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Pyomyositis in children

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OBJECTIVES

1. *Review the clinical presentation of pyomyositis in children.*
2. *Review the optimal methods to diagnose pyomyositis.*
3. *Review the organisms responsible for causing pyomyositis in children.*
4. *Review the treatment of choice for pyomyositis.*

Pyomyositis is a term used to denote spontaneous muscle abscess of skeletal muscle. It is predominantly a disease of tropical countries, where it accounts for ~4% of hospital surgical admissions,[1, 2] and hence is also referred to as tropical pyomyositis or myositis tropicans.

Pyomyositis is far less common in temperate climates where it is responsible for 1 per 3000 pediatric admissions.[2–7] Because of its rarity pyomyositis can cause a diagnostic problem in temperate climates.[8–11] It occurs more commonly in the warmer regions of a country and during the warmer months.[2, 6]

We analyzed retrospectively 16 cases of pyomyositis in children attending the Royal Alexandra Hospital for Children in Sydney (now the New Children's Hospital) in the 10-year period from 1989 to 1998 inclusive.

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METHODOLOGY

The cases were identified from the Medical Records Department using the Hospital's Disease Index System. Several coding classification terms were used in the search including pyomyositis, infective myositis, tropical pyomyositis, muscle abscess and psoas abscess. Additionally a few cases were provided directly from personal record files of consultant infectious disease physicians practicing at the hospital. There was considerable overlap with these two methods, but four patients provided by the consultants' records were not identified by the medical record search.

RESULTS

There were 16 cases of pyomyositis identified in this review. This extrapolates to an estimated rate of 1 per 3875 Emergency Department admissions. The mean age of patients was 7.2 years and ranged from 1.2 to 14 years. There was a male predominance with a male: female ratio of 2.2 (11 male, 5 female).

In 2 cases (12.5%) the muscle abscess was associated with systemic infections, meningococcemia and varicella. In 4 children (25%) there was a preceding history of muscle trauma (including one child who had exercised vigorously on the day before presentation). None of the patients was indigenous, and none was HIV-positive. Twelve (75%) of the 16 cases presented during the 6 warmer Sydney summer months, October through March. Table 1 shows the sites where abscesses developed. In all but one patient, who had iliopsoas and thigh involvement, the site was solitary.

The most common mode of presentation for the children in our study was pain (100%), fever (93.8%), swelling (62.5%) and a limp (100% of lower body abscesses). The mean duration of symptoms before presentation was 8.9 days. The mean duration from

TABLE 1. Site of 17 muscle abscesses in 16 children with pyomyositis

Site	*n*	%
Iliopsoas	6	35
Thigh	4	23
Calf	2	12
Arm/shoulder	2	12
Chest wall	1	6
Abdominal wall	1	6
Periorbital	1	6

admission to confirmed diagnosis of pyomyositis was 4.1 days. In 25% the diagnosis was correctly made at the time of hospital admission.

Serum creatinine kinase was measured in six patients. It was normal (<200 units/l) in four patients and only marginally raised (261, 496) in the other two.

The most common organism, cultured from pus or blood, from 8 (50%) of the children, was *Staphylococcus aureus. Streptococcus pyogenes* was cultured from four cases, and in the remaining four cases no organism could be identified. Five (31%) of the children had positive blood cultures (three with *S. aureus*).

The imaging modalities used and the proportion which were diagnostic of pyomyositis are shown in Table 2.

Of the 16 cases in this study, 8 were managed with antibiotics alone and the rest required surgical incision and drainage. Six of the 12 patients treated with flucloxacillin and both patients treated with penicillin also underwent surgical treatment. The remaining 2 patients were treated with combinations of flucloxacillin with clindamycin and of cefotaxime with amoxicillin/clavulanate. These patients did not have incision and drainage. The mean duration of antibiotic therapy was 4.3 weeks (range, 2 to 6). The average hospital stay, excluding those children with coexisting medical conditions, was 13 days. In those treated with antibiotics alone, the average stay was 10.4 days. The children treated with surgical drainage and antibiotics stayed an average of 17 days.

There were no deaths. Final outcomes were documented in 14 of the cases. Twelve (85.7%) made a full recovery. One patient with a psoas abscess had multiple recurrences and required long term antibiotic therapy (2 years). One patient with quadriceps pyomyositis sustained mild residual muscle weakness. This child developed pyomyositis after chickenpox with associated septicemia and multifocal osteomyelitis.

