Late sequelae of neonatal septic arthritis of the shoulder

C. F. A. Bos, L. J. C. D. Mol, W. R. Obermann, E. R. Tjin a Ton

From Leiden University Medical Centre and the Juliana Children’s Hospital, The Hague, The Netherlands

We reviewed eight children (ten shoulders) who had suffered neonatal sepsis, after a mean follow-up of 14 years (11 to 15). The delay between the onset of symptoms and diagnosis was one day in five patients, two days in three and seven days in one. All ten shoulders were treated by aspiration, followed by arthrotomy in two. At follow-up, five of the ten shoulders had a full range of movement and the others had minimal restriction of external rotation. Shortening of 10 cm was present in one patient, while two with bilateral involvement had disproportionally short humeri.

Early diagnosis and treatment favour the outcome in septic arthritis of the shoulder. With late diagnosis, deformation of the humeral head and shortening of the humerus cause marked cosmetic abnormality but negligible functional loss.

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Much attention has been paid to neonatal septic arthritis in the hip and knee in which late diagnosis may have crippling consequences. By contrast, there are few reports of neonatal infection in the upper limb\(^1\)\(^-\)\(^3\) and they lack long-term follow-up and description of the final radiological abnormalities.

We have reviewed eight patients who had ten septic shoulder joints when neonates, at two separate institutes after a minimum of ten years.

Patients and Methods

The eight patients were treated at the Leiden University Medical Centre and the Juliana Children’s Hospital. Five were born at term, two were preterm and one was a low-birthweight baby. One was a twin. In four only the shoulder was infected, but in the remainder other joints were involved. The right shoulder was affected in two patients and the left in four. Two patients had bilateral involvement. A total of ten shoulders was available for review.

All patients were under two months of age at the time of diagnosis. In five it had been made within a day of the onset of symptoms and in two the delay was two days. The longest delay between the onset of symptoms and diagnosis was seven days.

The most common presentation was swelling, pyrexia and inability to use the involved arm. In eight shoulders the treatment consisted of one or multiple aspirations, and in two this was followed by arthrotomy. The organisms were *Staphylococcus aureus* in seven, *Haemophilus influenzae* in two and haemolytic *Streptococcus* in one. Antibiotics were given to all patients for a mean of 90 days (60 to 100). All the children made a good recovery and were discharged after a mean hospital stay of 2.5 weeks, free from pain, apyrexial and using the affected arm.

We examined the shoulders functionally and radiologically at regular intervals over the next year and then subsequently annually. Clinical measurement of the humeral length was defined as the distance between the bony landmarks of the acromion and the lateral humeral condyle. Radiological examination consisted of an upper thoracic anteroposterior view including both shoulders in neutral rotation. Additional radiographs with the upper arm in maximum abduction were taken if the active range of movement was restricted. The neutral position of the shoulder was determined by placing the humerus so that elbow flexion moved the forearm in a plane perpendicular to that of the scapula. The range of flexion and extension in the glenohumeral joint was recorded by a forward and backward movement of the humerus perpendicular to the scapular plane, and the range of abduction and adduction by movement of the humerus in a lateral and medial direction from the same plane. The range of internal and external rotation was calculated by bringing the forearm, flexed to
Case 1. A three-week-old child with bilateral septic arthritis. Figure 1a – There is metaphyseal lucency and soft-tissue swelling of both shoulders. Figure 1b – Six weeks later the metaphysis is widened bilaterally by subperiosteal apposition of bone with considerable inferior subluxation (drooping) of the left shoulder. Figure 1c – After three years irregular ossification of the nuclei of the capital humeral head and greater tuberosity can be seen. Figure 1d – At the age of 13 years both the humeral heads are deformed with some overgrowth of the greater tuberosity. Functional outcome was hardly affected by the deformed humeral heads. Figure 1e – Full active abduction was also recorded radiologically as shown for the right shoulder. The only restriction appeared to be $20^\circ$ of external rotation in both shoulders.
90°, into medial and lateral rotation. The active range of both shoulders in abduction, adduction, flexion, extension and internal and external rotation was also measured. The mean follow-up was 14 years (11 to 15).

