The Predictive Value of Middle Cerebral Artery Peak Systolic Velocity in Repeated Intrauterine Transfusion: A Case Report

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Abstract

Objective: Middle cerebral artery peak systolic velocity has been used for predicting fetal anemia and timing for first and second cordocentesis. However, predicting value of middle cerebral artery peak systolic velocity after multiple intrauterine transfusions is unknown.

Case: Thirty-one-year-old woman, gravida 5, para 4, with Rh-isoimmunization who were presented with fetal hydrops at her 24th week's of gestation was undergone intrauterine transfusion four times between 24 and 31 weeks of gestation. Doppler examination of middle cerebral artery peak systolic velocity was performed before and after cordocentesis during each procedure. There was an inverse correlation between fetal hemoglobin values and Doppler measurements of middle cerebral artery.

Result: The timing of intrauterine transfusion is traditionally determined by fetal hemoglobin measurement from cord blood of the fetus. Middle cerebral artery peak systolic velocity has been found useful for determining fetal hemoglobin level in the severely anemic fetuses after first and second transfusion. It may also be an appropriate non-invasive alternative in repeated transfusions for the timing of transfusion.

Keywords: Rh-isoimmunization, middle cerebral artery, peak systolic velocity, intrauterine transfusion, severe anemia.

Tekrarlayan intrauterin transfüzyonlarda orta beyin arter tepe sistolik hızının değeri: Bir olgu sunumu

Amaç: Orta beyin arter tepe sistolik hızı, fetal anemi tahmininde ve ilk ve ikinci kordosentezlerin zamanlamasında kullanılmaktadır. Ancak, tekrarlayan çoklu intrauterin transfüzyonlar sonrasında, orta beyin arter tepe sistolik hızının belirleyici değeri bilinmemektedir.

Olgu: 31 yaşında, G5P4, 24. gebelik haftasında fetusta hidrops ile başvuran, Rh izoimmünizasyonlu gebeye 24-31. gebelik haftaları arasında dört kez intrauterine transfüzyon uygulandı. Her işlem sırasında, kordosentez ile fetal hemoglobin tayininden önce ve sonra, Doppler ultrason ile orta beyin arter tepe sistolik hızı bakıldı. Fetal hemoglobin değerleri ile orta beyin arter tepe sistolik hızı bakıldı. Fetal hemoglobin değerleri ile orta beyin arter tepe sistolik hızı bakıldı.

Sonuç: Tekrarlayan intrauterine transfüzyonlarda, transfüzyonun zamanlaması invaziv bir girişim olan kordosentez ile fetal hemoglobin tayini yapılarak belirlenmektedir. Daha önce transfüzyon yapılmamış ya da tek transfüzyon yapılmış olgularda, fetal anemi tayininde faydalı bulunan orta beyin arter tepe sistolik hızı, çoklu transfüzyonlarda intrauterin transfüzyonun zamanlanmasında invaziv olmayan uygun bir alternatif olabilir.

Anahtar kelimeler: Rh-izoimmünizasyon, orta beyin arteri, tepe sistolik hızı, intrauterin transfüzyon, ağır anemi.

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Background

The Doppler ultrasound and middle cerebral artery peak systolic velocity (OBA-TH) are used in the diagnosis of the fetal anemia ancillary to Rhisoimmunization as a non-invasive diagnosis method. It has been shown that if according to week of gestation 1.5 folds above the median OBA-TH measurement (1.5 MoM) is used as the threshold value, anemic fetuses at medium or heavy degree can be detected correctly.1 The method traditionally used to predict which fetus is anemic enough to require transfusion is the cordocentesis and hemoglobin measurement in fetal blood.^{2,3} However, this method has a 1-2% percent risk of fetal loss and at the same time increases the risk of sensitization.4 In cases which it is necessary to repeat the intrauterine transfusion, the timing of the subsequent transfusion is done according to the hematocrit value derived after the transfusion. OBA-TH has been found useful in determining the degree of fetal anemia and consequently the transfusion requirement in fetuses which were never transfused before or were only transfused once.5 However, adult red cells which change place with fetal red cells differ in terms of their capacity to carry oxygen, aggregation characteristics and vicosities.5 As a result, the effect of fetal blood characteristics that change after repeated transfusions on the OBA-TH measurement is not precisely known.