TABLE 2. Imaging results: proportion of imaging modalities that were diagnostic

Imaging Technique	*n*	%
Radiograph	0/10	0
Bone scan	1/5	20
Ultrasound	6/13	46.1
CT scan	4/8	50
MRI scan	2/2	100
Gallium scan	8/8	100

DISCUSSION

Etiology. The etiology of pyomyositis is poorly understood. Local mechanical trauma at the time of incidental bacteremia is frequently postulated as a mechanism that would explain the high incidence in tropical areas and the male preponderance. In animal studies attempts to create pyomyositis by challenge with intravenous injection of *S. aureus* succeeded only if muscles were first traumatized by electric shock, by ischemia or by pinching them.[9]

The suggestion that trauma is an important contributor is supported by obtaining a history of prior trauma in a substantial proportion of cases of pyomyositis, although usually less than one-half, with a range of 25 to 50% of cases in different series.[1, 3, 7, 9, 12]

Underlying conditions, such as immunodeficiency or chronic illness such as diabetes mellitus, may predispose to pyomyositis. In North America 55% of adult and pediatric patients had underlying conditions, notably HIV infection.[9] In tropical regions the suggestion that parasitic myositis, such as filariasis, might predispose is probably incorrect, because the distribution of pyomyositis differs from that of the parasites.[12]

Malnutrition has been proposed as one possible contributing factor to pyomyositis, which might explain the increased incidence and the earlier peak age of 2 to 5 years in poorer countries.[7] There is no direct evidence, however, of malnutrition in children with pyomyositis, although their nutritional status is not evaluated in most papers. From 1980 to 1989 in Ecuador, 96 of 97 patients with pyomyositis came from tropical rain forest areas and only one came from the high Andean plateau, despite comparable nutrition, suggesting that there is something unique about the tropical climate in the pathogenesis of pyomyositis.[13]

Clinical. Although pyomyositis was originally described in the tropics and is much more common there, the clinical features and microbiologic profile of the disease are similar regardless of age and geographic distribution.[12]

In North America and Africa ~33 to 40% of all cases of pyomyositis are seen in children.[7, 9] In Nigeria the peak incidence in children was 2 to 5 years of age,[7] but North American studies have shown that most cases occur in older children. Of 31 children aged 16 years or younger, Christin and Sarosi[9] reported a mean age of 8.4 years, with a range from 0.1 to 16 years.

A male preponderance is found in almost all series, with a male:female ratio usually reported around 2:1 to 3:1.[1–4, 7] However, 82 of 100 patients reported from North America were male.[9] The male preponderance may be partly associated with trauma, although

women in tropical countries often do as much or more physical work than the men.

The natural history of pyomyositis has been divided by various authors into three stages. The initial, *invasive* stage, during which the organism enters the muscle, is characterized by an insidious onset of dull, cramping pain, with or without fever and anorexia. There is localized edema, sometimes described as indurated or woody, but usually little or no tenderness. This stage lasts from 10 to 21 days,[13] and it is rare for patients to present at this stage, <2% of them in one study.[7] Thus in North America the mean duration of symptoms before hospitalization is 24 days,[9] whereas in an Hawaiian study of 18 patients it was 12 days.[14] The duration of ~9 days in our study compares favorably with these data.

The second *purulent* or *suppurative* stage, during which most patients present, occurs when a deep collection of pus has developed in the muscle. The muscle is usually but not always tender, and fever and chills are common. The overlying skin may be normal or show mild erythema.

The third or *late* stage of generalized infection is characterized by exquisite tenderness of the site, which is red and fluctuant. The patient has high fever and can occasionally be in septic shock.[1, 3, 5, 7–9, 12]

Pyomyositis is more commonly unifocal, particularly in temperate climates, but is multifocal in 15 to 43% of cases.[1, 3, 4, 7, 9, 12] In some series the iliopsoas abscess is included as a site of pyomyositis, whereas in other series this site is completely absent. If psoas or iliopsoas abscess is included, it is one of the commonest sites of pyomyositis. In a literature search of English language papers for an unknown period, Bresee and Edwards[15] identified reports of 141 children <18 years old with nontuberculous pyogenic psoas abscess. Primary abscesses, with no obvious focus, accounted for 96 of 104 evaluable cases, with the others secondary to Crohn's disease (6) or discitis (2). The most common symptom was pain in the ipsilateral hip, and the most common physical finding, in 51 of 69 children (74%), was pain on flexion of that hip. Christin and Sarosi[9] could find only 31 case of pyomyositis reported from North America in 20 years from 1971 to 1991.

In series that exclude psoas abscess, the most common single site is the thigh, representing 36% of North American and 44% of Nigerian cases.[9] Other important sites are the chest wall, buttock, abdomen and upper arm.[1, 3, 4, 7, 9, 12]

Diagnosis. *Laboratory tests.* The diagnosis of pyomyositis can be difficult, in view of its rarity and the often indolent presentation. Laboratory tests are generally nonspecific and of limited value. For example the white blood cell count is raised in ~50 to 60% of cases,[9] and the sedimentation rate is also frequently elevated.[7, 9] The serum creatinine kinase value is often not reported in papers, and when it is the value is frequently normal,[4, 11] as indeed it was in four of our six cases. This implies that in children who present early, the abscess is displacing muscle rather than invading it. In severe cases, particularly those in which the children present late, the serum creatinine kinase value can be in the thousands, suggesting extensive muscle destruction.[16] Only about one-third of children have positive blood cultures.[9] Most commonly the organism is identified only after pus is obtained at the time of surgical drainage.

