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Original Article

Pediatric Psoas Abscess, Early Diagnosis of a Challenging Condition

Laura M. Pérez-López[1,*], Isabel Vara-Patudo[2], Ferran Torner-Rubies[1], David Moreno-Romo[1], Lydia de Sena-de Cabo[1], Clàudia Fortuny[3], Gorka Knörr[1]

[1]Pediatric Orthopaedic Surgery Department, Sant Joan de Déu Children's Hospital, University of Barcelona, Barcelona
[2]Pediatric Orthopaedic Surgery Department, Niño Jesús Children's Hospital, Complutense University of Madrid, Madrid
[3]Pediatric Infectious Diseases, Pediatric Department, Sant Joan de Déu Children's Hospital. University of Barcelona, Barcelona

Introduction: Psoas abscess is a rare entity at the pediatric stage of life. The clinical presentation of psoas abscess is insidious and not specific, and this usually causes diagnostic delay. Early diagnosis is relevant to prevent devastating consequences of this condition.
Aims: This study aimed to describe the natural history of psoas abscess, present our experience in a children's hospital, determine warning signs and symptoms that may lead to early diagnosis, and describe differential diagnoses. We also discuss the devastating consequences of misdiagnosing psoas abscess.
Methods: This retrospective study was performed at Sant Joan de Déu Children's Hospital (Barcelona, Spain) from 2008 to 2016. All patients younger than 18 years old (n = 12) with psoas abscess who were diagnosed by imaging tests were included.
Results: The initial clinical presentation of the patients was variable. Painful hip mobility at extension (7 cases), limping (5 cases), and fever (4 cases) were the most frequent presentations. Laboratory parameters were abnormal in nine patients. The main responsible bacteria was *Staphylococcus aureus* (9 cases). The mean hospital stay was 28 days (range, 10-71 days). Percutaneous drainage under ultrasound control was applied in two patients. Surgical debridement was performed in seven patients, and repeated procedures were required in three of them.
Conclusions: Because of the erratic presentation of psoas abscess, its suspected diagnosis is essential for an early diagnosis, which will minimize the risk of diagnostic delay. One or more signs and symptoms at the same time might be considered as initiation of psoas abscess. Physicians should be aware of risk factors, such as previous traumatism and a known disturbed immunological system or temporal circumstances, which might lead to psoas abscess. Laboratory parameters may provide more confidence in diagnosis, and early imaging tests provide a definitive diagnosis.

Key words: *anti-Bacterial agents, infection, pediatric, psoas abscess, staphylococcus aureus*

Introduction

Psoas abscess is defined as a purulent infectious collection within the psoas muscle. The worldwide incidence of psoas abscess in the general population was 12 cases per 100,000 per year in 1992, but the current incidence is unknown.[1] Psoas abscess in children is less common than that in adults.[2] Clinical onset is insidious in children and adults, and there are not any specific clinical signs. For these reasons, a delay in diagnosis in psoas abscess in children is

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*Corresponding author: Laura M. Pérez-López, MD, MS, Paediatric Orthopaedic Surgery Department. Sant Joan de Déu Children's Hospital. University of Barcelona, Passeig de Sant Joan de Déu, 2, 08950 Esplugues de Llobregat, Barcelona. E-mail: lperezl@hsjdbcn.org

common. Postponed treatment may lead to severe potential complications from this condition.

Psoas abscess may be primary, caused by hematogenous dissemination, suppurative lymphadenitis, or direct colonization. This condition may also be secondary due to bacterial propagation from an adjacent focus close to the iliopsoas muscle.[3] Primary abscesses are more frequent in Asia and Africa, and secondary abscesses are most common in Europe.[4]

Similar to other types of pyomyositis, evolution of psoas abscess may involve three stages. The first invasive stage (subacute, occurring over 1-3 weeks) involves mild pain and variable high temperature. In contrast to other more superficial pyomyositis, initial local swelling and a "woody" texture cannot be observed. The diagnosis is often confused with thrombosis, hematoma, contusion, muscle strain/rupture, or osteomyelitis. At this stage, laboratory testing may show leukocytosis, an elevated erythrocyte sedimentation rate, elevated C-reactive protein (CRP) levels, and anemia. Blood cultures are positive in up to 70% of cases.[5] Magnetic resonance imaging (MRI) may provide an early diagnosis and it is the investigation of choice. A computed tomography (CT) scan might also stablish diagnosis, and thus it can also be the initial test used in suspected cases. However, irradiation in children should be avoided whenever possible. A negative ultrasound cannot rule out a psoas abscess and is only diagnostic in 60% of cases.[6] During the second or "suppurative" stage (which occurs after the first 10 to 21 days), tenderness and fever become more pronounced. This is the stage at which the diagnosis of pyomyositis is usually established. Imaging demonstrates a definitive abscess, and aspiration yields pus at this stage. If the infection remains undiagnosed and untreated, intense local pain, as well as systemic findings, including sepsis, will develop as part of the third stage of psoas pyomyositis.

