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Idiopathic brachial neuritis in children.

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Abstract

Brachial plexopathy is a rare disorder in children, which can occur as a result of trauma, inflammation, vasculitis or malignancies. Idiopathic Brachial Neuritis (IBN) is a rare neurologic disorder that affects mainly the lower motor neurons of brachial plexus and/or individual nerves or nerve branches. It is often preceded by antecedent events such as infection or immunization and commonly present with a triad of abrupt onset painful unilateral upper limb (frequently right-sided) and neck weakness followed by flaccid paralysis with associated wasting around the shoulder girdle and arm muscles. The diagnosis is made clinically, with MRI or electromyography reserved for less clear-cut cases. The long-term prognosis for children is better than adults. Here, the author will focus on paediatric phenotype IBN aiming to increase awareness of clinician to its treatment, prognosis, and important differential diagnosis such as hereditary neuralgic amyotrophy, asthmatic amyotrophy (Hopkins syndrome), osteomyelitis-associated neuritis and reemphanise it as a differential diagnosis in children with unexplained monoparesis.

Keywords: Brachial plexopathy, Brachial neuritis, Neurologic amyotrophy, Intravenous immunoglobulin (IVIG), Corticosteroid.

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Introduction

In the clinical approach to monoplegia in pediatrics, a variety of neurologic, and non - neurologic causes should be considered Table 1. Either pain or weakness may cause a refusal to use a limb. The cause of most painful limbs (pseudoparalysis) is either orthopaedic or rheumatologic such as arthritis, infection or tumour. A trivial pull on an infant's arm may dislocate the radial head and cause an apparent monoplegia. Stroke may present with monoplegia, but often affects one limb more than others, usually the arm more than the leg, and careful examination often reveals increased tendon reflexes and an extensor planter response in the seemingly unaffected limb. The presence of hemiplegia on exam calls for focus attention on the brain and cervical cord as the possible pathologic site. In complicated migraine and hemiparetic seizures in which hemiparesis can be mistaken for monoplegia, a careful history of documented previous similar episodes, short-lived weakness, absence of pain and detailed physical exam are the most important features to differentiate it from plexopathy. Brachial plexus problems are rare disorders in children and they are encountered infrequently by neurologists mainly in the emergency and inpatient settings as a leading cause of pure monoplegia. A variety of disorders affect the brachial plexus and the cervical radicals inside the cervical canal such as trauma, inflammation, vasculitis or malignancies [1-3]. Pain followed by weakness is a feature of either spinal cord compression or plexitis. In cord lesions the symptoms depend on the degree of cord impingement and duration of tumour involvement. Typically the pain is either localized due to vertebral destruction or radicular due to compression of the nerve roots, and it precedes other symptoms by 2-4 months. Commonly, it gets aggravated by Valsalva manoeuvre and it progresses to weakness in one or both limbs with loss of sensation, autonomic dysfunction and paralysis. In vague cases spinal cord imaging studies may be needed. Cervical radiculopathies are rare in children, and its clinical presentation could often be confused with brachial plexopathies, especially when multiple roots are involved. The upper trunk brachial plexopathy simulates the C5 or C6 root lesion. Unlike brachial neuritis, it is unusual for radicular pain to subside as weakness increases, with pain mostly persistent and associated with neck muscle spasm. While radiculopathies tend to be sensorimotor, brachial neuritis is often a motor-dominant situation. Fibrillation potentials are often seen on EMG of the cervical paraspinal muscles in cases of

Table 1. *Differential diagnosis of acute monoplegia*

Dislocation of the radial head
Stroke
Complicated migraine
Hemiparetic seizures
Cervical cord lesions
Cervical cord radiculopathy
Plexopathy
Acute plexitis/neuritis
Idiopathic plexitis *
Asthmatic plexitis
Osteomyelitis plexitis
Tetanus toxoid plexitis
Hereditary brachial neurits
Trauma/injury
Laceration
Pressure injuries
Traction injuries
Cancer/radiation plexitis
*Represents the most common conditions and the ones with disease modifying treatments

