Benign monomelic amyotrophy in a 7-year-old girl with proximal upper limb involvement: case report

Öznur Yılmaz[1], İpek Alemdaroğlu[1], Ayşe Karaduman[1], Göknur Haliloğlu[2], Haluk Topaloğlu[2]

[1]Department of Physical Therapy and Rehabilitation, Faculty of Health Sciences, and [2]Unit of Pediatric Neurology, Department of Pediatrics, Faculty of Medicine, Hacettepe University, Ankara, Turkey

SUMMARY: Yılmaz Ö, Alemdaroğlu İ, Karaduman A, Haliloğlu G, Topaloğlu H. Benign monomelic amyotrophy in a 7-year-old girl with proximal upper limb involvement: case report. Turk J Pediatr 2011; 53: 471-476.

Monomelic amyotrophy (MMA) is a benign motor neuron disease characterized by neurogenic amyotrophy, which usually affects one of the upper or lower extremities. Progression is slow and symptoms are clinically stable. Symptoms are seen in the second or third decades of life. In this study, we present a seven-year-old girl who was diagnosed and directed to the Physiotherapy Department at the age of 5 years and had unilateral proximal upper limb involvement. Family history of the case was recorded. Neurologic evaluation was performed. Range of joint motion, muscle shortness and strength, posture, extremity lengths, gait, timed performance, arm function, and motor and mental maturation were assessed. The physiotherapy program was designed progressively as strengthening and resistive exercises. Motor and mental developmental milestones were normal. There was no limitation in active or passive motion of all joints. She had more flexible joints, scapula alata, asymmetry between shoulder levels, and weakness on proximal muscles of the right upper extremity. In the follow-up assessment at eight months, there was no asymmetry between shoulder levels and scapular symmetry began to improve. Female gender and involvement restricted to one proximal upper limb are rare in the literature. This patient demonstrates the positive effects of physical therapy with early diagnosis of MMA. The rapid recovery of muscle weakness shows the importance of strengthening and resistive exercises applied to specific muscles in the treatment.

Key words: monomelic amyotrophy, lower motor neuron, proximal upper limb involvement.

Monomelic amyotrophy (MMA) is a benign motor neuron disease characterized by neurogenic amyotrophy, which usually affects one of the upper or lower extremities[1-3]. Young males are affected more. There is no sensory, bulbar or pyramidal involvement[1-4]. The symptoms are seen in the second or third decades of life[2,4,5]. Progression is slow and symptoms are clinically stable[6]. MMA is mostly reported from Asia[1-4]. Although the cause of the disease has not been clearly defined yet, the neuropathological studies showed that the lesion is on the anterior horn motor neuron cells of the spinal cord[7].

The laboratory findings are normal, except for electrophysiologic studies. In these studies, reduced compound muscle activation potential amplitudes (CMAP) and acute and chronic denervation in the affected muscles are seen[1]. Distal muscle groups are predominantly affected in this disease[1,2,4].

Monomelic amyotrophy (MMA) must be differentiated from other lower motor neuron diseases. The discriminative feature of the disease is the involvement of only one of the upper or lower extremities and restriction of only lower motor neurons[1].

In this case report, we present the two-year follow-up of a seven-year-old girl with MMA who had proximal upper limb involvement and was diagnosed and directed to physiotherapy at the age of 5 years.

Case Report

The presented case was born at term after an uneventful pregnancy. There was no consanguinity. Early motor and mental developmental milestones were normal. There was a family history of shoulder problems; however, there was no marked history of a neuromuscular disease.

At the age of 5 years, the patient started to complain of shoulder pain just after physical education classes and dancing in preschool. The family noticed asymmetry in the shoulder girdle. Her functional and motor development was appropriate for her age; however, during the physical examination, she had a mild scapular winging on the right side. Other than the mentioned muscle groups involved in Table II, she had no facial or proximal muscle involvement in the lower extremities.

Except for muscle strength, the neurological examination was normal, with normal deep tendon reflexes and absence of pyramidal tract involvement. Electromyography on referral was reported to be normal. She was directed to physiotherapy with the diagnosis of MMA and was evaluated in the Physiotherapy Department at four-month intervals over the following two years.

Physiotherapy Assessments

Range of motion: There was no limitation in active or passive motion of all joints. Moreover, she had more flexible joints (Fig. 1).

Figure 1. Hyperelasticity of elbow joints.

