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A Correlational study of Umbilical Venous Flow Rate and Mode of Delivery

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Abstract **Original Research Article**

Objective: The Primary Objective of the study was to establish the relationship between Mode of Delivery and subsequent Intrapartum outcome [Fetal Distress]. The findings of the study showed higher rate of caesarean section during labor in fetuses with <20th centile of UV flow rate. The women who had spontaneous vaginal delivery had flow rates above 80th centiles and had less fetal compromise. ***Study Design:*** A prospective observational study done at SMS MEDICAL COLLEGE, jaipur. Fetal biometry and Arterial Doppler and venous flow rates were measured in 90 women immediately before established labor. Labor was then managed according to local protocols and guidelines, and intrapartum and neonatal outcome details were recorded. ***Results:*** Fetuses delivered by cesarean section for fetal compromise had significantly lower umbilical venous flow rates than those born by spontaneous vaginal delivery. Fetuses with the lowest umbilical flow rates were more likely to require emergency cesarean for presumed fetal compromise than those with the highest flow rates. ***Conclusion:*** Asssessment of umbilical venous flow can predict the diagnosis of intrapartum fetal compromise and need for emergency delivery.

Keywords: Fetal Distress, Mode of delivery, umbilical venous flow rate.

INTRODUCTION

The intrapartum period represents the time during pregnancy when the fetoplacental relationship is challenged to the highest degree. Uterine contractions are associated with up to 60% decline in uterine artery flow velocities [1] and the associated reduction in placental perfusion may precipitate fetal compromise.

Intra-partum events leading to cerebral palsy and other neurological sequelae are over represented in medico-legal malpractice cases [2], and often result in the award of a large quantum of financial compensation [3]. With the possibility of affected individuals requiring a lifetime of care, and the spiraling costs of medico-legal malpractice insurance, intra-partum fetal compromise continues to represent a significant financial burden to healthcare providers. The psychological and emotional impact on both the affected individual and caregivers is enormous [4].

The final common pathway of many conditions that result in intra partum hypoxia is one of placental insufficiency [5]. Umbilical venous blood flow could be considered a direct and physiological measurement of vascular placental function, representing the quantity of oxygen and nutrients reaching the fetus.

The clinical use of umbilical venous blood flow was first suggested in the early 1980s [6] when reduced flow was demonstrated in growth-restricted fetuses. Doppler examination of the UV provides information about a compensatory mechanism in the fetal circulation. Evaluation of venous Doppler parameters has significantly contributed to the understanding of the vascular mechanisms that lead to fetal growth restriction (FGR) and subsequent fetal deterioration in the setting of progressive placental dysfunction. Indeed, Doppler measurement of umbilical venous blood flow has been found to be accurate when compared with several gold standards for in-vivo flow calculation.

Furthermore, abnormalities in umbilical venous flow have been associated with an increased incidence of operative delivery for fetal compromise.

AIMS &OBJECTIVE

To establish the relationship between Umbilical Venous Flow Rate and Mode of Delivery.

METHODOLOGY

Study Type - A hospital based observational study

Study Design - A hospital based prospective study.
Study Place - The Department of Obstetrics and Gynecology, in collaboration with Department of Radiology at SMS Medical College and attached hospitals, Jaipur.

Study Period - June 2018 to November 2019.

Study Population -The study included 90 women with singleton pregnancy with early labor (cervical dilation 4 cm or less).

Sample Size: Sample size was calculated at 95% confidence level assuming SD of 48.43 ml/min in umbilical venous flow rate among patients of normal term pregnancy as found in reference study (Tomas Prior, BSc; Edward Mullins, BSc; Phillip Bennett, PhD; Sailesh Kumar, PhD. American Journal of Obstetrics & Gynecology JANUARY 2014).

At the precision (absolute allowable error) of 10 ml/min in umbilical venous flow rate 90 cases were required, as sample.

Inclusion Criteria

- Singleton pregnancy
- Women with normal term pregnancies presenting in early labor, and likely to deliver within 72 hours.

Exclusion Criteria

- Known fetal growth restriction (preeclampsia)
- Known fetal anomaly
- Cervical dilatation greater than 4 cm, and ruptured membranes with meconium stained liquor.

METHODOLOGY

After applying inclusion and exclusion criteria informed written consent was be taken and women with uncomplicated singleton pregnancy in early labor cervical dilation ≤ 4cm likely to deliver within 48 hours and willing to participate in the study were recruited from labor room of department of obs and gynec, SMS medical college, Jaipur.

