Assessment of microvascularization is a reliable diagnostic criterion for cerebral ischemia in preterm newborns with oxidative-stress-related conditons

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Received 22 Jan 2026, Accepted 14 Mar 2026, Published online: 22 Mar 2026
Cite this article https://doi.org/10.1080/01616412.2026.2647422

ABSTRACT

Objectives

To improve management of neonatal diseases associated with oxidative stress by introducing advanced diagnostic methods integrating clinical, biochemical, and ultrasound parameters. The study focused on early detection of microvascular changes in preterm infants at risk of hypoxic-ischemic encephalopathy (HIE) and other brain injuries.

Methods

Sixty-three preterm infants (28–34 weeks GA) with RDS grades 1–3 and hypoxic brain injury, plus 19 control newborns, were studied. Oxidative stress was assessed using serum MDA, TAC, and SOD within 24 hours of life. Cerebral microvascularization was evaluated via a multiparametric ultrasound protocol with Microvascular Imaging (MVI), visualizing basal ganglia and periventricular vessels without contrast.

Results

Basal ganglia vessels were visualized in all infants. Periventricular vessel visualization decreased with severity: absent in infants with grade 3 RDS + GMH – IVH 3–4 + hydrocephalus ($r = 0.84$, $p < 0.001$). Highest MDA and lowest TAC/SOD were found in these infants. Positive periventricular visualization predominated in mild-moderate RDS. MVI showed 100% negative predictive value for severe ischemic injury but low positive predictive value (35.7%).

Discussion

MVI enables early, noninvasive detection of microvascular changes related to oxidative stress, reflecting endothelial injury. Basal ganglia perfusion remained preserved due to anastomoses, while periventricular white matter, a watershed region, was more vulnerable. Integrating MVI into neurosonography improves diagnostic precision, informs individualized management, and supports neuroprotective strategies in preterm infants with asphyxia and RDS.

KEYWORDS:

Microcirculation, microvascularization, neonates, neurosonography, oxidative, ultrasound

Disclosure statement

No potential conflict of interest was reported by the author(s).

Additional information

Funding

The author(s) reported there is no funding associated with the work featured in this article.