Shortness test: There was no shortness in six muscle groups of the upper and lower extremities (hip flexors, hamstrings, tensor fasciae latae, gastrocsoleus, pectoralis major or minor, lumbar extensor muscles). No muscle shortness developed during the two-year follow-up.

Posture analysis: There was no additional feature, except scapula alata and asymmetry between shoulder levels (Figs. 2, 4). In the follow-up assessment at eight months, there was no asymmetry between shoulder levels and scapular symmetry had begun to improve. In the assessment in May 2009, the appearance of shoulder levels was symmetrical (Figs. 3, 5).

Extremity lengths: It was confirmed that there was no difference between upper extremity lengths.

Gait analysis: There was no abnormal feature in gait analysis.

Table I. Physical Therapy Assessments

Assessments	1st evaluation April 2007	2nd evaluation April 2008	3rd evaluation May 2009
Joint limitation	No	No	No
Muscle shortness	No	No	No
Posture analysis			
Shoulder asymmetry	Yes	No	No
Scapular asymmetry	Yes	Yes	No
Scapula alata	Yes	Yes	No
Timed performance tests (sec)			
Standing up from prone position	1.5 sec	2 sec	3 sec
Standing up from supine position	2 sec	2.5 sec	2.5 sec
Gait analysis	Normal	Normal	Normal

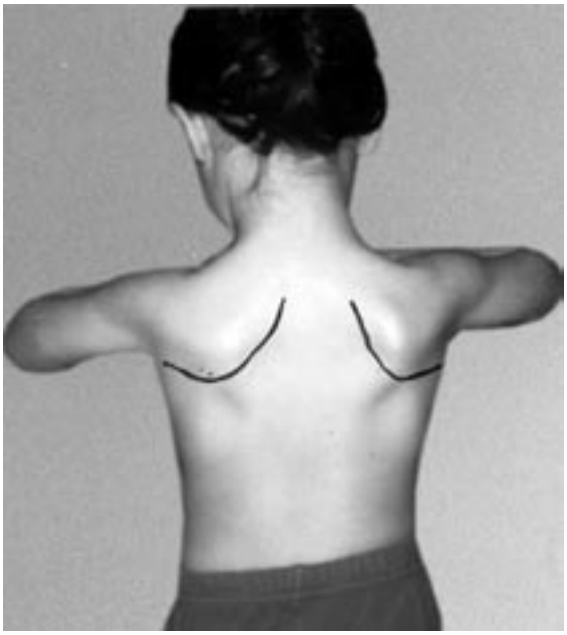

Figure 2. Levels of scapula lower angles and shoulders in arms-up position before physiotherapy.

Timed performance tests: Standing up from prone and supine position was selected for timed performance tests (Table I).

Arm functional test: The patient was required to make a circle with her arms to assess upper extremity function. At the first assessment, she could not perform this motion symmetrically; however, improvement was noted after eight months. At the end of the first year, symmetrical motion was observed in both extremities.

Muscle strength: The muscle strength was assessed in Lowet's manual muscle testing positions. There was no weakness in the lower extremities or the distal muscles of the upper extremities (pronators, supinators of the elbow, flexors and extensors of the wrist). The muscle strengths of the upper extremities and trunk are given in Table II.

Physical Therapy Program

An exercise program was planned to strengthen the trunk and proximal upper extremity muscles and to increase the active upper extremity range of motion. This active program was instructed to the family by converting to daily activities and games. The family was educated as to how to apply this program effectively by considering the age and motivation of the child. Swimming was advised. After the first assessment, within the first month, the patient started to swim two days per week.

The physiotherapy program was improved parallel to changes in the patient's clinical status. After the April 2008 assessment, the instructed activities were converted to a resisting form by using balls of different sizes and weights. On the other hand, age-related arrangements were performed using different games in therapy.

In the December 2008 assessment, the patient was instructed to use a yellow Thera-band for strengthening upper extremity muscles bilaterally. The family reported that the patient's endurance was improved after one year of therapy; swimming distance was especially increased.

