

RESEARCH ARTICLE

Critical Diagnoses to Consider in the Assessment of Pediatric Patients Presenting with Limp in the Rheumatology Ward: A Cross-Sectional Study

Abdolreza Malek, MD; Atefeh Esmati, MD; Abdolkarim Hamedi, MD; Mahdieh Vahedi, MD

Research performed at Akbar Hospital, Mashhad, Iran

Received: 27 May 2024

Accepted: 25 September 2024

Abstract

Objectives: Limping is a frequent reason for visits to emergency departments. The causes of limping in children are various, ranging from benign musculoskeletal problems to serious etiologies, such as malignancy and infections.

Methods: In this recent cross-sectional study, we evaluated the causes of limps in children referred to the pediatric rheumatology ward in northeast Iran. We collected clinical characteristics and demographic data of patients with musculoskeletal limping and documented laboratory tests and other para-clinical findings. Statistical analysis was performed in SPSS software (version 23). A P-value < 0.05 was concluded to be statistically significant.

Results: Our study investigated 95 pediatric patients with limping referred to the rheumatology department, the majority of whom exhibited acute-onset limping (≤ 2 days). The most common reason for hospitalization in the rheumatology ward was transient synovitis (43.1%), followed by other causes of reactive arthritis (15.7%). Acute lymphocytic leukemia (ALL) accounted for limping in 6% of the patients, while benign and malignant bone tumors, including osteoid osteoma, osteosarcoma, and Ewing sarcoma, contributed to limping in 4.2% of cases.

Conclusion: While the cause of limping in children is mostly benign, it is crucial to recognize that the causes may not solely stem from musculoskeletal problems. In instances where the musculoskeletal system is involved, infections of the joints and bones should also be considered.

Level of evidence: IV

Keywords: Child, Limping, Musculoskeletal problems, Pediatric, Pediatric rheumatology ward

Introduction

Limping is one of the most common causes of pediatric emergencies. A limp is a change in the normal gait pattern for the child's age. The causes of limping in children are various, ranging from benign musculoskeletal problems to serious etiologies, such as malignancy and infections. A lot of children limp as a result of pain or chronic deformity. Trauma and infection are among the most prevalent causes of painful limping. A history of fever or trauma helps to determine the etiology of the limp.¹⁻³ Limping can result from musculoskeletal issues. However, non-musculoskeletal factors, including abdominal pathologies and neurological diseases, should be ruled out in any child presenting with limping.⁴ The most important causes of limping in the rheumatology

department are joint swelling and limitation in the normal range of motion. Limping is one of the common musculoskeletal symptoms in pediatric rheumatology wards.⁵ Our study aims to evaluate the causes of limping in the department of pediatric rheumatology in a specific geographical area (Northeast of Iran). Understanding the causes of this prevalent complaint in children aids in enhancing diagnostic and therapeutic approaches.

Materials and Methods

In this cross-sectional study, we investigated the causes of limping in children admitted to the Department of Pediatric Rheumatology at Akbar Hospital in Mashhad during the years 2017-2019. This study included all children under 16

Corresponding Author: Mahdieh Vahedi, 1. Department of Pediatrics, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran/2. Clinical Research Development Unit, Akbar Hospital, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

Email: Vahedimh@mums.ac.ir



THE ONLINE VERSION OF THIS ARTICLE
ABJS.MUMS.AC.IR



who were referred to Akbar Hospital with complaints of limping and were admitted to the Department of Rheumatology.

Clinical characteristics and demographic factors, such as gender, medical history, and place of living, were evaluated [Table 1]. Para-clinical assessments, including laboratory tests, were also recorded according to patients' files and the hospital information system. The exclusion criteria were: 1. The Kocher criteria score of 3 or 4 for septic arthritis and C-reactive protein level of > 20 mg/L, 2. Non-musculoskeletal causes of limping, and 3. the patient's unwillingness to

complete the diagnostic tests. Data were analyzed by using SPSS software (version 23). A *P*-value of < 0.05 was concluded to be statistically significant. Patient data were documented on the checklist designed for this research. Data sets were compared using a T-test (dependent quantitative variables), a Chi-square test, and Fisher's exact test (categorical variables). All patients were visited in the Pediatric Emergency Department by a pediatrician's assistant. This study was approved by the Ethics Committee of Mashhad University of Medical Sciences (IR.MUMS.fm.REC.1396.349).

