerobic media can improve the rate of micro-organism growth (1). PCR may be useful in some cases (19).

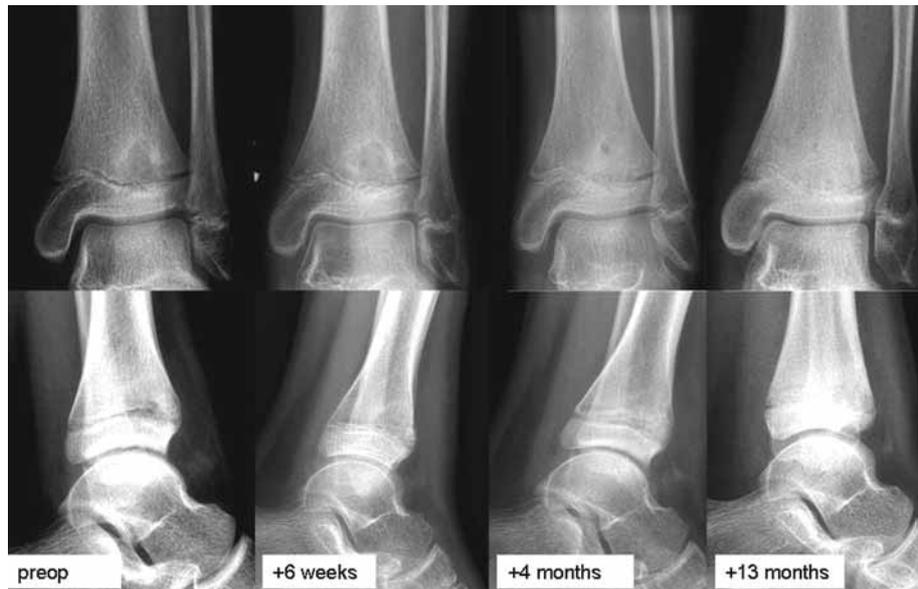
#### Septic arthritis (SA) (figs 3 & 4)

Septic arthritis is the most frequent osteo-articular infection in children. It predominantly affects the knee and the hip, where it usually has a loud clinical presentation. Fever, functional impairment and inflammation signs are usually present. Blood inflammatory markers give a good suspicion of the



**Fig. 4.** — Knee septic arthritis in a 9-year-old boy. Sonography showed a subperiosteal tibial abscess which was punctured at the time of the knee arthroscopy.

infection, but this is strongly reinforced by sonography, rarely by bone scan. Sonography is useful to detect a subperiosteal abscess in case of associated OM (fig 4). Plain radiographs are often negative in the initial stage. The best visualisation of the osteolysis, if present, is about the 6th week. Joint fluid taken by aspiration and cultured establishes the diagnosis in numerous cases when positive (12/25 cases in our series). If the culture is negative, it is recommended to carry out a universal PCR or a PCR targeted to the main pathogens responsible for septic arthritis (*S. Aureus* and *K. Kingae*) (19). Antimicrobial therapy is initiated after the joint



**Fig. 5.** — Subacute osteomyelitis of the distal tibial metaphysis in a 11-year-old girl. She had pain when walking. She had no fever, no swelling, no warmth and no redness. Blood CRP and WBC count were normal. Evolution after curettage. Complete healing.

aspiration. In some cases, it may be followed by surgical wash in case of unsatisfactory evolution. In SA of the knee, arthroscopic wash can easily be done percutaneously. A short course (4-days) of dexamethasone has been shown to reduce residual joint dysfunction and to significantly shorten the duration of symptoms in children with documented haematogenous septic arthritis (33). Sequels are not frequent in case of adequate treatment. Inadequate treatment or misdiagnosis may result in severe destruction of the joint, sometimes extended to the growth plate. Irreversible sequels may then occur : destruction of the epiphysis, joint incongruence, loss of joint mobility, partial or complete fusion of the growth plate.

