



Brachial Plexus in Infant during Delivery

DR. PRIYANKA RANJAN

PSYCHOLOGY

PATNA UNIVERSITY, PATNA

ABSTRACT

The peripheral nervous system is unique in its complexity and scope of influence. There are areas of interest in the anatomy, metabolism, physiology, and limb growth tropism of peripheral nerves.

The brachial plexus is important peripheral nerve functional unit and is extensively studied as a model for nerve injury management. It is a network of nerves that conducts signals from the spine to shoulder, hand and arm. The brachial plexus injuries are caused by damage to those nerves. Symptoms may include a lack of muscle control in the arm, hand, or wrist and a lack of feeling or sensation in the arm or hand.

KEYWORDS: Arm, Brachial Plexus, Erb's palsy , Motion, Neonatal Brachial Plexus Palsy, Nerve, Shoulder.

INTRODUCTION

The brachial plexus is a bundle of nerves around the shoulder. Lack of movement or weakness of the arm may occur if these nerves are damaged. This injury is called neonatal brachial plexus palsy (NBPP), brachial plexus birth palsy, or Erb's palsy. Erb's palsy is a form of brachial plexus palsy in infant. It is named by one of the doctors who first described this condition, Wilhelm Erb.

Causes:

Nerves of brachial plexus can be affected by contraction inside the mother's womb or during a difficult delivery. Injury may be caused by:

- 1) The baby's head and neck pulling toward the side as the shoulders pass through the birth canal.
- 2) Stretching of the infant's shoulders during a head-first delivery.
- 3) Pressure on the infant's raised arms during a breech (feet-first) delivery.

The following factors increase the risk of neonatal brachial plexus palsy (NBPP):

- 1) Breech delivery
- 2) Maternal obesity
- 3) Larger-than-average newborn (such as an infant of a diabetic mother)
- 4) Difficulty delivering the baby's shoulder after the head has already come out (called shoulder dystocia).

Neonatal Brachial Plexus Palsy is less common than in the past. Usually cesarean delivery is used when there are concerns about a difficult delivery. Although a cesarean delivery reduces the risk of injury, it does not prevent it.

Neonatal Brachial Plexus Palsy may be confused with a condition called pseudoparalysis. This is seen when the baby has a fracture and is not moving the arm because of pain, but there is no nerve damage.

Treatment:

Brachial plexus injuries do not always need treatment. Some brachial plexus may heal without treatment. So many children who are injured during birth, they improve or recover by 3 to 4 months of age. Treatment for neonatal brachial plexus injuries includes physical therapy and surgery in some cases.

Most babies with brachial plexus birth palsy will recover both movement and feeling in the affected arm, often with daily physical therapy exercises. Parents play an active role in helping their infant recover maximum function in the affected hand. It is so important to diagnose and treat a brachial plexus injury as quickly as possible. Early treatment offers the best chance for an infant's fullest recovery.

- **What Happens in a Brachial Plexus Injury?**

During childbirth, a brachial plexus injury can happen if the infant's neck is stretched to one side.

The brachial plexus nerve network begins with nerve roots from spinal cord in the neck and reaches to the armpit. Nerves branch comes out from spinal cord and continue down the arm to the forearm, hand, and fingers.

When a strong force increases the angle between the shoulders and neck, the brachial plexus nerves might stretch or tear. This injury may also pull the nerve roots of the brachial plexus from the spinal cord. Damaged nerves carry poor sensation and make weak muscle movements.

- **What Are the Signs and Symptoms of a Brachial Plexus Injury?**

Signs of a brachial plexus injury usually include:

- 1) Full or partial lack of movement
- 2) Numbness
- 3) A weakened grip
- 4) An odd position (the arm may bend toward the body or hang limp)

- **How Is a Brachial Plexus Injury Diagnosed?**

Neonatal Brachial Plexus Injuries (NBPI) are a common type of birth injury. But, identifying them in newborns can be hard. Doctors will check the affected arm for position, numbness, and grip strength. They also will check a infant's Moro reflex which means startle response. This is when a baby throws out the arms and legs, then curls them in when startled.

A specialist who treats babies with these injuries usually oversees the tests and treatments. The specialist might order:

- 1) X-rays
- 2) Nerve Conduction Study (NCS)
- 3) Magnetic Resonance Imaging (MRI)
- 4) Computed Tomography (CT or CAT scan)
- 5) Electromyogram (EMG) to test nerve and muscle function.

- **How Is a Brachial Plexus Injury Treated?**

Most infants with a brachial plexus injury regain both feeling and movement in the affected arm. In mild cases, this might happen without treatment. Other babies might need daily physical therapy. A physical therapist will show parents exercises to do at home to help their baby get better. Massage techniques also can help.

For a more severe injury, a child will be cared for by a team of specialists from neurology, neurosurgery, orthopedic surgery, occupational therapy, physical medicine and rehabilitation, physical therapy.

If weakness, pain, or numbness continues then surgery often can help. Surgical treatments include:

- 1) Nerve grafts: A nerve from another area of the body, such as a rib or the back of the foot, is used to patch an injured brachial nerve. A nerve framework from a manufactured nerve growth or an organ donor guide also can encourage nerve growth.
- 2) Muscle transfer: A muscle, usually taken from the child's thigh, replaces a paralyzed muscle in the arm.
- 3) Nerve transfer: A healthy nerve in the area or some of its fibers restores injured nerve connections.
- 4) Tendon transfer: Tendons are moved from working muscles near the shoulder to increase arm movement and control.