Treatment of psoas abscess is based on intravenous antibiotics. Classically, surgical drainage is used in most cases, but it is not mandatory.[7] Currently, ultrasound-guided drainage is an efficient alternative to open surgical drainage.[2] Conservative treatment is applied when the abscess is small with a size ranging from 10 to 20 mm and it presents with a favorable evolution.

This study aimed to describe the natural history of psoas abscess, present our experience of psoas abscess in a children's hospital, and discuss the available information in the literature on psoas abscess at the pediatric stage. Our goal is to provide a concise and rigorous update of the knowledge on this condition. The following five points that were examined in this study are: how to determine warning signs and symptoms that may lead to early diagnosis, describing the risk factors, making a differential diagnosis, therapeutic possibilities, and discussion of the devastating consequences of misdiagnosing psoas abscess in children.

Material and Methods

We performed a retrospective study from January 2008 to January 2016 in Sant Joan de Déu Children's Hospital. Patients aged 18 years old or younger, and with confirmed psoas abscess that was diagnosed by imaging tests were included.

We recorded the following variables: age, sex, primary or secondary cases, concomitant pathologies, clinical presentation, laboratory parameters (complete blood count, white blood cell (WBC) count, CRP levels, and erythrocyte sedimentation rate), imaging tests (ultrasound, MRI, and CT), bacterial cultures, mean stay at hospital, antibiotic treatment, surgical management, percutaneous drainage, resolution, and recurrence. The end of follow-up was defined as normal clinical and analytical evolution for at least 6 months. None of the patients dropped out from the follow-up.

The local ethics committee confirmed that informed consent of parents/legal representative was properly collected in all cases, and also from the child when it was possible.

Results

Epidemiology

Our series included a total of 12 patients (7 boys and 5 girls). The median age was 9.5 years old (range, 2-16 years old). Mean follow-up was 46 months (range, 10-97 months). Five patients were considered as primary cases and seven were considered as secondary cases. Three patients were affected by iliac osteomyelitis, two by sacroiliitis, and two by spondylodiscitis.

Clinical Presentation and Laboratory Tests

Clinical presentation of the patients included groin pain, mainly on attempted extension (n = 7) and

limping (n = 5), fever (n = 4), feverishness (n = 2), anemia and asthenia (n = 2), abdominal pain (n = 2), and lumbar pain (n = 2).

Some other types of pathology were associated with psoas abscess in four cases. These included erythematosus systemic lupus (n = 1), atopy associated with bronchospasm (n = 1), sickle-cell anemia (n = 1), and pneumonia (n = 1). In three patients, there was a well-defined traumatic antecedent that preceded the rest of the symptoms. This association between previous traumatism and posterior psoas abscess is likely to be explained by an infected posttraumatic hematoma (Fig. 1) or an infected muscular edema.

Laboratory parameters were normal in three patients. Six patients presented with isolated elevated CRP levels (130 mg/dL, 81 mg/dL, 175 mg/dL, 248 mg/dL, 274 mg/dL, and 280 mg/dL), two of which were associated with anemia (Hb 8,7 g/dL and Hb 6,5g/dL). Three patients presented with elevated CRP levels plus an elevated WBC count (CRP level, 53 mg/dL and WBC count, 14,100/mcL; CRP level, 84 mg/dL and WBC count, 20,200/mcL; CRP level, 109 mg/dL and WBC count, 17,000/mcL). Normal reference values of the laboratory data are as follows: CRP levels, < 10 mg/L; WBC count, 3,800-11,500/mcL; and hemoglobin levels, 11.50-16 g/dL.

