



Intraventricular Hemorrhage and Periventricular Leukomalacia

Intraventricular hemorrhage (IVH) is bleeding inside the lateral ventricles. Bleeding frequently occurs in areas of high arterial and capillary blood flow, which most commonly occurs in the subependymal germinal matrix of the brain in preterm infants. Bleeding occurs in the first 72 hours of life for about 90% of affected infants, with at least half of affected infants experiencing bleeding in the first 24 hours (Gardner, Carter, Enzman-Hines, & Hernandez, 2011). IVH is the most common type of intracranial hemorrhage present in infants.

Risk factors for IVH are prematurity and hypoxic events. Any event that results in hypoxia, alteration of cerebral blood flow, or intravascular pressure increases the risk of an infant developing IVH (Kenner & Wright Lott, 2007). IVH is also associated with perinatal asphyxia, low Apgar scores, low birth weight, respiratory distress requiring mechanical ventilation, rapid volume expansion, and pneumothorax. Depending on the degree of bleeding, infants with IVH may present with a range of symptoms. Some infants will not have a noticeable change in clinical condition; others will present with sudden deterioration or shock-like symptoms.

The extent of the bleed in the ventricles and brain will predict what future complications may occur. Bleeding may be confined to just the germinal matrix or may enter the ventricular system. When blood enters the ventricular system, it can cause the ventricles to dilate due to increased pressure.

There are different grades assigned to IVH based on their severity. These include

- grade I (slight)—isolated germinal matrix hemorrhage
- grade II (small)—IVH with normal ventricular size
- grade III (moderate)—IVH with acute ventricular dilation
- grade IV (severe)—both intraventricular and brain parenchyma hemorrhage.

The diagnosis of IVH is determined via cranial ultrasound. For monitoring of an extensive bleed, serial ultrasounds may be used.

Periventricular leukomalacia (PVL) refers to necrosis of white matter in the brain that occurs in a characteristic pattern. PVL is believed to be the long-term outcome of ischemia and injury to the fragile cerebral white matter in the premature infant. PVL can be caused by systemic hypotension, cerebral infarction and ischemia, and episodes of apnea and bradycardia.

Additional complications that may arise from PVL depend on the size of the initial lesion and how much time has passed since the injury first occurred. Clinically, at about 6–10 weeks of age, an infant with PVL will present with irritability, hypertonicity, frequent tremors, and may have an abnormal Moro reflex. Diagnosis is made via cranial ultrasound, computed tomography (CT) scan, or magnetic resonance imaging (MRI).

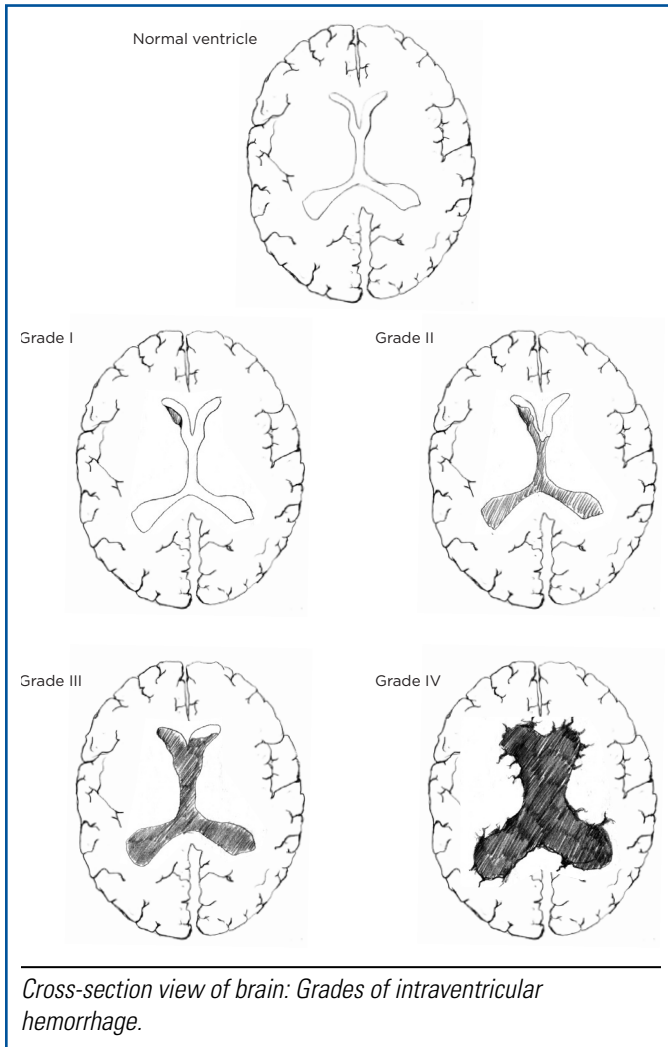
Neonates who are born at younger than 30 weeks should be screened with cranial ultrasound at 7–14 days of age. Many units will rescreen again at 36–40 weeks of age to determine if PVL is present. To help prevent IVH and PVL in the premature infant, care must be taken to avoid events that create swings in arterial and venous pressures. The immature neonatal brain does not have mature autoregulation of cerebral circulation in place to compensate for changes in blood pressure. Limiting handling, preventing changes in blood pressure or carbon dioxide levels, preventing breathing against the ventilator, and making sure blood coagulopathies are normal may help decrease the chances of developing IVH or PVL. These interventions will also help prevent extension of an initial hemorrhage. Treatment for IVH and PVL is supportive in nature.