After surgery of brachial nerve, it may take 8 months or longer for new nerve function to show improvements in strength, range of motion, and control may continue for up to 18 months or more after surgery. It is important to diagnose and treat a brachial plexus injury as quickly as possible. Early treatment offers the best chance for a infant's fullest recovery.

Peripheral nerves which are located outside the brain and spinal cord are bundles of information-carrying neurons that are something like old-fashion phone lines. The part of each nerve that carries the electrical impulse and transmits the message is called the axon. The insulating coating around each axon is called the myelin sheath. Bunches of sheathed axons which are bundled together in fascicles, which are themselves bundled together in a single nerve.

Children's axons are remarkably regenerative and, if damage is limited to the axons alone, their nerves often repair themselves within weeks or months. In such cases however, therapy will help to ensure that the maximum range of motion is restored. At the other end of the spectrum, if the entire nerve is severed or destroyed, only

surgical reconstruction or nerve replacement can restore control of the muscles or the sensation delivered by the damaged nerve.

- **Diagnosis of Brachial Plexus Injury**

Most of the brachial plexus injuries we have seen are birth related. If a newborn patient shows signs of complete brachial plexus injuries where the arm, hand and shoulder are all paralyzed, pediatricians should refer the patient to a multidisciplinary brachial plexus center, such as Lucile Packard Children's Hospital Stanford, for evaluation. In cases of Erb's palsy is that where a child can no longer flex the elbow and loses some range of motion in the shoulder or of Klumpke's palsy is that where the hand and wrist are paralyzed, pediatricians will sometimes track the patient's progress for the first month or two, during which time many cases begin to resolve on their own.

In the first months after injury, parents and therapists should perform gentle range-of-motion exercises to maintain passive range of motion and avoid joint stiffness. By the time the patient is three months of age, if she can bend her elbow, move her wrist upward, and straighten her thumb and fingers, these are excellent signs that the nerves are healing on their own.

On the other hand, if the patient's condition remains unimproved after three months of age, pediatricians should refer the patient to a center with specialized BPI expertise. In such situations, sequential exams should be performed until the infant is six months old, and if elbow flexion or shoulder motion still have not recovered, surgical exploration and repair or reconstruction are probably necessary.

Older children with traumatic, infection-related or tumor-related BPIs are easier to diagnose than infants because they can report sensation and follow instructions during examination. For example a Brachial Plexus Injury causes tingling or numbness in the injured hand or arm, but it is impossible to identify such sensations in children who cannot speak. A child may also experience weakness in their upper arm, have difficulty lifting or moving it, but unless they can understand a physician's instruction to try to move it, this can be hard to confirm.

Some common comorbidities of BPIs can also help with diagnosis. For example, ptosis (droopy eyelid) and asymmetrical pupil dilation, both resulting from associated nerve damage, are sometimes indicators of a BPI. Other occasional comorbidities are broken ribs, clavicle, or upper arm or a dislocated shoulder, resulting either from the original injury that caused the BPI or from the long-term muscle imbalance that comes with the nerve damage.

In addition to tracking recovery with serial physical exams and sometimes sonograms or MRIs, older patients may also undergo electromyograms (EMGs), which are tests that record the vitality of electrical current in muscles. Electromyograms can help assess nerve function and track recovery.

- **Brachial Plexus Surgery**

If brachial plexus surgery is required, many centers will schedule a date for an initial exploratory operation used to plan the actual repair itself. Because our entire team works together on each child, we typically accomplish that critical exploratory procedure during the same operation as the repair or reconstruction. Combining the procedures and eliminating an additional surgery reduces the patient's exposure to anesthesia, shortens her hospital stay, expedites recovery, and is easier on both the patient and her family.

Worldwide, nerve reconstruction is the most common surgical intervention for children with birth-related BPIs. After the extent and nature of the injury are evaluated during the exploratory part of the procedure, the damaged portions of the brachial plexus nerves are removed. Sections of nerve are then borrowed from

elsewhere in the patient, typically from the patient's legs, and grafted in place of the injured ones. This allows the axon to grow back across the injured area and restore some function to the muscle and nerve. Removing the nerve from the leg causes loss of sensation on the outer side of the foot but is not disabling. Although complete recovery is rare with nerve reconstruction, the surgery usually results in a significant improvement in function.

Nerve transfer, a more recently popularized brachial plexus surgical technique, redirects a nearby intact section of nerve to the muscle that is nonfunctional due to the injury. The redirected, working nerve supplies the muscle with an alternative functioning connection to the brain. Over time, and with the help of a therapist, the patient can learn to operate the muscle with the new nerve.

Nerve transfer and nerve reconstruction take around 4 hours to perform, and patients generally spend another day in the hospital for observation and recovery before they are sent to home.

- **After Brachial Plexus Surgery**

Arms are covered in a protective dressing for 3 weeks after surgery, and patients return for wound evaluation after these initial 3 weeks. Once they are at home and recovered, patients will generally work with a therapist. Nerve recovery can take up to 2 years, and patients typically return for a follow-up visit approximately every 3 months for 2 years after surgery to monitor functional recovery.

Some brachial plexus injuries repair in weeks or months. But others may cause challenges for years or for a patient's entire life. Working with an experienced multidisciplinary team of dedicated specialists who appreciate and employ the full spectrum of possible treatments and can adjust and optimize clinical strategies at each stage grants a huge advantage to patients.

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