The predictive value of studying the Uterine & umbilical artery resistance indices in cases of pre term labour

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Abstract

Objective: to assess the value of uterine artery and umbilical artery resistance indices changes in predicting cases of PTD

Setting: The study was carried on gravid women attending AI zahraa University Hospital between February 2009 to September 2010.

Design: A prospective study on gravid women picked up at 24 week gestation during ANC . They were subjected to Doppler velocimetry study of the Umbalical & Uterine artery blood flow to measure the resistive indices changes on going GA.

Patients & Methods: Participants were 24 weeks pregnant with a singleton pregnancy, Participants were seen at three study visits: at recruitment, at, 28 weeks gestation; and finally at 34 weeks gestation. Patients who later developed PTL formed the **study group** n=28.

The control group were the women who completed 40 weeks gestation at the time of delivery. For each patient seen at the three visits Doppler velocimetry ultrasound study of the umbilical and uterine were performed to assess the RI indices changes.

Results: The current study revealed a high significant difference in the RI value of the umblical artery starting from 28 weeks visit to be (0.74), (0.61) in the study group and control group respectively with p-value (0.001) also a highly significant diff. were noticed at the 34 weeks visit to be(0.65),(0.49) in the study group and control group respectively with p-value (0.0001). As regard the uterine artery RI the study group showed a highly significant difference at 28 weeks visit when compared to the value of the control group with p-value(0.001) in the same manner the RI value at 34 weeks visit showed a highly significant difference between both groups with p-value(0.0001).In the current study the mean RI for both uterine and umbilical arteries decreased steadily across all study visits from 24 weeks to 34 weeks gestation. In linear regression models, the relationships of both uterine and umbilical artery RI with gestational age were significantly different between study group and control group. The mean umbilical artery RI and uterine artery RI indices decreased significantly more slowly across gestation for study group than for control group. In univariate analyses, a 2.9 fold increase in risk for PTD was associated with a 0.1 unit increase in uterine artery RI across gestation; while a 3.4 fold increase in risk for PTD was associated with a 0.1 unit increase in umbilical artery RI across gestation.

Conclusion: The RI indices values in the umblical artery and uterine artery showed a significant slowly decrease along gestational age among gravid patients developed preterm labour so that they could be predictive for PTL.

Keyword: (Naemat – Inas- UT.&UMB-RI)

Introduction

Preterm birth rates continue to increase and account for 10-15 percent of all births globally in this decade. Modern obstetrics remain facing a challenge to understand and prevent both the occurrence and the poor outcomes of preterm delivery (Sayres *et al*.,2010& Simhan *et al* .,2007).

Preterm delivery (PTD) is associated with 75 percent of all perinatal deaths and may result in substantial morbidity in even a larger proportion. Epidemiological and clinical studies have identified a number of environmental risk factors for prematurity. However, the physiological pathways that mediate the effects of these risk factors are not well characterized. (Bittar *et al*., 2009 & Baker *et al*., 2008) The establishment of normal pregnancy till the birth of a full term newborn depends on a normal maternal-fetal vascular tree.(Weast *et al*.,2007) Spontaneous preterm delivery might therefore be a sequel of disordered placentation. Placentas from pregnancies complicated by PTD are found to have a greater degree of failure of physiologic transformation of the spiral arteries in the myometrium and decidua of the placental bed (Soares *et al*., 2007 & Cobian *et al*., 2004). Doppler velocimetry is a tool to understand into placental vascular development and to assess a pregnancy affected by abnormal placental blood flow. Few studies have adequately documented the relationship between variation in placental vascular flow and the risk of PTD. Color and pulsed wave Doppler ultrasonographic studies were performed of the maternal uterine, umbilical, and fetal middle cerebral and renal arteries in singleton preterm pregnancies or assessed retrospectively from mid-trimester studies.(Gakbovits *et al*., 1995 & Rizzo *et al*.,1996) Despite pathological evidence suggesting that defective placentation is associated with spontaneous preterm delivery, first and second-trimester uterine artery resistance, as assessed by Doppler ultrasound investigation, is not different in pregnancies subsequently complicated by preterm labor compared to pregnancies delivered at term. The mentioned early reports of a small cohort failed to show meaningful results but only contradictory ones. (Fratelli *et al*., 2008)

Aim of the work The objective of this study was to assess the changes in uterine artery and umbilical artery resistance indices in predicting cases of PTD.

