Another study endorses the same principle recommending that any patient without clear-cut evidence for SA, or lack thereof, needs an examination of the joint fluid for diagnosis [1]. Another study reported that the diagnosis is rarely established by the history and physical examination, and the clinician is led to rely on ancillary tests, specifically the white blood cell (WBC) count from peripheral blood and other serological markers for inflammation, such as the erythrocyte sedimentation rate [4]. A retrospective study examined the incidence, etiology and clinical features of septic arthritis in children less than 24 months and concluded that the diagnosis of SA in children needed to be made based on a high index of suspicion and could not be excluded based on lack of fever and normal laboratory tests [2].

Based on our understanding of the literature, and in the absence of an absolute test, it appears that the diagnosis of SA in children needs to be made using a combination of clinical findings, laboratory tests and appropriate imaging. For patients with equivocal findings, clinical suspicion should override laboratory findings, because missing SA in a child, especially when caused by a virulent organism, can have serious consequences.

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QUESTION 4: Is there a role for arthrocentesis (joint puncture) of an infected joint in a pediatric patient?

RECOMMENDATION: Yes. Arthrocentesis of an infected joint is effective for decompression of the joint. However, some children need arthrotomy.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 83%, Disagree: 11%, Abstain: 6% (Super Majority, Strong Consensus)

RATIONALE

Arthrocentesis (joint puncture) is one of the most valuable procedures for the diagnosis and treatment of joint diseases [1]. In children with septic arthritis (SA), arthrocentesis can be very useful for both diagnosis and as means of treatment [2,3]. It is safe and simple, but approaching the joint correctly, especially of the hip, is not possible for all physicians in emergency departments [4].

In a child with acutely swollen, red, painful joint and fever, if C-reactive protein (CRP) > 20mg/dL or erythrocyte sedimentation rate (ESR) > 20mm/h, then arthrocentesis may be indicated to confirm the diagnosis [5]. Arthrocentesis is also used as the treatment of SA in combination with antibiotic therapy. Ultrasound-guided aspiration of the hip evacuates pus, reduces damage to the articular surfaces, differentiates joint sepsis from other arthritides and helps direct antibiotic treatment [6,7]. Furthermore, there is a concern about the adverse effect of emergent open arthrotomy in severely inflamed joints, and it is debatable whether early decompressive arthrotomy is always useful [8–11].

In a retrospective study, hip arthrocentesis was found to avert the need for invasive surgery in more than 80 % of children (ranging from 3 months to 15 years of age) in a cohort of 261 culture-positive patients with SA. Outcome was comparable between arthrotomy and non-arthrotomy group. The study found that in the case of adjacent osteomyelitis, arthrotomy was more useful [12]. The results are supported by another study by Journeau et al. that reported favorable outcome in about 90% of the patients with hip arthrocentesis. They identified CRP > 100 mg/L, polymorphonuclear cell > 15,000, and ESR > 25 mm/hr as predictive of the need for arthrotomy [13].

In a prospective randomized trial, 201 consecutive children with the diagnosis of SA, arthrocentesis and arthrotomy were compared, and the patients were followed for one year. There were no differences regarding clinical outcome in any of the groups; hospital stay was lower in arthrocentesis group [8]. Smith et al. in a randomized control trial reported similar results for outcome of arthrotomy vs. arthrocentesis in 61 children with SA of the shoulder [10]. The findings of the latter study are also reflected in another study by Pääkkönen et al. involving nine children with SA affecting the shoulder [14].

Existing evidence for knee joint is different. Arthroscopic irrigation and decompression has been found to be successful in the majority of patients. The procedure can be performed through a single portal and without the need for a repeat procedure. In a retrospective study, around 40% of children older than three years who underwent a knee arthrocentesis required further arthrotomy to eradicate the infection and high initial CRP levels were identified as a predictor of aspiration failure [15].

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QUESTION 5: Is there a role for percutaneous bone sampling (biopsy) for microbiological diagnosis of septic arthritis/osteomyelitis (OM)? If so, when should this be performed?

