Brachial Plexus Palsy

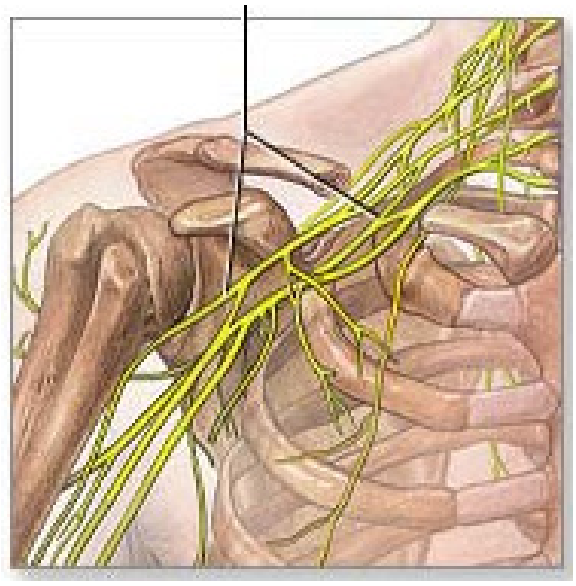
INTRODUCTION

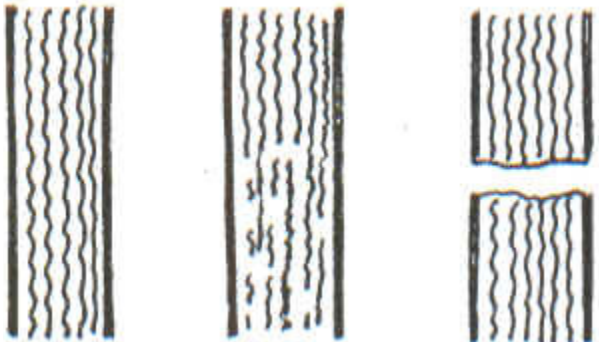
Your child has been diagnosed with a brachial plexus injury. This condition is also called Erb's Palsy or obstetrical birth palsy. The injury is due stretching of the nerves during the delivery process. The injury may range from mild to severe, but there are limited options to assess the extent of damage or to predict the potential for recovery. Most infants will recover both movement and sensation in the affected arm without surgery. But parents must be active participants in the treatment process to ensure maximum functional recovery.

BACKGROUND

The brachial plexus is a network of nerves that come from the cervical spine, down through the shoulder and into the arm that are responsible for movement and sensation to the arm, hand and fingers. The nerves come from the spinal cord and then branch and join together near where the neck joins the shoulder, in a group that is called the brachial plexus.

Brachial plexus injuries are uncommon and affect less than 2 out of every 1,000 births. Brachial plexus injuries are more common in newborns who come through a difficult labor and delivery, such as with a large baby, a breech presentation, or a prolonged labor. During labor, the brachial plexus nerves on one side of the baby's neck were probably stretched and damaged. If just the upper nerves are affected, the condition is called Erb's palsy. The infant may not be able to move the arm, but may be able to move the fingers. Injuries that involve both the upper and lower nerves are more severe and result in a condition called global brachial plexus palsy. The severity of the injury is a function of what parts of the nerve are damaged. The primary nerve cell is called a neuron which has very long arms called axons that carry the nerve signals. The axons are surrounded by supporting cells that create a coating of a special substance called myelin. Nerves are made up of multiple large groups of myelin coated axons, which are surrounded and protected by tough fibrous tissue. Mild stretch injuries are the most common and are called neuropraxia (new-rah-PRAK-see-ah). The nerve is damaged enough to block function, but the nerve is not structurally damaged or torn. This type of injury




Neuropraxia Axonotmesis Neurotmesis

recovers quickly, usually within a few weeks or months. If the nerve is stretched more, the axon will be structurally damaged, but its myelin coating will stay intact. This type of injury is called axonotmesis. The part of the axon that is below the point of injury will die, but the upper part of the nerve cell will regrow a new axon within the existing myelin coated pathway. This process is slow but quite reliable. The rate of growth is about 1 inch per month, so for an infant it takes 3-4 months for recovery of the biceps which is about 3-4 inches below the brachial plexus. Severe stretch injuries disrupt the axon, the myelin coating, and sometimes the fibrous sheath. This type of injury is called a neurotmesis and has less chance of recovery. The degree of disruption can be complete with the 2 ends separated by a gap or the 2 ends may still be partly connected. Like the axonotmesis injuries, the part of the axon that is below the point of injury will die and the upper part of the nerve cells will attempt to regrow a new axons. The recovery of nerve function depends on how well the new axons can cross the point of disruption. If the two ends are still partly together, the axons can find the pathways to regrow down to the muscles. If the gap at the disruption is narrow, some of the axons will be able to jump the gap and find pathways to regrow. If the gap is wide, the regrowing axons will get stuck in the gap. If at least some of the axons can cross the gap and reach the muscles, usually they can develop the capacity to control more of the muscle than normal axons. This means that even a small number of repaired axons can learn to control a big muscle and get fair to good recovery of muscle strength. It is also interesting that the axons don't even need to find their original pathways. If an axon that used to control the biceps is able to grow across the gap and ends up growing down a pathway that controls wrist motion. The brain has the ability to adapt so that nerve can be used to control wrist motion instead of elbow flexion. This is called remapping and is part of the brains amazing "plasticity".

