ORIGINAL RESEARCH

Incidence of foetal anaemia in ICT Positive Rhnegative pregnancies using MCA-PSV colour doppler studies

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ABSTRACT
Introduction- Rh isoimmunization occurs when a pregnant woman develops antibodies against paternally derived red cell antigens, which can harm the fetus by causing hemolysis and related complications. Traditional invasive diagnostic techniques like amniocentesis and cordocentesis are used to monitor at-risk fetuses. However, non-invasive Doppler ultrasound of the middle cerebral artery (MCA) offers a valuable alternative. Increased peak systolic velocity (PSV) in the MCA indicates foetalanaemia, with a PSV above 1.5 multiples of the median for gestational age detecting 88-90% of moderate to severe cases. This study aims to evaluate the effectiveness of MCA-PSV as a non-invasive predictor of foetalanaemia in non-hydropic foetuses affected by maternal red cell isoimmunization. **Materials and Methods-** This prospective study, conducted over a period of one year at a tertiary care centre, involved 26 Rh-negative pregnant women with positive Indirect Coomb's tests. Doppler ultrasound assessed the middle cerebral artery (MCA) peak systolic velocity (PSV) in non-hydropicfoetuses, using a cut-off of 1.5 multiples of the median (MoM). The peak systolic velocity (PSV) in the middle cerebral artery (MCA) was assessed in all non-hydropicfoetuses, with measurements compared against a reference chart, using a cut-off of 1.5 multiples of the median (MoM). After delivery neonatal haemoglobin levels were analysed to define anaemia and compare with MCA-PSV values. **Results-**The study included 26 cases of Rh isoimmunization, diagnosed in the second trimester for 10 patients and in the third trimester for 16. Delivery methods comprised 15 vaginal births and 11 caesarean sections. The distribution of gestational age at delivery was as follows: 30-33 weeks (9 cases), 34-36 weeks (10 cases), and ≥37 weeks (7 cases).Doppler ultrasound of the middle cerebral artery (MCA) showed peak systolic velocity (PSV) above 1.5 MoM in 8 cases. Neonatal haemoglobin evaluations revealed normal levels in 7 cases and anaemia in 19 cases, including 4 with severe anaemia.Using the 1.5 MoM cutoff, the MCA-PSV demonstrated a sensitivity of 88.9%, specificity of 100%, a positive predictive value of 100%, and a negative predictive value of 25%. **Conclusion-** Doppler ultrasound of the middle cerebral artery peak systolic velocity (MCA-PSV) serves as an effective non-invasive screening method for foetalanaemia in cases of Rh alloimmunization, replacing invasive techniques like amniocentesis and cordocentesis. Our study indicates that MCA-PSV is reliable for predicting foetalanaemia, potentially reducing the need for invasive interventions until intrauterine blood transfusion is necessary.

INTRODUCTION

Rh isoimmunization occurs when a pregnant woman has an immunological response to a paternally derived red cell antigen that is foreign to the mother and inherited by the foetus[1]. The antibodies may cross the placenta, bind to antigens present in the foetal erythrocytes, and carries risk to the foetus (haemolysis, hydrops foetalis and foetal death) and newborns (anaemia, hyperbilirubinemia, and kernicterus)[2].Invasive techniques such as amniocentesis and cordocentesis are used for the diagnosis and treatment of foetuses at risk for anaemia in ICT(Indirect Coomb's test) positive pregnancies.

However, the peak velocity in the foetal middle cerebral artery has been shown to have a good correlation with foetal anaemia and is a non-invasive method to detect foetalanaemia[3].
MCA Doppler is a non-invasive ultrasound technique used to assess blood flow in the middle cerebral artery of the foetus. Increased blood flow in the MCA can be indicative of foetal anaemia, as the foetus compensates for reduced oxygen-carrying capacity by increasing blood flow to vital organs. Peak systolic velocity (PSV) of the blood flow in the middle cerebral artery(MCA) above 1.5 multiples of the median (MOM) for gestation age has been found to

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detect 88-90% cases of moderate to severe anaemia[4]. The objective of this study is to assess the value of MCA-PSV as a non-invasive method in non-hydropic foetuses for prediction of foetal anaemia due to maternal red cell isoimmunization.

MATERIAL AND METHODS
This was a prospective study which was conducted in the Department of Obstetrics and Gynaecology, Government Medical College Jammu, from 1st September 2023 to 31st August 2024.Data of 26 Rh negative pregnant females, who have been tested Indirect Coomb's test positive and D-type antibodies were detected in them was collected. In view of positive ICT status, maternal serum antiglobulin titres were measured and in patients with increasing antiglobulin titres, with risk of haemolytic disease of foetus, Doppler ultrasound studies were conducted. Middle Cerebral Artery- Peak systolic velocity (MCA-PSV) was measured in all non-hydropic foetuses and measurements were plotted against a reference chart. The reference cut-off was taken as 1.5 Multiples of the Median(MoM). They underwent either a vaginal delivery or caesarean section resulting in live birth. Haemoglobin values of these neonates was used to define anaemia and its severity.   A comparison of MCA-PSV values and neonatal haemoglobin concentration was done.

