When babies are born early (premature) and/or with a very low birth weight (less than 3.3 pounds or 1,500 grams), their body organs and tissues are very fragile and may be underdeveloped or not functioning properly, which may cause organ injury. These injuries may occur before, during or after birth. When injuries occur with tissues that involve the brain, they are grouped under the term *encephalopathy* [en-ˌsef-uh-LOP-uh-thee] of prematurity, which means brain injury in babies born early. These problems may range from mild to severe. Some infants may have long-term effects. The extent of problems depends on where the damage occurs and how severe it is. In some cases, early treatment may help avoid further damage. Also, close medical follow-up and appropriate interventions throughout childhood can help many infants and parents address problems that may occur as a result of brain injury. To learn about these problems and how they are treated, it is helpful to take a brief look at how the brain works.

**A brief look at the brain:** The brain is known as the central organ that serves as the control center for the body. It connects with a network of nerves that run throughout the body. These nerves send signals between the brain and parts of the body. This process controls all of our actions (such as movement), as well as our body functions (such as heartbeat and hearing).

The picture at the right shows some of the key tissues in the brain that can be injured in premature babies:

1. the network of blood vessels that takes oxygen and nutrients to brain tissue
2. a type of brain tissue called white matter (because it is white in color). This tissue is made up of the parts of brain cells that connect with other brain cells. These connectors are called *synapses* and serve as the highway for nerve signals traveling from one brain cell to another. Without this tissue, brain cells would not be able to send signals throughout the body.
3. spaces inside the brain called *ventricles* that are filled with spinal fluid. The ventricles form a canal network that connects to the spinal cord. The spinal fluid flows around the brain and through the spinal cord to serve as a cushion for these structures.
4. a type of tissue called grey matter, which controls higher level functions of movement and thought.
How does injury to the brain happen? The most common brain injury happens in premature babies. Brain injury may result from damage of the fragile blood vessels and/or the white matter in premature babies. Often, this is caused by a complex mix of the events listed below. These events can occur while the fetus is in the womb, during the delivery, or after birth.

- **Low supply of oxygen** — called hypoxia [hie-pok-SEE-uh]. Babies born before 37 weeks have a higher risk for this problem because their lungs and other organs are not yet fully formed and do not function as well as those in a full-term baby. While in the womb, the fetus obtains oxygen from the mother’s placenta. During the delivery, this supply of oxygen may decrease. Most full-term infants can adjust to this period of reduced oxygen because their own lungs quickly take over breathing. But, if the lungs and other organs are not fully mature (as in premature babies), they may not adjust to the reduced oxygen even with intense medical care, which can lead to hypoxia and brain injury.

- **Infection in the womb before birth, or infection in the baby after birth** — in either of these cases, this infection can cause the infant’s body to set up an infection-fighting response. This response, known as inflammation [in-fluh-MEY-shuhn], may damage fragile body tissues, such as those in the brain.

- **Decreased blood supply to the brain** — damage to tissues due to a lack of blood flow is called ischemia [i-SKEE-mee-uh].

Other health problems in the infant may create a series of changes in body systems, much like a domino effect. For instance, illness may create a sudden rise and fall in blood pressure, which can disrupt blood flow to the infant’s brain, which then injures brain tissue.

What types of brain injury can happen? Types of brain injury may include:

- **Intraventricular hemorrhage (IVH)** — blood leaks into the ventricles due to increased pressure in the baby’s fragile blood vessels. IVH sometimes causes a build-up of fluid in the baby’s skull (called hydrocephalus [hie-druh-SEF-uh-luhs]), which causes the head to enlarge.

- **Periventricular leukomalacia (PVL)** — damage to the white matter. PVL can occur in certain spots throughout the white matter or it can be spread throughout the tissue (called diffuse damage).

- **Hypoxic ischemic encephalopathy (HIE)** — a general term used to describe damage due to a lack of oxygen and blood flow to the brain.

Sometimes more than one of these problems may affect the infant. Talk to your baby’s doctors and nurses about the precise problem(s) that affect your infant and what can be done to help.

How will I know if my baby has a brain injury? There may be only a few visible signs. Some of the more subtle signs may include an initial limpness in the baby’s legs and trunk; decreased response to people, movement or touch; seizures; and poor feeding. The baby’s vital signs, such as heart rate, breathing, and body temperature, also help doctors know if there is a problem. Doctors may request a brain scan or ultrasound exam that creates a picture of the inside of the brain to help them see if there is any damage.