RECOMMENDATION: Yes. Percutaneous bone sampling (biopsy) is very safe and cost-effective and can be obtained from any site under the guidance of fluoroscopy or computed tomography (CT). It has a low sensitivity for microbiological diagnosis of OM that can be enhanced by the addition of histopathological examination. Literature suggests that bone sampling should be performed before initiating empirical antibiotic therapy.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 88%, Disagree: 7%, Abstain: 5% (Super Majority, Strong Consensus)

RATIONALE

OM is described as inflammation of the bone marrow and adjoining bone and is usually related with cortical and trabecular destruction. It can be caused by bacteria, fungi and a variety of other organisms [1]. Prompt identification and treatment of OM is necessary since undiagnosed cases can result in chronic pain, amputation and death. Even though clinical symptoms, inflammatory serological markers and imaging, such as magnetic resonance imaging (MRI), play an essential role in reaching a diagnosis of OM, the most important aspect of diagnosis relies on isolation of the infective organism from the infection site [2–4]. Pathogen identification and determination of its antibiotic susceptibility are paramount for successful treatment with antimicrobial therapy. Blood cultures may also be positive in a small number of patients with OM, which can guide antimicrobial therapy, so definite diagnosis and suitable therapy depend on tissue samples collected through bone biopsy [4].

Although surgical biopsy is also an option for confirming the diagnosis, percutaneous biopsy with fluoroscopic or computed tomography (CT) guidance has been proven to be a more reasonable, faster and more cost-effective modality with fewer complications [5,6]. The first percutaneous vertebral bone biopsy was performed by Ball in 1934. The use of image guidance was first seen with radiography in 1949, fluoroscopy in 1969, CT in 1981, MRI in 1986 and CT fluoroscopy in 1996 [6].

Literature review from the 1990's and early 2000's stated the accuracy of a percutaneous biopsy of vertebral lesions guided with CT or fluoroscopy ranged from 88% to 100% [6]. The recent and most comprehensive retrospective review done by Sehn and Gilula reported that 63 of 113 cases were positive when samples were tested histologically (55.7%) and only 28 of the 92 cases were positive when samples were investigated microbiologically (30.4%). Culture and/or pathology review was positive in 73 (64.6%) of the 113 cases. Pathology review along with culture of biopsy specimen supported a diagnosis of OM in 64.6% of investigated cases. However, the age of the participants ranged from 1 to 92 years [7]. This is in contrast to the study done in the 1990s and early 2000s [6].

Ballah et al. reported that there were 26 biopsies performed, 21 out of 26 biopsies were diagnostic (81%); 2/26 (8%) were false-negative extracting nonlesional tissue, 2/26 (8%) were nondiagnostic and 1/26 (4%) were technically unsuccessful. The diagnoses were as follows: 12/26 biopsies (46%) were OM; 3/26 (11%) biopsies were Langerhans cell histiocytosis; 3/26 biopsies (11%) were normal bone; 2/26 (8%) biopsies were malignant tumors and 1/26 (4%) biopsies were osteoblastoma. Of 12 children with OM only 3 had a positive culture; 9/12 (75%) children had a negative culture. They did not report any p-value or confidence interval. They concluded that percutaneous CT guided vertebral bone biopsy is safe in children with a high degree of diagnostic accuracy [8].

A systematic review and meta-analysis of 7 studies (later excluded 2 studies) indicated that image-guided percutaneous needle aspiration biopsy has a high specificity (99.9%) and, therefore, is quite effective when positive. However, it has low sensitivity (52.2%) and can miss a substantial proportion of patients. Image-guided spinal biopsy had a diagnostic odds ratio (DOR) of 45.50 (95% confidence interval [CI], 13.66–151.56), a likelihood ratio of positive test (LRP) of 16.76 (95% CI, 5.51–50.95), a likelihood ratio of negative test (LRN) of 0.39 (95% CI, 0.24–0.64), a sensitivity of 52.2% (95% CI, 45.8–58.5) and a specificity of 99.9% (95% CI, 94.5–100). The results of this study strengthen