Bangladesh Journal of Neuroscience 2019; Vol. 35 (2): 110-114

CASE REPORT

A Case Report of Reverse Split-hand Syndrome: An Overlooked Clinical Sign of Hirayama Disease

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Abstract:

Hirayama disease (HD) is considered to be a relatively benign, slowly progressive and less disabling rare neurological disorder where flexion induced compressive ischemic lower cervical myelopathy causes selective anterior horn cell injury resulting weakness and atrophy of distal upper limb without any pyramidal, spinothalamic and posterior column disturbance. Herein, we report a young male with clinical and imaging features suggestive of Hirayama disease presented with dissociated hand muscle atrophy (hypothenar more affected than thenar) in both hands. This less recognized finding was previously termed as reverse split-hand syndrome just opposite to split-hand syndrome found in amyotrophic lateral sclerosis. We also observe electrophysiological correlation of reverse split-hand syndrome in HD.

Key words: *Reverse split-hand syndrome, Hirayama disease, split-hand syndrome, Amyotrophic lateral sclerosis*

Introduction:

Hirayama disease (HD) is a rare neurological disorder where either unilateral or bilateral wasting & weakness of forearm and hand muscles occur. In 1959 Hirayama et al. first described the condition as 'Juvenile muscular atrophy of unilateral upper extremity'[1, 2].Other names used to describe this process are benign juvenile brachial spinal muscular atrophy, juvenile asymmetric segmental spinal muscular atrophy, juvenile muscular atrophy of the distal upper extremity, monomelic amyotrophy and oblique amyotrophy[3]. Recently the term brachial amyotrophy spectrum included classical form-unilateral distal involvement or brachial monomelic amyotrophy (BMMA)[1,2,4,5], distal asymmetric amyotrophy[5,6], distal bimelic amyotrophy (DBMA)[7,8], bilateral proximal or proximo-distal forms[9]. It is relatively benign, young age at onset, slowly progressive usually not more than five years and can be disabling sometimes. But disability can be reduced to a great extent if early intervention can be applied. Male are affected more than female (3:1) with high prevalence in Asia particularly in Japan but also noted in China, Taiwan, Malaysia, India, and Sri Lanka, with few cases from Europe and North America. The condition is assumed to be caused by chronic ischemic changes to the anterior horn cells of the cervical cord, caused by limited dural sac laxity& altered cervical spine dynamics[3]. Sensory functions, reflexes & bowel-bladder remain normal and lower extrimities are also not involved here. However a characteristic pattern of wasting was observed in HD where hypothenar muscles

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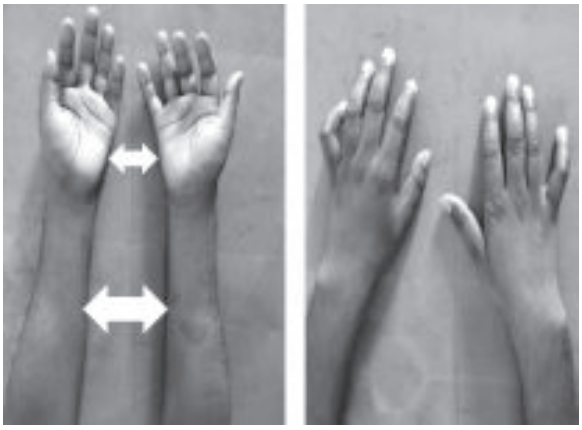
(abductor digiti minimi-ADM) were more affected with relative preservation of thenar muscle (abductor polocis brevis-APB). This phenomenon is just opposite to split hand syndrome characteristically found in amyotrophic lateral sclerosis (ALS) where thenar muscles (APB) are more wasted than hypothenar muscles (ADM). So the term reverse split hand has been introduced[10]. In this case report we observed electrophysiological correlation with reverse split hand syndrome in HD.

Case report:

A 23-year-old right handed Bangladeshi male of non-consanguineous parents presented with insidious onset slowly progressive weakness and wasting of both upper limbs for about 3 years. His right upper limb was affected first and one year later left upper limb was also involved. Weakness and wasting were more marked distally. At first he noticed mild clumsiness in right hand and occasional slippage of objects from hand. But he had no difficulty in raising the arm above head or flex the forearm. He developed gradual wasting of medial aspect of hand and then forearm without any muscle twitching. One year later his left upper limb was also involved in same manner. He also noticed tremulous movement of right hand on stretching and could not straighten the fingers properly. He could hold a pen or key and grip an object with a feeling of heaviness. He was performing his daily activities with little modification. There was no tingling, numbness or paresthesia in the limbs. His lower limbs were normal without any weakness, wasting, sensory complaints or walking difficulty. His bowel and bladder habits were normal. He had no history of neck pain or trauma to the neck as well as exposure to toxin. Patient did not complaint of difficulty in deglutition, headache, visual disturbance, convulsion or learning difficulty. His milestones of development were normal and family history was also noncontributory.