Table 1. Demographic data and other characteristics of patients

Variable	Frequency(N)	Percent (%)
Gender		
Male	57	60
Female	38	40
Past Medical History of:		
Trauma	7	7.4
Upper respiratory tract infections	30	31.6
Gastrointestinal tract infection	16	16.8
Exposure to tuberculosis(TB)	1	1
Consumption of Unpasteurized Dairy Products	12	12.6
Positive family history for rheumatic diseases	6	6.3
Parents with consanguineous marriages	17	17.9
Location		
Urban	93	98
Rural	2	2
Duration of symptoms		
≤2 days(Acute onset)	67	70.5
>2 days	28	29.5

Results

In this study, we evaluated 95 pediatric patients who were referred for limping to the Rheumatology Ward. The mean age of patients was 5.7 ± 3.2 years, with 40% (n=38) being female and 60% (n=57) male. The mean duration of hospital admission was 5.5 ± 3.8 days [Table 1]. The findings of joint examination and frequency of joint involvement were also reported [Tables 2, 3]. Primary laboratory tests were evaluated on the first day of the hospital admission [Table 4]. Additional laboratory tests were examined according to the patient's condition [Table 5, 6].

The majority (n=67, 70.5%) of patients reported acute onset of symptoms ≤ 2 days [Table 1]. A refusal to bear weight was observed in 94.7% of patients (n=90). Low-grade fever was a presenting feature in 42.1% of children (n=40). Ultrasonography reported a joint effusion in 51.6% of patients (n=49). Joint radiography showed evidence of joint effusion in only 6.3% (n=6) of children. Only one patient had a positive result of the tuberculin skin test [Table 5].

Table 2. Joint examination findings in patients

Variable	Frequency(N)	Percent (%)
Swelling	32	33.7
Limitation of motion	84	88.4
Tenderness(and pain)	82	86.3
warmth	9	9.5
erythema	4	4.2

Table 3. Frequency of joint involvement in patients

Variable	Frequency(N)	Percent (%)
Hip	59	62.1
Knee	24	25.2
Ankle	8	8.4
Wrist	3	3.1
Elbow	1	1.05

Variable	Mean	SD	maximum	minimum
White Blood Cell /ml	10500	3700	23000	1000
Hb g/dl	11.8	1.2	15	7.4
Platelets /MCL	352700	115900	929000	170000
Erythrocyte Sedimentation Rate (ESR) mm/hr	36	27.5	130	2
C-Reactive Protein mg/dl	15.7	25.4	136	0

Variable	Frequency(N)	Percent (%)	
Induration(mm)	>10mm	1	1.1
	10 mm	0	0
	<10mm	94	98.9

Positive result: Induration \geq 10

Variable	Titer	Frequency(N)	Percent (%)
Wright	<1/80	89	93.7
	1/80	1	1.1
	>1/80	5	5.3
2ME	<1/40	90	94.7
	1/40	2	2.1
	>1/40	3	3.2

*Wright test: tube agglutination test, 2ME test: 2-mercaptoethanol agglutination test Positive serology for brucellosis: wright test \geq 1/80 and 2ME \geq 1/40.

Five patients tested positive for brucellosis via serology tests (Wright test \geq 1/80) (Northeast Iran is an endemic area for brucellosis) [Table 6]. Only 2 (2.1%) patients had elevated antistreptolysin O titer. Out of 41 patients with transient synovitis, synovial fluid was analyzed in 48.7% (n=20), with 70% of these patients having inflammatory synovial fluid (white blood cell count: 10000-25000/mm³) [Table 7]. Synovial fluid culture in patients was negative in all studied patients except two patients with septic arthritis. Polymerase chain reaction analysis of synovial fluid was not performed in patients due to high cost. Other results of the study are summarized in the tables at the end of the article [Table 8].

Discussion

A thorough history and physical examination play a critical role in identifying the causes of limping in children. While most studies have focused on identifying these causes in the emergency department,³ our research examined common causes of limping in pediatric rheumatology wards. A notable aspect of our study is its focus on the causes of limping within a specific geographic region and population.

The most prevalent cause of limping among patients was transient synovitis or another form of reactive arthritis. Previous studies on musculoskeletal limping also identified transient synovitis as a common factor.^{1,3} Therefore, the leading causes of limping in the rheumatology ward were benign (self-limiting) conditions.^{1,2} Nevertheless, in

emergency centers, septic arthritis should be investigated as one of the critical causes of the limp.⁴ About 6% of patients with acute limping were diagnosed with acute lymphocytic leukemia (ALL). The result of this study highlights that hematologic malignancies, such as ALL, should be recognized as potential life-threatening causes of acute limping in children.⁵

There was no child with neuroblastoma or lymphoma in this study, which was consistent with the results of other studies. Neuroblastoma is one of the rare causes of atypical claudication in children. In rare cases, the initial clinical manifestation of lymphoma can be limping.^{6,7} Among our patients, 4.2% had benign and malignant bone tumors, such as Ewing sarcoma and osteoid osteoma. Osteoid osteoma is a small bone tumor in children, which may involve the hip or other joints. Clinical manifestations include night bone pain and limping.^{8,9}

Our study highlights the significant role of bone tumors as a cause of limping in children. Northeast Iran is an endemic area for brucellosis. Especially in our country, Brucella arthritis and osteomyelitis are common causes of musculoskeletal complaints and limps in children.¹⁰⁻¹³ However, a small percentage of our patients had Brucella septic arthritis. These results could be attributed to our study population, which consisted of patients hospitalized in the Department of Rheumatology. Although 60% of patients exhibited cloudy fluid, only 2% were found to have septic

arthritis. This suggests that the appearance of synovial fluid may not be a reliable indicator of septic conditions.