#### *Subacute OM* (fig 5)

Subacute OM is a difficult diagnosis. The diagnosis is generally delayed because of mild general symptoms (25). This delay however gives time to the infection to show radiological signs. Plain radiographs are therefore a useful tool for the diagnosis. The penumbra sign is a characteristic magnetic resonance (MR) feature of subacute osteomyelitis (11). It can be identified on non-enhanced T1-weighted



**Fig. 6.** — Same patient as figure 5. CT-Scan showed presence of a sequestrum. A surgical curettage was performed.

spin echo images as a discrete peripheral zone of marginally higher signal intensity than the central bony abscess cavity and the surrounding lower signal intensity of the reactive new bone and oedema (11). Conservative treatment is possible (16,25). Generally an oral course of antibiotic is given

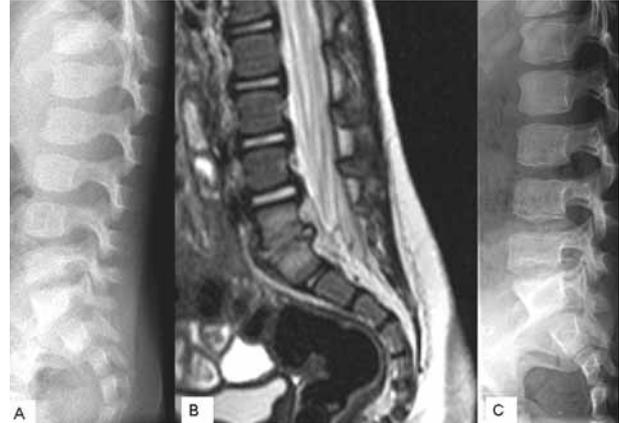


**Fig. 7.** — Twelve year-old girl with subacute osteomyelitis of the proximal tibia. On T2-weighted MRI, a sequestrum is shown. A surgical curettage was performed.

(oxacillin for 10 days). The responsible pathogen is only rarely isolated (25). In our series, we isolated one *S. Aureus*, but biopsy was performed in only two cases. Therefore, surgical curettage can be limited to sequestra. Sequestra (fig 6 & 7) can be visualised on CT-Scan or on MRI. Complete healing without sequelae is achieved in the majority of cases, even when the physis seems to be involved. We had no complications in our eight cases, similar to the literature (11,16,25).

#### *Spondylodiscitis (SD)* (fig 8)

SD is an uncommon problem in children (incidence 1/250000) but the diagnosis remains difficult (41). The diagnosis is often delayed (mean of 14 weeks) (28). Our small series of 8 patients displayed the poor presentation of the disease (functional impairment and local pain). Blood tests are often normal. Elevated CRP and/or WBC count was found in only 3/8 cases (table I). The course of childhood spondylodiscitis is generally benign. Segmental ankylosis may occur during the healing



**Fig. 8.** — Spondylodiscitis in a 22-month-old boy with pain and a limp. A. radiograph shows L5-S1 spondylodiscitis. B. MRI. C. After 4 years of follow-up : the narrowing of the disc space is still present.

process but does not normally lead to serious functional deficits (28). Neurological deficits are very rare ; none was noted in our series. Biopsy is not required except in the few cases where diagnostic uncertainty prevails (28). Magnetic resonance imaging may allow for early diagnosis when the clinical signs are difficult to interpret (22). An epidural abscess with an indented dural sac may look threatening, but it is not an indication for surgery unless the patient has neurological signs (22). Follow-up MRI studies show that these abscesses spontaneously disappear with antibiotic treatment and immobilisation (22). Conservative management includes oral antibiotherapy with oxacillin for 10 days and a thoraco-lumbar brace for 3 months. Disc fibrosis and occasional vertebral fusion often develop in the long term (22) but generally without functional deficits. Kyphosis may develop in 16% (22).

#### *Sacro-iliitis (SI)* (fig 9)

SI in children is a rare entity, and the delay before diagnosis may also be important. In our three cases, symptoms were fever, limp, and hip pain. Change from lying to sitting position was painful. All these children had elevated CRP and two had elevated WBC. Radiographic signs are delayed (widening of the joint line, geodes, condensation, and at an



**Fig. 9.** — Radiograph 6 weeks after the beginning of a sacroiliitis in a 10 month-old girl. There is an osteolytic area surrounded by sclerosis. Periosteal apposition is visible in the sciatic notch.

ultimate stage, fusion of the joint). Radiography is not reliable but may be helpful in late diagnosis. Bone Scan (Tc 99m) always shows the localisation. The pathogen could not be identified in our 3 cases (all haemocultures were negative) and none were punctured. Few successful SI aspirations are reported in the literature (30). Surgical drainage is only indicated in cases with an important collection, an abscess, or an intra-articular sequestrum (30). No sequels occurred in our small series and none are reported in literature (30).

