VOLUME - 11, ISSUE - 04, APRIL - 2022 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Radio-Diagnosis

CEREBRAL BLOOD FLOW ASSESSMENT BY TRANSCRANIAL DOPPLER TO EVALUATE THE PERCENTAGE OF HIGH RISK OF STROKES IN SICKLE CELL ANEMIA PATIENTS – A CROSS SECTIONAL OBSERVATIONAL STUDY

Dr. Shyam chhadi	M.D. Radiodiagnosis, Associate Professor, Department of Radiodiagnosis, Government Medical College, Nagpur, India.
Dr. Aarti Anand	M.D. Radiodiagnosis, Head of The Department, Department of Radiodiagnosis, Government Medical College, Nagpur, India.
Dr. Vishal padmashil Gajbhiye*	MBBS, M.D.Radiodiagnosis (ongoing) Department of Radiodiagnosis, Government Medical College, Nagpur, India. *Corresponding Auhtor

ABSTRACT

- **1. AIMS AND OBJECTIVES :**To assess the proportion of high risks of stroke in sickle cell disease patients using Transcranial Doppler findings.
- To assess the abnormal time average mean of maximum velocity in cerebral blood vessels so as we can prevent future stroke by giving proper treatment.

2. Materials and Methods: In our cross-sectional- observational study, 164 patients of age group 2 to 16 years have sickle cell disease were referred to radiology department. After taking informed consent, Transcranial Doppler of the patients was done either transtemporal or transforamenal approach. Data obtained from the study will be subjected to appropriate statistical analysis so as to facilitate interpretation and P-Values were found out. P-Value<0.05 was considered to be statistically significant.

- **3. Results:** Among 164 patients, 106 are male and 58 are female, from which 37 % of male and 27% of female are at high risk, considering the haemoglobin level in normal range.
- In Transcranial Doppler study, we found out that from 164 patients, 108 are normal, 39 are conditional risk and 17 are at high risk of stroke.
- After interpretation, the patients how have the values of TAMMV of MCA and/or ICA more than 200 are in the high risk of stroke with **P-Value <0.05; which was statistically significant.**

4. Conclusion: Prevalence of abnormal cerebral blood flow velocity is high in children with Sickle Cell Anemia which require more availability of transcranial Doppler machine for routine screening of children with SCD. This will help in early identification of children at risk of a Cardio-Vascular Accident for prompt intervention that can avert the deadly complication

KEYWORDS : Sickle Cell Anemia, Transcranial Doppler, TAMMV value, MCA (middle cerebral artery).

INTRODUCTION

Sickle cell disorder (SCD) is one of the commonest genetic diseases in the world. Of the world's population, 5.2% carry a significant variant of sickle cell gene(1). SCD is a generic term for a group of disorders that includes homozygous sickle cell anemia, sickle cell hemoglobin C disease, sickle cell thalassemia disease and other compound heterozygous conditions. They are all characterized by the presence of mutated b-globin gene, bS-globin and all-cause clinical disease(2).

Cerebrovascular disease (CVD) is one of the major causes of morbidity and mortality in children with sickle cell disease (SCD), and as many as 12% of patients will experience a clinically overt stroke before the age of 20 years old (7). Furthermore, silent brain infarctions are present in 17%-22% of children with SCD who have not been identified as having a clinically evident stroke (overt stroke) by 14 years of age (5)(6).

The introduction of Transcranial Doppler (TCD) screening has substantially reduced overt stroke morbidity in children with SCD, but there seems to be having some advantage in using just TCD to evaluate hemodynamic consequences of silent infarctions (6).

The Stroke Prevention Trial in Sickle Cell Anemia study (STOP) recommends that yearly TCD screening should be done for children with SCD between the ages of two years and sixteen years with a repeat within three months for those children with abnormal results. Early identification of children at risk of CVA with cerebral blood flow velocity of at least 200 cm/second and prompt interventions help to curtail the devastating neurological complication.(1).

Adams et al. in a stroke prevention study (STOP study) set the guidelines for screening SCD patients at risk of developing stroke for proper management. In transcranial Doppler non-imaging (TCDNI), a time-averaged maximum velocity (TAMxV) of >200 cm/s is considered a high risk for stroke, while those below 170 cm/s are normal and values in-between are conditional.

The present study aimed to determine the pattern of cerebral blood flow velocities of children to evaluate the percentage of high risk of stroke in sickle cell anemia patient.