Imaging. Imaging studies are of paramount importance in the diagnosis of pyomyositis. Plain radiographs are rarely useful, being abnormal only when there is extensive soft tissue swelling or concurrent osteomyelitis that has been present for several days.[12] There are no direct comparisons between other modalities, although several have been reported as being clinically useful. Ultrasound, computerized tomography (CT) and magnetic resonance imaging (MRI) are the most frequently used.[17–20] In general it is advocated that ultrasound should be used first as it is inexpensive and widely available.[17–19] Royston and Cremin[19] successfully used ultrasound to evaluate 45 cases, although ultrasound findings are not always diagnostic early in the course of the disease. When ultrasound is inconclusive and a high index of suspicion persists, an MRI scan is indicated in preference to a CT scan because it has greater resolution.[20] Hall et al.[21] had no false positive CT scans, but Falasca and Reginato[22] found that CT scanning failed to identify 3 of 5 cases. In contrast Spiegel et al.[12] found that MRI diagnosed all 12 cases, and 9 of them at presentation, and it had the advantage of identifying coexisting bony changes in 58% of cases. ^{99}Tc bone scan identifies coexistent bone involvement and was abnormal in 6 of 7 children tested by Spiegel et al.[12] ^{67}Ga scanning is also highly effective in locating precisely a muscle abscess, particularly a small one, but both tests have the disadvantage of delivering a relatively high radiation dose to the child, and results are delayed.[2] In our study all gallium scans and both MRI scans were abnormal, whereas only about one-half of the ultrasound and CT scans were diagnostic.

Microbiology. *S. aureus* is the most common organism responsible for pyomyositis in all studies, in both tropical and temperate climates, being responsible for 50 to 95% of all cases.[1, 3–5, 7, 8, 12] In general *Streptococcus pyogenes* is responsible for most of the remaining cases; in our small series this was 25% of the total, and all 4 cases occurred in the last 5 years. In immunocompromised patients a range of other organisms has been described, including Gram-negative enteric organisms, anaerobes and fungi,[9] but these are virtually never

described in immunocompetent children. Of 31 North American children with pyomyositis reviewed by Christin and Sarosi,[9] 26 (84%) were caused by *S. aureus*, and the rest by *Streptococcus pyogenes* (2 cases), *Streptococcus anginosus* (2) and *Haemophilus influenzae* (1).

In general empiric antibiotic therapy should include antistaphylococcal and antistreptococcal coverage until the causative organism is identified (see below).

Treatment. *Surgical.* The mainstay of treatment is usually surgical, although if antibiotic therapy is begun early, surgery may sometimes be avoided. For example 5 of 20 children in 3 studies were successfully managed with antibiotic therapy alone.[4, 5, 12]

That we were able to manage one-half of our patients without surgical intervention suggests that they were diagnosed early.

Surgical drainage can be percutaneous, using CT or ultrasound guidance, or via an open surgical approach. Spiegel et al.[13] reported that 5 of 12 children had successful percutaneous drainage using CT control.

Antibiotics. Penicillin, the drug of choice for most streptococcal illnesses, is sometimes ineffective in streptococcal pyomyositis.[23] An explanation for this, termed "the Eagle effect," is as follows. Streptococcal organisms proliferate rapidly in skeletal muscle until a steady state of growth is reached. By the time antibiotics are started, the colony growth rate has often slowed. In this setting penicillin has a diminished effect.[24] Clindamycin is not adversely affected by the Eagle effect, and there is evidence from animal models that clindamycin is a more effective agent in this setting.[25] Clindamycin provides activity against staphylococci and streptococci, and a recent nonrandomized study suggests that children with invasive streptococcal infection treated with clindamycin, with or without a penicillin, fared better than children given a beta-lactam antibiotic alone.[26]

Considerable morbidity, a protracted hospitalization and the potential for serious complications of pyomyositis are more likely with delayed diagnosis and treatment.[2] The overall results are generally good if aggressive management is started early. A high index of suspicion is needed in temperate countries where the prevalence is low and where a lack of familiarity with the condition exists.

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Multiple Choice Questions. Answer the following four questions by circling the letter of the correct answer.

1. Which one of the following would be the method of choice for diagnosing pyomyositis?
   a. Computerized tomographic (CT) scan.
   b. ^{67}Ga scan.
   c. Magnetic resonance imaging (MRI) scan.
   d. Plain radiograph.
   e. Ultrasound.
2. Which of the following would be the most likely site of pyomyositis occurring in a child in a country with a temperate climate?
   a. Arm.
   b. Buttock
   c. Calf.
   d. Chest wall.
   e. Thigh.
3. Which organism causes most cases of pyomyositis?
   a. Coagulase-negative *Staphylococcus.*
   b. *Haemophilus influenzae.*
   c. *Staphylococcus aureus.*
   d. *Streptococcus milleri.*
   e. *Streptococcus pyogenes.*
4. Which of the following antibiotics would be the most appropriate for monotherapy of pyomyositis?
   a. Cefotaxime.
   b. Cefuroxime.
   c. Clindamycin.
   d. Nafcillin.
   e. Penicillin G.

Correct Answers:
1. c
2. e
3. c
4. c