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CASE REPORT

Fetal heart rate tracing interpretation in cases of fetal heart block: A case series

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Abstract

Simple assessment of FHR baseline variability can differentiate second-degree heart block (SHB) from complete heart block (CHB). In cases of SHB, antepartum NST can be reliably used for fetal surveillance. Intrapartum assessment of FHR variability and accelerations is useful to select cases for safe vaginal delivery.

KEYWORDS

complete heart block, fetal heart rate acceleration, fetal heart rate variability, second-degree heart block

1 | INTRODUCTION

Fetal heart rate (FHR) accelerations and FHR variabilities are mainly influenced by push-pull effects of sympathetic and parasympathetic impulses generated by well-oxygenated CNS and myocardium.[1] Hypoxic fetuses show no accelerations and variabilities, suggesting poor oxygenation in fetal CNS and myocardium. Clinically, FHR accelerations and variabilities recorded on FHR tracings represent ventricular rate, controlled by atrial signals, which transmitted from well-oxygenated CNS to SA node and AV node. In case of heart block, the ventricles beat independently without influence of CNS, in spite of good oxygenation, resulting in false interpretation of FHR tracings to have hypoxia.

Fetal heart block causes bradycardia, usually thought to be a sign of non-reassuring fetal heart rate (FHR) pattern. It is believed that FHR tracings cannot be reliably interpreted, leading to unnecessary cesarean section, though fetal status is reassuring and it can well tolerate labor course and vaginal delivery. As an antepartum testing, non-stress test (NST) is commonly used to reassure fetal status among fetuses at high risk of asphyxia. Reactive tests based on at least 2 accelerations (> 15 bpm, >15 s) in 20 min indicate fetal reassuring (well-oxygenated). Theoretically, in fetuses with heart block, FHR accelerations cannot be expressed and falsely interpreted as non-reassuring fetal well-being. In practice, obstetricians, therefore, prefer to use other modalities of antepartum testing in cases of heart block such as biophysical profile. However, we hypothesize that among reassuring fetuses with second-degree heart block (SHB), FHR accelerations should be preserved and NST is still effective, since the ventricular accelerations are dependent on atrial accelerations, which can be passed through AV nodes to the ventricles while those with complete heart block (CHB) cannot. Likewise, as an intrapartum testing, FHR variability is an important component used to reassure fetal status among fetuses at high risk. Normal FHR variability indicates fetal reassuring status. In fetuses with heart block,

FHR variability may not be expressed and falsely interpreted as non-reassuring fetal well-being, often leading to unnecessary cesarean section. The study on intrapartum FHR monitoring in cases of congenital heart block is very rare.[2] Nevertheless, we believe that among reassuring fetuses with SHB, FHR variability should be preserved and intrapartum FHR monitoring is still effective, since the ventricular variability is depending on atrial variability, which can be passed through AV nodes to the ventricles while those with CHB cannot. The objective of the series is to determine whether antepartum NST and intrapartum FHR tracings in fetuses with heart block are reliable or not.

2 | CASE PRESENTATION

This case series was carried out with ethical approval by the Institutional Review Boards (IRB; Faculty of Medicine, Chiang Mai University) and the patients provided written informed consent.

2.1 | Case 1

A 24-year-old pregnant woman, G1 P0, was referred to our hospital at 34 weeks of gestation due to fetal bradycardia. Her antenatal care record revealed normal FHR and was categorized as low-risk pregnancy. Obstetric history and physical examination showed otherwise normal. Fetal bradycardia (FHR 60–85 bpm) was persistently detected by Doppler device. Fetal echocardiography showed normally structural heart with SHB (A:V ratio 2:1) as presented in Figure 1A. Fetal biometry and growth were within normal limits. Laboratory for standard antenatal care was unremarkable. Anti-Ro and anti-La antibodies were negative. Dexamethasone was prescribed for management of SHB. Serial ultrasound showed the same over 2 weeks of close follow-up. Interestingly, on antepartum surveillance, the fetus had normal biophysical profile (BPP) scores and reactive NST, typical accelerations in spite of bradycardia, as presented in Figure 1B. At 37^{+2} weeks of gestation, she had spontaneous labor and was admitted to the labor room. Intrapartum monitoring revealed fetal bradycardia (70 bpm) with normal FHR variability and sporadic accelerations. She had normal labor course and normal vaginal delivery, giving birth to a female newborn with birthweight of 2640 g, no gross structural anomaly, and Apgar score 8 at 5 min (heart rate less than 100). Though the newborn had normal course of neonatal life, she finally needed permanent pacemaker.