Inclusion Criteria
- Rh-negative pregnant women with an ICT positive result.
- Pregnancies where MCA Doppler assessment has been performed.

Exclusion Criteria
- Pregnancies with known conditions that could affect MCA Doppler results unrelated to anaemia.
- Incomplete data or lack of MCA Doppler measurements.

RESULTS
A total of 26 Rh isoimmunised cases were included in the study. The diagnosis of Rh isoimmunization was made in second trimester in 10 cases and in third trimester in 16 cases. Out of these 15 patients had vaginal delivery and 11 had caesarean section.
Gestational age at delivery had the following distribution: 30-33 weeks in 9 cases, 34-36 weeks in 10 cases and ≥37 weeks in 7 cases.

Gestation age at delivery	No. of patients
30-33 weeks	9
34-36 weeks	10
≥37 weeks	7

Doppler Ultrasound for Middle cerebral artery- peak systolic velocity(MCA-PSV) of foetus revealed values above 1.5 MoM in 8 cases.

Haemoglobin evaluation of the neonates after the delivery revealed normal values in 7 cases and anaemia in 19 cases, including 4 cases of severe anaemia.

Neonate	Hb level
Term(≥2.5kg)	17.0
Premature(1.2-2.5 kg)	16.4
Small premature(<1.2kg)	16.0

Considering a cutoff of 1.5 MoM, the MCA-PSV had a sensitivity of 88.9%, specificity of 100%, a Positive Predictive Value (PPV) of 100% and a Negative Predictive Value(NPV) of 25%. No false positive cases of foetal anaemia were detected.

DISCUSSION
The MCA-PSV has shown a high specificity (100%) and a PPV (100%), meaning that when the MCA-PSV value is above 1.5 MoM, it is very likely that the foetus will have anaemia. This indicates that the test is very reliable in identifying cases where foetalanaemia is present when elevated MCA-PSV is observed.The sensitivity of 88.9% indicates that while the test is very effective in detecting cases of anaemia, there are still some cases where it might not detect anaemia, suggesting that not all anaemic foetuses will have elevated MCA-PSV values.**Kachewar et al.** reported a lower sensitivity (75%) and a specificity of 88.5%. This indicates that while the test was good at avoiding false positives, it was less effective at detecting all cases of foetalanaemia compared to our study[5].
The NPV of 25% is quite low, indicating that if the MCA-PSV is below 1.5 MoM, there is a high chance that the foetus may still have anaemia. This low NPV means that a normal MCA-PSV measurement does not reliably rule out the presence of anaemia. **Oakes et al.** reported a higher NPV of 78.0%, which means that normal MCA-PSV values were more reliably associated with the absence of anaemia compared to our study[6]. The higher PPV in our study suggests more accurate confirmation of anaemia when MCA-PSV is elevated, but the lower NPV indicates that normal values are less reliable for ruling out anaemia.
The discrepancy between MCA-PSV findings and postnatal haemoglobin levels suggests that while MCA-PSV is useful in identifying cases of anaemia, it may not be fully comprehensive. Specifically, MCA-PSV values above the cutoff were associated with anaemia in 19 cases, yet 7 neonates had normal haemoglobin despite elevated MCA-PSV, highlighting that the test might not capture all cases accurately.**Schenone and Mari** in their study found that while MCA-PSV is a reliable marker for detecting foetalanaemia, it is not perfect and may show false positives. They reported that elevated MCA-PSV correlates strongly with foetalanaemia, but some cases did not align perfectly with postnatal anaemia diagnoses. This aligns with our observation that MCA-PSV can sometimes predict anaemia when

it is not present. It confirms that MCA-PSV is not infallible and can yield false positive results[7].

Given the low NPV, it is crucial to complement MCA-PSV with other diagnostic measures (such as cord blood sampling or other biomarkers) to ensure that cases of foetalanaemia are not missed, particularly when MCA-PSV is within normal ranges.**Chiaie et al.'s** study highlights the value of MCA-PSV Doppler ultrasound in predicting foetalanaemia, particularly in high-risk pregnancies. While MCA-PSV provides high specificity and PPV, its moderate sensitivity and low NPV underscore the importance of using it as part of a comprehensive diagnostic strategyin conjunction with other assessments to ensure comprehensive evaluation and management of foetalanaemia[4].

CONCLUSION

Doppler study of MCA-PSV is a screening procedure for foetal anaemia in cases with Rh alloimmunization. It is a non-invasive method which has replaced invasive methods like amniocentesis and cordocentesis for the diagnosis of foetal anaemia in ICT positive pregnancies.

Our study suggests that MCA-PSV has a good performance in detecting foetal anaemia and it can be a reliable indicator in predicting foetalanaemia in cases with Rh isoimmunization and can reduce the need of invasive methods till treatment (intrauterine foetal blood transfusion) is required. MCA-PSV Doppler ultrasound is a valuable diagnostic tool for detecting foetalanaemia in Rh isoimmunized cases, particularly given its high specificity and PPV. However, due to its moderate sensitivity and low NPV, it is important to use MCA-PSV in conjunction with other diagnostic methods to ensure comprehensive evaluation and management of foetalanaemia.

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