cervical radiculopathy but not so in cases with brachial plexus involvement. Traumatic brachial plexus injury can result from a direct blow or traction or stretch injury. The prognosis depends on the extent and site of injury as well as the surgical expertise [1]. Although both T2WI with contrast-enhanced magnetic resonance imaging (MRI) (MR myelography) and Computed tomography myelography can detect root avulsions, intrinsic and extrinsic masses of the brachial plexus, post-traumatic hematomas, fibrosis, and inflammatory plexitis such as infectious, immune-mediated, radiation-induced, or idiopathic**,** but Computed tomography myelography is better in demonstration of nerve roots, and it is the standard investigation of choice for root avulsion [4,5]. Its major disadvantage is that it is invasive and very difficult to perform, especially in newborns. Chronic progressive monoplegia is uncommon and raises the possibility of either syringomyelia and tumours of the cervical cord or brachial plexuses such as neurofibroma. Cancer-related brachial plexopathy may occur secondary to metastatic infiltration or radiation therapy. This article will focus on current status, pathogenesis, clinical work-up, treatment strategy and prognosis of the paediatric phenotype of IBN and its major differential diagnosis encountered by neurologists.

Idiopathic Brachial Neuritis (IBN)

Idiopathic brachial neuritis is a rare neurological disorder in children affecting the peripheral nerves, with relatively few cases having been reported with diverse aetiology. It is also known as an Idiopathic Neuralgic Amyotrophy (INA) or brachial plexus neuropathy or brachial plexitis. The term Parsonage Turner syndrome has been used interchangeably with BN since their original description of motor loss and atrophy following BN [6]. BN exists in an inherited and an idiopathic form. The idiopathic form (IBN) is a disorder that thought to be immune-mediated and most commonly involving the upper branches of the brachial plexus. It is a clinical triad of an acute onset of severe unilateral pain of the shoulder girdle, followed by muscular weakness with flaccid monoparesis or monoplegia and atrophy of the parascapular muscle group affected; it was first described by Feinberg [7]. He first reported a case of unilateral brachial neuritis associated with influenza. It has rarely been documented in children with so far only around 60 cases reported worldwide. [8-11]. Before 1970, the diagnosis of IBN was probably missed due to clinical similarities with poliomyelitis [12]. Nowadays because of its rarity and some similarities to other common neurological conditions such as cervical spinal cord lesion and Guillain Barre syndrome, it is often misdiagnosed and therefore mistreated.

Epidemiology

Brachial neuritis (BN) is frequently seen in males with a male to female ratio of 2.3:1, which is similar to that of adults. This reflects the importance of a sex-specific factor in the pathogenesis of IBN [10]. Generally, its onset varies in age from infancy to adult life, but most of the patients are 20-40 years old. The mean age of onset is 41.3 years [2]. In children, its onset varies from 3 days - 15 years of age [10]. The reported old incidence is 2–3/100.000/ year in the whole population [13,14]. Recently van Alfen et al. reported an incidence rate of 1 per 1,000 individuals. Unawareness of the disorder and its clinical presentation seems the most likely explanation for this difference [15]. Its incidence in children varies according to age and it has a biphasic appearance with a first sharp peak mainly representing newborns (<8 weeks old) and a second smaller and broader peak in adolescence between the ages of 7–15 [10].

Clinical Presentations

It affects the lower motor neurons of brachial plexus and/or individual nerves or nerve branches. The onset of symptoms is usually explosive. Its clinical triad typically starts with a severe deep, ‘sharp’, ‘burning’, ‘throbbing’ or ‘aching’ (i.e., neuralgic) pain around the shoulder girdle lasting from days to few weeks, which is present in about 95% of adults[2,16]. In children, however, only two-thirds experience pain, thus its absence by no means excludes the diagnosis. [2,8]. Høst et al. [10] report in their review of 58 children with BN that pain was present in 47% of cases, absent in 25% and unknown in the rest.

