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Fetal Doppler Irregularity, A Warning Sign of Cord Knot: Case Report

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Abstract: In this study we investigated and discussed umbilical cord knot prediction by color Doppler and related placental insufficiency as one of the most serious morbidities that threaten pregnancy in its different stages. It may relate to many comorbidities such as diabetes mellitus, maternal blood diseases, etc. Intrauterine fetal death is considered the worst fate for any pregnancy. It occurs frequently and suddenly in diabetic pregnant women with no significant warning signs. Color Doppler is a commonly used tool for the assessment of placental blood flow and prediction of early placental insufficiency changes.

Case: A 25-year-old pregnant female with a history of gestational diabetes mellitus in the previous and current pregnancy is presented to an obstetric clinic in Muli regional hospital, Maldives for pregnancy followed up at gestational age of 36 weeks to ER with Left lower abdominal pain. Abdominal US and urgent obstetric Doppler was done and findings analyzed in correlation to co-existing morbidity. Color Doppler was showing an intermittent unexplained significant irregularity of Color Doppler wave form mainly involving EDV. Follow-up was done the next day and revealed worse of the changes. The decision to end the pregnancy by caesarian section was made for fear of the baby. A true umbilical cord knot was discovered and explained the cause of the described color Dopler fluctuant flow. Placental insufficiency is a dangerous morbidity and a direct leading cause of intrauterine fatal death. It is more suspected with diabetes mothers with no sufficient or clear warning signs. Color Doppler is a good tool for assessment of placental blood flow and prediction of early placental insufficiency, but unexpected cause as cord knot may be non-discovered in color, especially when expected with associated certain co-morbidity as diabetes. UA artery flow irregularity is a described sign of many causes of placental insufficiency, but cord knot must be in mind as a cause of intermittent waveform irregularity and variable indices.

Keywords: Kord Knot, Obstetric Doppler, Placental Insufficiency, Gestational diabetes.

1 Introduction

Fetal life and good health are the aims of all medical teams that are dealing with obstetric cases. Placental blood supply is the source of life for the fetus and any impairment of it due to any cause can threaten fetal life. Color Doppler is an important tool for the assessment of vascular abnormalities. It has the benefits of anatomical and dynamic assessment in addition to being a non-ionizing modality. Doppler assessment of fetal blood supply is assessing mainly 3 parameters (SD ratio, RI and PI) which are calculated automatically depending on equations according to relations to PSV and EDV in two arteries, UA and MCA. Cord knot is one of the uncommon abnormalities that can significantly decrease fetal blood supply. It is not commonly detected by the color Doppler due to the nature of the umbilical cord, which is formed of 3 vessels twisted on each other and the usual coiled nature of it beside the fetus (1,2,3). The course and fate of a cord knot is quite variable as it doesn't have a stationary or logic course but can be suddenly progressed due to any cause causing more tension on the knot like fetal or maternal movement. This case report explains how the waveform of Doppler, an indicator of the presence of a cord knot, can be and assesses its current effect on fetal blood supply. Umbilical cord knots (UCK) are among the accidentally observed abnormalities during routine sonography. True knots range from 0.3% to 2.1%, and, usually solitary, multiple knots also occur. The clinical significance of a knot depends on whether it is tight or loose; a tight knot, especially in a hyper-coiled cord, is less flexible and more prone to complications during birth (2,3,5,9).

2 Case Report:

2.1 Medical History:

On 2nd Jan 2022, the patient who was married 2 years ago, presented for the first time to the hospital for her 1st pregnancy follow-up, with LMP 5th Sep 2021 and EDD



12th June 2022. 27th Jan 2022 she presented with intermittent lower abdominal pain referred to the back and was admitted to the hospital for 3 days, two weeks later anomaly scan was done and revealed no detected anomalies. Regular supervision of the patient in an obstetric clinic as a high-risk pregnancy was done every 2 weeks, until she presented on 29th May 2022, with GA +/- 37 weeks of pregnancy by US and date, she delivered by LSCS due to fetal distress and meconium stain and gestational diabetes. The fetal weight of the newborn female baby was about 2570 gm with overall good general conditions. On 14th May 2024, she was presented with a missed period, LMP 7th April 2024, pregnancy diagnosis was confirmed with noticed no chronic medical illnesses, no drug allergies, no previous blood transfusions, Blood group A positive, Gestational diabetes in her previous pregnancy. Regular obstetric follow-up and anomaly scans were done, and no abnormalities were detected. 8th Sep 2024 laboratory investigation showed normal results except for urinalysis: sugar +++. Metformin 850 gm, one tablet per day, was prescribed for 3 months. On 19th Oct 2024, metformin 1000 mg was prescribed for better control of gestational diabetes. On 14th Oct 2024, an internal medicine consultation added 14 units of insulin glargine in addition to the previously prescribed metformin 1 gm tablet once daily.

2.2 Clinical Presentation:

On 21 Dec 2024, 7.30 pm, the patient is presented to the ER with left lower abdominal pain with a pregnancy of GA 37 weeks and known gestational diabetes. A clinical assessment was done and revealed normal vital signs and good general condition with mild tenderness in the left lower abdomen. Urine analysis and urgent abdominal US and obstetric doppler were requested. Urine analysis showed no significant findings.

2.3 Radiological Assessment:

Abdominal US was done and showed bilateral mild renal backpressure (related to the pregnancy). Gall bladder stone was 8 mm with no other abnormalities. Obstetric color Doppler finds were quite variable on the same scan. After full adjustment of setting and mode of examination, color gain and applying pulsed wave doppler gate on the middle part of the clear segment of umbilical artery at the middle zone between fetus and placenta, repeated measures were done and revealed significant variabilities. The UA Doppler waveform was normal as some scans (Fig.1) with minimal changes of indices (SD Ration, RI and PI) in the normal range for correlated gestational age. But other scans showed unusual intermittent irregularities mainly involving EDV with significant unexplained variability (Fig.2). MCA doppler parameters were normal indicators and flow patterns during this scan (Fig 3). The notice finding was described, and close clinical and radiological follow-up was recommended.