Approval from Institutional Research, Review Board and Ethical Committee was taken. Detail history, examination and all routine investigations were done. Ultrasound assessment was done for fetal biometry (head circumference, biparietal diameter, abdominal circumference, femur length and fetal weight) and umbilical venous Doppler was assessed. All ultrasounds scans was performed by a single operator using (ALOKA PROSOUND alpha6 with convex probe).

For Doppler assessment, the umbilical vein was imaged at a free loop and pulsed wave Doppler was used to obtain umbilical vein flow velocities. The angle of insonation was maintained as close to 0 degree as possible and always less than 30 degree, to ensure accurate assessment of flow velocities. The image was magnified and internal diameter of vein was measured. An estimated fetal weight was calculated from fetal biometry.

Umbilical venous Doppler was done for the umbilical vein flow velocity and umbilical vein diameter, to calculate umbilical venous flow rate.

The following formula was used for calculation:

Umbilical venous flow rate (milliliters per minute) = velocity (centimeters per second) x 0.3 x cross-sectional area (square millimeters).

Case were managed according to local protocol and guidelines and then case were subcategorized according to mode of delivery and corrected umbilical venous flow rates.

Statistical Analysis

- Continuous variables were summarized as mean and standard deviation while nominal / categorical variables as proportion.
- Parametric test were used for continuous variable whereas $\chi 2$ (chi-square) test.
- Fisher-exact test were used for nominal / categorical variability. P-value <0.05 was taken as significant

RESULTS

Patient demographics are shown in Table-1 and mode of delivery in Table-2. The mean age in our study population was 26.4 ± 2.73 yrs. Most of the patients 62 (68.89%) belonged to urban areas and were Hindus. Maximum (93.33%) number of cases had a BMI <25 and mean BMI of the study population was 22.14 ± 1.39 kg/m^2 Maximum patient in our study were primigravidas. No difference in maternal age, residence and BMI was observed in different mode of delivery groups. The mean umbillical venous flow rate in the study was 211.96 ± 30.98 ml/min whereas the mean of the corrected umbillical venous flow rate was 73.46 ± 9 ml/min/kg . Cases were sub classified according to mode of delivery. 34.44% patients had LSCS out of which 64.52% patients had LSCS for presumed fetal compromise and 35.48% had caesarean for indication other than fetal distress. 54 (60%) patients had Spontaneous Vaginal Delivery. 5 (5.55%) patients had

Instrumental deliveries of which 3 (60.00%) patients had it for presumed fetal compromise and 2 (40.00%) patients had instrumental deliveries for prolonged second stage. Both uncorrected and corrected flow rates were significantly different between the various modes of delivery groups. Out of 90, 26 women in our study had UV flow rate less than 200ml/min , of these 18 (69.23%) women developed fetal distress during labor, suggesting a strong correlation of decreased UV flow rate with fetal distress. 60 cases had UV flow rate between 201 and 250 ml/min out of which only 5 (8.33%) cases had fetal distress. There was no FD case in UV flow rate of >250ml/min. The number of patients who underwent LSCS for presumed fetal distress in group with umbilical flow rate below 20th centile was 6 as compared to 0 in group with flow rates above 80th centiles with relative risk of 2.28. Higher rate of caesarean section for presumed fetal compromise and diagnosis of fetal compromise at any time during labor were observed in fetuses in <20th centile group. The number of women who had spontaneous vaginal delivery in 20th centile UV flow rate was 8 as compared to 17 in group with flow rates above 80th centiles. The p-value was 0.01 with relative risk being 2.14. Fetuses with >80th centile UV flow rate were more likely to be born by SVD compare to cohort of fetuses with <20th centile flow rate. A UV flow rate of >80th centile yielded a 100% negative predictive value for cesarean section for presumed fetal compromise.

