

# Effect of mode of delivery on postnatal decline in pulmonary artery pressure

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## ABSTRACT

**الأهداف:** تقييم تأثير الولادة القيصرية، والولادة الطبيعية على الضغط الشرياني الرئوي لدى الأطفال حديثي الولادة، وعمل مقارنة فيما بينهما.

**الطريقة:** أُجريت هذه الدراسة في أجنحة الولادة في كل من مستشفى دنيا، ومركز كامليكا، ومستشفى سلطان للحمل والولادة، دياربكر، تركيا، وقد استمرت خلال الفترة من يونيو إلى أغسطس 2009م. لقد بدأت الدراسة بمشاركة 80 طفلاً من الأطفال حديثي الولادة الأصحاء والذين قد أكملوا طور الحمل، وأستبعد الأطفال الذين لم يصابوا بقصور الصمام الثلاثي الشرف في اليوم الأول والثالث والخامس بعد الولادة، وهكذا فقد شملت الدراسة 42 حالة، يتضمنهم 22 طفلاً مولوداً بالطريقة القيصرية، و20 طفلاً بطريقة الولادة الطبيعية. لقد تم التحري عن قصور الصمام الثلاثي الشرف بواسطة تخطيط صدى القلب مع الدوبلر الملون، وأُجريت القياسات المطلوبة فيما بعد باستخدام تقنية الموجه المستمرة في اليوم الأول والثالث والخامس بعد الولادة. لقد تمت الاستعانة بالسرعة القصوى لتدفق الدم أثناء قصور الصمام الثلاثي الشرف من أجل حساب ضغط البطين الأيمن الذي سيعكس نتيجة الضغط الشرياني الرئوي.

**النتائج:** أشارت نتائج الدراسة إلى انخفاض الضغط الشرياني الرئوي في كلي المجموعتين خلال اليوم الثالث والخامس بعد الولادة. ولم يكن هناك اختلافاً واضحاً في انخفاض هذا الضغط بين اليوم الثالث والخامس بعد الولادة الطبيعية، غير أن الضغط الشرياني الرئوي في مجموعة الولادة القيصرية قد استمر بالانخفاض بشكل واضح حتى اليوم الخامس بعد الولادة ( $p=0.01$ ).

**خاتمة:** أثبتت الدراسة سرعة تكيف الجهاز الدوري الدموي لدى الأطفال المولودين بالطريقة الطبيعية مقارنة بالأطفال المولودين بالطريقة القيصرية، وهذا بالرغم من عدم تأثير طريقة الولادة على الجهاز الدوري الدموي كما يحدث مع الجهاز التنفسي.

**Objectives:** To evaluate the effect of the mode of delivery on the course of pulmonary artery pressure (PAP) in neonates.

**Methods:** Eighty healthy and term neonates delivered in the maternity wards of Dunya Maternity Hospital, Camlica Maternity Center, and Sultan Maternity Hospital in Diyarbakir, Turkey from June to August 2009 were included in the study. Tricuspid regurgitation (TR) was determined using color Doppler echocardiography, and the measurements were carried out with continuous wave technique on the first, third, and the fifth days of birth. The babies who had no TR flow on the first, third, or the fifth day were excluded, and the study was completed with 42 cases. Twenty-two of them were delivered by cesarean section (CS), and 20 by vaginal delivery. The peak flow velocity of TR was used in the calculation of the right ventricular pressure, which reflects PAP.

**Results:** In both groups, PAP continued to decline on the third and fifth days. However, in the vaginal delivery group, the decrease between the third and fifth days was statistically insignificant, whereas a statistically significant decline ( $p=0.01$ ) in the CS group lasted until the fifth day.

**Conclusions:** Although the birth method does not create a clinical morbidity on the circulatory system as seen in the respiratory system, it can be stated that the circulatory adaptation of vaginally delivered babies is completed earlier.