Radiological Findings

Final diagnosis was confirmed by MRI in eight patients and CT in three patients. Both MRI and CT were performed in one patient, and they showed the same diagnosis. Additionally, a bone scan was performed in one patient, and this demonstrated concomitant infectious sacroiliitis. Ultrasound was the initial imaging test in two patients, and it was negative in one of them.

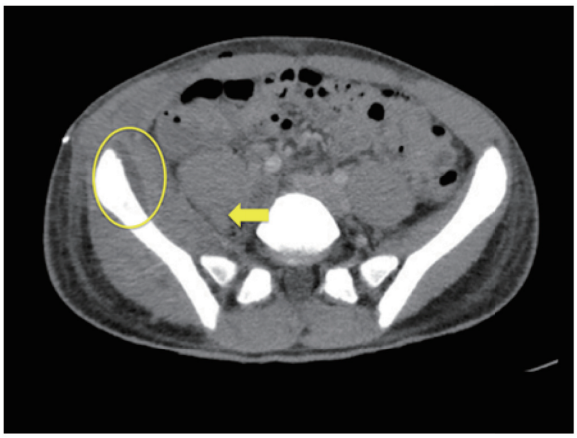

Fig. 1. Axial contrast-enhanced pelvis computed tomography (CT) showing fluid collection (circle) within an enlarged right iliopsoas muscle (arrow) corresponding to an infected post-traumatic hematoma.

The mean time between onset of symptoms and diagnosis was 17 days (range, 5-60 days). Once the diagnosis was confirmed with imaging tests or suspected in patients with greater systemic involvement, antibiotic treatment was started immediately.

Causative Pathogens

The responsible bacteria were *Staphylococcus aureus* (n = 9), *S. epidermidis* (n = 1), *Salmonella* (n = 1), and *Mycobacterium tuberculosis* (n = 1).

Antimicrobial Therapy

The mean stay at hospital was 28 days (range, 10-71 days). Six patients received intravenous antibiotic treatment with a combination of cloxacillin and cephalosporin (mean treatment, 8.3 days; range, 2-21 days). In these patients, once the culture was known as positive for *S. aureus*, cloxacillin alone was applied and maintained for 12 days (range, 2-21 days). In one patient in whom bacteriological cultures were already known to be positive for *S. aureus* before starting antibiotic treatment, cloxacillin was used from the beginning for 18 days. In four patients, vancomycin and various wide-spectrum antibiotics, such as linezolid and meropenem, were used at the same time because of an insufficient response They were continued for 27.3 days (range, 7-41 days). Post-hospitalization oral treatment included third-generation cephalosporin in six patients for 26 days (range, 14-42 days), amoxicillin/clavulanic in four patients for 25 days (range, 7-42 days), and ciprofloxacin in one patient for 28 days. One patient had Pott's disease. In this patient, antituberculosis intravenous treatment was administrated during 7 days plus 72 days of oral treatment.

Surgical Febridement or Ultrasound-Guided Debridement

In our series, five patients did not require open surgical debridement or ultrasound-guided debridement. All of these cases were at the end of the first invasive stage, starting the suppurative stage. They all presented with one or more purulent collections, but they were always smaller than 20 × 20 mm. In

two patients, only ultrasound-guided puncture was applied. In seven patients, open surgical debridement was performed (in two of them, ultrasound-guided puncture had been applied before). It was necessary to repeat it up to three times in two patients, and twice in one patient.

Outcome

Definitive resolution was achieved in all of the patients, but there were severe associated complications in two patients. Severe neutropenia occurred in one patient. Common iliac and internal iliac deep venous thrombosis (Fig. 2), as well as septic pulmonary emboli and pulmonary infarction (Fig. 3), occurred in another patient. This patient received anticoagulant treatment. Sequela was observed in only one patient, who was affected by concomitant infectious sacroiliitis, and who presented with local degenerative changes at the follow-up (Table 1).

Discussion

This study represents the third largest series on psoas abscess in children. The largest series on pediatric psoas abscess were published by Belgith et al.[8] and Gharbi et al.[9], including 18 and 16 patients, respectively. Other published reports on psoas abscess reported 11 cases[10], five cases[11], or less[3,7,10,12-25]. Gharbi et al.[9] showed that fever (38.2°C-39.7°C), low back pain, and CRP levels > 40 mg/dL were constant in all patients. In contrast to Gharbi et al.'s study,[9] the clinical presentation and laboratory changes were much more erratic in our series. We found five of 12 cases of primary psoas abscess, Belgith et al.[8] found 14 out of 18, and Gharbi et al.[9] found 100%. The delay in time to diagnosis was constant, with results of 4-30 days in Belgith et al.'s study,[8] 2-35 days in Gharbi et al.'s study,[9] and 5-60 days in our study.