Hemorrhage alone will not account for all neurological deficits in the neonate with IVH. Ironically, half of premature infants with IVH will be free of neurologic symptoms. Outcome will depend on the severity of the hemorrhage. For a small hemorrhage, neurodevelopment disability is similar to that in premature infants without hemorrhage. For a moderate hemorrhage, major neurodevelopmental

disability occurs in 40% of infants; for severe hemorrhage, major neurodevelopmental disability occurs in 80% of infants.

The long-term outcome of an infant with PVL may include spastic diplegia, motor deficits, intellectual deficits, visual impairments, upper arm involvement, and lower limb weakness.



References

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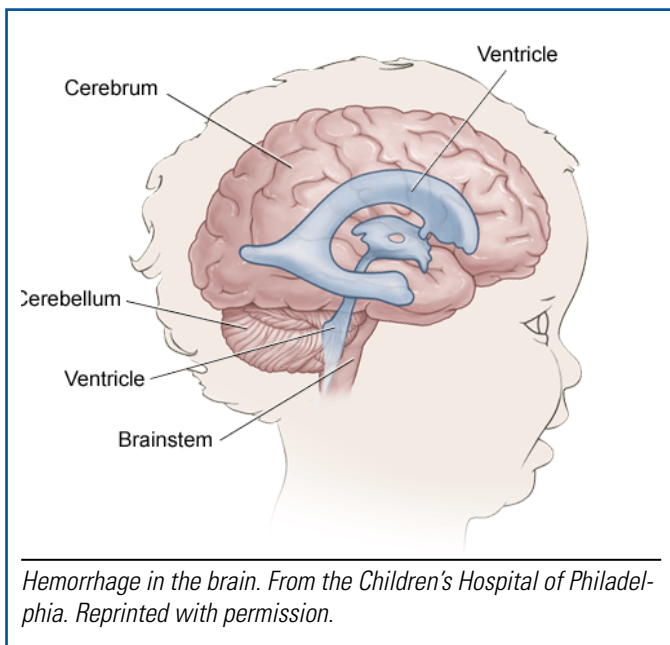
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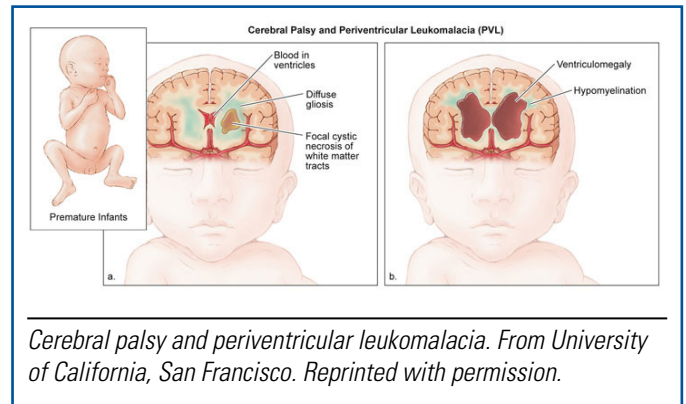
Intraventricular Hemorrhage and Periventricular Leukomalacia: Information for Parents

Your baby is very fragile, including the way that his or her brain is forming. Right now, your baby's body is not able to control blood pressure changes in the same way that an older infant or adult body can. Sometimes, when your baby's brain receives too much blood, it can cause the vessels that carry the blood to break. When these vessels burst, blood can build up inside your baby's brain and can cause what is known as an *intraventricular hemorrhage (IVH)*. The term *intraventricular* refers to the inside of the brain. The term *hemorrhage* refers to bleeding (see image below). Both terms together mean there is bleeding inside the brain.



