

Preterm and sick term neonates are prone for neurological injury. Point of care cranial ultrasonography (CUSG) is the imaging modality of choice for routine neuroimaging in NICU as it is safe, inexpensive and serial repetitive examinations are possible even in critically sick neonates.<sup>1</sup>

The aims of CUSG are to ascertain brain growth and maturation, presence of structural brain malformations, identify brain injury- type and timing and the neurological prognosis.

### Indications for CUSG<sup>2,3</sup>

- Screening neurosonogram in preterm infants to rule out hemorrhage or parenchymal brain injury
  - All infants <32 weeks or <1500 g
  - Infants of 32 to 34 weeks gestation or 1500 to <1800 g birth weight who had significant sickness during neonatal period like need for extensive resuscitation, ventilation or exchange transfusion or had illnesses such as sepsis, necrotizing enterocolitis etc
- To assess the progress of IVH (hydrocephalus, resolution etc.)
- To evaluate newborns with signs of poor feeding, lethargy and seizures
- Antenatally detected central nervous system malformations, for e.g, meningomyelocele, choroid plexus cysts, absence of corpus callosum, etc.

### Screening CUSG (timing)<sup>1,3</sup>

The following are the broad guidelines for timing of CUS screening in NICU.

1. Routine screening of well preterm babies
  - First scan- 48 to 72 hours (detects most IVH)

- Second scan - 1 to 2 week (detects early PVL)
  - Third scan - at 3-4 weeks (detects cystic PVL)
  - Fourth scan at term equivalent age (detects sequelae such as ventriculomegaly, hydrocephalus)
  - As and when required depending upon clinical indication
2. Sick symptomatic term/ preterm infants
    - Immediately after birth or when decided clinically
  3. Follow up scans in infants if abnormalities are detected on above-mentioned scans
    - At 1-2 weeks interval as per clinical decision

**Table 44.1: Classification of abnormalities in CUSG**

Pathology	Description	
Intraventricular hemorrhage (IVH) <sup>7</sup>	Volpe's grading <sup>4</sup>	<b>Grade I:</b> Germinal matrix hemorrhage (<10% of ventricular area in parasagittal view)
		<b>Grade II:</b> Ventricular bleed occupying 10-50% of ventricular area in parasagittal view
		<b>Grade III:</b> Ventricular bleed occupying >50% of ventricle, usually distending the lateral ventricle
		Separate notation: Parenchymal echodensity representing periventricular hemorrhagic infarction
Periventricular leukomalacia (PVL) <sup>7</sup>	De Vries grading <sup>5</sup>	<b>Grade I:</b> Persistent flare (usually bilateral) for at least 7 days without cystic evolution
		<b>Grade II</b> (cystic PVL), parenchymal lesion persisting for 7 days and evolving into localized small fronto-parietal cysts.
		<b>Grade III:</b> Multiple cysts in parieto-occipital area
		<b>Grade IV:</b> Same with evolving cysts in deep white matter and subcortical region
Ventricular dilatation	Levene Index <sup>6</sup>	Normative size of lateral ventricles from 26-40 weeks infants measured in coronal section at the level of 3 <sup>rd</sup> ventricles. Smoothened centile curves permits early detection of ventricular dilatation secondary to cerebral atrophy.

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		Hydrocephalus is defined as ventricular size exceeding the 97 <sup>th</sup> centile by 4 mm.
Cerebral malformations		Cystic lesions, vein of Galen malformation, corpus callosal agenesis, etc. may be picked up by CUSG

\*IPL-Intraparenchymal lesion

### Doppler imaging in CUSG

There is a limited role of Doppler (pulse waved Doppler of anterior or middle cerebral artery) in assessing cerebral perfusion especially in following settings. The flow related indices like resistive index of Pourclet (RI) or the pulsatility index (PI) may be used as surrogates of cerebral perfusion and intracranial pressure and may predict outcome (Table 44.2).<sup>7,8</sup>

- Cerebral blood flow (CBF) estimation in infants with HIE, shock
- Monitoring infants with hydrocephalus and decide timing of treatment
- In preterm infants with significant PDA to assess severity of ductus (diastolic steal)
- The flow related indices may be predictive of white matter injury

**Table 44.2: Doppler imaging in CUSG**

Resistive Index (RI)= $\frac{\text{Systolic flow (S)} - \text{Diastolic flow (D)}}{\text{Systolic flow (S)}}$	Normal: 0.60-0.85 Low: <0.60 (low resistance, increased CBF) High: >0.85 (high resistance, reduced CBF) In hydrocephalus- indication for treatment <ul style="list-style-type: none"> <li>• RI &gt;0.71 without pressure by transducer</li> <li>• RI &gt;0.90 with pressure by transducer*</li> </ul>
Pulsatility Index (PI)= $\frac{\text{Systolic flow(S)} - \text{Diastolic flow(D)}}{\text{Mean blood flow velocity(M)}}$	Normal: 0.5-1.05; less widely used than RI

\*Applying inward pressure at anterior fontanel for 5 seconds and measuring blood flow velocities.<sup>8</sup>

### Prediction of neurodevelopmental outcome with CUSG or MRI

Though the superiority of MRI as an imaging modality is well established, it's still not clear whether it adds heavily to prediction of outcomes.

- Carefully performed serial CUSG seems to provide as much information as MRI and is able to recognize most of the lesions that will result in moderate to severe cerebral palsy.<sup>9,10</sup>
- In a recent study Horsche et al<sup>11</sup>, contemporaneously done CUSG and MRI at 40 weeks corrected age showed acceptable agreement, with none of the infants with normal CUSG findings (n=28; 40%) having moderate or severe MRI abnormalities. Moreover, all with infants severe MRI abnormalities (n=3; 4%) were picked up by CUSG as well.
- MRI at term equivalent age is not done routinely for our preterm infants.

### References

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