With regard to the microbiology, purulent material cultures were positive in 16 cases in Belgith et al.'s study[8] (13 cases of *S. aureus*), 12 cases in Gharbi et al.'s study[9] (11 cases of *S. aureus*), and all cases in our study (9 cases of *S. aureus*). In our study, culture was not multibacterial in any patient. Methicillin-resistant *S. aureus*[26] was not observed in any of our patients either. Imaging diagnostic modalities that were used by Belgith et al.8 and Gharbi et al.[9] included ultrasonography in all of the patients, except for one patient in Belgith et al.'s[8] study. In both previous studies, ultrasonography showed a mass within psoas muscle in all of the patients. Belgith[8] used CT to confirm the diagnosis and define etiology in three patients who were affected by secondary psoas abscess. Nevertheless, Riyad et al. precluded CT and MRI as more definitive diagnostic tools, while ultrasonography did not appear to have such a high sensitivity.[27]

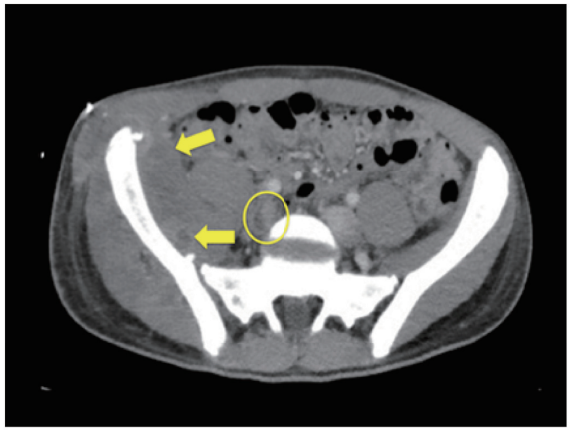

Fig. 2. Axial contrast-enhanced pelvic computed tomography (CT) showing fluid collection within the right iliopsoas muscle, indicating abscesses (arrows), and a filling defect within the right common iliac vein, indicating venous thrombosis (circle).

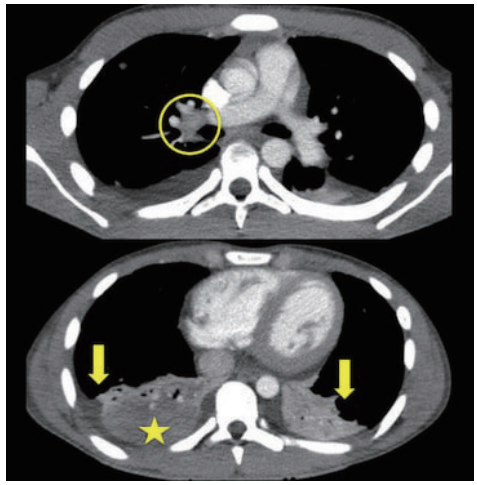

Fig. 3. Axial contrast-enhanced thoracic computed tomography (CT) showing filling defects within the right pulmonary artery, indicating a pulmonary embolism (circle). CT also shows a small volume of bilateral pleural effusions with lung atelectasis (arrows) and an area of pulmonary infarction in the right lower lobe (star).

With regard to the ratio of conservative (antibiotics only) treatment and surgical intervention,

Table 1. Characteristics of enrrolled patients

Patient	Age (years)	Antecedents	Clinical presentation	Fever	Clinical duration before diagnosis (days).	Laboratory data
						White blood cell count (/mcL)
1	4	No.	Hip pain, not weight bearing, limping.	No.	30	Normal.
2	4	No.	Hip flexion, limping.	Feverishness.	15	Normal.
3	8	Lupus.	Hemiabdomen and hip pain mainly at extension.	No.	15	Normal.
4	12	Bronchospasm, atopic dermatitis.	Anaemia and asthenia.	Feverishness, intermitent.	35	Normal.
5	16	No.	Painful hip mobility at extension.	No.	2	Normal.
6	2	No.	Painful hip rotations.	No.	60	Elevated (14.100).
7	3	Scikle cell disease.	Functional impairment, limping. Anemia and asthenia.	Yes	5	Normal.
8	11	No.	Limping.	No.	4	Normal.
9	14	Pneumoia at 3 years old.	Abdominal pain irradiated to lumbar area and leg.	No.	15	Elevated (20.200).
10	13	No.	Lumbar pain and intermitent sciatica.	Yes.	7	Normal.
11	14	No.	Painful hip mobility.	Yes.	10	Normal.
12	14	No.	Painful hip movements. Limping.	Yes.	6	Elevated (17.000)