On examination we found gross wasting of hypothenar muscles of hand and medial aspect of forearm in both upper limbs (right>left) without any fasciculation but there was tremor in outstretched hands. Lateral aspect of hand and forearm were remarkably preserved denoting reverse split-hand (Figure 1A). We observed mild clawing in both hands along with Wartenberg's sign (Figure 1B). In both upper limbs adduction, abduction, extension of fingers were weak (MRC grade 3+) other than thumb. In thumb adduction, abduction, extension and opposition were normal. Wrist adduction was weak (MRC grade 4) but grip was normal. Writing, buttoning and counting were preserved as well as elbow flexion and extension in both upper limbs. His deep tendon reflexes in both upper limbs were diminished or hypoactive and Hoffman's sign was absent. There was no sensory disturbance including spinothalamic and posterior column functions. Motor and sensory system examinations were preserved in both lower limbs including deep tendon reflexes and planter response. There was no nerve thickening and his cranial nerves were also intact including tongue and bulbar function. Neck movements were also not restricted.



A B

Fig.-1: *(A) Marked hypothenar (medial hand) and medial forearm atrophy with preservation of thenar (lateral hand eminence; (B) Mild clawing of both hands.*

We performed MRI of Cervical spine (both neutral and flexed position) with screening of whole spine along with NCS and EMG of all four limbs. Cervical MR images in neutral position showed focal atrophy of lower cervical cord at the C5-C7 vertebral levels without intramedullary abnormal high signal intensity (Figure 2A, 2B & 2C). When the neck was ûexed, the posterior wall of the cervical dural sac between C5 and D1 vertebral levels was seen to shift anteriorly. The markedly ûattened and anteriorly displaced cervical cord was compressed over the posterior surface of the C5 to D1 vertebral bodies (Figure 2D).

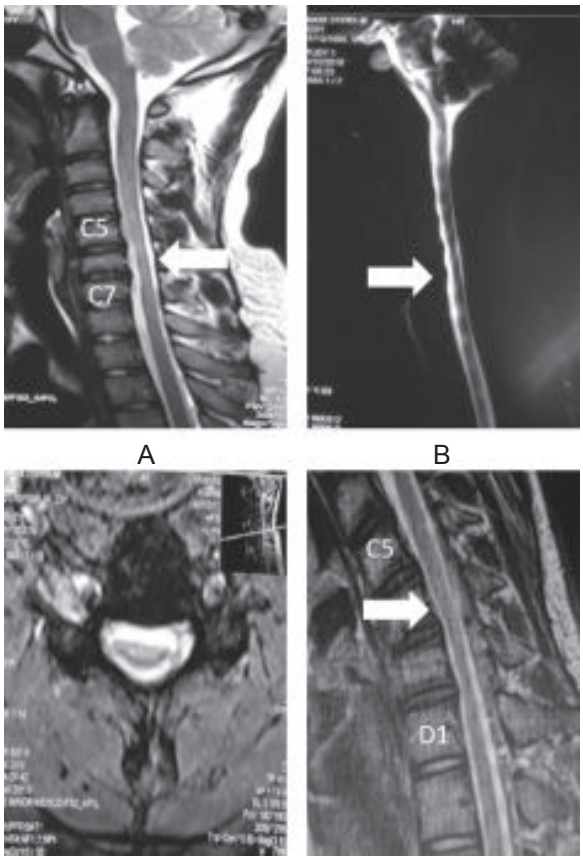


Fig.-2: *MRI of cervical spine. T2 sagittal (A & B) section showing focal cord atrophy (C5-C7 vertebral level), T2 axial © section showing marked anterior-posterior flattening of cord, T2 sagittal in flexed position (D) showing posterior dural sac shifting anteriorly with flattened cord compression against posterior surface of C5 to D1 vertebral bodies.*

NCS of both upper limbs showed marked reduction of CMAP (compound muscle action potential) amplitude recorded over ADM than that of APB (Figure 3). But conduction velocity and distal latency were normal in both median and ulnar nerves. EMG showed high amplitude, normal durationMUAPs (motor unit action potential) with reduced recruitment in 1st dorsal interosseous, pronator teres, biceps and flexor carpi ulnaris without any features of denervation (positive sharp waves, fibrillations). NCS and EMG of both lower limbs revealed normal. On the basis of MRI and Electrophysiological features Hirayama disease was diagnosed. The CMAP amplitude recorded over ADM (right: 0.64 mV and left: 1.030 mV; normal: ≥5.5 mV) was greatly reduced than that of APB (right: 16 mv and left: 16.90 mV; normal: e"4 mV) with ADM/APB ratio 0.04 (right) and 0.06 (left). So, electrophysiological correlation of reverse split-hand was assumed. For therapeutic purpose cervical collar was advised to prevent further flexion induced injury. Patient was also advised to take neurosurgical consultation.