What can be done to help prevent or treat a brain injury? For infants, steps are taken in an attempt to avoid problems, such as a lack of oxygen, that can lead to brain injury. The NICU team works to maintain a careful balance of the baby’s fragile body systems. This means that aspects of your baby’s body systems, such as blood
pressure, oxygen level, and fluid levels (to name only a few), may be tested and monitored. In some cases, medicines may be given to control seizures. Other forms of treatment depend on the baby’s overall health and which type of injury has affected the baby:

- **For IVH** — if the IVH leads to a build-up of fluid and pressure in the head, doctors may remove excess fluid through a process called a *spinal tap*. This treatment involves inserting a needle into the spinal canal to withdraw the fluid. This may help prevent pressure from building up in the baby’s head. If fluid continues to build up in the head despite the spinal tap, doctors may place a shunt (a small tube) in this area to direct the excess fluid to other parts of the body, where it can be absorbed into the bloodstream. In some children, the shunt can be removed after a few weeks to months. In others, the shunt may need to remain in place for life. If your child needs a shunt, talk to the doctor about the shunt, how it works, and how long your child may need it.

- **For PVL** — research shows that infants with PVL may become more stressed than other infants by a variety of stimuli (such as light, sound and touch), because PVL affects the nerves that are involved in these functions.* Care in the NICU attempts to limit this stress as much as possible. Because PVL also affects the infant’s ability to coordinate actions (such as sucking and swallowing), these babies have a higher risk for feeding problems and poor growth.

- **For HIE** — in full-term and near-term infants, studies now show that lowering a baby’s body temperature may help decrease long-term damage due to a lack of oxygen.** This process is called *induced hypothermia* (hypo = below, thermia = body temperature). If this treatment occurs within the first six hours of the baby’s loss of oxygen, it has been shown to help prevent and/or to slow down damage to the brain and other organs (in some cases, though not all). This process is still being studied and may not yet be offered in some NICUs.

**What are the long-term effects of brain injury?** The effects of brain injury may range from mild to severe. How it affects your child depends on what part of the brain is damaged and on the extent of the injury. Long-term effects may range from problems with movement and coordination (called *cerebral palsy*), to problems with learning, hearing, and vision. The effects differ in each child, so it is not possible to predict the outcome.

Some effects of brain injury may not be noticed right away. When a child reaches school age, for instance, parents may notice more subtle effects such as problems with attention, learning, memory, and verbal skills. Children also may have problems with trying to balance emotion and behavior at this time. Since all of these problems affect one another, it is difficult to determine all the underlying causes. For instance, behavior problems may be due to the child’s feelings about having a physical problem, to nerve damage that affects the way the child processes information, or to a combination of both. Most likely, a complex mix of all these factors is involved.

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**Cerebral palsy (CP)** is a group of problems that happens due to damage in the part of the brain that controls movement. It causes problems mainly with the large muscles in the lower body, and leads to problems with walking and keeping balance. Check the sources listed at the end of this topic sheet for more in-depth detail about CP and sources of help.
Brain growth does not stop at birth. A child’s brain grows rapidly for the first five years of life. Since the brain is still in this process of growing and changing, it may be able to overcome or to work around some types of damage.*

What can parents do? Parents can play a vital role in their child’s growth and health. If your child has any damage to his or her brain, you play a key role in making sure your child has regular checkups with doctors and other types of services that are advised. This may include services that focus on your child’s learning, emotions, behavior, and motor skills (for instance, with a developmental pediatrician or neurodevelopmental specialist). This may include hearing and vision checkups. You can also learn about sources of help in your area, especially when your child begins school.

Keep in mind that it helps to keep a balance. Placing too much focus on problems that may occur can lead to undue stress for you and your child. While it is helpful to remain aware that problems may occur, try to balance this with a focus on your child’s strengths and talents.

Find the research

NICHD Cochrane Neonatal Review Group
www.nichd.nih.gov/cochrane
Neonatology on the Web
www.neonatology.org

Find out more: these websites may be helpful

American Academy of Pediatrics
www.aap.org/parents
Healthy Steps for Young Children
www.healthysteps.org
The Maternal & Child Health Library at Georgetown University
www.mchlibrary.info
National Center on Birth Defects and Developmental Disabilities
www.cdc.gov/ncbddd
National Institute of Child Health and Human Development
www.nichd.nih.gov/health/education
National Institute of Neurological Disorders and Stroke
www.ninds.nih.gov

Medline Plus®
www.nlm.nih.gov/medlineplus
Sidelines National Support Network
www.sidelines.org
United Cerebral Palsy
www.ucp.org
U.S. Department of Health & Human Services
www.healthfinder.gov
World Association of Infant Mental Health
www.waimh.org
Early Head Start National Resource Center
www.ehsnrc.org


This information is for educational purposes only and is not intended to substitute for professional medical advice. Always consult with a health care professional if you have any questions about the health of your baby.