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Original Research Paper

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A COMPARATIVE STUDY TO DETERMINE THE ROLE OF SHEAR WAVE ELASTOGRAPHY OF BRAIN PARENCHYMA IN PRETERM AND TERM NEONATES

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ABSTRACT

Introduction: Birth before the 37th week of pregnancy is known as prematurity, and it is a major global health issue. Premature births can cause a wide range of disabilities in their victims, from moderate developmental delays to complete neurological destruction. Among the neurologic aftereffects, cerebral palsy poses a 5% to 10% risk to preterm newborns, while cognitive, behavioral, or communication impairments pose a 50% risk. **Methods:** This prospective study carried out over a period of 18 months involving 41 term and 41 preterm infants. **Results:** The mean thalamus SWE (kPa) was higher in term deliveries (8.825 ± 0.3754) compared to preterm 7.805±0.5901 (P < 0.001). The mean periventricular white matter SWE (kPa) was higher in term deliveries (7.298 ± 0.4300) compared to preterm, 6.538±0.5300 (P < 0.001). The cut-off value of SWE of mean thalamus, kPa < 8.35 predicted the preterm delivery with 95% sensitivity and 87.5% specificity. **Conclusion:** Preterm neonates had stiffer thalamus and periventricular white matter than term neonates, with the thalamus having stiffer values than the periventricular white matter.

KEYWORDS : Neonatal brain, congenital malformations, Brain stiffness, Shear wave elastography, Prematurity complications.

INTRODUCTION

Birth before the 37th week of pregnancy is known as prematurity, and it is a major global health issue.[1] Among the neurologic aftereffects, cerebral palsy poses a 5% to 10% risk to preterm newborns, while cognitive, behavioral, or communication impairments pose a 50% risk.[2–9] Reduced gestational age is linked to an increase in mental and neuromotor deficits in extremely preterm infants.[5] Premature births can cause a wide range of disabilities in their victims, from moderate developmental delays to complete neurological destruction. Healthy preterm newborns show changes in their brain structure even when there are no overt neurological injury, which may explain why they are more likely to experience cognitive impairments, neuro-motor abnormalities, and neuro-developmental problems. In recent years, Studies have generally tended to focus on trying to comprehend the fundamental processes behind these detrimental neurologic impacts.[10] Similar to numerous organ systems, an improved knowledge of disease pathogeneses and prognoses requires an understanding of the stiffness of brain tissues.[11] In this regard, it is important to be aware of the rigidity of the newborn brain in order to comprehend the neurologic deficiencies resulting from preterm.

ARFI is used in the comparatively new technique where, tissue stiffness is measured using ultrasound SWE). Compared to other ultrasound-based elastography techniques like strain elastography, the ARFI technique is intrinsically less operator-dependent since it causes interior tissue deformation (shear waves). SWE enables quantitative stiffness assessment and correlation with grayscale images at the same time. SWE has shown promise as a safe and effective method to assess diseases impacting several organ systems in the juvenile population, including the musculoskeletal system, central neurological system, and gastrointestinal system (mostly liver illness).

The main objective of the present study is to determine the role of wave shear elastography of brain parenchyma among the preterm and term neonates.

MATERIALS & METHODS

This prospective study carried out over a period of 18 months involving 41 term and 41 preterm infants. Patients with suspected congenital malformations, Central nervous system infections, cerebral hemorrhage, Hydrocephalus, Periventricular leukomalacia and nsufficient fontanel space were excluded from the study. Comparison of continuous variable gestational age, SWE values for thalamus, periventricular white matter) across the groups (term vs pre-term group) was performed using the student's t test. Chi square test will be used to compare categorical variables (sex, etc.) between research groups. A P-value of less than 0.05 was deemed statistically noteworthy.

RESULTS

The specifics of the cut-off values for the periventricular white matter and thalamus's stiffness in determining a significant preterm classification are shown in Table 1.

Test Result Variable(s)	AUC	P-Value	Asymptotic 95% Confidence Interval		Cut-off Value	Sensi-tivity	Speci-ficity
			Lower Bound	Upper Bound			
SWE of Right thalamus, kPa	0.935	P<0.001	0.881	0.990	8.45	92.5%	87.5%
SWE of Left thalamus,kPa	0.937	P<0.001	0.889	0.985	8.55	82.5%	87.5%
SWE of mean thalamus	0.930	P<0.001	0.868	0.992	8.35	95%	87.5%
SWE of right periventricular white matter, kPa	0.847	P<0.001	0.760	0.933	6.85	82.5%	77.5%
SWE of left periventricular white matter, kPa	0.794	P<0.001	0.694	0.895	7	75%	80%
SWE Of Mean Periventricular White matter, kPa	0.864	P<0.001	0.783	0.946	6.85	87.5%	72.5%

Table 1: The specifics of the cut-off values for the periventricular white matter and thalamus's stiffness in determining a significant preterm classification.

