

Brachial Plexus Injury

Overview

The brachial plexus is the network of nerves that sends signals from spinal cord to shoulder, arm and hand. It lies in the posterior triangle of the neck between the scalenus anterior and scalenus medius muscles, at the root of the neck, behind the clavicle.

A brachial plexus injury occurs when these nerves are stretched, compressed, or in the most serious cases, ripped apart or torn away from the spinal cord.

Minor brachial plexus injuries, known as stingers or burners, are common in contact sports, such as football, or wrestling, when the brachial plexus nerves get stretched or compressed.

The *most severe brachial plexus* injuries usually result from motorcycle accidents and can leave the arm paralyzed, with a loss of function and sensation. Surgical procedures such as nerve grafts, nerve transfers or muscle transfers can be helpful to restore function.

Babies sometimes sustain brachial plexus injuries during birth. Other conditions, such as inflammation or tumors, may affect the brachial plexus.

Pathological anatomy

The brachial plexus is formed by the confluence of nerve roots from C5 to T1; the network and its branches. The plexus, as it passes from the cervical spine between the muscles of the neck and beneath the clavicle en route to the arm, is vulnerable to injury—either a stab wound or severe traction caused by a fall on the side of the neck or the shoulder.

Traction injuries are generally classed as supraclavicular (65 per cent), infraclavicular (25 per cent) and combined (10 per cent).

Supraclavicular lesions typically occur in motorcycle accidents: as the cyclist collides with the ground or another vehicle his neck and shoulder

are wrenched apart. In the most severe injuries the arm is practically avulsed from the trunk, with rupture of the subclavian artery.

Infraclavicular lesions are usually associated with fractures or dislocations of the shoulder; in about a quarter of cases the axillary artery also is torn. Fractures of the clavicle rarely damage the plexus and then only if caused by a direct blow.

The injury may affect any level, or several levels within the plexus, often involving a mixture of nerve root(s), trunk(s) and nerve(s).

An important distinction is made between preganglionic and postganglionic lesions. Avulsion of a nerve root from the spinal cord is a *preganglionic lesion*, i.e. disruption proximal to the dorsal root ganglion; this cannot recover and it is surgically irreparable. Rupture of a nerve root distal to the ganglion, or of a trunk or peripheral nerve, is a *postganglionic lesion*, which is surgically repairable and potentially capable of recovery.

Lesions in continuity, generally have a better prognosis than complete ruptures. *Mild lesions (neurapraxia)* are fairly common and may be caused by comparatively trivial trauma such as sudden compression by a tight harness or motor vehicle seatbelt; these recover spontaneously but mild residual symptoms may prove a nuisance for many months.

Causes

Damage to the upper nerves that make up the brachial plexus tends to occur when your shoulder is forced down while your neck stretches up and away from the injured shoulder. The lower nerves are more likely to be injured when your arm is forced above your head. These injuries can occur in several ways, including:

- **Contact sports.** Many football players experience burners or stingers, which can occur when the nerves in the brachial plexus get stretched beyond their limit during collisions with other players.
- **Difficult births.** Newborns can sustain brachial plexus injuries when there are problems during birth, such as a breech presentation or prolonged labor. If an infant's shoulders get wedged within the birth canal, there is an increased risk of brachial plexus palsy.

- **Trauma.** Several types of trauma — including blunt trauma like motor vehicle accidents, motorcycle accidents or falls and penetrating trauma like in war injuries or stab wounds — can result in brachial plexus injuries.
- **Inflammation.** Inflammation may cause damage to the brachial plexus. A rare condition known as *Parsonage-Turner syndrome* (brachial plexitis) causes brachial plexus inflammation with no trauma and results in paralysis of some muscles of the arm.
- **Tumors.** Noncancerous (benign) or cancerous tumors can grow in the brachial plexus or put pressure on the brachial plexus or spread to the nerves, causing damage to the brachial plexus.
- **Radiation treatment.** Radiation treatment may cause damage to the brachial plexus.

Obstetrical Palsy

Obstetrical palsy is caused by excessive traction on the brachial plexus during childbirth, e.g. by pulling the baby's head away from the shoulder or by exerting traction with the baby's arm in abduction. Three patterns are seen:

(1) *upper root injury (Erb's palsy)*, typically in overweight babies with shoulder dystocia at delivery.

(2) *lower root injury (Klumpke's palsy)*, usually after breech delivery of smaller babies.

(3) *total plexus injury*.

Incidence

There is a wide variation in reported figures ranging from 0.15 to 3 per 1000 live births. These figures reflect health care availability, reporting methods, referral bias and population differences. In general, a figure of 1:1000 live births is generally agreed upon as an average of various series.

Causes :

Foetal

- Macrosomia
- Breech

Maternal

- Diabetes in pregnancy
- Shoulder dystocia
- Small stature/cephalopelvic disproportion
- Primi or multiparity
- Prolonged second stage of labour.

Clinical features

The diagnosis is usually obvious at birth: after a difficult delivery the baby has a floppy or flail arm. Further examination a day or two later will define the type of brachial plexus injury.

Erb's palsy is caused by injury of C5, C6 and (sometimes) C7. The abductors and external rotators of the shoulder and the supinators are paralysed. The arm is held to the side, internally rotated and pronated. There may also be loss of finger extension (waiter's tip). Sensation cannot be tested in a baby.

Klumpke's palsy is due to injury of C8 and T1. The baby lies with the arm supinated and the elbow flexed; there is loss of intrinsic muscle power in the hand. Reflexes are absent and there may be a unilateral Horner's syndrome.

Total plexus injury the baby's arm is flail and pale; all finger muscles are paralysed and there may also be vasomotor impairment and a unilateral Horner's syndrome.

X-rays should be obtained to exclude fractures of the shoulder or clavicle (which are not uncommon and which can be mistaken for obstetrical palsy).

Diagnosis

To diagnose brachial plexus injury, a review of the signs and symptoms through a detailed history and conducting a proper physical examination most of the time will be sufficient, and to diagnose the extent and severity of the injury, we may have one or more of the following tests:

- *Electromyography (EMG) and Nerve conduction studies.*
- *Magnetic resonance imaging (MRI).*
- *Computerized tomography (CT) myelography.*
- *Angiogram.*

Management

Over the next few weeks one of several things may happen.

Paralysis may recover completely Many (perhaps most) of the upper root lesions recover spontaneously. A fairly reliable indicator is return of biceps activity by the third month. However, absence of biceps activity does not completely rule out later recovery.

Paralysis may improve A total lesion may partially resolve, leaving the infant with a partial paralysis.

Paralysis may remain unaltered This is more likely with complete lesions, especially in the presence of a Horner's syndrome.

While waiting for recovery, physiotherapy is applied to keep the joints mobile.

TREATMENT

If there is no biceps recovery by 3 months, operative intervention should be considered. Unless the roots are avulsed, it may be possible to excise the scar and bridge the gap with free sural nerve graft.

If the roots are avulsed, nerve transfer may give a worthwhile result. This is highly demanding surgery which should be undertaken only in specialized centers. The shoulder is prone to fixed internal rotation and adduction deformity. If diligent physiotherapy does not prevent this, then a subscapularis release will be needed, sometimes supplemented by a tendon transfer.

In older children, the deformity can be treated by rotation osteotomy of the humerus.

Prognosis

The site and type of brachial plexus injury determine the prognosis. Avulsion and rupture injuries require timely surgical intervention for any chance of recovery. For milder injuries involving build-up of scar tissue and for neurapraxia, the potential for improvement varies, but there is a fair prognosis for spontaneous recovery, with a 90 - 100% return of function