Table II. Muscle Strength of the Upper Extremities

Muscles	1st assessment April 2007		2nd assessment April 2008		3rd assessment May 2009	
	R	L	R	L	R	L
M. rectus abdominis	3+		4		4	
Back extensors	4		5		5	
M. serratus anterior	4	4	5	5	5	5
Upper part of M. trapezius	5	5	5	5	5	5
Middle part of M. trapezius	3	3+	5	5	5	5
Lower part of M. trapezius	2	3	4	4	5	5
Anterior part of M. deltoideus	4	4	5	5	5	5
Middle part of M. deltoideus	4	4	5	5	5	5
Posterior part of M. deltoideus	3+	4	5	5	5	5
M. biceps brachii	5	5	5	5	5	5
M. triceps brachii	5	5	5	5	5	5

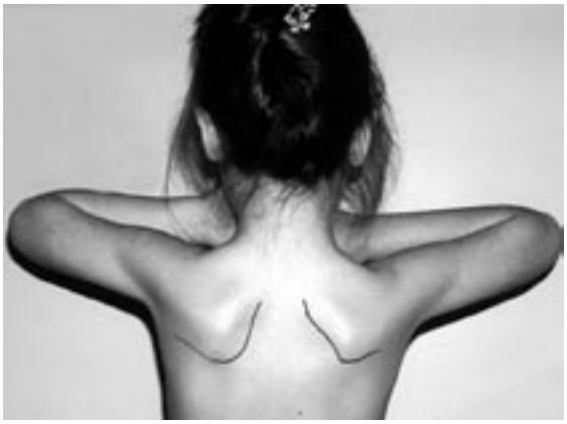

Figure 3. Levels of scapula lower angles and shoulders in arms-up position after 1 year of physiotherapy.

The patient's right upper extremity became as functional as the left after physiotherapy, and she participates in sportive and dancing activities at school.

Discussion

Monomelic amyotrophy (MMA) is a rare condition, which may present a diagnostic challenge, and it affects especially one limb of the upper or lower extremities. There is usually unilateral, asymmetric motor neuropathy. Patients with upper or lower limb syndromes have been reported. This is usually a sporadic condition, with familial cases with focal upper limb involvement. The initial progressive course is followed by a period of stability. Individual nerves or nerve roots may be affected, leading to multiple mononeuropathy. Differential diagnosis, especially in adulthood, includes lymphoma, granuloma (sarcoidosis), inflammatory demyelination when the nerve roots are affected, and mechanical injury, entrapment, inherited pressure palsy, inflammatory demyelination, tumor, granuloma, and ischemic injury when individual nerves are affected. In the childhood period, inflammation, wild-type poliovirus myelitis, polio-like virus myelitis, and vaccine-associated paralytic poliomyelitis have all been discussed under the etiological classification. Incidence and prevalence of the disease are not reported; it is very uncommon in European populations, and most cases described in the literature are from Japan and India[1,2,5,8-13].

Diagnosis of MMA is based on: a) painless and insidious onset of focal weakness and wasting of one limb, either arm or leg, of neurogenic cause, b) a history of progression over a period of at least three years without clinical involvement of any other limb or bodily region, c) pure motor features without sensory symptoms or signs, d) no evidence of generalized neuropathy, multifocal motor neuropathy or compressive neuropathy, according to clinical criteria and nerve conduction studies, e) exclusion of causative local pathology and cord compression by magnetic resonance imaging (MRI), f) no additional neurological signs, and absence of cranial nerve or respiratory involvement, g) no potential causative disease such as trauma, cancer, radiation therapy, diabetes, vasculitis, and remote poliomyelitis, h) no family history of a neuromuscular disorder, i) no signs of corticospinal involvement at presentation, and j) normal motor and sensory nerve conduction velocity and absence of conduction block in all four limbs.

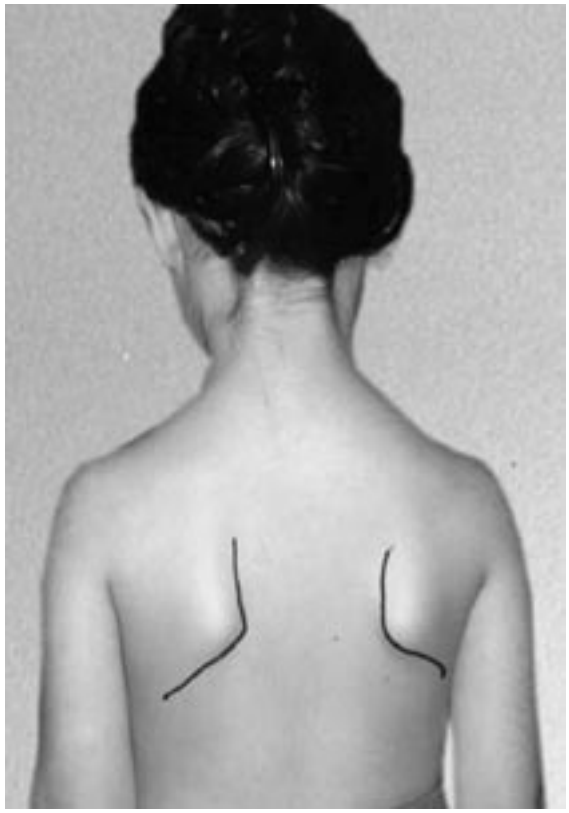

Figure 4. Levels of scapula lower angles and shoulders in arms-down position before physiotherapy.