Our objective with this case report is to emphasize the association and significance of OBA-TH measurements with fetal hemoglobin values in a hydropic fetus treated with repeated intrauterine transfusions.

Case

Thirty-one-year old woman, G5, P4, who was referred to Celal Bayar University Department of Obstetrics and Gynecology, Perinatology on her 24th week of gestation upon the detection of ascite and hydrops in the abdomen of the fetus in the ultrasonography. Epidemic ascite was detected in the abdomen and edema was detected on the scalp and abdominal walls in the ultrasonography (Figure 1). The patient with an obstetric history of gestational loss and fetal mortality due to three Rh-isoimmunizations was found to be negative in the indirect coombs test applied one week prior to contact despite being monitored with the indirect coombs test since the 13th week of gestation. The patient with the repeated indirect coombs test was notified that the test result is positive and that the antibody titre is too high for titration. Cordocentesis was done one the 24th week of ges-



Resim 1. Fetusta asit ve hidrops.



Resim 2. OBA-TH'nın Doppler ultrasonografi ile ölçümü.

tation of the patient for whom intrauterine transfusion was decided. Upon hemoglobin (Hb) values being 3.5 g/dL, hematocrit (Htc) 13%, the 80% hematocrit, 0 Rh (-), serologic infection tests being negative, the amount of blood which is necessary to be given in the previously defined form, through the transperitoneal and intravascular method was calculated with the formula and transfused with the plan to increase hematocrit to 30%.4 Blood was taken after the transfusion process for the Hb and Htc values, however, these value could not be reviewed due to the technical failure in the laboratory. The fetal blood type 0 Rh (+) was positive with the direct Coombs test. Pre and post transfusion OBA-TH was measured from the peak waveform in way to enable the angle between the Doppler ultrasound and artery to be near 0, in the form previously described with the Doppler ultrasonography (Figure 2). The patient had undergone three more intravascular transfusions up to the 31st week of her gestation. Fetal Hb and Htc values and also OBA-TH measurements were taken before and after every transfusion. The weeks of transfusion, the time between transfusions, the volume of blood given, the Hb, Htc, OBA-TH measurements

taken before and after the transfusion are all shown in Table 1. On the 2nd transfusion, the decision as to when the transfusion would be repeated was taken due to the continuation of fetal ascite, and according to post transfusion fetal Hb and Htc values in the following transfusions.¹ The fetus was observed between transfusions a couple of times per week with ultrasonography, and in addition, weekly with the non-stress test after the 28th week of gestation. Fetal ascite disappeared after the 2nd transfusion (Figure 3). While fetal Hb and Htc values increased after the transfusions, the measured OBA-TH decreased (Table 1). There was an inverse correlation between the fetal Hb, Htc values and the OBA-TH.

Upon the development of acute persistent bradicardia during the final transfusion performed on the 31st week of gestation, a 1900 gr live baby girl was delivered with an emergency caesarean section. The Hb and Htc value after delivery was 11 g/dL and 34%, relatively.

Discussion

The measurement of OBA-TH with the Doppler ultrasound is a valuable tool in the assay of the

Transfüzyon No	Gebelik haftası (Aralık)	Hemoglobin		Hematokrit (%)		Verilen kan miktarı	OBA-TH (cm/s)	
		Önce	Sonra	Önce	Sonra	(ml)	Önce	Sonra
1	24. hafta							
	(10 gün)	3.5	-	11.5	-	40	52	34
							(1.7 MoM)	(1-1.3 MoM)
2	25. hafta							
	(16 gün)	1.5	8.9	3	27	75	80	39
							(>2 MoM)	(1-1.3 MoM)
3	27. hafta							
	(21 gün)	5.9	10.2	17.8	29.4	55	50	27
							(1.3-1.5 MoM)	(<1 MoM)
4	31. hafta							
		5.7	11	17	34	60	0.63	
							(1.5 MoM)	*

Tablo 1. Hemoglobin, hematokrit ve OBA-TH'nin transfüzyonlar öncesi ve sonrasındaki değerleri.