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It has been known that vital cardiopulmonary changes takes place in newborn babies during the transition phase, from fetal to post-natal life. Important changes occur in the early neonatal period, during the shift from fetal parallel pulmonary and systemic circulation, to 2 separate circulations. As these changes progress, compliance mechanisms step in, and help the newborn to adapt to the new conditions.<sup>1</sup> It was reported that babies delivered by vaginal route compared to the ones delivered by cesarean section (CS) have high doses of catecholamine release in the post-natal period, and higher doses of nitric oxide (NO) and adenosine levels in the blood.<sup>2-4</sup> It was suggested that respiratory morbidity is higher in babies delivered by CS due to respiratory distress syndrome, and transient tachypnea of the newborn.<sup>5</sup> This study was planned with the assumption that factors leading to respiratory morbidity may also affect pulmonary arterial pressure (PAP), as it is closely related to lung compliance and pulmonary vascular resistance. The purpose of this study is to investigate the possible effects of CS delivery on PAP in the early post-natal period, in comparison with babies delivered by vaginal route.

**Methods.** This study was conducted in babies delivered in 3 different maternity wards (Dunya Maternity Hospital, Camlica Maternity Center, and Sultan Maternity Hospital) in Diyarbakir, Turkey, from June to August 2009. This study was initiated in 80 healthy babies with gestation age of 37-41 weeks. From these 80 cases, the study group was chosen on the following inclusion criteria: babies born at term, having one of the Apgar scores in the first and fifth minute not <7, absence of congenital heart disease (CHD), and presence of measurable tricuspid regurgitation (TR) flow in echocardiographic examinations. Patent foramen ovale (PFO) and small patent ductus arteriosus (PDA) with minimal left to right flow on the first day of the post-natal period was not regarded as CHD. Two babies with muscular ventricular septal defect (VSD), and one baby with secundum atrial septal defect (ASD) were excluded. Thirty-five cases were excluded, as their TR flow was not determined in any examination performed on the first, third, or the fifth day. The study was completed with 42 cases. Twenty-two of them were delivered by CS, and 20 by vaginal delivery. The characteristics of the cases are presented in Table 1. The study protocol was approved by the local medical ethic committee. The parents were informed regarding the study conducted, and consent was obtained. Presence of elective cesarean, and the absence of a medical history during the gestation were prerequisites. Echocardiographic examination of the cases was conducted by a single pediatric cardiologist using Vivid 3 (GE Vivid 3 Ultrasound Machine, [GE

Medical Systems, Milwaukee, WI, USA), and 7 MHz linear probe (GE Medical Systems, Milwaukee, WI, USA). With routine echocardiographic examination, the presence of CHD was eliminated. The TR in cases was determined using color Doppler on the parasternal 4 chambers or parasternal long axis views, and measurements were carried out with continuous wave (CW) technique. The measurements were repeated 3 times, and the mean results were recorded. The calculation program (using Bernoulli's equation) of the device was used to convert the regurgitation velocity to pressure as mm Hg. Since the right atrial pressure in neonates is approximately zero, the pressure which is provided from the peak flow velocity of the TR reflects the right ventricular systolic pressure. In this method, systolic pulmonary pressure, which is approximately equal to the right ventricular systolic pressure was obtained. Using a standard newborn cuff and monitor (Mindray PM 8000 [Mindray Medical USA Corp, Mahwah, NJ, USA]), the oscillometric measures of the blood pressure were obtained as systolic, diastolic, and mean.

Statistical analysis and calculations were performed using the Statistical Package for Social Sciences for Windows version 11.5 (SPSS Inc, Chicago, IL, USA). All data were shown as mean  $\pm$  standard deviation. Two-way repeated measures of analysis of variance, and Least Significant Difference multiple comparison test were performed in comparing the groups, and for different days. For the relationship of dispersion in groups, discontinuous parameters such as, PFO and PDA, the Chi-square test was applied.  $P < 0.05$  was considered statistically significant.