When we review the characteristics of the

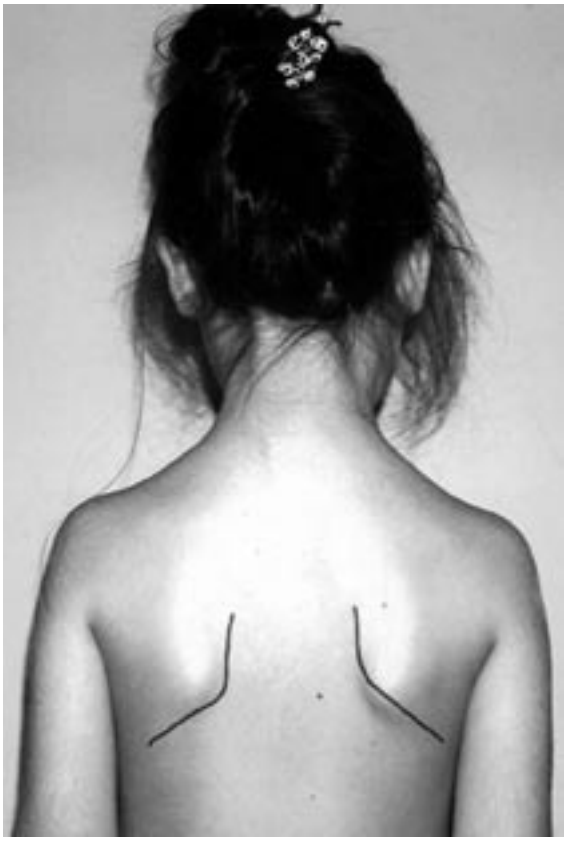

Figure 5. Levels of scapula lower angles and shoulders in arm-down position after 1 year of physiotherapy.

reported patients, it is also known that males are mostly affected between 26-42 or 15-25 years of age[5]. Freitas and Nascimento[1] studied 21 cases with benign MMA and found no familial cases. About 90% of the patients developed the disease symptoms between the ages of 18-22 years in their study. The youngest patient was 4 years old and the oldest was 41 years. Few cases have been described in the first decade of life and few female cases are reported. Although Freitas et al.[1] reported no male predominance in their series, Gourie-Devi et al.[8] reported 13 cases with upper limb involvement and 10 with lower limb involvement, and only 2 patients were female. Sobue et al.[14] reported female gender in 12 of 71 cases.

Our patient is interesting with respect to both the female gender and involvement of one upper limb at the time of presentation. Other than the affected muscles in the upper extremity, her neurological examination was normal. Electromyography performed at referral was normal, which may be because of subclinical involvement or pitfalls in the evaluation of diagnostic electrophysiological studies in children. Subclinical motor involvement in patients can be demonstrated with central motor conduction time (CMCT), especially during voluntary contractions from affected and unaffected limbs[15]. Multichannel somatosensory evoked potentials may also help to demonstrate segmental cervical cord involvement[16]. These two advanced electrophysiological studies were not available in our patient. Because of the rather benign course and distribution of muscle groups involved, cervical MRI study was not done at the time of presentation in our patient; however, it should be included in the laboratory work-up to exclude spinal cord pathology in patients with signs of cervical cord compression.

In many of the studies, it has been reported that the involvement of the upper extremities is usually restricted to the distal parts of the extremities and that deep tendon reflexes are absent[1,12,13]. The proximal involvement of our patient was restricted to the shoulder girdle, and deep tendon reflexes were preserved. These variations in clinical presentations should be considered in the diagnosis of MMA.

No familial patient has been presented to date; however, our patient's father, the father's sister and the paternal grandmother had frozen shoulder in their medical history. This history of shoulder problems in the family must be considered in the development of the child and in physiotherapy follow-ups to differentiate the possible problems that may be caused by MMA and other orthopedic problems in the future.