2.2 | Case 2

A 34-year-old pregnant woman, G2 P1, was referred to our hospital at 28 weeks of gestation due to fetal bradycardia. Her antenatal record showed normal FHR. The pregnancy course was unremarkable, except gestational diabetes under diet control. Obstetric history and physical examination revealed otherwise normal. Fetal bradycardia (FHR ~75 bpm) was persistently detected by Doppler device. Fetal echocardiography showed normal cardiac structures but echogenic endocardium at the area of endocardial cushion, with SHB (A:V ratio 2:1) as presented in Figure 2A. The fetus had positive tests for anti-Ro and anti-La antibodies. Dexamethasone was prescribed to treat SHB. Serial ultrasound showed the same over the remaining course of pregnancy. On antepartum surveillance, the fetus had normal biophysical profile (BPP)

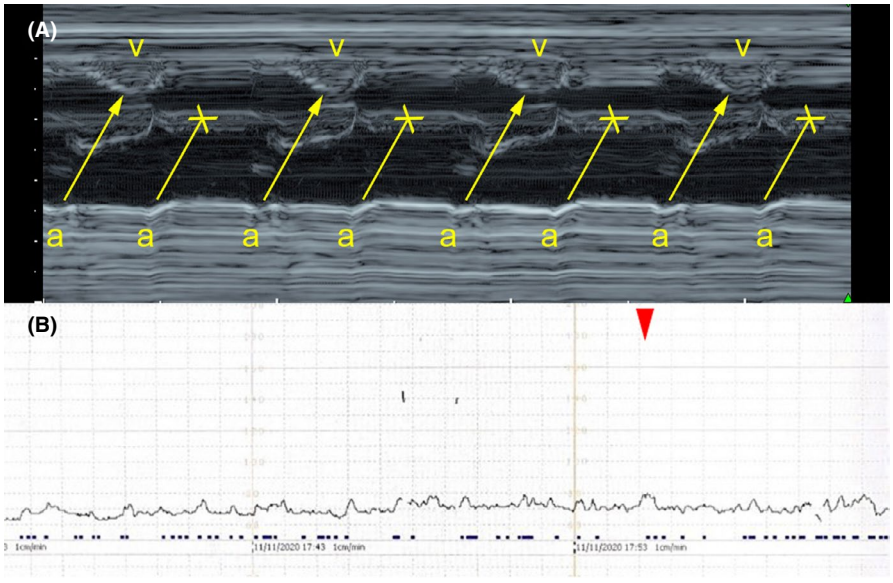

FIGURE 1 Case 1; Second-degree heart block: A) M-mode shows atrial (a) to ventricular rate (v) ratio 2:1 (144:72); B) NST shows fetal bradycardia with baseline of 70 bpm, normal baseline variability, spontaneous accelerations and acceleration provoked by acoustic stimulation (red arrow head)

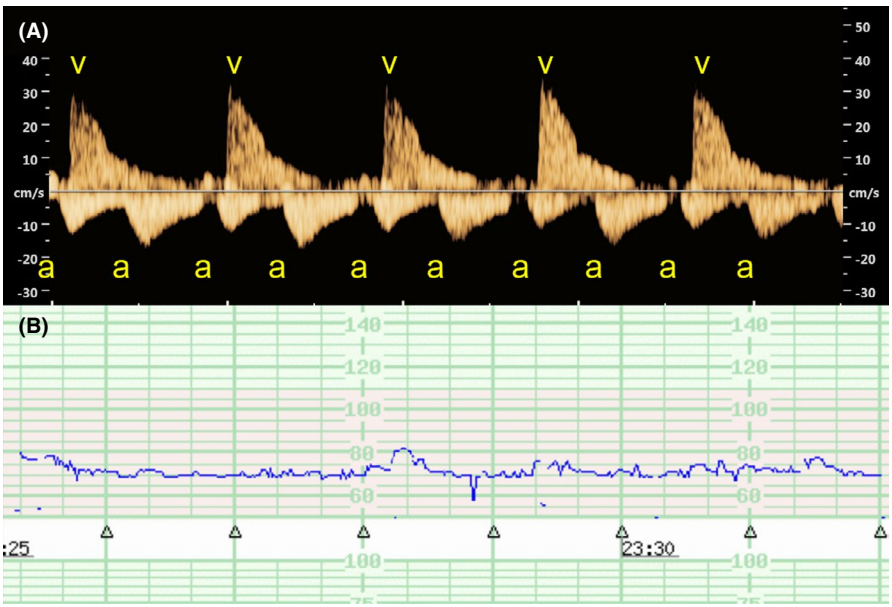

FIGURE 2 Case 2; Second-degree heart block: A) Doppler study of renal vein (indicating atrial contraction: a) and renal artery (indicating ventricular contraction: v) shows a:v ratio 2:1; B) Fetal heart rate tracing shows bradycardia with baseline of 70 bpm, normal baseline variability and spontaneous accelerations