Patients & Methods: The study was carried on gravid woman attending **AI zahraa University hospital** between February 2009 to September 2010.

Participants were 24-26 weeks pregnant with a singleton pregnancy, Participants were seen at three study visits: at recruitment, at 28 weeks gestation; and finally at 34 weeks gestation. Data analyses were carried out on. At each of the follow-up visits, Doppler velocimetry was used to measure uterine artery and umbilical artery vascular blood flow. Primary outcome measure was the rate of preterm delivery (gestation lasting less than 37 completed weeks). A prospective study on gravid women picked up at 24 week gestation during ANC . They were subjected to Doppler study of the Umbalical & Uterine artery resistive indices changes. Participants were 24-26 weeks pregnant with a singleton pregnancy, Participants were seen at three study visits: at recruitment, at, 28 weeks gestation; and finally at 34 weeks gestation. Patients who later developed PTL formed the **study group** n=28. The **control group** were the women who completed 40 weeks gestation at the time of delivery. For each patient seen at the three visits Doppler velocimetry ultrasound study of the umbilical and uterine were performed to assess the RI indices changes. SPSS software version 15 was used for all data analyses. The $p<0.05$ level= significant difference, $p<0.01$=highly significant difference while $p>0.05$=non significant . The study statistician used univariate analysis to explore each variable separately.

Results:

Table (1) shows patients data in both groups

Item	Study G N=28	Control G N=52	p-value
Mat. age	31.1 ± 2.2	30.9 ± 2.1	N.S
Parity	2.9 ± 1.8	2.8 ± 0.4	N.S
GA at delivery	35.1 ± 0.8	39.3 ± 0.9	S

Table (2) shows RI of the umb.art. indices at 3 visits in both groups

Item (visits)	Study G N=28	Control G N=52	p-value
Visit at 24 W gestation	0.79 ± 0.08	0.76 ± 1.02	0.789
At 28 W	0.71 ± 0.09	0.61 ± 1.06	0.001
At 34 W	0.67 ± 3.02	0.49 ± 2.09	0.0001

Table(3) shows Uterine artery RI along the 3 visits in both groups

Visits at :	Study G (N=28)	Control G (N=52)	p-value
24 W (gest.)	0.72 ± 2.01	0.68 ± 1.03	0.683
28 W (gest.)	0.69 ± 1.01	0.56 ± 1.03	0.001
34 W (gest.)	0.67 ± 0.04	0.51 ± 1.06	0.001

P-value <0.05=S   P-value>0.05=NS   P-value<0.01=HS

In this study the Inlinear regression models, the relationships of both uterine and umbilical artery RI with gestational age were significantly different between study group and control group. The mean umbilical artery RI and uterine artery RI indices decreased significantly more slowly across gestation for study group

Discussion

Fetal, placental and maternal vessels may be checked by Doppler. Doppler velocimetry is presumably a good clinical tool to assess placental performance in high-risk pregnancies. Normally there is an increase in the diastolic blood flow velocity component in umbilical artery with advancing gestation.(Ghosh *et al*., 2006& Geipel *et al*.,2001) In pregnancies complicated by placental dysfunction, end-diastolic velocity is decreased and finally becomes absent due to increased impedance that is brought about by the reduction in the number of functional villi and/or small blood vessels. Further increase in the resistance causes reversed end-diastolic velocity. Uterine artery Doppler is useful in predicting pregnancies at high risk of developing complications related to utero-placental insufficiency.(

than for control group. In univariate analyses, a 2.9 fold increase in risk for PTD was associated with a 0.1 unit increase in uterine artery RI across gestation; while a 3.4 fold increase in risk for PTD was associated with a 0.1 unit increase in umbilical artery RI across gestation.

Smith *et al*., 2007 & Abramowicz *et al*., 2008).

This current follow up study has shown that a pregnancy with a higher uterine and umbilical artery RI is more likely to be affected by PTD. The mean uterine artery RI was consistently larger during the follow up in the second and third trimester in mothers who had PTD. The mean umbilical artery RI decreased significantly more slowly across gestation than for those who had term delivery.

The importance of finding a tool to predict preterm delivery stems from the fact that preterm delivery remains the major cause of perinatal morbidity and mortality and one third of cases of preterm delivery remain idiopathic. Therefore, the best preventive strategy is finding a reliable

predictor to plan preemptive measures in advance (Boulvain *et al.*, 2008).