The disease has a special prognosis and the course is slowly progressive over one or two years but then stable afterwards[17]. In a different long-term study conducted by Peiris et al.[10], it was shown that the disease ceased within five years in 75% of patients. Our patient was followed by our unit for two years after the diagnosis. It is different from the cases declared in the literature previously in that the weakness was not progressive during the physiotherapy follow-ups. Conversely, most of the upper limb muscles strengthened, and symmetrical posture was achieved within one year of the follow-up and was maintained afterwards. This

may highlight the importance of this dynamic and operational physiotherapy approach. Early diagnosis and appropriate physiotherapy may have a positive effect in the prognosis of the patients with MMA. Regular follow-ups by physiotherapy and pediatric neurology are important to maintain the medical and physical improvement and stabilization.

In conclusion, among the patients with an early diagnosis of MMA, female gender, involvement restricted to one proximal upper limb, and stability in the prognosis of the disease are rare presentations. In this case report, a seven-year-old girl who was diagnosed at the age of 5 years with proximal upper limb involvement is presented. The positive effects of dynamic physical therapy in this case with MMA were shown in this report. The rapid recovery of muscle weakness and then a stable phase of disease demonstrate the importance of strengthening and resistive exercises applied to specific muscles involved in the rehabilitation process as well as the family's cooperation.

REFERENCES

1. Freitas MR, Nascimento OJ. Benign monomelic amyotrophy: a study of twenty-one cases. Arq Neuropsiquiatr 2000; 58: 808-813.
2. Orsini M, Freitas MR, Catharino A, Mello MP, Nascimento OJ. Upper limb proximal form of benign monomelic amyotrophy: on purpose of 2 cases. Rev Bras Neurol 2008; 44: 13-17.
3. Aktaş İ, Albay T, Gündüz H, Akyüz G. Monomelic amyotrophy: case report. Turk J Phys Med Rehab 2008; 54: 116-118.
4. Orsini MA, Freitas MR, Mello MP, Dumard CH, Freitas GR, Nascimento OJ. Benign monomelic amyotrophy with proximal upper limb involvement. Arq Neuropsiquiatr 2007; 65: 524-527.
5. Little AA, Teener JW. Presenting symptom(s): progressive left arm weakness, cramping, and muscle twitching. Am J Phys Med Rehabil 2003; EMG Case No. 61.
6. www.ninds.nih.gov. Monomelic Amyotrophy Information Page: National Institute of Neurological Disorders.
7. Gourie-Devi M, Nalini A. Long-term follow-up of 44 patients with brachial monomelic amyotrophy. Acta Neurol Scand 2003; 107: 215-220.
8. Gourie-Devi M, Suresh TG, Shankar SK. Monomelic amyotrophy. Arch Neurol 1984; 41: 388-394.
9. Uncini A, Servidei S, Deli Pizzi C, et al. Benign monomelic amyotrophy of lower limb: report of three cases. Acta Neurol Scand 1992; 85: 397-400.
10. Peiris JB, Senevinatre KN, Wickremashingre HR, Gunatilake SB, Gamage R. Non-familiar juvenile distal spinal atrophy of the upper extremity. J Neurol Neurosurg Psychiatry 1989; 52: 314-319.
11. Fetoni V, Briem E, Carrara F, Mora M, Zeviani M. Monomelic amyotrophy associated with the 7472insC mutation in the mtDNA tRNA gene. Neuromuscul Disord 2004; 14: 723-726.
12. Yoldaş TK, Çoruh Y, Keklikoğlu HD, Polat HG, Güven B. Hirayama hastalığı (monomelik amyotrofi). Fırat Tıp Dergisi 2008; 13: 274-276.
13. Talbot K. Monomelic amyotrophy or Hirayama's disease. Practical Neurol 2004; 4: 362-365.
14. Sobue I, Saito N, Lida M, Ando K. Juvenile type of distal and segmental muscular atrophy of upper extremities. Ann Neurol 1978; 3: 429-432.
15. Pal PK, Atchayaram N, Goel G, Beulah E. Central motor conduction in brachial monomelic amyotrophy. Neurol India 2008; 56: 438-443.
16. Nalini A, Praveen-Kumar S, Ebenezer B, Ravishankar S, Subbakrishna DK. Multichannel somatosensory evoked potential study demonstrated abnormalities in cervical cord function in brachial monomelic amyotrophy. Neurol India 2008; 56: 368-373.
17. Hirayama K, Toyokura Y, Tsubaki T. Juvenile muscular atrophy of upper extremity: a new clinical entity. Psychiatr Neurol Jap 1959; 61: 2190.