As the pain subsides, weakness and various degrees of paresis appear. The arm is held in an inward rotated and adducted position with flexed elbow. Weakness is in the distribution of the upper branches of the brachial plexus (axillary and suprascapular nerves)

(C5–C7) alone in half of patients and the entire plexus in most of the rest [17,18]. Deltoid muscle, supra and infraspinatus muscles as well as bicep muscle will show various degrees of weakness on MRC (Medical Research Council), with reduced reflexes of the entire right arm [19]. Sensorial involvement is rare and often of minor concern appearing at lateral shoulders over the inferior half of the deltoid corresponding to the affection of the axillary nerve. A subsequent muscle atrophy occurs 2-4 weeks afterwards in the trapezoid (accessory n.), pectoral muscles (lateral and medial pectoral n.) and serratus anterior muscle (long thoracic n.), resulting in winging (upward positioning) of the scapula [20]. Unilateral affection has been reported in the majority of children and, in some of these, EMG of the contralateral limb may reveal a subclinical involvement [17]. Both the right and left side seemed equally involved, but starting from school age the right side affection is common, similar to the adult distribution pattern [10]. Bilateral affection has just recently been reported in a child, although seen among one-third of adults [17,21,22]. Fewer than 10% of cases involve single motor nerve paresis such as phrenic or laryngeal nerves [17]. In fact, IBN is a disease with a wide spectrum of clinical manifestations ranging from mild painless paresis and quick recovery to profound brachial plexus involvement with severe painful palsies with the involvement of nerves outside the plexus such as bulbar nerve or lumbosacral plexus affection, although the latter scenario is rare [10,23].

Pathogenesis

Its exact aetiology is not known and it is probably heterogeneous. It has a complex pathogenesis that includes an underlying predisposition, susceptibility to dysfunction of some peripheral nerves and a trigger for the attacks, such as viral infection, vaccination, trauma, surgery and strenuous exercise. Genetic factors also contribute to the pathogenesis of BN, but the hereditary form is considered to be 10 times less common than the idiopathic one. The available evidence suggests that BN is essentially an idiopathic immune-mediated neuritis of the brachial plexus and immunosuppressive therapy may play a role in its management [24]. This is supported by the findings of anti-ganglioside antibodies, elevated liver enzymes and various CSF abnormalities in some patients [2,25]. In one study, lymphocytes sensitized to different nerve branches of the brachial plexus were found in IBN patients examined post mortem [26]. The majority of patients have no preceding events, while in others specific events did display a clustering depending on age. The presence of preceding events supports the immune-mediate theory. During infancy, it is seen mostly in association with osteomyelitis / septic arthritis. The preceding events in toddlers were commonly upper respiratory infections, illness, fever, and vaccinations, while a broad range of viral infections prevailed in adolescence (Table 2) [1,2,8]. In the largest study to date, Tsairis et al. [17] found no preceding illness or associated symptoms in over half of 99 patients studied, while van Alfen N. et al reported 33% of paediatric cases had preceding upper respiratory tract infections, 8% followed immunization

Table 2. *Common preceding events reported in children with IBN*

Osteomyelitis [Devathasan, 1980; Clay, 1982; Wang, 1994; Sadleir, 1998; Estienne, 2005; Van Eijk, 2009]
Septic arthritis [Young, 1983; Wang, 1994; Gabriel, 1996]
Fever [Bale, 1979; Renault, 1986; Zehaira, 1990; Kotsopoulos, 2007]
Upper airway infection [Shaywitz, 1975; Bale, 1979; Devathasan, 1980; Charles, 1980; Tonali, 1983; Renault, 1986; Lidor, 1998; Weller, 2001; Verheulpen, 2004]
Otitis media [Zeharia, 1990; Van Alfen, 2000]
Cerevical lymhadenitis [Masson, 1994]
EBV infection [Kouyoumdjian, 1984; Dussaix, 1986; Cruz-Martinezz, 2002; Janes, 2003; Verheulpen, 2004]
Paravovirus B19 [Kirchh Moradpour, 2001]
Chicken pox [Kennedy,1989]
HSV [McCarthy,1999]
DPT vaccination [Tsairis, 1972; Martin, 1974;Van Alfen, 2000]
HIB vaccination [Van Alfen, 2000]
Oral polio vaccine [Ooi, 2003]
Trauma [Magee,1960; Charles,1980; Beghi,1985; Patel,1990]
HSP [Serratrice,1992;Yilmaz, 2006]
Kidney transplant/ TAC drug [Al Masri, 2008]
Exanthema (cheeks & neck) [Høst C, 2010]
Antibiotics [Jain S, 2014]
Facial nerve palsy [Verheulpen, 2004]
Bulbar affection [To,1999]
IBN: Idiopathic Brachial Neuritis; EBV: Ebstein-Barr Virus; HSV: Herpes Simplex Virus; DPT: Diphtheria, Pertussis, Tetanus Vaccine; HIB: Haemophilus Influenzae Type B; TAC: Tacrolimus (Immunosuppressive agent); HSP: Henoch Schoenlein Purpura.

and 22% had recent osteomyelitis, and in majority of cases the precise aetiology remains elusive [8].