MATERIALS AND METHODS

1. Ethics:

a. Approval from Institutional Ethics Committee (IEC) was sought. Informed written consent in Subject's vernacular language was taken before enrolment for study.

2. Selection Of Patients:

a. This a cross sectional-observational study, where the included patients are sickle cell anemic patients of 2 to 16 years of age from tertiary care centres in central India.

Inclusion And Exclusion Criteria:

- **Inclusion Criteria:**

a. Homozygous for the sickle cell gene, confirmed by DNA-based mutational analysis
b. Age 2 to 16 years
c. Absence of localizing abnormalities on neurological examination indicating previous vascular territory ischemic injury
d. No history of stroke.

- **Exclusion Criteria:**
- History of major head injury

- History of seizure disorder requiring anticonvulsant therapy
- Active chronic transfusion or hydroxyurea therapy
- Occurrence of acute chest syndrome or other significant acute illness in the period between laboratory blood and sonographic testing
- History of prenatal or perinatal hypoxic-ischemic brain injury
- Evidence of human immunodeficiency virus infection
- Pregnancy

Method Of Collection Of Data:

- Patients have sickle cell disease of appropriate age group was included in our study after written informed consent, explaining procedure in detail to the patient.
- On the day of transcranial doppler appointment, complete history and clinical evaluation of the patient will be done. Patient will be explained about transcranial doppler procedure and transcranial doppler will begin.

Transcranial Doppler Protocols

- Patients will be subjected to Transcranial Doppler after clinical evaluation, either transtemporal or transforamenal.

EQUIPMENT:

MACHINE GE LOGIQ S8 with transducer probe (M5S) for transtemporal Doppler.

Data Analysis:

- Data obtained from the study will be subjected to appropriate statistical analysis so as to facilitate interpretation.

RESULTS

1. Distribution according to age group and gender.

- Majority (33.5%) of the study participants were from 5-10 years and <5 years followed by11-16 years age group. Mean age was 7.7+3.9.
- Majority (64.6%) of the study participants were male.

2. Distribution of high risk no. in male and female and according to age groups

- majority (37%) of the study participants were male which are in high risk than female (27%).
- Majority (42%) of the study participants were from 5-10 years followed by <5 years age groups.

3. Distribution according to TCD (TAMMV of MCA and/or ICA)

- Majority (65.9%) of the study participants had normal TCD, while 23.8% conditional TCD and 10% had abnormal.

4. Distribution according to Risk of Stroke

- 34.1% participants had high risk of stroke.

5. Association between TCD (TAMMV of MCA and/or ICA) and Risk of stroke.

- 23.8% participants having conditional TCD had high risk of stroke.
- It has been observed that there is strong association between TCD (TAMMV of MCA and/or ICA) and Risk of stroke. (Chi. Sq. Value= 164, p Value= <0.0000001).

DISCUSSION:

In this study, majority (33.5%) of the study participants were from 5-10 years and <5 years followed by 11-15 years age group. Mean age was 7.7+3.9. Majority (64.6%) of the study participants were male. As per the study by Adekunle MO et al, which reported similar observations, the age range was two and sixteen years respectively while the mean age was 7.66±4.2 years. The female to male ratio was 1:1.4.

Majority (65.9%) of the study participants had normal TCD, while 23.8% conditional TCD. 23.8% participants having conditional TCD had high risk of stroke. It has been observed that there is strong association between TCD (TAMMV of MCA and/or ICA) and Risk of stroke. In the study by Adekunle et al, The mean total TAMMV was highest in subjects below five years and lowest in subjects above ten years. The patients who have abnormal value should be scan after a month, according to the guidelines of Stroke Prevention Trial in Sickle Cell Anemia (STOP) trial.

Tables And Figures

Table No. 01: Distribution of high risk no. according to age groups.

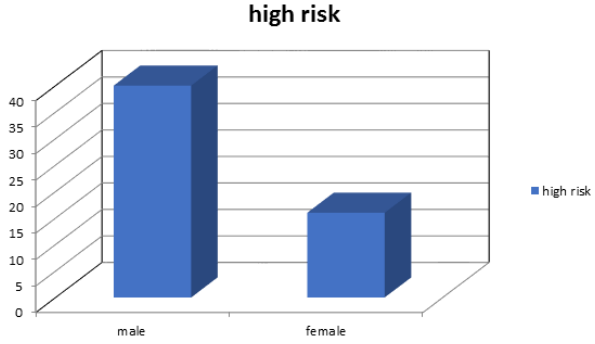
Age in Years	Frequency (n=164)	Percentage (%)
< 5 Years	21/55	38
5-10 Years	24/55	42
11-16 Years	11/54	20
Total	56/164	100

Table No. 02: Distribution according to TCD (TAMMV of MCA and/or ICA).