Patient		Cultured pathogens	Imaging test		
	C-reactive protein (mg/L)		MRI	CT	Ultrasonography
1	Normal (2).	S. aureus	No.	Psoas collections, sacroiliac affectation.	Inflamation of psoasiliac muscle bursa, probable septic arthtitis
2	Elevated (13).	S. aureus	Psoas collection.	No.	No.
3	Elevated (8'1).	S. epidermidis	Psoas abscess with L4-L5 affectation.	No.	No.
4	Elevated (17'5).	S. Aureus	No.	Solid mass at psoas with L2-L3 affectation.	No.
5	Elevated (25'8).	S. aureus	No.	Contusion abdominal fat, posas illiac collection and septic lung emboli.	No.

Table 1. Characteristics of enrrolled patients (continued)

Patient		Cultured pathogens	Imaging test		
6	Elevated (5'3).	Mycobacterium tuberculosis	Psoas abscess.	No.	No.
7	Elevated (27'4).	Salmonella	Psoas collection.	No.	Negative.
8	Normal (1'7).	S. aureus	Inflammatory signs at Illiac muscle with abscess, sacroiliac affectation.	No.	No.
9	Elevated (8'4).	S. aureus	Sacral osteomyelitis, collections before sacoiliac joint.	Psoas iliac collection, iliac osteolytic lesion.	No.
10	Elevated (28).	S. aureus	Iliac osteomyelitis with subperiosteal abscess at psoas muscle.	No.	No.
11	Normal (1'2).	S. aureus	Iliac osteomyelitis, psoas abscess collections, gluteal abscess.	No.	No.
12	Elevated (10'9).	S. aureus	Psoas abscess.	No.	No.

Patient	Primary or secondary	Previous traumtism	Stay at hospital (days)	Antibiotics, type
1	Septic sacroiliitis.	No.	11	Cloxaciline and Cefotaxime iv. Cefadroxile oral.
2	1ary	No.	22	Cloxaciline and cefotaxime iv. Cefadroxile oral.
3	L4-L5 spondylodiscitis.	Yes. Gluteal contusion 2 months before diagnosis.	49	Cloxaciline and cefotaxime iv. Vancomycin/meropenem/ linezolid iv. Cefuroxime oral.
4	L2-L3 spondylodiscitis.	Yes. Right hip dislocation after traumatism 3 months before hospitalization.	73	Cloxaciline and cefotaxime iv. Vancomycin/meropenem/ linezolid iv. Amoxicillin/clavulanic oral.
5	1ary	No.	43	Cloxaciline and cefotaxime iv. Vancomycin/meropenem/ linezolid iv. Cefuroxime oral.
6	1ary	No.	25	Anti-tuberculosis therapy.
7	1ary	No.	22	Cloxaciline and Cefotaxime iv. Amoxicillin/clavulanic oral.
8	Septic sacroiliitis.	No.	14	Cloxaciline and Cefotaxime iv. Cefadroxile oral.
9	Iliac osteomyelitis.	No.	17	Cloxaciline and cefotaxime iv. Vancomycin/meropenem/ linezolid iv. Cefuroxime oral.

Table 1. Characteristics of enrrolled patients (continued)

Patient	Primary or secondary	Previous traumtism	Stay at hospital (days)	Antibiotics, type
10	Iliac osteomyelitis.	No.	21	Cloxaciline iv. Amoxicilin/clavulanic oral.
11	Iliac osteomyelitis.	Yes, 3 weeks before diagnosis.	23	Cloxaciline and Cefotaxime iv. Ciprofloxacin oral.
12	1ary	No.	11	Cloxaciline and Cefotaxime iv. Amoxicillin/clavulanic oral.