**Results.** There was no significant statistical difference in the groups regarding the age of the mother, number of pregnancies, number of deliveries, and gestation week of the newborns, birth weight, and gender ( $p > 0.05$ ). The comparisons of the demographic data of the groups are shown in Table 1. Measurable TR was detected in 42 (54%) of the newborns throughout the study period. The frequency of PFO was 15 in the vaginal delivery, 16 in cesarean delivery groups, and statistically no significant difference was found ( $p > 0.05$ ). Transient ductal patency rate on the first day of the postnatal period was 15 in vaginal delivery, and 17 in the cesarean delivery groups. There was no statistical difference between the groups ( $p > 0.05$ ). On the third day, the rate of PDA was 0 in the vaginal delivery, and 2 in the cesarean delivery groups. The difference between the 2 groups was statistically insignificant ( $p > 0.05$ ). On the fifth day, PDA was not determined in both groups. The course of systemic blood pressure as systolic, diastolic, and mean values on the first, third, and fifth day, and

**Table 1** - Demographic data of the study group.

Variables	Vaginal		Cesarean		P-value
Number of patients	20		22		>0.05
<i>Gender of babies</i>					>0.05
Girl	8		11		
Boy	12		11		
Gestational age, weeks*	39.6 ± 0.7	(38-40)	39.3 ± 0.8	(37-40)	>0.05
Weight, grams*	3367 ± 509	(2500-4800)	3280 ± 359	(2500-4100)	>0.05
Maternal age, years*	26.5 ± 4.9	(17-28)	27.9 ± 4.1	(21-37)	>0.05
Number of pregnancies*	2.1 ± 1.4	(1-6)	2.7 ± 0.4	(1-8)	>0.05
Number of deliveries*	2.1 ± 1.4	(1-6)	2.0 ± 1.5	(1-8)	>0.05

\*mean ± standard deviation (range)

**Table 2** - Course of systemic blood pressure on the first, third, and fifth days.

Days	Vaginal	Cesarian	P-value
<i>One, mm Hg</i>			
Systolic	77.4	74.9	>0.05
Diastolic	41.2	40.0	>0.05
Mean	55.5	52.8	>0.05
<i>Third, mm Hg</i>			
Systolic	83.9	81.2	>0.05
Diastolic	49.8	45.6	>0.05
Mean	60.6	58.0	>0.05
<i>Fifth, mm Hg</i>			
Systolic	82.2	87.4	>0.05
Diastolic	48.8	49.1	>0.05
Mean	60.0	61.8	>0.05

the comparison of the groups are shown in Table 2. There was no significant difference between the groups regarding the arterial blood pressure ( $p>0.05$ ). The PAP on the first, third, and fifth day of the postnatal period, and the comparison of the groups are shown in Table 3. The PAP was 5 mm Hg higher on the first day of life in neonates delivered by CS. Statistical analysis on the course of the pressure on daily basis in each group is shown in Table 4. In both groups, PAP continued to decline on the third and fifth days. However, the decrease in PAP between the third and fifth days was not statistically significant in the vaginal delivery group, whereas the decline was significant ( $p=0.01$ ) in the CS group until the fifth day.

**Table 3** - Course of pulmonary artery pressures derived from peak flow velocity of tricuspid regurgitation on the first, third, and fifth days.

Variables	First	Third	Fifth
	Mean ± standard deviation (range)		
Vaginal birth	25.7 ± 6.0 (15.7-36.0)	20.4 ± 7.0 (10.5-35.5)	19.7 ± 5.2 (14.1-32.0)
Cesarian birth	30.3 ± 10.4 (16.9-63.0)	23.5 ± 5.9 (15.4-38.3)	20.3 ± 3.8 (14.7-26.8)
P-value*	0.07	0.22	0.74

\*statistical significance of the difference between the mean values of the pulmonary artery pressures in the 2 groups on each day

**Table 4** - Statistical significance of differences between pulmonary artery pressures on different days within each group.