Diagnosis

Diagnosis is made clinically with invasive tests and imaging reserved for less clear-cut cases where other conditions need to be ruled out. Pain usually dominates in adult form, but it presents in only 1 out of 2 patients in paediatric form; therefore, the diagnosis should not be excluded in its absence [10]. Basic tests should include haematological, liver and renal profiles to rule out associated illnesses. Serology for the common infections, such as Varicella Zoster virus, cytomegalo virus, Ebstein-Barr virus, parvovirus B-19, ECHO-virus, and mycoplasma, associated with IBN should be done. Vasculitis workups, such as anti-nuclear antibodies, anti-DNA, rheumatoid factor IgG can be done to rule out vasculitis in extensive BN. Shoulder X-ray can be done to detect any evidence of trauma or infection. High-resolution ultrasound (HRUS) of the brachial plexus may be helpful in detecting compressive lesions, segmental swelling of affected nerves and atrophy of muscles in adolescent [27]. MRI of the shoulder and cervical spine region does not establish the diagnosis, but it rules out focal pathology. Helms et al. [28] demonstrated high-intensity signals on T2 weighted MRI images of the denervated muscles. Magnetic Resonance Neurography (MRN) of brachial plexuses is superior to MRI in the acute phase and typically will show thickening and increased signal intensity on T2 - weighted images along the involved roots, cords , and divisions of the involved plexus related to neurogenic edema [27,29]. Mononeuropathia multiplex has been suggested as a more accurate denomination of the disorder as mostly individual nerves are affected rather than the whole plexus [30]. Electrophysiological studies are not needed in typical cases but may be helpful both for localizing the lesion and confirming the diagnosis. Electromyography (EMG) may reveal a multifocal involvement of acute denervation, consistent with an axonal degeneration/neuropathy in affected and some clinically unaffected muscles compatible with the diagnosis of IBN usually detected 10-15 days after onset [31,32]. In a few cases demyelination with conduction block aspects has also been demonstrated, and few others EMG can be normal, especially in the early course of illness [25]. Sensory nerve conduction studies (NCS) were found to be insensitive and of limited value, as they poorly differentiate between IBN and cervical plexopathies in most cases of IBN despite the presence of clinical symptoms [10]. Of most importance, a normal brachial plexus sensory NCS does not preclude the diagnosis [33]. Motor NCS are often normal, although distal areas may exhibit slowed conduction velocities in more branches of the plexus than detectable upon clinical examination with decrease amplitude of motor action potentials in palsied muscles [34]. Biopsies are not routinely performed but may demonstrate axonal degeneration [17]. In a minority of patients, the cerebrospinal fluid will reveal raised protein levels and/or oligoclonal bands and sometimes pleocytosis**,** but this procedure is not mandatory unless CNS infection is suspected [2,25].

Differential Diagnosis

The differential diagnosis of IBN should include all possible causes that can result in an unexplained monoparesis, including the following. a) Marked weakness secondary to pain as in trauma, rheumatological disorder, or rotator cuff disease might imitate IBN, but here the history, presentation, course and early radiological evaluation should help the clinician differentiate [8,20]. b) Cervical spinal cord lesion characterized by pain and followed by weakness usually has an insidious onset and can be differentiated based on imaging spinal cord studies and its progressive nature. c) Transverse myelitis presents with flaccid paralysis initially but spasticity appears later on. It has a characteristic picture of symmetrical involvement, presence of sensory level and autonomic disturbance, and absence of cranial nerves involvement. d) Paralytic poliomyelitis might imitate IBN, but here the history of fever and sore throat lasting for 1 to 2 days followed by pain in the limbs or over the spine with subsequent presentation of asymmetric flaccidity with no sensory or autonomic disturbance but with bulbar cranial nerves in some and CSF polymorphonuclear cell count of 50-200/mm^3 initially that changes to lymphocytosis after 2-3 weeks with raised protein should help the clinician differentiate [8,20]. e) Guillain-Barre syndrome (GBS) presents with a unique history and symmetrical flaccidity with sensory, autonomic disturbances and facial nerve palsy. f) Asthmatic Amyotrophy (Hopkins syndrome), mostly based on the sequence of events after an attack of asthma sensation is intact and EMG will show denervation that, does not follow the radicular distribution seen in IBN. g) Hereditary neurologic amyotrophy with a similar picture but positive family history, the recurrence, and the dysmorphic features support its diagnosis. h) Osteomyelitis – Neuritis during infancy with evidence of paralysis in absence of pain and presence of bony destruction and bone scan abnormalities in the affected region [8]. A few other rare disorders can mimic IBN in childhood as they have clinical similarities with it. Nerve sheath or nerve tumour of the plexus usually has an insidious onset and painless palsy and can be differentiated based on imaging studies and its progressive nature [20]. Hereditary neuropathy with liability to pressure palsies (HNPP) is another rare neurological disorder that shares clinical similarities, but here there is often a positive family history of compressive neuropathies and polyneuropathy in late adulthood [20].