Patient	Surgical intervention		Complications	Outcome
	Percutaneous drainage	Open drainage		
1	No.	Yes.	No.	Resolution without sequelae.
2	No.	Yes, 2 times.	No.	Resolution without sequelae.
3	No.	No.	Neutropenia 21 days after hospitalization.	Resolution without sequelae.
4	No.	Yes, 3 times.	No.	Resolution without sequelae.
5	US guided.	Yes, 3 times.	Common illiac and internal iliac deep venous thrombosis. Pulmonary embolsim/infarction.	Degenerative sacrolliac changes at CT.
6	US guided.	Yes, once.	No.	Resolution without sequelae.
7	No.	Yes, once.	No.	Resolution without sequelae.
8	No.	No.	No.	Resolution without sequelae.
9	No.	No.	No.	Resolution without sequelae.
10	No.	No.	No.	Resolution without sequelae.
11	No.	No.	No.	Resolution without sequelae.
12	No.	Yes, once.	No.	Resolution without sequelae.

Belgith et al.'s study[8] showed that 2/16 patients had conservative treatment and 16/18 were surgically treated (4 with open drainage and 12 with percutaneous drainage). In Gharbi et al.'s study,[9] 2/16 patients were conservatively treated and 14/16 patients were treated with ultrasound guided drainage (in 4 of them percutaneous drainage failed and open drainage was necessary). In our series, four patients were conservatively treated and eight required surgery (7 had open drainage, 1 was under ultrasound).

The mean stay at hospital was 28.4 days in our study. Gharbi et al.[9] reported a shorter stay than our study of 12 days. Although this was a large difference between studies, this long length of hospital stay indicates the difficulties in treatment of psoas abscess and the high number of complications due to this condition.

In our study, there was a clear association between traumatism and psoas abscess in three of 12 patients, which is consistent with previous findings.[9,14,15] Another condition associated with psoas abscess is sickle-cell anemia,[19] which was found in one patient in our series. Some authors[12,16,22] have also described patients who were affected by vertebral tuberculosis complicated by psoas abscess, which was also observed in one of our patients. Psoas abscess is also known to be associated with chickenpox.[21] This exanthematic pathology implies a loss of skin barrier function and it predisposes to other infections.

Making a differential diagnosis of psoas abscess is difficult. Pathologies that share symptoms with psoas abscess can be differentiated into two groups: local entities and systemic entities. Local entities include infectious sacroiliitis,[20] pyomyositis of the adductor muscles, genitourinary pathology, infected retroperitoneal cystic lymphangioma,[24] superior mesenteric artery syndrome (vascular compression, functional and intermittent, at the third portion of the duodenum),[28] and Ewing sarcoma.[13] Systemic entities include leukemia, metastatic neuroblastoma, Langerhans histiocytosis, and peritonitis.[29]

Moreover, there are difficulties in making a differential diagnosis between septic arthritis and psoas abscess.[10,21,23,25] Courvoisier et al.[15] referred to psoas abscess as an evolved sequela of septic arthritis. However, we did not find this association in our patients.

There are no objective data relating psoas abscess and some type of immunodeficiency. Although there is not any known immunological alterations, we observed torpid evolution or other previous/concomitant infections in some patients without any other risk factor. This clinical circumstance suggests a disturbance of the immunological system that is currently undetermined.

Therapeutic management of psoas abscess is based on antibiotic therapy (mono and double therapy), associated with purulent collection of surgical drainage or drainage under ultrasound control.[2,9] We recommend surgical drainage or ultrasound-guided drainage in case of a volume of collection larger than 20 × 20 mm. Surgical drainage can be reserved when the abscess is multiloculated, if an associated condition requires definitive surgical management, or when percutaneous drainage has failed.[3]

In summary, psoas abscess is an infrequent pathology in childhood, but with potentially devastating consequences. One or more signs and symptoms at the same time,[20] such as groin pain, limping, fever, bad general condition, abdominal pain, and lumbar pain, might be considered as initiation of psoas abscess, in this order. Apart from these presenting signs and symptoms, there are other risk factors in children, such as previous traumatism and a known disturbed immunological system or temporal circumstances that might lead to it. Once psoas abscess is suspected according to this possible clinical presentation, prompt differential diagnosis via laboratory findings with imaging evidence can reduce the frequency of a delayed diagnosis and minimize the risk of invasive management. Prompt differential diagnosis can also reduce the possibility of complications, such as septic thromboembolisms or sepsis-related neutropenia.

Conflicts of Interest Statement

The authors have not received any financial support that might bias our work. No commercial company is involved. The authors declare no conflicts of interest.

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