Variables	One to third	One to fifth	Third to fifth
	P-value		
Vaginal birth	0.01	0.01	0.73*
Cesarian birth	0.01	0.01	0.01

\*statistically insignificant

**Discussion.** Various studies have been conducted in newborns with the idea that the mode of delivery may have effects on the post-natal adaptation period, and it has been indicated that respiratory morbidity is higher in babies delivered by elective CS.<sup>6,7</sup> In studies comparing the babies delivered through vaginal route to the ones delivered by elective CS, it was reported that vaginal delivery increases the release of catecholamine, and adrenaline triggers the liquid absorption in the lungs.<sup>8,9</sup> In an experimental study carried out in sheep fetuses by Jaillard et al,<sup>4</sup> it has been ascertained that noradrenaline decreased pulmonary vascular resistance and PAP significantly, and increased systemic arterial pressure. Although the mechanism of action is not clearly known, it has been assumed that noradrenaline enables pulmonary vascular dilatation through NO.<sup>4</sup> This assumption is based on the findings in another study of the same research team, who stated that the pulmonary vasodilator effect of noradrenaline

disappears with NO synthase inhibition.<sup>10</sup> Akihiko et al<sup>3</sup> compared NO and endothelin levels of newborns delivered by vaginal route and CS on the first, and fifth day of post-natal period, and stated that, although there was no significant difference during birth, the NO level in the vaginal delivery group showed an increase on the fifth day. As for the endothelin levels, which were the same during birth, it was lower on the fifth day in the vaginal delivery group.<sup>3</sup> All these studies state that the post-natal adaptation period may be affected by the birth method.

We have investigated the effect of the birth method on PAP. For the measurements of PAP, we used echocardiographic CW Doppler technique as it is a non-invasive method. As all the studies published have been taken into consideration, measuring the TR peak velocity using the CW Doppler technique, seems to be most beneficial in predicting PAP. It was demonstrated that PAP obtained from the TR jet is in accordance with catheter measurements.<sup>11,12</sup> The advantages of this method include the fact that it is a non-invasive method, and is not affected by the heart rate. However, measurable TR is needed for this method. In our study, TR was determined by echocardiographic examination in 54% of the newborns. This rate is in agreement with a study in the literature.<sup>13</sup> It was reported that babies delivered by CS have extended temporary, or persistent pulmonary hypertension compared to the ones delivered by vaginal route.<sup>13</sup> In our study, a statistically insignificant pressure difference of 5 mm Hg at the beginning in both groups gradually declined, and on the fifth day decreased below one mm Hg. The striking point was, whereas the decrease in the PAP of the vaginal delivery group was insignificant after the third day, the pressure difference in the CS group on the third and fifth day were still important. In other words, the decrease in PAP in the vaginal delivery group was apparent on the first 3 days. In contrast, the decrease in the CS group continued until the fifth day. The difference between the 2 groups, have been thought to arise from the effects of catecholamines and NO, which is seriously affected by the birth method.<sup>3,10</sup>

In a study conducted by Coskun et al,<sup>14</sup> vaginal birth babies and elective CS newborns were compared in terms of cardiac adaptation. In this study, with the measurements carried out one hour following birth, the mean blood pressure, and total systemic resistance was found high in the vaginal delivery group. In the measurements carried out on the twenty-fourth and seventy-secondth hour similar findings were found in both groups. It has been concluded that the delivery method did not affect the hemodynamic adaptation of healthy newborns seriously in both groups.<sup>14</sup> In our study, systolic, diastolic, and mean systemic blood

pressures progressed higher until the third day in the vaginal delivery group, although statistically did not remain in significant levels. There is no clear evidence on the fact that the 2 major features of post-natal circulatory adaptation, PFO, and closure of PDA are affected by the birth method.<sup>14</sup> In our study, there was no difference in this respect, and the PDA was closed on the fifth day in all cases. Similarly, it has been observed that the age of the mother, the number of pregnancies, and the number of births did not affect the post-natal cardiovascular adaptation.

The limitation of this study was that the method that was used needs a measurable TR, which may not exist in all neonates. However, the effect of the mode of delivery on post-natal circulatory system adaptation in preterm neonates can be demonstrated using the same method in further studies. In our study, the fact that, whereas the statistically significant decline in the PAP was completed in the vaginal delivery group on the third day, the extension of this period to the fifth day in the CS group indicates that birth method has effects on the post-natal circulatory system.

In conclusion, it can be noted that the birth method as observed in the respiratory system does not create clinical morbidity on circulatory system. In addition, it can be stated that circulatory adaptation of the vaginally delivered babies is completed earlier.

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