Combined oxygen 15-labeled positron emission tomography (15O PET) and brain tissue oximetry have demonstrated increased oxygen diffusion gradients in hypoxic regions after traumatic brain injury (TBI). These data are consistent with microvascular ischemia and are supported by pathologic studies showing widespread microvascular collapse, perivascular edema, and microthrombosis associated with selective neuronal loss.

Positron emission tomography (PET) now provides the capability of measuring regional cerebral blood flow with high resolution and little risk.

In a study, Volpe et al utilized PET in six premature infants (920 to 1,200 g) with major intraventricular hemorrhage and hemorrhagic intracerebral involvement to measure regional cerebral blood flow during the acute period (5 to 17 days of age).

Cerebral blood flow was determined after intravenous injection of H2O, labeled with the positron-emitting isotope, 15O PET(oxygen 15). Findings were similar and dramatic in all six infants. In the area of hemorrhagic intracerebral involvement, little or no cerebral blood flow was detected. However, in addition, surprisingly, a marked two- to fourfold reduction in cerebral blood flow was observed throughout the affected hemisphere, well posterior and lateral to the intracerebral hematoma, including cerebral white matter and, to a lesser extent, frontal, temporal, and parietal cortex. In the one infant studied a second time, ie, at 3 months of age, the extent and severity of the decreased cerebral blood flows in the affected hemisphere were similar to those observed on the study during the neonatal period. At the three autopsies, the affected left hemisphere showed extensive infarction, corroborating the PET scans. These observations, the first demonstration of the use of PET in the determination of regional cerebral blood flow in the newborn, show marked impairments in regional cerebral blood flow in the hemisphere containing an apparently restricted intracerebral hematoma, indicating that the hemorrhagic intracerebral involvement is only a component of a much larger lesion, ischemic in basic nature, ie, an infarction. This large ischemic lesion explains the poor neurologic outcome in infants with intraventricular hemorrhage and hemorrhagic intracerebral involvement [1)].

1)
Volpe JJ, Herscovitch P, Perlman JM, Raichle ME. Positron emission tomography in the newborn: extensive impairment of regional cerebral blood flow with intraventricular hemorrhage and hemorrhagic intracerebral involvement. Pediatrics. 1983 Nov;72(5):589-601. PubMed PMID: 6605514.