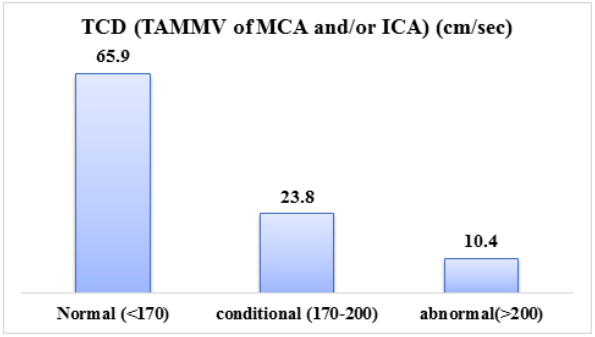
TCD (TAMMV of MCA and/or ICA) (cm/sec)	Frequency (n=164)	Percentage (%)
Normal (<170)	108	65.9
conditional (170-200)	39	23.8
Abnormal (>200)	17	10.4
Total	164	100.0

Table No. 03: Association between TCD (TAMMV of MCA and/or ICA) and Risk of stroke.

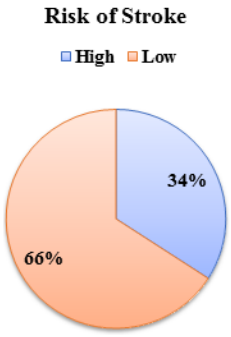
TCD (TAMMV of MCA and/or ICA) (cm/sec)	High Risk of Stroke		Low Risk of Stroke	
	Frequency (n=164)	Percentage (%)	Frequency (n=164)	Percentage (%)
Normal (<170)	0	0.0	108	65.9
conditional (170-200)	39	23.8	0	0.0
abnormal(>200)	17	10.4	0	0.0
Total	56	34.1	108	65.9
	Chi Sq. Value = 164		P Value = <0.0000001	



Graph No. 01: Distribution of high risk no. in male and female.



Graph No. 02: Distribution according to TCD (TAMMV of MCA and/or ICA).



Graph No. 03: Distribution according to Risk of Stroke.

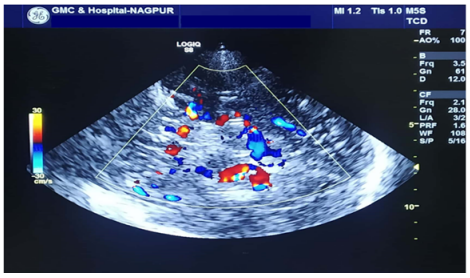


Figure 1: Shows Circle Of Willis In Tcd Imaging.

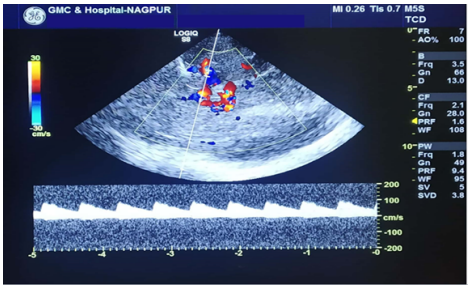
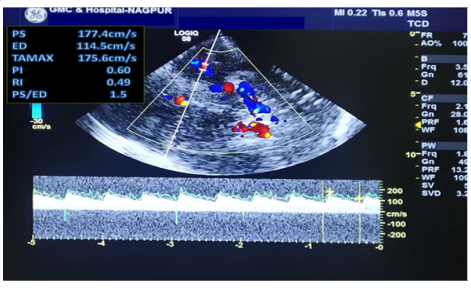
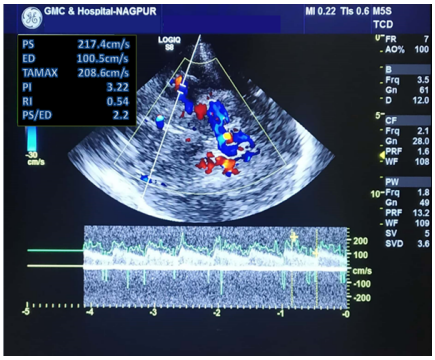


Figure 2: Shows Normal Waveform Of Mca In Colour Doppler Tcd Imaging.