Management

Due to the lack of evidence-based treatment in children and adults, standard regimens for IBN have so far been supportive and include a combination of analgesics (non-steroidal anti-inflammatory drugs, opioids, neuroleptics) and immobilization to minimize pain exacerbation by activity during the initial phase [31]. Furthermore, antiepileptic drugs such as gabapentin and pregapalin can be used to suppress the neuropathic pain. When recovery begins, active rehabilitation is encouraged and physiotherapy may be beneficial to maintain muscle strength [35]. Corticosteroids may help during the acute phase and have been recommended by some, but there is poor literature evidence to support its efficacy and there is also no evidence that it alters the course of the disease [17]. Smaller case series have reported beneficial effects following immunotherapy [2,25]. Van et al. [36] reported a good outcome on pain and paresis with early corticosteroid treatment in a study of 50 IBN patients**,** but the retrospective, non-blinded design, however, precludes conclusions on its effectiveness. A recent Cochrane review found no evidence of any form of treatment for IBN but identified one open-label, retrospective series, the results of which suggested that administration of corticosteroids in the first month after and during the acute phase of BN could shorten the duration of painful symptoms and also accelerate recovery in some patients [37]. Based on this, immunosuppressive therapy should be reserved for those with intractable pain during the early phase of illness, especially if their response is unpredictable, pending a prospective, randomized trial verifying its effectiveness [36,38].

There is also some evidence that other immunotherapies, such as intravenous immunoglobulin (IVIg) with methylpredonisolone pulse therapy, are effective for motor impairment of BN and may help decrease the length of symptoms but their efficacy remains unestablished [38-40]. There are enough data to suggest the existence of a continuum between some brachial plexopathy cases and Guillain-Barré syndrome. Some cases of BN are thought to be related to Guillain-Barré Syndrome (GBS). Moriguchi et al. [41] reported 4 patients with BN associated with positive anti-ganglioside antibody, namely anti-N-acetylgalactosaminyl GD1a (anti-GalNAc-GD1) antibody, who had a preceding infection and showed a good response to intravenous immunoglobulin infusion therapy. He suggested that such antibodies can be a useful marker for predicting response to immune therapy [41]. Naito et al. [42] in a recent retrospective study, reported that intravenous immunoglobulin and methylprednisolone pulse therapy had proven efficacy with improvement documented in 9 out of 10 patients. Currently, though, a short trial, a 14 day regimen of high-dose oral corticosteroid treatment, should be considered in the early phase of IBN in children as well as adults [10].