DISCUSSION

Elastography is a new technique used in several organ evaluations. Few studies have used elastography in the

newborn brain, despite the fact that sonography is common imaging technique for newborns that are under 30 weeks old gestational age and that at the term- equivalent age, recurrent imaging is indicated.[11] Shear wave elastography may be utilized to assess potential disparities in elasticity between term and preterm infants, as well as to measure stiffness of the brain in each group.

The SWE method was utilized in this work to evaluate the stiffness of the neonatal brain in both preterm and term neonates in order to develop a cut off reference range for measuring newborn brain stiffness between preterm and term neonates.

One novel method being used in many organ evaluations is elastography. Although sonography is a standard imaging tool for babies under 30 weeks gestational age, and recurring imaging is required at the term-equivalent age, few studies have used elastography in the newborn brain.[12] Shear wave elastography can be used to determine the brain stiffness in each group and to evaluate any potential differences in elasticity between term and preterm infants.

In present study, the mean gestational age of term infants (38.93 ± 0.797 weeks) was significantly higher compared to preterm infants (35.88 ± 1.09 weeks), with a statistical significance of $P < 0.001$. Mean maternal age and birth weight were also observed to be higher in term deliveries. No significant association was observed between gender and term/preterm delivery (P-value = 0.502). Enrique Garcés Iñigo conducted a comparable study during which 40 weeks was the median gestational age (interquartile range: 38 - 40 weeks) and the mean gestational age was 39.15 ± 1.42 weeks.[92] 3.33 ± 0.422 kg was the mean weight, while 3.400 kg was the median weight (interquartile range: 3.115–3.618 kg).

CONCLUSION

This work demonstrates that quantitative stiffness bedside measurement in premature infants using 2D-SWE is both possible and repeatable. We discovered that preterm newborns had stiffer thalamus and periventricular white matter than term neonates, with the thalamus having stiffer values than the periventricular white matter. The mean thalamus and mean periventricular white matter stiffness cutoff values that were most effective in identifying preterm were 8.35 kPa and 6.85 kPa, respectively. The use of SWE imaging method will enable advancements in monitoring neonatal brain growth from an early postnatal period that are therapeutically meaningful.

Advanced cranial USG and MRI scans have become indispensable tools in the comprehensive understanding of overt brain damage and secondary changes in brain maturation in the developing brain. Our recommendations concern the utilization of various modalities such as neurosonogram, shear wave elastography, and cUS, which offer convenient and frequently urgent information regarding overt brain injury. They are also highly effective in diagnosing GMH IVH, PVHI, and PVL.

REFERENCES

1. Blencowe H, Cousens S, Oestergaard MZ, et al. National, regional, and worldwide estimates of preterm birth rates in the year 2010 with time trends since 1990 for selected countries: a systematic analysis and implications. Lancet 2012;379:2162–72.
2. Vohr BR, Msall ME, Wilson D, Wright LL, McDonald S, Poole WK. Spectrum of gross motor function in extremely low birth weight children with cerebral palsy at 18 months of age. Pediatrics 2005;116:123-9.
3. Platt MJ, Cans C, Johnson A, Surman G, Topp M, Torrioli MG, et al. Trends in cerebral palsy among infants of very low birthweight (<1500 g) or born prematurely (<32 weeks) in 16 European centres: a database study. Lancet 2007;369:43–50.
4. Allin M, Walshe M, Fern A, et al. Cognitive maturation in preterm and term born adolescents. J Neurol Neurosurg Psychiatry 2008;79:381–6.
5. Larroque B, Ancel PY, Marret S, Nosarti C, Cuddy M, Rifkin L, et al.Neurodevelopmental disabilities and special care of 5-year-old children born before 33 weeks' gestation (the EPIPAGE study): a longitudinal cohort study. Lancet 2008;371:813–20.
6. Volpe JJ. Neurology of the Newborn. 5th edn. Philadelphia, PA: Saunders Elsevier 2008.
7. Woodward LJ, Moor S, Hood KM, Champion PR, Foster-Cohen S, Inder TE, et al. Very preterm children show impairments across multiple neurodevelopmental domains by age 4 years. Arch Dis Child Fetal Neonatal Ed 2009;94:339–44.
8. Luu TM, Ment L, Allan W, Schneider K, Vohr BR. Executive and memory function in adolescents born very preterm. Pediatrics 2011;127:639–46.
9. Woodward LJ, Clark CA, Bora S, Inder TE. Neonatal white matter abnormalities: an important predictor of neurocognitive outcome for very preterm children. PLoS One 2012;7:51879.
10. Ortinau C, Neil J. The neuroanatomy of prematurity: normal brain development and the impact of preterm birth. Clin Anat 2015;28:168–83.
11. Cheng S, Clarke EC, Bilston LE. Rheological properties of the tissues of the central nervous system: a review. Med Eng Phys 2008;30:1318–37.
12. Steggerda SJ, Leijser LM, Walther FJ, vanWezel-Meijler G. Neonatal cranial ultrasonography: how to optimize its performance. Early Hum Dev 2009;85:93–9