

1 **Discordant pH between two umbilical cord arteries at delivery for a**  
2 **fetus with undetected blood flow at a unilateral umbilical artery**

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4       Keywords: discordant pH; umbilical arterial pH; delivery; Doppler waveform;  
5       discordant flow

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7 **Introduction**

8 An umbilical cord blood gas analysis at delivery can help assess foetal acid-base  
9 physiology. The arterial pH is crucial for predicting morbidity and mortality of  
10 newborns (ACOG Committee Opinion No. 348 2008). Blood sample is usually obtained  
11 from a randomly selected unilateral umbilical artery.

12       Discordance in Doppler waveforms or diameters between the umbilical arteries  
13 has been reported. However, discordance in gas analysis measurements of two umbilical  
14 cord arteries has not been discussed, based on our search of the PubMed database using  
15 “discordance,” “umbilical artery,” “gas analysis,” and “pH”.

16       To our knowledge, this is the first case report of discordant pH values in a gas  
17 analysis between two umbilical arteries.

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19 **Case Report**

20 A 35-year-old woman in her first pregnancy was referred with an antenatal diagnosis of  
21 foetal congenital heart disease (CHD) at 28 weeks’ of gestation. The foetus was  
22 diagnosed with arterio-ventricular septum defect and coarctation of the aorta. Screening  
23 was negative for any other abnormalities of major organs. The estimated body weight  
24 was 1485 g, and Doppler velocimetry of the umbilical artery was normal.

1           At 32 weeks' gestation, foetal bradycardia (90 beats per minute) was observed.  
2   The blood flow of the unilateral umbilical cord artery could not be detected at the free  
3   loop portion (Fig. 1). After admission, recurrent severe late deceleration was observed  
4   during foetal heart rate monitoring. A female newborn weighing 1360 g was delivered  
5   by emergency Caesarean section with 1- and 5-minute Apgar scores of 8 and 9,  
6   respectively. Two blood samples were obtained from both umbilical cord arteries at the  
7   same time. An umbilical cord blood gas analysis using a Radiometer ABL-800 revealed  
8   a pH value of 7.295 in one artery and 7.058 in the other; the latter's blood sample was  
9   rather viscous, and a gross examination revealed no blood clots. A microscopic  
10  examination found no evidence of thrombosis or vasculitis.

11           The newborn was transferred to the neonatal intensive care unit. Fluorescence in  
12  situ hybridization test revealed that the newborn had trisomy 21. Informed consent was  
13  obtained from the mother of the patient for the publication of this report, and the ethics  
14  committee approval was unnecessary due to the nature of the study.

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## 16   **Discussion**

17   We described a case in which apparent discordance in umbilical cord arterial pH values  
18  was detected.

19           Generally, umbilical cord arterial blood samples are obtained from a unilateral  
20  artery. However, there has been no discussion regarding which artery is more  
21  appropriate for gas analysis sampling, as both are considered essentially identical.  
22  Occasional discordance in the Doppler waveforms (Bracero *et al.* 1997, Figueras *et al.*  
23  2006) or diameters (Dolkart *et al.* 1992, Raio 1998, Predanic and Perni 2006) of the two  
24  umbilical cord arteries has been reported. However, data comparing umbilical cord  
25  arterial blood samples between sides are not available.

1           In the present case, the blood flow of the unilateral umbilical cord artery was  
2 undetectable on Doppler velocimetry. First, we suspected umbilical cord artery  
3 thrombosis, which is associated with foetal growth restriction, intrauterine foetal death,  
4 and other adverse perinatal outcomes (Devlieger *et al.* 1983, Heifetz 1988, Cook 1995).  
5 The risk factors for this are reported to include such factors as an excessively long (>70  
6 cm) or short (<30cm) umbilical cord, an excessively twisted umbilical cord, and the  
7 presence of knots in umbilical cords (Benirschke 1994, Redline 2004). Although gross  
8 findings, such as a short (30 cm) and excessively twisted cord, corresponded to the risk  
9 factors, thrombosis was not detected histologically. Interestingly, the measured pH  
10 values of the two umbilical arteries were quite different; the pH value of the normal  
11 sample was 7.295, while that of the viscous sample was 7.058. The difference in pH  
12 value of 0.237 was considered significant, given the accuracy of the measuring  
13 apparatus, where 90% of the absolute measuring errors are under 0.013.

14           Focusing on the haemodynamics of the umbilical cord arteries, thrombosis of the  
15 unilateral artery could be considered to indicate the extreme condition of a discordant  
16 umbilical arterial blood flow since there is no blood flow in the unilateral artery at all.  
17 The present case may be considered an intermediate condition between the unilateral  
18 arterial thrombosis and simple discordant Doppler waveforms. Discordance in pH  
19 values between the two umbilical cord arteries might be detected when considerably  
20 discordant Doppler waveforms are found. While the difference in pH values may be  
21 relatively small, it can still have a substantial impact on determining whether or not the  
22 foetus is acidotic.

23           This is the first case report to describe discordance in pH values between the two  
24 umbilical cord arteries based on an umbilical cord blood gas analysis performed at  
25 delivery. It might be challenging to validate whether or not discordant Doppler

1 velocimetry results are indicative of discordance in pH values. Further observational  
2 investigations will be required to verify this problem.

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Figure 1. Undetectable flow in the unilateral umbilical cord artery using Doppler velocimetry.

At 32 weeks' gestation, the blood flow in the unilateral umbilical cord artery could not be detected after supposed mild variable deceleration of the foetal heart rate.