Fig. 1: (A, B,) – Color Doppler assessment of UA has different repeated reads at the same scan, showing normal waves from and indices.



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Fig. 2: (A, B,) – Color Doppler assessment of UA different repeated reads at the same scan, showing wave form irregularity mainly involving EDV.



Fig. 3: Color Doppler assessment of MCA different repeated reads at the same scan, showing normal wave form and indices.

The next morning, a follow-up color Doppler of UA and MCA was done and showed persistent and more significant waveform irregularities, increased indices UA with early vasodilation changes of MCA (**Fig 4**). Upon the doppler examination and follow-up findings and co-existing gestational diabetes, the obstetric decision was to terminate the pregnancy by caesarian section and during the operation a true umbilical cord knot (**Fig 5**) was discovered and explained the associated doppler changes (**Table 1**).







Fig. 4: Follow UP Color Doppler assessment of the case in the next day follow up, showing A- increased indices of UA Doppler with persistent flow irregularity and Bdecreased indices of MCA denoting vasodilation changes associated with placental insufficiency with associated flow irregularity. C. The significant intermittent unexplained flow irregularity



Artery	&	PSV	EDV	SD	RI	PI
Parameters				Ratio		
1 st	UA	45.6	16.7	2.72	0.63	1.04
Scan		cm/s	cm/s			
	MCA	51	< 5	-	1	2.84
		cm/s	cm/s			
Follow	UA	cm/s		3.06	0.67	1.12
Up	MCA	46	9	-	0.79	1.54
		cm/s	cm/s			

 Table 1: The reported average of Different parameters

 during doppler scan and follow up of the case.



Fig. 5: Tru cord knot with discovered after caesarian section.

3 Discussion

I IUFD is the worst fate of any pregnancy, either for a doctor or for mother and family. Placental insufficiency is one of the common causes of IUFD. Placenta abnormalities or related diseases are not the only cause of fetal blood insufficiency. UKC is one of the abnormalities that can significantly affect fetal blood supply (1,4,5,6,9).

Normally, the blood flow of UA is continuous biphasic flow all over the cardiac cycle with the characteristic saw tooth appearance. Decrease or absence of EDV is the indicator of placental insufficiency as the resistance will affect it mainly due to its lower velocity. While the flow of MCA is more resistant in normal conditions, it appears as monophasic blood flow earlier and a high resistance occurs. Biphasic blood flows in more advanced pregnancies, but all over the time its indices are higher than UA. When placental insufficiency occurs and progresses, the cerebral blood supply undergoes vasodilatation, which alters the waveform to biphasic flow and decreases the number of MCA indices. The normal indices of both UA and MCA have a chart of normal levels in correlation to gestational age in weeks, but the general rules are, the more advanced a pregnancy is, the more decreased numbers, and the numbers of MCA are generally higher than UA. The irregularity of the flow is not a common sign of insufficiency, it may also relate to fetal arrythmia (6,10,12). Umbilical cord knot is an acquired anatomical state that can result from excessive fetal rotation with a relatively prolonged cord. The normal cord length is 35 to 70 cm (average 55 cm) (13,15). The longer cord gives more chance for cord knots, either single or even multiple knots. The cord knot is a condition that can significantly alter blood flow in a short time, as it is the tension on the knot which can be significantly altered from time to time according to fetal or maternal movements with no predictable indicators. As the tension on the knot is variable over a short time, the alteration of doppler indices and waves will also be related to it. As EDV is the weaker point of flow, it is the first parameter to be altered for any increase in resistance. In this case report, the intermittent irregularity of flow was the main indicator of an abnormality of fetal blood and the following on the next day (about 10 hours later), approved that the changes were progressive, and the threat became more serious, forcing the obstetrician to take the decision to terminate the pregnancy for fear of sudden IUFD which is more common in diabetic mothers (16,17,20). The changes to Doppler were unclearly explained during the time of the scan and followed after, but it was an indicator of early insufficiency and warning conditions. After labor, the umbilical cord true knot was discovered. Diagnosis of a cord knot by color doppler depends on the detection of a non-changed coil of the cord in follow-up, especially in the cut section view (14,18,21).

4 Conclusion

Umbilical cord knot is a dangerous finding that can lead to fetal morbidity or sudden unexpected or explained IUFD. Color Doppler of UA and MCA is a common method for assessing placental and fetal blood flow integrity and dynamic indices. Umbilical cord knots are relatively more to occur with prolonged cord, but diagnosis with color doppler alone is not an easy mission, but it may be relatively easier by using 4D scan. This case report approved that the dynamic changes of wave from irregularity can be an indicator for prediction cord knot and make the suitable decision of terminating pregnancy for saving the life of the fetus which can be seriously threatened by significant cutoff blood supply by more tension applied on the knot either by maternal or fetal motility.

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EDD	Expected Date of Delivery			
EDV	End Diastolic Velocity			
GA	Gestational Age			
IUFD	Intra Uterine Fetal Death			
LMP	Last Menstrual Period			
MCA	Middle Cerebral Artery			
PI	Pulsatility Index			
PSV	Peak Systolic Velocity			
RI	Resistive Index			
SD	Systolic Diastolic			
UA	Umbilical Artery			
UCK	Umbilical Cord Knot			
US	Ultrasound			

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