It was revealed that 88.4% of patients experienced limited joint movements, which is a significant finding in the examination. Even patients without joint effusion have a limited range of motion. Ultrasonography reported joint effusion in 51.6% of patients; however, evidence of arthritis on joint X-ray was present in only 6.3% of patients, highlighting that ultrasound is the most effective and readily available imaging method for confirming joint effusion.^{14,15} None of the patients were diagnosed with Tuberculosis (TB) arthritis. Tuberculosis monoarthritis is an uncommon manifestation of TB, usually occurring as chronic monoarthritis, and TB arthritis is considered an exceptionally uncommon cause of acute arthritis in

children.^{16,17} Juvenile idiopathic arthritis (JIA) is one potential cause of lameness in children; those with JIA may arrive at the emergency department with a sudden onset of this condition. The history of morning stiffness, the absence of clinical manifestations (e.g., erythema of the joint), and severe joint pain help physicians differentiate JIA from infectious causes.¹⁸ In our study, 6.3% of patients were finally diagnosed with one of the subgroups of JIA.

A small percentage of patients (1%) had orthopedic problems, including Legg-Calve-Perthes disease. Due to mild symptoms and the absence of systemic symptoms, such as fever, these patients usually do not need hospitalization. The results of this study is consistent with those reported by similar studies.^{19,20}

Table 7. Synovial fluid analysis in patients with Transient synovitis

Variable	Frequency(N)	Percent (%)	
The appearance of joint fluid	<i>Clear</i>	4	20
	<i>Semi-Clear</i>	12	60
	<i>Cloudy</i>	3	15
	<i>Pussy</i>	1	5
	<i>Bloody</i>	0	0
The synovial fluid white blood cell count	<i>Less than 10000/mm3</i>	2	10
	<i>10000-25000/mm3</i>	14	70
	<i>25000-5000/mm3</i>	3	15
	<i>Greater than 50000/mm3</i>	1	5

Table 8. A final diagnosis of children with limping in the pediatric rheumatology ward

Variable	Frequency(N)	Percent (%)
Final Diagnosis	---	---
Transient synovitis	41	43.1
Reactive arthritis	14	14.7
serum sickness-like reaction	9	9.4
brucellosis arthritis	6	6.3
juvenile idiopathic arthritis	6	6.3
Acute lymphocytic leukemia	6	6.3
Bone tumors	4	4.2
Viral myositis	3	3.1
Septic arthritis	2	2.1
Henoch-Schönlein purpura	2	2.1
Legg-Calve-Perthes disease	1	1.0
acute rheumatic fever	1	1.0

Conclusion

The most common causes of musculoskeletal limping in children are usually benign; nevertheless, identification and attention to serious illnesses, such as infections and malignancies, should also be taken into account. Hematologic malignancies, such as ALL and bone tumors, were considered causes of acute limping in children, which is a predictor of significant morbidity and mortality.

Acknowledgement

This article is derived from a medical thesis of general medicine, which was approved by Mashhad University of Medical Sciences with research project number: 9149.

Authors Contribution: Authors who conceived and designed the analysis: Abdolreza Malek, Mahdiah Vahedi, Abdolkarim Hamedi/ Authors who collected the data:

Atefeh Esmati/ Authors who contributed data or analysis tools: Atefeh Esmati, Abdolreza Malek, Mahdiah Vahedi/
Authors who performed the analysis: Abdolreza Malek/
Authors who wrote the paper: Mahdiah Vahedi

Declaration of Conflict of Interest: The authors do NOT have any potential conflicts of interest for this manuscript.

Declaration of Funding: Authors received NO financial support for the preparation, research, authorship, and publication of this manuscript.

Declaration of Ethical Approval for Study: This proposal was approved by the Ethics Committee of Mashhad University of Medical Sciences (IR.MUMS.fm.REC.1396.349).

Declaration of Informed Consent: There is no information

(names, initials, hospital identification numbers, or photographs) in the submitted manuscript that can be used to identify patients.