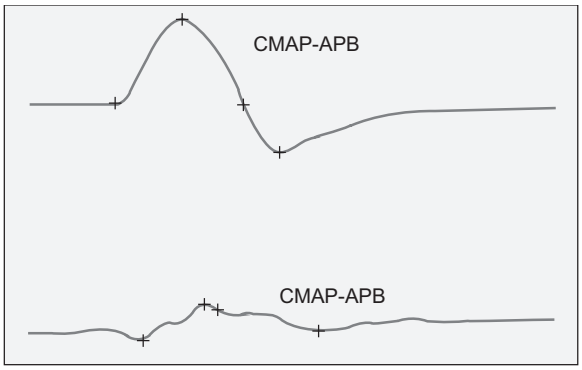


Fig.-3: *Marked reduction of CMAP amplitude recorded over ADM than that of APB.*

Discussion:

Since 1959 after description of the disease by Hirayama, it is being increasingly reported from many parts of the world but most notably from Asian subcontinent[1, 2,4-9, 11]. It is relatively benign in course and less disabling. Moreover there remains hopeful intervention maneuver. So it should be differentiated from ALS which is a relentlessly progressive neurodegenerative disorder with early fatal outcome.

In ALS split-hand syndrome is considered to be an early and important clinical sign where lateral hand (thenar-APB) is more affected with relative preservation of medial hand (hypothenar-ADM). The exact opposite phemenon was observed in HDand considered to be reverse split-hand. But this dissociated hand muscle atrophy in HD has got poor attention and not been studied systematically rather a very few studies are there[12, 13]. On the other hand split hand in ALS is now a focus of intense investigation[14, 15]. But reverse split-hand syndrome and its electrophysiological measuremay help to differentiate HD from ALS to a great extent.

The exact mechanism of reverse split-hand in Hirayama disease remains to be elucidated. Based

on some previous reports, ischemic/venous congestive myelopathy may damage selectively the hypothenar innervated anterior horn cells (AHC)[15]. According to several MRI studies disproportionate rate of growth between spine and dural sac causes dynamic flexion induced myelopathy. Dynamic anterior shift of dura in flexion results in cord compression, inducing microcirculatory disturbances and necrosis of the anterior horns, which are most vulnerable to ischaemia. As anterior dural shift is prominant at C6 vertebral level, the lower cervical spinal cord suffers maximum dynamic compression. This finding may explain the maximum denervation seen in C7 to T1 spinal myotomal levels and preferential involvement of ADM is the result of C8 myotomal involvement due to possible maximum cord compresson at C8 myotomal level[16, 17].

Currently HD is diagnosed on the basis of specific clinical features and MRI findings.Standards of clinical features described by Tashiro et al.help to identify and diagnose this condition are predominant distal muscle weakness with hand and forearm atrophy,unilateral upper limb involvement, age of onset between 10 to early 20s, insidious onset and gradual progression for several years then stabilizes, no lower extremity involvement, no irregular sensory disturbances or tendon reflexes and other disease excluded[18]. Suggestive MRI findings in neutral position are focal lower cervical cord atrophy with or without increased intramedullary signal intensity and crescent shaped lesion in the posterior epidural space of lower cervical cord. Flexion MRI shows anterior shift of posterior dural sac and compression of cervical cord to posterior surface of lower cervical vertebral bodies with corresponding post contrast high intramedullary signal intensity indicatingischemia[19].Besides these electrophysiology is done to exclude other differentials most notably ALS and myotonic dystrophy.

Previously several studies were done to see diagnostic accuracy of ADM/APB ratio in HD. In 2017 Kalita et al. showed ADM/APB ratio of <0.86 with 80.4% sensitivity and 86.3% specificity[20]. Jin et al. in 2014 found ADM/APB ratio<0.6 in 61% of HD patients and 2% patients with ALS[21]. In another study conducted by Kim et al. in 2015 found the ratio <0.6 in 46.7% HD patients and 3.6% ALS patients[22]. In our case we found ADM/APB ratio 0.04 in right hand and 0.06 in left hand which was consistent with previous studies.

As flexion induced injury of lower cervical cord is considered to be responsible for HD, wearing of cervical collar is the first line treatment option. In more advanced and severe functional disability surgical option like duroplasty with tenting has been performed with improved success rate and prognosis.

Conclusion:

Reverse split hand and its electrophysiological measure as ADM/APB ratio may prove important diagnostic tool in HD besides specific MRI features. It may also be used to differentiate it from ALS which is important as there are therapeutic and prognostic discrepancy. But relative study in this field is warrented.

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