Current Approach to Obstetric Brachial Plexus Palsy

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Abstract

Obstetrical brachial plexus palsy (BPP) is defined a flaccid paresis caused by damage of brachial plexus before or during delivery. Beyond 80-90% of patients may develop spontaneous remission; in 5-25% may develop lifelong disability. Recovery in 2 weeks period is an indicator of good prognosis. Although magnetic resonance imagination is often used for screening method, ultrasonography is detected as a rapid, visible, reliable method in recent years. Electrodiagnostic studies provide us for disease origin, severity, prognosis and anatomic localization. In diagnosis and clinical evaluation there have been lack of specific scales and methods for BPP patients. Treatment program consume of conservative (physical therapy, occupational therapy and botulismus toxin A) therapy and surgery. In surgery: neurolysis, nerve graft reconstructions and osteotomies could be done. Still, the timing and indication of surgery is controversial. Recently there is a tendency for doing surgery in 3-6 months period in absent of remission signs. On the other hand with delayed surgery there have seen better results in some new studies so a common opinion arised for delaying surgery not to skip patients developing spontaneous remission.

Key words: Brachial plexus, surgery, palsy, ultrasound.

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Introduction

Obstetric BPP is flask paralysis which develops after traction is applied to the brachial plexus during a difficult birth. Prevalence has been reported of 0.5-5.1 per 1000 live births.
The risk factors for BPP are primarily births of 4 kg or more, a rapid second stage of delivery (<15 mins) and vacuum birth. Additional factors may include breech birth, maternal diabetes mellitus, multiparity, previous delivery of an infant with brachial paralysis, intrauterine torticollis, familial congenital BPP, maternal uterine malformation, congenital varicella syndrome, humerus proximal pressure, osteomyelitis of the cervical vertebrae, shoulder dysostosis, neoplasm (neuroma, rhabdoid tumor), humeral osteomyelitis, hemangioma, and rib exocytosis. BPP is more often encountered in overweight mothers (BMI >29) and those aged over 35 years. There is a higher incidence of BPP in vaginal births than in caesarean section births and it is more often seen in breech vaginal deliveries. The most common finding accompanying obstetric BPP is clavicular fracture. While there is no difference in gender of the newborns with BPP, most cases occur in spontaneous deliveries. BPP which develops in the newborn associated with insufficient placenta is known as Kaiser Wilhelm syndrome and is included in the obstetric BPP group [1,2].

Clinical Characteristics

5 sub-types have been defined according to the clinically involved roots:

1. In upper trunk involvement, there is damage to the $C_{5,6}$ roots. The most commonly seen type is known as Erb-duchenne paralysis.
2. In upper-mid trunk involvement, the C_{5-7} roots are damaged.
3. In lower trunk damage, the C_8-T_1 roots are damaged, which is known as Klumpke paralysis.
4. In total brachial plexus damage the C_5-T_1 roots are damaged. This is the most severe type seen.
5. Horner syndrome (meiosis, ptosis, anhydrosis) may be seen as a result of damage to the upper sympathetic ganglions and C_8-T_1 roots. There may be concomitant respiratory problems associated with phrenic nerve damage [3].

In addition to these clinical sub-types, BPP patients were classified as mild, moderate and severe by Eng et al [4].

Appearance

Although magnetic resonance imaging (MRI) is often used as a diagnostic tool in practice in the diagnosis of BPP, in recent years the use of high-resolution ultrasound (US) has become widespread.
Various studies have researched the visualization with US of the cervical root and brachial plexus in newborns. The scarcity of connective tissue, muscle and nerves around the brachial plexus in newborns makes differentiation more difficult. In addition, an excess of brown-colored fat tissue leads to a different appearance. Consequently, there has been increased use in recent years of US as a non-invasive imaging technique to visualize cervical roots in the

obstetric examination of newborns. As a result of examination with high-resolution US in the diagnosis of brachial plexus root lesions, very few cases are missed in the preoperative ultrasonographic evaluation and a swift diagnosis can be made with correct determination of the localization of the root lesions [5,6].