Abdolreza Malek MD ^{1,2}

Atefeh Esmati MD ¹

Abdolkarim Hamedei MD ^{1,2}

Mahdiah Vahedi MD ^{1,2}

1 Department of Pediatrics, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

2 Clinical Research Development Unit, Akbar Hospital, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

References

- Tu J, Haines M, Gowdie P, Craig S. Paediatric acute non-traumatic limp presenting to the emergency department: a retrospective observational study. *Emerg Med J.* 2023; 40(3):182-188. doi: 10.1136/emmermed-2022-212624.
- Syed R. Evaluating the limping child: a rheumatology perspective. *Mo Med.* 2016; 113(2):131-135.
- Payares-Lizano M. The limping child. *Pediatric Clinics.* 2020; 67(1):119-138.
- Vezzetti R, Bordoni B. Antalgic Gait in Children. *StatPearls [Internet]. StatPearls Publishing; 2022.*
- Yagdiran A, Zarghooni K, Semler JO, Eysel P. Hip pain in children. *Dtsch Arztebl Int.* 2020; 117(5):72-82. doi: 10.3238/arztebl.2020.0072.
- Parmar R, Wadia F, Yassa R, Zenios M. Neuroblastoma: a rare cause of a limping child. How to avoid a delayed diagnosis? *J Pediatr Orthop.* 2013; 33(4):e45-51. doi: 10.1097/BPO.0b013e318279c636.
- Habib MB, Tannos B, Abdelrazek M, Yassin MA. Acute lymphoblastic leukemia presenting with limping in a young adult. *Clinical Case Reports.* 2022; 10(2):e05426.
- Malghem J, Lecouvet F, Kirchgessner T, Acid S, Vande Berg B. Osteoid osteoma of the hip: imaging features. *Skeletal Radiol.* 2020;49(11):1709-1718. doi: 10.1007/s00256-020-03515-8.
- Mohammadhoseini P, Razzaghi S, Barazesh M, Jalili S. Ewing's sarcoma of the hip: A case report with no evidence of tumor recurrence and literature review. *Bone Rep.* 2021;15:101131. doi: 10.1016/j.bonr.2021.101131.
- Bukhari EE. Pediatric brucellosis: an update review for the new millennium. *Saudi Med J.* 2018; 39(4):336-341. doi: 10.15537/smj.2018.4.21896.
- Golshani M, Buozari S. A review of brucellosis in Iran: epidemiology, risk factors, diagnosis, control, and prevention. *Iran Biomed J.* 2017; 21(6):349-59. doi: 10.18869/acadpub.ijb.21.6.349.
- Gharehdaghi M, Rahimi H, Eshraghi R, Mousavian A, Assadian M. Hip Arthroplasty and its Revision in a Child: Case Report and Literature Review. *Arch Bone Jt Surg.* 2015; 3(3):207-11. doi: 10.22038/abjs.2015.4169.
- Abadi HD, Parsa A, Stelzer J, et al. Screening for Femoral Head Osteonecrosis Following COVID-19: Is It Worth It? *Arch Bone Jt Surg.* 2023; 11(12): 731-737. doi: 10.22038/abjs.2023.73742.3414.
- Karaszewski W, Pehanovic A, Streich NA, Herbort M, Petersen W, Schmidt-Lucke C. Ultrasonography for quantitative assessment of knee joint effusions—useful tool for objective evaluation of rehabilitation progress? *Int Orthop.* 2023; 47(4):955-961. doi: 10.1007/s00264-023-05697-x.
- Jindal G, Bansal S, Gupta N, Singh SK, Gahukar S, Kumar A. Comparison of Ultrasonography and X-Rays for the Diagnosis of Synovitis and Bony Erosions in Small Joints of Hands in Early Rheumatoid Arthritis: a Prospective Study. *Maedica (Bucur).* 2021; 16(1):22-28. doi: 10.26574/maedica.2020.16.1.22.
- Carender CN, Akoh CC, Kowalski HR. Mycobacterium tuberculosis monoarthritis of the knee in children: A case report. *Iowa Orthop J.* 2018;38:17-23.
- Gunton A, Losie J, Connors W. Tuberculous monoarthritis of the knee joint. *CMAJ.* 2023; 195(22):E782-E785. doi: 10.1503/cmaj.220838.
- Barut K, Adrovic A, Şahin S, Kasapçopur Ö. Juvenile idiopathic arthritis. *Balkan Med J.* 2017; 34(2):90-101. doi: 10.4274/balkanmedj.2017.0111.
- Rodríguez-Olivas AO, Hernández-Zamora E, Reyes-Maldonado E. Legg–Calvé–Perthes disease overview. *Orphanet J Rare Dis.* 2022; 17(1):125. doi: 10.1186/s13023-022-02275-z.
- Malek A, Aelami M, Afzali N, Parsa A, Jalalinia H. Chronic Recurrent Multifocal Osteomyelitis in a 9-year-old Boy. *Arch Bone Jt Surg.* 2017; 5(3):196-200.