CASES



CASE 1: Transcranial doppler study shows, TAMMV of MCA artery is 175 cm/s, which is comes under conditional risk.



CASE 2: Transcranial doppler study shows, abnormal TAMMV (208 cm/s) in MCA on colour Doppler in TCD imaging, which is comes under high risk.

CONCLUSION:

1. Prevalence of abnormal cerebral blood flow velocity is high in children with Sickle Cell Anemia.
2. Sickle Cell Disease(SCD) is associated with serious neurological complications and morbidities that can be avoided by raising the awareness of the importance of early screening and follow-up of all affected children according to the guidelines.
3. There is a need for more availability of transcranial Doppler machine for routine screening of children with SCD. This will help in early identification of children at risk of a CVA for prompt intervention that can avert the deadly complication.
4. Further investigations are required to assess CBF in children with SCD, as CBF abnormalities are potentially associated with risk of ischemia
5. Furthermore, the use of other physiological parameters, such as cerebrovascular reactivity, as well as other neuroimaging methods, such as high resolution angiographic assessment, may further characterize CBF abnormalities and could possibly assist in managing SCD patients.

ABBREVIATIONS

CVA-Cerebrovascular accident, CBF-Cerebral blood flow, CNS-Central nervous system, HbSS-Homozygous sickle haemoglobin, TAMMV- timed averaged maximum mean velocity, SCD- sickle cell anemia.

REFERENCES:

1) Adekunle MO, Animasahun AB, Diaku-Akinwumi IN, Njokanma OF. Pattern of Cerebral Blood Flow Velocity Using Transcranial Doppler Ultrasonography in Children with Sickle Cell Disorder in Lagos State, Nigeria. Mediterr J Hematol Infect Dis. 2017;9(1):e2017050. Published 2017 Aug 14. doi:10.4084/ MJHID. 2017.050
2) Abd-Allah et al, Factors associated with abnormal cerebral blood flow in Egyptian children with sickle cell disease, Clinical & Translational Neuroscience January-June 2020: 1–5
3) Ismail WIM, Elnour M, Mustafa AEM. Evaluation of transcranial Doppler abnormalities in children with sickle cell disease in El-Obeid Specialized Children's Hospital. J Family Med Prim Care. 2019;8(3):1176-1181. doi:10.4103/jfmpc.jfmpc_112_19
4) Adams R et al, The Use of Transcranial Ultrasonography to Predict Stroke in Sickle Cell Disease, N Engl J Med 1992; 326:605-610, DOI: 10.1056/ NEJM1 99202273260905
5) Gill, F. M., L. A. Sleeper, S. J. Weiner, A. K. Brown, R. Bellevue, R. Grover, C. H. Pegelow, and E. Vichinsky. 1995. Clinical events in the first decade in a cohort of infants with sickle cell disease. Cooperative Study of Sickle Cell Disease. Blood 86 (2):776-83
6) Miller, S. T., L. A. Sleeper, C. H. Pegelow, L. E. Enos, W. C. Wang, S. J. Weiner, D. L. Wethers, J. Smith, and T. R. Kinney. 2000. Prediction of adverse outcomes in children with sickle cell disease. N Engl J Med 342 (2):83-9.
7) Adams RJ, Ohene-Frempong K, Wang W. Sickle cell and the brain. American Society of Haematology. 2001:31–46.
8) Adams R et al, The Use of Transcranial Ultrasonography to Predict Stroke in Sickle Cell Disease, N Engl J Med 1992; 326:605-610, DOI: 10.1056/ NEJM1 99202273260905
9) Asbeutah AM, AlMajran AA, Adekile A. Pattern of cerebral blood flow and the interrelationship of vascular parameters of transcranial Doppler imaging in children with sickle cell disease. J Clin Ultrasound. 2018;1–5. doi.org/ 10.1002/ jcu.22663
10) Lagunju I, Sodeinde O, Brown B, Akinbami F, Adedokun B. Transcranial doppler ultrasonography in children with sickle cell anemia: Clinical and laboratory correlates for elevated blood flow velocities. J Clin Ultrasound. 2014;42(2):89–95. https://doi.org/10.1002/jcu.22099.