The relationship between PTD and uterine artery Doppler indices has been sought .

Prior case-control studies examining the cross-sectional relationship between PTD and uterine artery Doppler indices measured only at single time points in pregnancy have reported contradictory results. For instance, (Strigini *et al.*,1995) used Doppler velocimetry to measure the uterine artery systolic to diastolic ratio (S/D) in 417 women at 25-36 weeks of gestation and reported that the S/D was significantly higher in the 31 women with spontaneous PTD. (Carbilon *et al.*, 2011)

Similarly, (Fonseca *et al.*, 2006) found that the median uterine artery mean pulsatility index measured in singleton pregnancies at 22-24 weeks of gestation was significantly higher in 237 women who had a spontaneous delivery before 33 weeks than in 31,633 women delivering at or after 33 weeks. However, (Cobian *et al.*, 2004)reported that the mean uterine artery RI measured between 18-23 weeks gestation in 72 singleton pregnancies that delivered before 34 weeks was not significantly different from that in 5472 patients who delivered at term.

Similarly,(Soares *et al.*, 2007). found that the mean uterine artery RI measured between 11-14 weeks in 73 singleton pregnancies with spontaneous preterm labor was not significantly different from that in 2417 pregnancies delivered at term.

We find that the risk of PTD is associated with an increased resistance to flow in both of these arteries. It can be speculated that placental vascular compromise represents a unifying pathologic process that may explain a significant proportion of PTD.The study of(Fonseca *et al.*,2006) proved that several pathophysiologic processes can compromise placental vascular function at different times during gestation leading to adverse pregnancy outcomes. These processes include thrombophilias, effect of acute chorioamnionitis, and uteroplacental vascular lesions. These pathologic changes may result in increased resistance to maternal intervillus flow and increased uterine artery Rls. It is possible that the prolonged reduction in maternal intervillusflow, may also result in a secondary reduction in placental stem villus flow that manifests as an increased resistance to flow in the umbilical artery.

Conclusion: The RI indices values in the umblical artery and uterine artery showed a significant slowly decrease along gestational age among gravid patients developed preterm labour so that they could be predictive for PTL.

References

1. Abramowicz JS, Sheiner E. (2008)Ultrasound of the placenta: a systematic approach. Part ǁ: functional assessment(Doppler).Placenta;29(11):921-9

2. Baker VL. (2008)Prevention of preterm delivery. Nurse Pract.;33 (5):42-6.

3. Bittar RE, Zugaib M. (2009) Management of preterm labor. Rev Bras Ginecol

O b s t e t . ; 3 1 (8) : 4 1 5 - 2 2 .

4. Boulvain M, de T ejada BM, Qayoom Z, Pfister R, Palacio-Espasa F, Irion O.(2008) Prevention of preterm delivery: new interventions. Rev Med Suisse. 25;2(84):2396-8, 400.

5. Carbillon L, Challier JC, Alouini S, Uzan M, Uzan S. (2011)Uteroplacental circulation development: Doppler assessment and clinical importance. Placenta.;22(10):795-9.

6. Cobian-Sanchez F, Prefumo F, Bhide A, Thilaganathan B. (2004)Second-trimester uterine artery Doppler and spontaneous preterm delivery. Ultrasound Obstet Gynecol.;24(4):435-9.

7. Fonseca E, Vu CK, Singh M, Papageorghiou AT, Nicolaides KH. (2006)Relationship between second-trimester uterine artery Doppler and spontaneous early preterm delivery. Ultrasound Obstet Gynecol. ;27(3):301-5.

8. Fratelli N, Rampello S, Guala M, Platto C, Frusca T.(2008) Transabdominal uterine artery Doppler between 11 and 14 weeks of gestation for the prediction of outcome in high-risk pregnancies. J Matern Fetal Neonatal Med. ;21 (6):403-6.

9. Geipel A, Ludwig M, Germer U, Katalinic A, Diedrich K, Gembruch U.(2001) Uterine artery Doppler velocimetry and the outcome of pregnancies resulting from ICS!. Hum Reprod. ;16(7):1397-402.

10. Ghosh G, Breborowicz A, Brazert M, Maczkiewicz M, Kobelski M, Dubiel M .(2006) Evaluation of third trimester uterine artery flow velocity indices in relationship to perinatal complications. J Matern Fetal Neonatal Med.;19(9):551-5.