There are different levels of bleeding in the brain with IVH. These levels are also called *grades*. Grade I means that there is a small bleed in the brain. Grade II means that there is a little more bleeding in the brain than Grade I, but it has not affected the inner part of the brain. Grade III means that there is bleeding that has also affected the inner parts of the brain. This includes the way that blood moves out of the brain. Grade IV means that there is more bleeding than in Grade III, and that there is so much

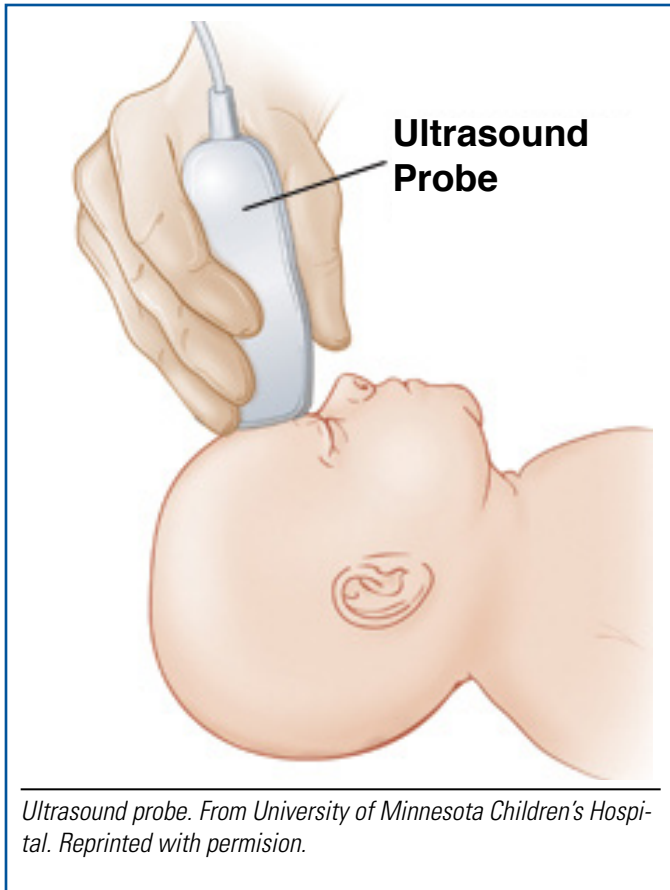
bleeding that the brain is being pushed against the bones of the head (see image below).



Periventricular leukomalacia (PVL) is a different disorder than IVH; they do not mean the same thing. *Periventricular* refers to the brain; *leukomalacia* describes the way the baby's brain looks. PVL means that sections of your baby's brain have been hurt. These areas that have been hurt have died and left little holes in the brain tissue.

Your baby's provider will tell you if your baby has any bleeding in his or her brain (IVH) or if your baby has PVL. To test for IVH or PVL, your baby will have a special procedure done called an ultrasound. An *ultrasound* is a painless test that uses a special wand with a jelly-like substance to take a video of your baby's brain (see photo below). These videos can be broken down into pictures that a doctor will look at. Your baby's provider will then let you know the results of the test. Expect that an ultrasound be done on your baby after about a week of being in the hospital. Not all babies will have an ultrasound done. This is only done if your baby was born before 32–34 weeks. The ultrasound may be done again when your baby is 36–40 weeks gestation (considered full term).

Your baby is at risk for bleeding in the brain because he or she was born early. Some other risks are if your baby had a low amount of oxygen during birth, had a low birth weight, or needs a machine to help with breathing.



If your baby is diagnosed with IVH or PVL, the outcome will be different depending on how much of your baby's brain is affected. Talk to your baby's provider to find out what the future effects will be for your baby. If your baby has a small bleed, there is a slight chance he or she will have future disabilities. If your baby has a severe bleed, there is a greater chance of having problems in the future. It is hard for your baby's providers to predict what will happen in the future for your baby, but it is important that you ask questions about any concerns that you have.