Even though it is initially difficult to see the brachial plexus on US, it is an examination which is easy to apply, very quickly and provides theoretical experience. Roots are correctly diagnosed according to the superficial position of the C_5 in inter scalene space and the form of the C_7 transverse process in the paravertebral cavity. The cable-car technique allows easy monitoring of the root, shaft and trunks towards the supraclavicular fossa. In experienced hands, sufficient information is provided for thoracic outlet syndrome, traumatic events and tumoral diseases. In these cases although MR is still the standard imaging method, with high-resolution and dynamic character for which experience has not yet been gained, US is an excellent additional diagnostic method [7].

In a study in which the severity of BPP in newborns was quantitatively evaluated with US, the ultrasonographic properties of the muscles after damage were examined. The muscle thickness of the elbow flexor muscle group was measured with US and compared with the undamaged side with classification as normal, moderate and severe. When damaged muscles were compared with normal ones, severe damage was seen at a rate of 15% in thin muscles, moderate damage at 17% in thick muscles and there was no difference in muscles with normal function. The study concluded that a difference was seen in the muscle thickness in moderate and severe damage and the thickness was seen to increase with recovery [8].

The use of US has become more widespread in upper extremity surgery in recent years with the aim of preventing potential complications. Previous studies have found supraclavicular brachial plexus block under US guidance to be an effective and reliable method. No nerve damage, pneumothorax, arterial damage or systemic anesthetic side effects have been observed. US imaging of the brachial plexus in routine anesthesia examination as a guide for nerve blocks will become a routine procedure within a few years [9].

In electromyographic evaluation made 2-3 weeks after injury, valuable information is obtained regarding the time of injury, degree of injury, prognosis and localization. EMG has been observed to provide co-activation in antagonist muscles and re-innervation in voluntary muscles. Insufficient re-innervation is seen when recovery is not complete. The degree of nerve damage is classified as neuropraxia, axonotmesis and neurotmesis. With classification of the results of EMG applied to patients with BPP as severe, moderate and mild axonotmesis, prognosis can be made. EMG is a very valuable diagnostic method in the determination of patients with poor prognosis and root avulsions, but its importance is ignored. The best predictive method of prognosis in BPP patients is examination based on the muscle scoring system [10].

Treatment

Treatment approaches for BPP patients include physiotherapy, occupational therapy and surgical treatment. There have been randomized, controlled studies related to the choice of conservative or surgical treatment. Recovery starts in the first 3 months and continues until

the age of 2 years. Spontaneous recovery is seen in most patients (80-90%) because the treatment decision is made according to the patient history, physical examination, EMG and imaging findings [11].

Rehabilitation

The aim of the first stage of a rehabilitation program is to prevent contracture and deformities through the inclusion of tactile stimulus and home activity education to increase sensory differentiation and encourage active movements with joint range of motion exercises [12,13]. Severe contractures can be prevented with active and passive stretching, flexibility exercises, myofascial relaxation techniques and joint mobilization. In addition, hand-wrist resting splints, wrist and elbow extension splints and dynamic elbow flexion-extension splints may be prescribed to help movement and prevent contracture.

Botulinum toxin A is used in BPP to reduce antagonist muscle co-contraction and increase range of movement. Joint contractures are caused by an imbalance in the muscles around the shoulder and elbow, co-contraction abnormal motor performance and bone deformities. Although conventional therapies such as physiotherapy and educational therapy are often used, they remain insufficient. Studies made on the use of botulinum toxin A to increase movement in the treatment of BPP have shown good results to have been obtained with a reduction in abnormal co-contractions of antagonist muscles [14].

Prognosis

Although 80-90% of patients are seen to recover spontaneously, permanent disability develops in 5-25%. Previous studies have reported that if recovery occurs in the first 2 weeks, that is an indicator of good prognosis and full recovery. Therefore, clinical differences can be seen in each patient. In addition to EMG, MRI and US methods, various evaluations and measurements are used to determine prognosis and treatment. These measurement methods are based on the International Function, Disability and Health classification system (IFC) measurements of body function and structures. However, there is inconsistency in the functional measurements based on the activity and participation levels in the IFC. While some of the evaluation methods used (active movement scale, Toronto scale score, Mallet score, assisted hand skills evaluation, comparative tool for pediatric data results) are scales used in the evaluation of the BPP population, there has been observed to be a lack of a valid, reliable method specific to this disease. There is a need for the future development of evaluation scales specific to this disease, taking into account the spontaneous recovery of the affected arm and the psychosocial status of the patient [15].

Patients with BPP may encounter various complications throughout their lives. Complications which may develop include contractures, bone deformities (gleno humeral deformities, glenoid dysplasia, posterior shoulder dislocation), scoliosis, agnosia in the affected extremity, cosmetic (nail and skin infections) and psychosocial problems. These complications cause negative effects for both the child and the family. Family education is of great importance in the adaptation of the child to the community [13-15].

Surgical Treatment

BPP surgery requires correct timing and indications. The vast majority of patients recover in the first 3 months. While some specialists think that surgical intervention is not necessary in the early stage as there will be spontaneous recovery within the first year, others purpose intervention within the first 2 months to reduce delayed recovery. Studies are still ongoing on the subject of surgical timing [16].

Surgical interventions are classified as early and late stage. There are 2 types of early surgical intervention: the first is neurolysis removing scar tissue while protecting nerve fibers and the other is nerve graft reconstruction using a nerve (usually the sural nerve) as the donor. In Figure 1, the surgical scar is seen of right sural nerve transfer at 9th months of a 6-year old male patient with C_{5-7} root involvement in obstetric brachial plexus paralysis. The child was born with a high birth weight delivered vaginally by a diabetic mother.

Figure 1. The surgical scar is seen of right sural nerve transfer at 9th months of a 6-year old male patient with C_{5-7} root involvement in obstetric brachial plexus paralysis.

In late surgical interventions, tendon transfer or osteotomy is performed. The aim in tendon transfers is to protect internal rotation. In transfers, the triceps, biceps, pectoralis major and latissimus dorsi muscles are preferred. Humeral osteotomy with the aim of recovering function can be applied at older ages.

The timing and indications of surgical repair in BPP are controversial. In a study showing the results of early surgical repair in BPP, it was seen that especially with less force than gravity, better outcomes were obtained in biceps, triceps and deltoid muscle strength with surgical repair at the 6th month. Therefore, to determine the treatment decision in these patients, the correct approach would be referral to specialist centers to make the correct decision [16].

Nowadays, most specialists apply primary surgical repair if clinical recovery is not sufficient. There is a tendency towards surgical repair in the first 3-6 months of life [17]. Nevertheless, Erb palsy is overlooked in the spontaneous recovery seen in the early repair approach. In a study by Ali ZS et al [18] to determine the optimal time for surgical repair, better results were observed in the group which underwent surgical repair in the 12th month. The results of that study support the view that delayed surgery optimizes quality of life. Early surgery to be able to achieve spontaneous recovery is seen as an aggressive choice for infants. In addition, biceps muscle function is used as an indicator for the timing of surgery by several specialists.

When there is no recovery in the biceps muscle within the first 3 months in total BPP, this shows poor shoulder function and is used as an indicator for early micro-surgery.

Conclusion

Despite advances in the field of obstetrics, BPP is still often seen and causes lifelong permanent deficits. With the observation of lack of movement in the affected extremity, diagnosis is easily made soon after birth.

BPP affects not only the involved arm but through the complications caused, the whole life and psychosocial status of the patient is affected. Treatment includes conservative (physiotherapy, occupational therapy, botulinum toxin A) and surgical (early or late stage) treatments. There are still different views on the subject of the timing of surgical treatment due to spontaneous recovery observed within the first year. All conservative and surgical treatment methods provide short-term results. Nevertheless, treatment recommendations with long-term results and evaluation scales specifically for this population are still insufficient.

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