*Acil sezaryen ihtiyacı nedeniyle ölçülemedi.

fetal hemoglobin value in fetuses carrying the risk of anemia. It has been found to be useful in the assay of fetal hemoglobin value and the prediction of the time of transfusion in anemic fetuses with severe or medium degree anemic fetuses even if the value of prediction is not too high in lightly anemic or non-anemic fetuses.⁶ In fetal anemia related to Rh-isoimmunization, cardiac "output" increases in response to hematocrit decrease and fetal cerebral arteries increase blood flow with quick response to hypoxia. If OBA-TH values are above 1.5 MoM according to week of gestation, it is considered that the fetus has severe or medium degree of anemia.1 However, OBA-TH values may show variation since the characteristics of fetal blood change in fetuses that have previously undergone transfusion due to the adult blood given. Thus, when 100% sensitivity is taken in the detection of severe, medium degree and light anemia with studied OBA-TH measurements in the prediction of the 2^{nd} transfusion time for cases which have undergone transfusion for one time, the wrong positive rate has been found to be 6%, 37% and 70%, respectively.5 Researchers have



Resim 3. Transfüzyon sonrası azalan asit.

reported the OBA-TH threshold value for severe anemia in the same study as 1.69 MoM. This value is higher than the threshold value for cases that have not undergone any transfusion before (1.5 MoM). The low capacity to carry oxygen and low viscosity of the "new" blood has been indicated as the cause of this. There is no study in relation to the OBA-TH value in determining the fetal anemia in intrauterine transfusions repeated more than once. Furthermore, it is suggested that the measurement of OBA-TH with the Doppler ultrasound particularly in hydropic fetuses could be an ancillary method in determining the fetal hemoglobin value with cordocentesis and amniocentesis, however that it cannot substitute these methods.⁷

In our case, the OBA-TH measured before the first transfusion when the fetus was in the hydropic state was over the 1.69 threshold value. The OBA-TH value which dropped below 1.5 MoM after the transfusion increased again over 2 MoM in 10 days after the first transfusion. These values were inversely proportioned with the fetal Hb and Htk values measured with cordocentesis. However, despite the OBA-TH values measured after the 2nd transfusion being below the threshold value necessary for transfusion, the Hb and Htc values observed with cordocentesis were at the border requiring transfusion (Table 1). These values indicate that it may be necessary to use different threshold values from fetuses that have not undergone transfusion before or that have undergone transfusion once only for OBA-TH measurement and fetal hemoglobin assay in transfusions repeated more than once in hydropic fetuses. However, since it will not be possible to reach a conclusion with a single case, new prospective studies are necessary to predict the OBA-TH value and threshold values in fetal hemoglobin assay in repeated transfusions. The objective of this case report is not to reach a conclusion on this subject, but to emphasize this requirement.

A majority of the cases with Rh-isoimmunization are non-anemic or are lightly anemic. In their study, Detti et al. report the ratio of non-anemic or light anemic fetuses as 72%, medium degree anemic fetuses as 11%, and severely anemic ones as 17%. The low proportion of pregnant women who are severely anemic and far from their term makes it difficult to reach the sufficient number of cases in a prospective study on the subject.

In our case, post transfusion fetal Hb and Htk values dropped quicker than expected. The cause of this may be high maternal antibody titre or the intraperitoneal application of a section of the first transfusion. It is suggested that red cells given intraperitoneal are absorbed later in hydropic fetuses and consequently, intravascular transfusion is preferred.⁴ On the other hand, some authorities recommend the intravascular and intraperitoneal method in combination, and suggest that red cells that are to be left for the peritoneal will form a reservoir.8 For this reason, in the first transfusion we preferred to combine the intraperitoneal method with the intravascular one. As a result, OBA-TH which is found to be useful in the assay of fetal anemia in cases that have not undergone any transfusion before or that have undergone a single transfusion, may be a suitable non-invasive alternative in the timing of the intrauterine transfusion in multiple transfusions. There is need for prospective studies on this subject.

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