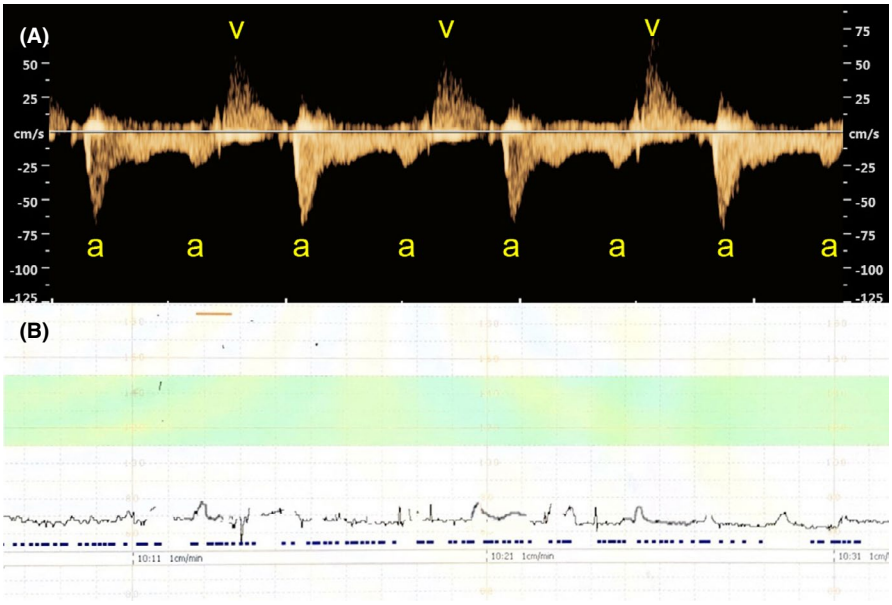

FIGURE 3 Case 3; Second-degree heart block: A) Cardiac Doppler study shows conduction rate 2:1 (a: atrial contraction, v: ventricular contraction); B) Fetal heart rate tracing shows bradycardia with baseline of 70 bpm, normal baseline variability and spontaneous accelerations

scores and reactive NST, typical accelerations in spite of bradycardia, as presented in Figure 2B. At 38^{+2} weeks of gestation, she had spontaneous labor with successful vaginal delivery, giving birth to a normally-formed male newborn, with birthweight of 2850 g and Apgar score of 8 at 5 min (FHR 72 bpm). Echocardiography revealed normal cardiac structure and SHB as prenatally seen. The newborn survived but required permanent pacemaker.

2.3 | Case 3

A 25-year-old pregnant woman, G2 P1, was referred to our hospital at 30^{+4} weeks of gestation because of fetal bradycardia. Her prenatal course was uneventful. Fetal anomaly screening and fetal biometry at mid-pregnancy were unremarkable. On physical examination, fetal bradycardia with FHR of approximately 70 bpm was detected. Fetal echocardiography revealed echogenic interventricular septum and mitral valve and SHB with AV ratio of 2:1, as presented in Figure 3A. NST was also reactive with normal FHR variability but bradycardia, as presented in Figure 3B. Anti-Ro antibody was positive but anti-La antibody was negative. Dexamethasone was prescribed to treat SHB. Nevertheless, the follow-up ultrasound at 36 weeks showed CHB as presented in Figure 4A, and NST was non-reactive with minimal FHR variability, also non-responsive to acoustic stimulation as presented in Figure 4B. Surprisingly, the fetus had normal biophysical profile (BPP) scores in spite of