Table-1: Distribution of Cases According to Age

Age Group (in yrs)	No.	%
<25	36	40.00
26 - 30	47	52.22
31 - 35	7	7.78
Total	**90**	**100.00**

Table-2: Distribution of Cases According to Gravidity

Gravidity	No.	%
G_1	37	41.11
G_2	28	31.11
G_3	25	27.78
Total	**90**	**100.00**

Table-3: Distribution of Cases According to Mean of Umbilical Venous Flow Rate

Variable	Mean	SD	Median
Umbilical Venous Flow Rate (in ml/min)	211.96	30.98	216.40
Corrected Umbilical Venous Flow Rate (in ml/min/kg)	73.46	9.00	73.6

Table-4: Distribution of Cases According to Mode of Delivery

Mode of Delivery (n=90)				Total	
		No	%	No.	%
Instrumental Deliveries (n=5)	Presumed Fetal Compromised	3	60.00	5	5.55
	Prolonged Second Stage	2	40.00		
LSCS (n=31)	Presumed Fetal Compromised	20	64.52	31	34.44
	Other Indication	11	35.48		
SVD		54	100.00	54	60.00
Total		90		90	100.00

Table-5: Correlation between Foetal Distress and UV Flow Rate

Foetal Distress	UV Flow Rate (ml/min)						p-value
	<200		201-250		>250		
	No.	%	No.	%	No.	%	
Present	18	69.23	5	8.33	0	0.00	0.001
Absent	8	30.77	55	71.67	4	100.00	
Total	26	100.00	60	100.00	4	100.00	

Table-6: Delivery Details According to Umbilical Venous Flow Rate Centile

Variable	<20th	20th-80th	>80th	p-value
LSCS (For Presumed Fetal Compromise)	6 (30.00%)	14 (26.41%)	0 (0.00%)	0.04
LSCS (For Other Indication)	5 (25.00%)	6 (9.43%)	0 (0.00%)	0.05
Instrumental Delivery (For Presumed Fetal Compromise)	0 (0.00%)	3 (100.00%)	0 (0.00%)	0.155
Instrumental Delivery (For Prolonged Second Stage)	1 (0.00%)	0 (0.0%)	1 (5.55%)	0.221
SVD	8 (40.00%)	29 (54.71%)	17 (94.44%)	0.04

Table-7: Delivery Details According to Umbilical Venous Flow Rate Centile

Variable	<20th	>80th	p-value	RR
LSCS (For Presumed Fetal Compromise)	6 (30.00%)	0 (0.0%)	0.01	2.28
LSCS (For Other Indication)	5 (25.00%)	0.02		2.20
Instrumental Delivery (For Presumed Fetal Compromise)	0 (0.0%)	0.93		0.94
Instrumental Delivery (For Prolonged Second Stage)	1 (5.00%)	1 (5.55%)	0.01	2.14
SVD	8 (40.00%)	17 (94.44%)		

DISCUSSION

The results from this study demonstrate that assessment of the umbilical venous flow, in term infants from low risk pregnancies before active labor, can predict the diagnosis of intrapartum fetal compromise and the need for emergency delivery with good reliability. Currently, multivessel Doppler assessment of fetal well-being is considered valuable only in cases of fetal growth restriction. Our data suggests that assessment of the umbilical venous flow rate can also be of value in the apparently normally grown fetus at term. Although the risk of intrapartum fetal compromise being diagnosed is highest in infants with the lowest umbilical venous flow rate, a high umbilical venous flow rate appears to suggest better fetal tolerance to the stresses of labor, with a reduced incidence of abnormal fetal heart rate patterns necessitating emergency delivery. No infants in our study with UV flow rate>80th percentile required delivery by emergency cesarean section for presumed fetal compromise (NPV 100%). The mean umbillical venous flow rate in the study was 211.96 ± 30.98 ml/min whereas the mean of the corrected umbillical venous flow rate was 73.46 ± 9 ml/min/kg.Various studies have examined corrected UV flow rate at differing gestations,but few have examined UV flow rates in appropiately grown fetuses at term. Our study results were similar to the study done by Prior T *et al*., [7] the mean umbillical venous flow rate in study population was 213.6 ml/min. Similar results were also obtained by Tchirikov M *et al*., [8]. We compared with those with a flow rate greater than the 80th centile, fetuses with an umbilical venous flow rate less than the 20th centile were noted to have a significantly increased risk of being diagnosed with fetal compromise during labor and were also noted to have the highest incidence of cesarean section for presumed fetal compromise. Similar results were obtained in other studies also.

CONCLUSION

We suggest that measurement of umbilical venous flow may have a potential clinical application in the risk stratification of normal pregnancies prior to labor. Such stratification would allow more informed decisions to be made regarding the mode and place of delivery as well as a more targeted approach to intrapartum monitoring.

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