Results

Examination of the radiographs showed that there were two distinct groups of shoulders. The first was those which had marked radiological changes in the epiphysis, physis and metaphysis, all of which occurred in the three patients who were diagnosed after two days or more from the onset of symptoms. Figure 1 (case 1) shows the typical findings. The initial radiological changes which appeared within two weeks of the onset of symptoms included a zone of metaphyseal lucency parallel to the chondroepiphyseal plate and soft-tissue swelling (Fig. 1a). After four more weeks there was some loss of metaphyseal bone centrally with subperiosteal metaphyseal bone formation, giving the appearance of a cupped and widened metaphysis. Septic arthritis which occurred before the appearance of the ossific nucleus of the humeral head, delayed the appearance of the latter by months in three shoulders. Drooping of the affected shoulders appeared to be a temporary phenomenon, and persisted for no longer than one year (Fig. 1b). The ossification pattern in the humeral head was disturbed. The ossific nuclei were irregularly ossified and small in size for the patient’s age (Fig. 1d); this was also seen in case 3 (see Fig. 3a). Sepsis after the appearance of the capital ossific nucleus caused its disappearance in both shoulders of the third patient, who had a delay in diagnosis of one week. In this patient (case 2) the ossific nuclei of the greater and lesser tuberosities gradually developed and were irregular and small (Fig. 2a). Since the humeral heads were radiologically absent at
follow-up additional MRI was performed for further analysis. This showed that the deformed heads consisted mainly of cartilage (Fig. 2b). Humeral retroversion, measured by CT, was absent in both shoulders of this patient, while retroversion in the other three shoulders in this group appeared to be decreased (by 10°, 20° and 20°, respectively). At follow-up all five shoulders in the group (cases 1 to 3) showed loss of external rotation varying between 10° and 20°. Flexion, extension, abduction, adduction and medial rotation were not disturbed (Figs 1e, 2c and 2d, 3b and 3c). A humeral length discrepancy of 10 cm was measured in one patient (Fig. 3c), while the two with bilateral involvement had disproportionally short humeri (Fig. 2c).

The second group consisted of five patients in whom the diagnosis of septic arthritis of the shoulder had been made within one day of the onset of symptoms. The early radiological changes were similar to those seen in the first group, with metaphyseal radiolucency (case 4, Fig. 4a). Subsequent radiological changes were few. The ossific nuclei of the humeral head and the greater and lesser tuberosities appeared on time. That of the humeral head, however, showed some mottling and fragmentation (Fig. 4b). In two patients a central metaphyseal defect with a small bridge of the growth plate appeared to be the only reactive abnormality during growth (Fig. 4c). The development of the humeral head was not disturbed. The other three patients had reached skeletal maturity at follow-up with a normal radiological appearance of the proximal humerus. No humeral length discrepancy was recorded. These patients had a full range of movement compared with the uninvolved shoulder.

Discussion

The same prognostic factors which have been associated with the poor results of septic arthritis of the hip can be applied to this condition in the shoulder. These include delay in diagnosis and treatment, the age at onset of infection, premature birth and the virulence of the organism. Late diagnosis of suppurative arthritis of the shoulder may cause damage to the growth plate and to the growth of the secondary ossification centres of the proximal humerus, resulting in a shortened upper arm and with a deformed humeral head. Development of retroversion of the humeral head may be impaired. This may explain the restricted external rotation in our patients in the first group. Medial rotation during growth of the proximal humerus has been attributed to the insertion of the medial rotator muscles above the epiphyseal line. The medial rotators are stronger than the lateral rotators. In contrast with the complications of septic arthritis of the hip, instability of the shoulder and pseudarthrosis are unlikely to occur. Bad prognostic radiological signs are the delay in the appearance or definite disappearance of the secondary ossification centre of the humeral head, drooping of the shoulder and massive metaphyseal periosteal bone formation. Drooping of the shoulder or inferior subluxation can be secondary to a number of
causes including trauma, hemiplegia, neoplastic involvement of the brachial plexus, injury to the axillary nerve, replacement arthroplasty and haemophilia. In septic arthritis this appeared to be irreversible, and can be attributed to a large volume of intra-articular pus.

Approximately 80% of growth in the humerus occurs at the proximal growth plate. The ossification centre for the head usually appears between the fourth and sixth months, while that of the greater tuberosity is seen at three years and that of the lesser tuberosity at the age of five. It is not known how much each ossification centre at the proximal end of the humerus contributes to its growth. Our findings suggest that the greatest amount is derived from that for the humeral head. Delay in its appearance will cause deformation and shortening of the head and upper humerus. A system of treatment has been established for septic arthritis of the hip, but there is controversy about the management of infection in the joints in the upper limbs. Our results suggest that, in addition to systemic antibiotics, aspiration has a definite role in management, but with later diagnosis an arthrotomy will be needed.

Since functional restrictions are reasonable there is no place for reconstructive surgery. Humeral shortening can give cosmetic and psychological problems. One report of humeral lengthening for a septic disturbance of neonatal growth has been published with a relatively short follow-up. In bilateral cases there is less need for humeral lengthening. Our results show that the late devastating sequelae of osteoarthritis of the shoulder may be avoided by an early diagnosis followed by immediate treatment.

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References