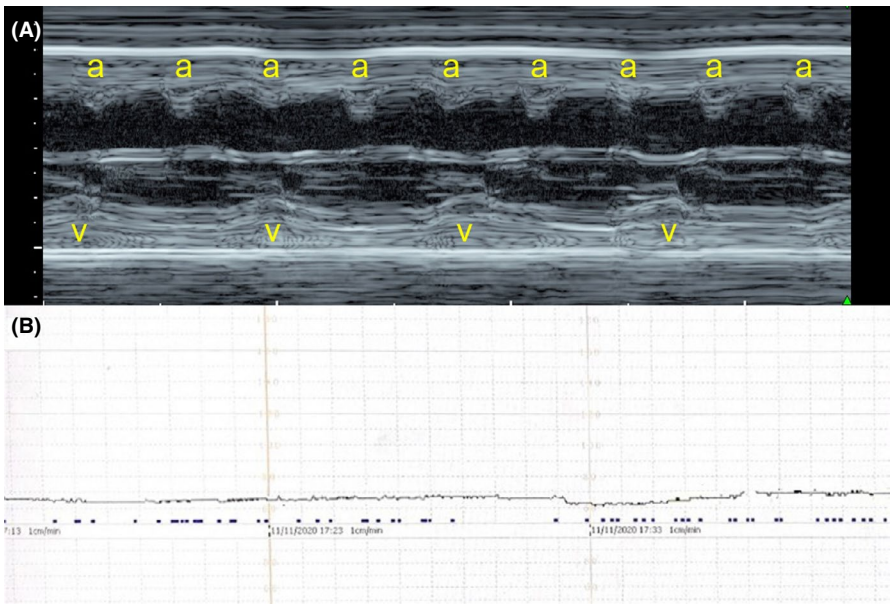

FIGURE 4 Case 3; Complete heart block: A) M-mode shows dissociations between atrial contractions (a) and ventricular contraction (v); B) Fetal heart rate tracing shows bradycardia, representing ventricular rate of 65–70 bpm, absent/minimal baseline variability and no acceleration with acoustic stimulation

bradycardia with absent variability. At 37^{+1} weeks of gestation, spontaneous labor occurred and intrapartum FHR tracings showed bradycardia with absent variability and absent accelerations. Cesarean delivery was performed, giving birth to a 2710-g male newborn, Apgar scores 7 and 8 at 1 and 5 min (heart rate <100 bpm), respectively. Echocardiography revealed normal cardiac structure and complete heart block. The newborn survived but required permanent pacemaker.

3 | DISCUSSION

New insights gained from this study are as follows: 1) Antepartum assessment of FHR variability and accelerations in daily obstetric practice can be helpful in differentiating SHB from CHB. 2) Since fetuses with SHB can show FHR accelerations, antepartum NST can still be reliable, in spite of bradycardia, whereas NST of fetuses with CHB is unreliable because of false non-reactive tests. 3) FHR tracings of fetuses with SHB can show baseline variability and can be reliably used for intrapartum fetal surveillance in spite of bradycardia, whereas those with CHB cannot. 4) Of fetuses with bradycardia caused by heart block, intrapartum assessment of FHR variability can be helpful in differentiating between reassuring and non-reassuring fetal well-being and unnecessary cesarean sections can be avoided. However, in cases of absent variability, interpretation of FHR tracings may not be reliable. FHR tracings represent the ventricular rate, not atrial rate. In case of CHB, though fetal status is good and can tolerate labor and delivery, FHR variability passing AV node to the ventricles is blocked. Thus, it can be falsely interpreted as fetal distress, as seen in Case 3.

In obstetric practice, fetal bradycardia is usually interpreted as an ominous sign representing fetal distress or asphyxia. However, bradycardia secondary to heart block does not represent asphyxia, and pregnancy can be prolonged to term as long as fetal well-being is reassured. Nevertheless, fetal surveillance of these fetuses is often problematic because most cases have minimal FHR variability and show no accelerations in spite of being healthy. Therefore, once fetal heart block is diagnosed most obstetricians prefer other modalities of antepartum surveillance other than NST, such as biophysical profile; and prefer elective cesarean section rather than vaginal delivery due to the reason of difficulty in interpretation of intrapartum FHR monitoring. However, this small series provides evidence that vaginal delivery can be safely performed with reliable FHR monitoring in selective cases or the cases of SHB, because two essential components of fetal surveillance, FHR variability and FHR accelerations (either spontaneous occurrence or acoustic stimulation) are preserved in SHB. In fetuses with SHB, though bradycardia, as long as normal variability and/or having accelerations are preserved, fetal well-being can be reassured. In case of CHB, vaginal delivery may possibly be allowed but it is difficult to be monitored because of unreliable FHR pattern. Other modalities may be needed, such as intrapartum biophysical profile, etc. Nevertheless, it must be kept in mind that fetuses with heart block are vulnerable to have fetal distress, especially in cases of hydrops fetalis and not all of them can well tolerate labor and delivery. Accordingly, we must have hard evidence that fetal status during labor is reassured by demonstration that FHR variability, reflective of well-oxygenated CNS and heart, is preserved.

On the contrary, simple assessment of fetal heart rate variability in daily use of obstetric practice can differentiate between SHB and CHB. As already known, differentiating

between second-degree and third-degree (complete) heart block is important for optimal management, prognosis, and informative counseling. For example, dexamethasone is effective in prevention of the progressive deterioration and hydropic changes, as seen in both of the first two cases, whereas it is not effective in cases of CHB.[3-6] In practice, 2D M-mode or spectral Doppler study can be effectively used to differentiate the two entities. However, this study provides an additional simple tool for the differentiation by FHR tracings; minimal variability and no acceleration indicating CHB; and normal variability with accelerations indicating SHB. