

## Short Communication

# Birth Palsy (Obstetric Brachial Plexus Palsy)

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In this short review article we wish to present our attitude to the indications and management of obstetric brachial plexus palsy cases based on our experience with more than 500 children. A great many international meetings and repeated discussions with colleagues concerning the subject have taken place in the past years.

**INTRODUCTION**

Most brachial plexus injuries in childhood are traction injuries following birth and are rare in older children. The reported incidence of birth palsy in different countries varies from 0.42-to 2.5 per 1000 births. Obstetricians are well aware of the danger of birth palsy, but are sometimes not able to prevent this. Macrosomia and shoulder dystocia during birth in vertex position is a well known cause of a brachial plexus injury. Thus previous occurrence of shoulder dystocia will present a warning that dystocia may occur again, but sometimes the possibility of a recurrence is discarded. Thus it is important to recognise the possibility of the presence of shoulder dystocia during labour. Also following breech presentations unilateral or bilateral brachial plexus injury may occur.

**ANATOMICAL FEATURES**

A lesion to the brachial plexus can be situated at any level from the origin of the nerve root to the division in the axillary region. The birth palsy usually results in a combination of partial or complete rupture of upper plexus elements and partial or complete avulsion of one or several lower roots supplying the brachial plexus. Avulsion means that intradurally some or several of ventral or dorsal rootlets emanating from the spinal cord are ruptured. Extraforaminal lesions are as a rule postganglionic lesions and are referred to as nerve ruptures.

**EPIDEMIOLOGY**

The published incidence of obstetric brachial plexus palsy varies considerably. Official registration institutions in The Netherlands (SIG) quoted an incidence of 1.02‰ in 1995, 1.34‰ in 1996, and 0.90‰ in 1997 [1]. The reported incidence from other countries in the last three decades of the twentieth century varies from 0.42 to 2.5 per 1000 births [2-6].

**CLINICAL FEATURES**

In most neonates, a functional disturbance of the arm is noted directly after birth, in some the cause is initially suspected to be a

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fracture. A local haematoma may point to the site of the trauma. A fractured clavicle is more frequent than a fractured humerus. Dislocations and/or fractures of the cervical spine emphasize the traumatic birth. Sometimes there are also fractures of the lower limbs. Bilateral lesions mainly occur following breech delivery and hemiplegic nerve palsy may then also be present. The future of the palsy is often difficult to assess directly after birth. In some cases function will recover in a matter of days.

On the whole the cases can be divided into four groups, following Narakas' classification system [7], which assesses the future of the palsy and excludes many mild cases, which recover full function in a matter of days.

Group I: This includes paralysis of shoulder abduction and external rotation, of elbow flexion and of supination of the forearm resulting in adduction-endorotation posture of the shoulder, extension of the elbow and fixed pronation of the forearm. It is caused by a lesion to roots C5 and C6, or upper trunk and is often called Duchenne's or Erb's paralysis.

Group II: This is an extended Duchenne's Erb's palsy: spinal nerve C7 is involved, as indicated by a palsy of the elbow, wrist and finger extensors and paralysis of the latissimus

dorsi. The elbow may lie slightly flexed and waiter's tip position of the hand is pronounced. In groups I and II pectoralis major, finger, and thumb flexors are usually active, but muscle atrophy often develops early. Distal sensation and vasomotor control are usually unaffected. In the majority of obstetric lesions there is paralysis of the upper roots only, of C5 and C6, or of C5, C6 and C7.

Group III: The injury has extended to spinal nerves C8 and T1. There is no Horner's syndrome. In some cases where the injury to the lower nerves of the brachial plexus is of a lesser degree, partial recovery of the hand function usually takes place and serious deficit of the muscles to shoulder and elbow persists. Sometimes the opposite is true and recovery of function is more pronounced proximally than distally. This is referred to as lower

brachial plexus or Klumpke's palsy.

Group IV: There is (almost) complete motor and sensory deficit of the arm. A Horner's syndrome is present.

## INDICATION AND SURGERY

When spontaneous recovery takes place in the first three months from proximal to distal this may indicate that we have a case which can achieve significant recovery without surgery. EMG can make an important contribution to the solution of the lesion's aetiology and the likely prognosis [8,9].

Reviewing the extensive reports on the natural history of birth palsy 20-30% residual deficits can be expected. The often-cited excellent prognosis for birth palsy cannot be considered to be based on criteria for scientifically sound evidence [10].

At present, surgical exploration of the brachial plexus in birth palsy cases is considered to be indicated if spontaneous recovery is insufficient at a preset age. Absence of biceps function at 3 months of age is regarded by many as the key indicator for surgery in upper brachial plexus lesions [11], in persisting total lesions, surgery should be performed earlier. Others use a combined score of different movements to decide whether nerve surgery may be performed at a later date but not later than 9 months [12].

If an upper brachial palsy is present, we often find at operation a neuroma of the upper trunk, sometimes also of the middle trunk; the neuroma is resected until a healthy zone is reached. When avulsion is present this is recognized and it means that reconstruction to the proximal root is impossible. Fortunately C5 usually withstands avulsion and may thus be used for reinnervation. Thus surgery often consists of a combination of nerve repairs and nerve transfers. Nerve repairs are possible when adequate proximal and distal stumps are available following resection of neuromas, but interposition of sural or other grafts is usually necessary to cover the gap. Nerve transfers are an adjunct if nerve repair is only partially possible. The transfer of a proximal uninjured nerve to the distal stump of an injured nerve can be very successful. Favourable transfers are: accessory to suprascapular nerve for recovery of shoulder functions and medial pectoral branches to musculo-cutaneous nerve if the pectoralis muscle is contracting [13] or intercostals to musculo-cutaneous nerve if the pectoralis muscle is not working. Several other transfers are available, but these are not widely used.

In complete lesions the principle of repair is that everything must be done to improve hand function. As the lower roots are avulsed in most cases, it will be necessary to use upper roots for reinnervation of distal arm muscles by connecting upper roots to the lower trunk.

## RESULTS

It was expected that primary surgery would diminish the sequelae of obstetric birth palsy. Although primary surgery achieved greater functionality, a number of joint problems persisted due to imbalance of muscular function which may cause serious malformations during growth. In particular these cause gleno-humeral deformities.

Upper brachial plexus lesion (Erb's palsy) is the most

common type. An isolated lower lesion (so-called Klumpke's palsy, although she did not in fact describe this [14]) is extremely rare (if at all present); it may be the clinical presentation of a total lesion with significant recovery of the upper part of the brachial plexus with persisting palsy of the lower plexus parts. Thus we are left with upper lesions and total lesions with lesion of upper plexus elements as the common denominator; hence it is understandable that impairments and disabilities by glenohumeral deformities are most common, although they are less frequent in patients who had early nerve surgery. It is, therefore, important to offer nerve reconstruction when the prognosis is known.

At the beginning of the last century, when nerve reconstruction was not yet widely practiced, the occurrence of a fixed internal rotation contracture of the shoulder in 40-60% of cases was described [15-17]. In 1934, L'Episcopo [18] concluded that the disability resulting from upper obstetric palsy is essentially often due to a severe internal contracture of the shoulder and this opinion is still valid. From these experiences we are familiar with many aspects of the shoulder problems and some surgical solutions. A number of deformities may also develop in spite of primary (nerve) surgery, such as:

1. Posterior subluxation of the humeral head: passive lateral rotation of the arm in the shoulder is restricted. There is no secondary deformity of acromion, coracoid or glenoid.
2. Posterior dislocation; the humeral head can be seen and palpated behind the glenoid. Reposition of the humeral head is possible causing a "click". Passive lateral rotation is more restricted.
3. Complex subluxation/dislocation of the humeral head: at this stage marked skeletal deformities are present such as elongated coracoid, elongated and downward hooked acromion, bifacet glenoid, retroversion of the glenoid, torsion deformity of the humerus. Passive external rotation is usually impossible [19].

It is clear that prevention of internal rotation deformity of the shoulder is necessary in obstetric brachial plexus palsy, but scoring while assessing active shoulder function may give rise to serious disagreement about indications for surgery [20]. Thus the parents are instructed to exercise the arm. Sometimes this is not sufficient to prevent contracture, necessitating surgical measures. First of all, persisting shoulder impairment due to internal rotation contracture and concomitant external rotation weakness around the shoulder needs attention. Subscapular release or subscapular tendon lengthening is sometimes required at an early stage when contracture is evident. Then patients with rotator cuff muscle imbalance, minimal joint contracture and no glenohumeral deformity are treated with latissimus dorsi transfer, sometimes with additional teres major tendon transfer or humeral derotation osteotomy. Patients with a glenohumeral deformity or dislocation are treated with some form of surgical reduction supplemented by tendon transfers and musculocutaneous lengthenings.

In the elbow, insufficient flexion, extension or pro- and supination may be present. For elbow flexion a flexor-pronator plasty (Steindler's operation [21]) may be indicated. To improve

pronation, especially in supination contracture, osteotomy of the radius is undertaken, forcing the hand in pronation, eventually supplemented with biceps rerouting transfer. Elbow extension is usually sufficiently enhanced by the force of gravity.

Weakness of wrist and/or finger extension is a recurring problem both in upper brachial plexus lesions and in total lesions following initial nerve surgery. If strong wrist and finger flexors are present, it is possible to deal with this problem using tendon transfer. The results of hand function following nerve reconstruction in total lesions are often modest but are greatly appreciated by the patients and their environment and are useful. Secondary surgery is not standardized for these patients, but is tailored to the functional result in the individual patient.

Although the same techniques are used in neonates as in adults the results are far better in neonates, because of shorter regeneration distances, stronger potential for regeneration, and the greater capacity for brain adaptation.

In obstetric palsy cases one of the biggest problems is being able to compare the results of the different treatment policies because of lack of consensus about the method of assessment and how to use the various scoring systems. This of course makes it complicated to compare, for example, the results of a more conservative attitude in treating obstetric palsy with a more aggressive surgical approach. Bae et al. [22], have demonstrated that the modified Mallet Classification, the Toronto Test Score and the Active Movement Scale are reliable methods of quantifying upper-extremity function in patients with brachial plexus birth palsy and may be used clinically and to assess functional outcomes.

Using the Mallet scale, Gilbert [23] reviewed 237 patients who had undergone brachial plexus reconstruction before 1996. Of these, 103 patients were operated for C5-C6 lesions. Including those patients (one-third) who had required secondary surgery, he concluded that 80% had a good or excellent result (grade IV-V) and 20% were average (grade III). In 61 patients who had C5-C6-C7 defects (7 patients had subscapularis release and 25 had tendon transfers for the shoulder following primary surgery), the results were excellent or good (grade IV-V) in 61%, average (grade III) in 29%.

Complete paralysis and associated root ruptures and avulsions are severe, and the results cannot be evaluated before completion of growth. From Gilbert's patient group, a series of 73 patients with complete paralysis operated on from 1978 to 1994 were followed with a mean follow-up of 6.4 years [24]. Secondary operations (mainly on the shoulders) were necessary on 123 occasions. Although the results show that the shoulders and elbows did not do as well as in upper-type lesions, because in these cases upper roots were used to reinnervate lower roots, the results at the level of the hand were encouraging, showing 75% useful results after 8 years, even in patients with avulsion injuries of the lower roots. In this paper, scoring scales for elbow and hand function were used.

In our series of more than 500 neurosurgical obstetric cases, we examined functional results of 171 cases who had undergone accessory nerve transfer to the suprascapular nerve with at least a 2-year follow-up. We evaluated active external glenohumeral

rotation, because this is particularly exerted by the infraspinatus muscle which is innervated by the suprascapular nerve and thus reflects specifically the result of the transfer. Results were evaluated in patients who had had the transfer more than 24 months earlier using the Mallet scale. In 4 cases, data were lost and 14 cases, which had required a latissimus dorsi transfer to improve external rotation, had to be excluded. Thus, we could evaluate 153 cases. Results were not good in 47 cases (Mallet scale 2 in 38 cases (22%) and Mallet scale 3 in 9 cases (5%)), but in 106 cases (62%) the Mallet scale was 4. Possible reasons for the failures could be technical, lack of neurotization of the infraspinatus muscle for unknown reason, or lack of central learning.

## SUMMARY OF MANAGEMENT OF PATIENTS WITH BIRTH PALSY

In obstetric lesions Gilbert's biceps rule in upper lesions is applied, while total lesions can be operated earlier. Thus we recommend that surgery should take place before three months of age for global palsy cases and at three months in upper (Erb's type) lesions, for best functional results. Even in complete lesions the end results at the level of the hand are encouraging. When spontaneous recovery takes place in the first month from proximal to distal this may indicate that we have a case which can achieve significant recovery without surgery. In partial lesions operation is advised when paralysis of abduction of the shoulder and of flexion of the elbow persists after the age of three months and neurophysiological investigations predict a poor prognosis. Operation is carried out earlier in complete lesions showing no sign of clinical recovery.

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