Prognosis

IBN is a self-limiting, benign disorder showing good recovery without specific treatments. The overall prognosis is good, although often slow, even when there is complete denervation. Two-thirds of people report improved strength during the month after the onset. Upper plexus palsies improve faster than do lower plexus palsies. Tsairis et al. estimated recovery rates and motor remission in adults at 36% at 1 year, 75% after 2 years and 89% within 3 years. After 3 years, further improvement may occur but permanent residua are expected [17]. Sensorial deficit may persist for more than 3 years before disappearing. A major observational study in adults found the prognosis of IBN less optimistic than previously anticipated, and with the majority of patients still suffering from persisting paresis and pain at a mean follow-up time of 3 years. Furthermore, a significant number of patients experienced recurrent attacks within a 6 year follow-up period [2]. Risk factors for a longer time to recovery include a greater severity of pain and weakness, bilateral involvement, and lower brachial plexus trunk lesions [16-18]. Different studies show contradictory results in children. A study by van Alfen et al. states that children have a slightly less favorable recovery (47% had full recovery and 17% had a partial recovery after a mean follow-up of 10 months) despite the lower frequency of both pain and bilateral plexus involvement, but when they fully recover they do so in a shorter period (average of 6 months much quicker than adults) [8]. However, Høst et al. reviewed the literature and identified 58 patients with IBN. They found that out of 58 patients, 48 reported on recovery. Of these, 63% made a full recovery, 25% a partial and 13% made no recovery. Full recoveries were made in 7.9 months, partial recovery in 17.4 months**,** and the mean follow-up time was found to be 11.1 months. Thus, they indicated better prognosis in children than previously anticipated [10]. Although Høst et al. [10] study has its own limitation of being retrospective, data collected from various sources and the overall limitation in follow-up time, it indicates that almost 2 out of 3 children with BN were expected to have a full recovery within only 8 months, and 1 out of 4 will experience partial recovery, which contrast with the poorer recovery rates in adults where many patients are left with residual pain and decreased exercise tolerance in the affected limb. Recurrence is unusual and less severe than the initial episode. However, further studies should be conducted to define the course of the disease in children.

Asthmatic Amyotrophy (Hopkins Syndrome)

Sudden flaccid paralysis of one or more limbs, resembling poliomyelitis, may occur during recovery from an asthmatic attack. Its exact aetiology is unknown. All affected children had previously received poliomyelitis. Infection by a neurotropic virus other than poliovirus is a possibility. Adenovirus, echovirus and coxsackievirus have been isolated from stool and throat or cerebrospinal

fluid in some cases. A recent case report suggests a possible atopic myelitis [43].

Clinical Features

Onset is usually between I and 11 years of age and male to female ratio is 7:4. The interval between the asthmatic attack and the paralysis is 1-11 days, with an average of 5 days. Monoplegia occurs in 90%, with arm involved twice as often as the leg. The other 10% have hemiplegia or diplegia. Sensation is intact, but the paralyzed limb is painful in half of cases. Recovery is incomplete, and all affected children have some degree of permanent paralysis [44].

Diagnosis

It is primarily a clinical diagnosis based on the sequence of events. The diagnosis requires distinction from paralytic poliomyelitis and idiopathic BN. The basis for excluding paralytic poliomyelitis is normal cerebrospinal fluid in asthmatic amyotrophy. A few white blood cells may be present in the cerebrospinal fluid but never to the extent encountered in poliomyelitis, and the protein concentration is normal. EMG during the acute phase shows active denervation of the paralyzed limbs, but the pattern of denervation does not follow the radicular distribution expected in a BN.

Management

All modalities of analgesic, including antiepileptic drugs such as Gabapentin and pregabalin, may be helpful in controlling neuropathic pain. As with plexitis, physical and occupational therapy are often required.

Hereditary Brachial Plexopathy (Hereditary Neurologic Amyotrophy)

Hereditary Neuralgic Amyotrophy (HNA) has been described with around 200 families known worldwide, but paediatric reports were scarce or incorporated into larger retrospective family studies with only poor supportive data [8,10,20]. It is an autosomal dominant type of focal familial recurrent neuropathy with high penetrance. It is caused in some families by mutation of SEPT9 gene located in chromosome 17q25 [45,46].

Clinical Features

HNA is characterized by repeated episodes of paralysis and sensory disturbances in an affected limb which is preceded by severe pain. The presence of mild dysmorphic features, such as hypotelorism, epicanthal folds, shortened palpebral fissures, cleft palate, microstomia with normal intellect, and a positive family history or a patient`s history of similar episodes, can distinguish the hereditary form from the idiopathic BN. Triggering factors include infection, emotional stress, strenuous use of the affected limb and childbirth. Immunization is not a triggering factor for the hereditary form. Two different courses exist, classic and chronic courses, with only one type per family, suggesting the possibility of genetic heterogeneity [8,47]. The classic course characterized by recurrent severe attacks with a relatively symptom-free interval, while in the chronic undulating course the patient experiences interictal persistence of pain and weakness. Patients experience their first attack earlier than patients with the idiopathic form (2nd vs. 4th decade, respectively) [9,20]. The initial attack may appear also at birth. Attributing palsies at birth to trauma is common despite the positive family history. Return of function is usually complete, although some residual weakness may persist after repeated attacks. The frequency of attacks is variable, but the usual pattern is two or three attacks per decade.