Other problems that limit how well the arm recovers relate to the muscle and joints. Muscles need nerve stimulation to stay healthy. If the muscles don't get nerve stimulation within 12 to 18 months they may become fibrotic and they will not recover function even if the axon regrows down to it. Also, joints are dependent on motion to maintain the cartilage and smooth motion. If a joint is not moved appropriately, it can be stiff or may not grow properly and become dysplastic (malformed). It is important to note that manually moving and massaging a weak limb will help to prevent stiffness and fibrosis in the muscles and joints while the nerves are recovering.

DIAGNOSIS

A newborn with a brachial plexus palsy will typically hold the arm straight down at the side and will not move it. Sometimes, the arm may be slightly turned, with a bent wrist and straight fingers. A droopy eyelid on the affected side may indicate a more severe injury. The diagnosis is made by physical examination. The doctor may order an X-ray or magnetic resonance image (MRI) to see if there is any damage to the bones and joints of the neck and shoulder. During the

treatment process additional testing may include electromyogram (EMG) or nerve conduction studies (NCS) to see if any nerve signals are present in the upper arm muscle.

TREATMENT

Most newborns with brachial plexus palsy will show fair to good spontaneous recovery. About half of the nerve injuries will have good spontaneous recovery and another 25% will have fair recovery. Initial treatment is to gently stretch and move the arm to keep the joints and muscles in good shape, while waiting for signs of nerve recovery. The first sign of recovery is active elbow flexion. If this occurs within 3 months, this is a good prognostic sign that additional recovery will follow. Daily exercises to stretch and move the arm should continue as the nerve recovery continues. Your baby will be examined each month to see if the nerves are recovering. It may take up to two years for complete recovery. During this time, range of motion exercises are important to keep the joints from getting stiff.

If there is not return of biceps function by 3-4 months, it is possible to test the nerves and if there are no signs of nerve recovery, surgery is sometimes recommended to salvage some nerve recovery. However, nerve surgery is complex and does not always restore full function, especially for infants over one year of age. Even with surgery, it may take many months or even years for nerves repaired at the neck to reach the muscles of the lower arm and hand. Surgical exploration and grafting prior to 3 months of age is a controversial topic. Some centers advocate early surgical intervention to optimize results. While, there is some data supporting this, there are also good arguments to wait, given that it is a major surgery on a young infant for a condition that seems to do well with out surgery in more than 50% of patients.

Some children with brachial plexus injuries will continue to have weakness in the shoulder, arm or hand. They may find it difficult to raise the hand over the head, to turn the hand palm up, or to extend the wrist. In some of these cases, a surgical procedure called tendon transfers may be helpful. Tendons are the connective tissues between muscle and bone. The surgeon will separate the tendon from its normal attachment and reattach it in a different place. This is often helpful in improving shoulder and wrist motion as well as elbow position and hand grip. Tendon transfers are generally performed when the child is old enough to follow instructions. After surgery, the child will have to wear a cast for about six weeks and a splint at night for up to six months. Physical therapy may continue for up to one year after surgery. Your doctor will discuss the various treatment options with you and make a specific recommendation based on your child's individual situation. Do not hesitate to ask questions; there is much that parents can do to help ensure a good functional outcome.

CAUTIONS

Because your baby cannot move the affected arm normally, it is important that you take an active part in keeping the joints limber and the functioning muscles as fit as possible. Your doctor will

recommend physical therapy and range of motion exercises. Do these exercises with your baby every day, two or three times a day, beginning when your baby is about three weeks old. The exercises will maintain a range of motion in the shoulder, elbow, wrist and hand and prevent the joint from becoming permanently stiff, a condition called a joint contracture.

Sometimes, the affected arm is noticeably smaller than the unaffected arm. This occurs because the muscles are smaller and arm is not used as much. You should also remember that your child is very adaptable. Be supportive and encouraging; focus on what your child can do. This will help your child develop a healthy sense of self-esteem and adjust to any functional limitations.

EXPECTED OUTCOMES AND COMPLICATIONS

Because this is an uncommon injury and it takes years to know the outcome of various treatments, there is limited data to compare various treatment options. The reported incidence of full spontaneous recovery varies widely from 12-80%. When there is some muscle activity by the first month and a normal contraction by the second month, full recovery can usually expected. Good results can be expected when the child has some contraction of biceps and deltoid at the third month and full function by the fifth month. There can be residual weakness of the external rotation of the shoulder and slight weakness of elbow flexion and shoulder abduction. When biceps activity is not seen by the third month, function will usually not recover to normal. This is the group that seems to benefit from nerve surgery at a young age, but nerve surgery also does not always lead to full recovery. If there is residual weakness, surgery after age 3 can be done to transfer muscles to improve shoulder abduction. Limited shoulder motion due to stiffness or poor joint development was a common problem in the past, but more recent emphasis on early and continued stretching and range of motion exercises are expected to reduce this aspect of the long term outcome.

MORE INFORMATION

Further information can be obtained on the internet. Your local public library can help you explore these sources if you are interested. Two good sites for expert and peer reviewed information are the American Academy of Orthopedic Surgeons at www.aaos.org and the Pediatric Orthopedic Society of North America at www.orthokids.org.