#### Antibiotic treatment

All patients in our series received a combination of oxacillin and cefotaxim (third generation cephalosporine). Cefotaxim alone has not been proved efficient against *S. Aureus* (29). Oxacillin remains the first choice since no MRSA were reported in our series. None of our patients failed to respond to treatment. Although the risk of acquiring invasive HIB is low in areas with effective immunisation, cases continue to be reported. Children younger than 5 years of age without immunisation against HIB should be treated initially with a regime that combines oxacillin (50 mg/kg iv/6-

hourly ; max 2 g) and cefotaxim (50 mg/kg iv/8-hourly ; max 2 g) (18, 27). Older children should be treated initially with oxacillin alone, followed by oral flucloxacillin 25 mg/kg/6-hourly) (27). When the pathogen is identified, antibiotic treatment should be changed taking into account the pathogen sensitivity.

The total course of antibiotic was 3 months in our series (intravenous + oral) but this is too long compared to literature. It is generally agreed that antibiotic treatment should be maintained for at least three to six weeks, but the duration is often extended for fear of an insufficient treatment. Syrogiannopoulos *et al* showed that longer treatments are not necessary to cure the patients (37) : a mean of 22 days treatment for *S. Aureus* acute OM was enough, and 23 days for an SA. Bachur reported in his recent study the success of short antibiotic treatment (5). The median duration of parenteral antibiotics and oral antibiotics was 4 days (range, 0-7 days) and 28 days (range, 14-42 days) respectively. The median duration of combined (parenteral and oral) therapy was 32 days (range, 20-49 days). The six months follow-up of the 27 patients revealed no complications (5). Similar studies of Vinod *et al* about the treatment of uncomplicated acute osteomyelitis revealed effectiveness of a three to four weeks antimicrobial therapy (40). Abuamara also noted no additional morbidity with shorter antibiotic therapy (34 days versus 47 days) (1). A recent study of Ceroni *et al* reported the risks associated with a prolonged antibiotherapy in these affections. The major complications reported were related with allergic reaction to drugs (antibiotics or anaesthetic drugs for central venous catheter insertion) (8). Based on recent literature, we intend to reduce the duration of antibiotic treatment from 3 months to 4 weeks.

Although splinting and immobilisation may be necessary in treating acute infections in order to decrease pain, early range of motion is important in preserving long-term joint function (15).

#### CONCLUSION

The majority of osteo-articular infections occur in the lower limbs. Running a complete anamnesis

including recent previous infections or cutaneous lesions is helpful, as this may give an orientation for antibiotic selection, especially if no pathogen has been identified. Considering the symptoms, SA, OM, septic OA and SI have a louder presentation than SD and subacute OM. Fever is often absent (in half of the cases of acute OM and in all cases of subacute OM and SD). Special attention should be given to the functional impairment, because it is the only constant sign, but sometimes it only amounts to limping or walking denial. Blood biology keeps an important place in the diagnosis, with inflammatory markers frequently disturbed (80%). It is less important in the detection of subacute OM and SD. Radiographs and sonography must be done in every case with a suspected bone or joint infection. Radiographic changes are often delayed in acute OM but are generally present in cases of subacute OM and SD, due to delay in diagnosis. Sonography is the major examination for SA. When in doubt, bone scan helps to disclose the SI and OM (acute and subacute). MRI has limited indications for diagnosis, but remains a gold standard to evaluate the severity of the lesion and as a tool before surgery. Our series showed similar results about pathogens. *Staph.Aureus* is the predominant causative agent, followed by *Pneumococcus* and *Streptococcus* A and B. HIB tends to disappear, contrary to *K. Kingae*. There were no MRSA infections in this series. In the empirical period of antibiotherapy, we recommend a monotherapy with oxacillin (in children > 5 years) or a combined antibiotherapy, with immunisation against HIB. Parenteral antibiotherapy is adapted when the pathogen is cultured. Parenteral antibiotics are relayed to oral antibiotics when three conditions are fulfilled: when the child has been afebrile for 48 hours or more, when the clinical status has improved and when the CRP and WBC counts are normalised. Oral antibiotherapy is continued, to obtain a 4 weeks treatment.

Early recognition of osteo-articular infections is essential because of the functional impairment they may entail, such as significant reduction of the mobility of joints, joint deformity or leg length discrepancy at adult age. Early diagnosis followed by adequate treatment allows for a good outcome.

Inappropriate or delayed treatment may result in chronic osteomyelitis, growth plate destruction or irreversible joint destruction (12).

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