Isolated cranial nerve palsies may occur in families with HNA. The commonest is the vagus nerve followed by transitory facial paly and unilateral hearing loss. Bilateral brachial plexopathy is a relatively common event.

Diagnosis

The family history, early age at onset, recurrences, and involvement of other nerves outside the brachial plexus differentiate the hereditary from the idiopathic BN [2,48]. EMG shows a diffuse axonopathy in the affected arm and some evidence of denervation in the asymptomatic arm.

Management

Mainly symptomatic with all modalities of analgesia to control the neuropathic pain including antiepileptic drugs such as gabapentin (20-60 mg/kg/day, TID) or pregabalin (3-10 mg/kg/day, BID). Corticosteroids do not affect the outcome but can be used during the acute phase to shorten the duration of pain and improve recovery. A range of motion exercises and occupational therapies are recommended until strength recovers to maintain the normal function of the affected limb [37].

Osteomyelitis-Neuritis

Apparent limb weakness (pseudoparalysis) caused by pain is a well-recognized phenomenon [49]. Neonatal osteomyelitis of the humerus is rare but is commonly accompanied by ipsilateral pseudoparalysis than brachial neuritis. One should think of the latter in those who do not recover with antibiotic treatment [10,50].

Clinical Features

It occurs predominately during infancy. The initial feature is a flaccid arm without pain or tenderness. Body temperature may be elevated. Pain develops on movement of the shoulders, and tenderness to palpation follows. No swelling is present and deep reflexes may be depressed or absent [51].

Pathogenesis

Høst et al. [10] suggested peripartal strain of the shoulder region as a possible contributing factor in the development of osteomyelitis and subsequent neuritis in those below 8 weeks of age. Also the close anatomical proximity of the osteomyelitis to the brachial plexus suggests a different pathogenesis which might be either direct spread of

infection, soft tissue oedema or ischemic neuropathy due to the inflammatory involvement of the vasa vasorum [50,52].

Diagnosis

One should suspect osteomyelitis of the proximal humerus when brachial plexitis develops during infancy. Radiographs of the humerus may show the destruction of the lateral margin by the end of the first week, and radioisotope bone scan shows a focal area of uptake in the proximal humerus, the scapula or both shortly after the onset. After 3 weeks, EMG shows patchy denervation in the muscles innervated by the upper plexus. These results support the idea that this is a true plexitis and not just a painful limb. Aspirates from the shoulder joint or blood culture identify the organism. Group B Streptococcus is often isolated in specimens from young infants. Older children have other bacterial species.

Management

Three to 4 weeks of intravenous antibiotic is the recommended treatment. A trial of short course oral corticosteroid therapy may shorten the duration of illness, and enhances it rapid recovery [37]. Recovery of arm strength may be incomplete.

Conclusion

Although IBN is well documented in the adult literature, it is a rare neurological disorder in children with relatively few cases having been reported with diverse aetiology. It is considered to be autoimmune in origin. It has distinct clinical features in children when compared to adults. The clinician must have a high index of suspicion to make the diagnosis. It should be suspected in children with a sudden onset of painful upper extremity palsy, as well as in patients with painless deficits. The majority of patients have no preceding events, while in others specific events did display a clustering depending on age. The pain and bilateral affection seem less common and recovery is quick. The paediatric phenotype has a milder presentation and a slightly better prognosis than the adult form. The presence of dysmorphic facial features and a family history of recurrent BN should lead to genetic analysis and the suspicion of the HNA variant. Neuroimaging and ancillary tests such as CSF analysis and electrophysiological studies should be reserved for less clear-cut cases. EMG will reveal a patchy denervation of individual nerves or branches of the plexus and eventually confirm the diagnosis. Corticosteroids have no proven efficacy, but a trial of short course is recommended as it shortens the duration of painful symptoms and accelerates recovery in some patients. Intravenous immunoglobulin showed promising results in latest studies.

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