11. Jakobovits AA. (1996) Doppler velocimetry of the fetal middle cerebral artery in preterm labor. J Ultrasound M e d . ; 1 5 (7) : 5 4 7 - 8 .

12. Jakobovits A, Jorn H.(1995) Maternal-fetal circulation in premature labor. Orv Hetil. 23;136(17):889-92.

13. Rizzo G, Capponi A, Arduini D, Turri E, Romanini C. (1996)Uterine and fetal blood flows in pregnancies complicated by preterm labor. Gynecol Obstet Invest.;42(3): 163-6.

14. Simhan HN, Caritis SN. (2007) Prevention of preterm delivery. N Engl J Med. 2;357(5):477-87.

15. 14.Sayres WG, Jr. Preterm labor. Am Fam Physician. 2010 Feb 15;81 (4):477-84.

16. Smith GC, Vu CK, Papageorghiou AT, Cacho AM, Nicolaides KH. (2007) Maternal uterine artery Doppler flow velocimetry and the risk of stillbirth. Obstet Gynecol. ; 1 09(1): 144-51.

17. Soares SC, Fratelli N, Prefumo F, Bhide A, Thilaganathan B.(2007) First-trimester uterine artery Doppler and spontaneous preterm delivery. Ultrasound Obstet G y n e c o l . ; 2 9 (2) : 1 4 6 - 9 .

18. Strigini FA, Lencioni G, De Luca G, Lombardo M, Bianchi F, Genazzani AR. (1995) Uterine artery velocimetry and spontaneous preterm delivery. Obstet Gynecol.;85(3):374-7.

19. Yeast JD, Lu G.(2007) Biochemical markers for the prediction of preterm delivery. Cl in Perinatol. ;34(4):573-86, vi.

الملخص العربى

دراسة المقدرة الاستنتاجية للتعرض للولادة المبكرة تبعاً للتغيرات التى تحدث فى مقاومة الشريان الرحمى أو السرى وخطورته

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تهدف هذه الدراسة إلى قياس التغييرات فى معاملات مقاومـة فى الشريان الرحمى والشريان السرى فى حـالات الولادة المبكرة.

وقد أجريت هذه الدراسة على سيدات حوامل فى الفترة من 24 – 26 أسبوع حيث تمت مناظرتهن ثلاث مرات – مرة عند الاختيار للدراسة ومرة عند 28 أسبوع والأخيرة عند 34 أسبوع.

تحليل المعطيات أجرى على مجموعة من 223 سيدة وضعن طفل حى ما بين 28 – 41 أسبوع من الحمل عند كل زيارة متابعة. وقد تم قياس معدل سريان الدم فى الشريان الرحمى والشريان السرى بواسطة مقياس السرعة بالدوبلر.

النتيجة :

متوسط معدل المقاومة لكل من الشريان الرحمى والشريان السرى كان يقل بثبات خلال الزيارات من 24 إلى 41 أسبوع.

وقد كانت العلاقة بين كل من معدل مقاومـة الشريان الرحمى والشريان السرى مختلفة إحصائياًَ بين الولادة المبكرة والولادة عند تمام نمو الجنين.

متوسط معدل مقاومة الشريان الرحمى أظهر معدلات مماثلة للنقصـان خلال الحمل بالنسبة للولادة المبكرة عن الولادة عند تمام نمو الجنين. ومـع هذا كـان معدل مقاومـة الشريان الرحمى كـان أعلى خـلال فترة الحمل عند الولادة المبكرة وعلى العكس نقص معدل مقاومة الشريان السرى إحصائياً بمعدل أبطأ خـلال فترة الحمل بالنسبة للولادة المبكرة عند الولادة عند تمام نمو الجنين.

وقد وجد أن هناك زيادة أكثر 2.4 مرة للتعرض للولادة المبكرة مـع زيـادة أو (0.1) وحدة زيادة لمعدل مقاومـة الشريان الرئوى خلال فترة الحمل. بينما هناك معدل زيادة 3.7 مرة للتعرض للولادة المبكرة مع 0.1 وحدة زيادة لمعدل مقاومة الشريان السرى خلال الحمل.

المحصلة :

زيادة معدل مقاومة الشريان الرحمى أو السرى قد تتأثر بالولادة المبكرة.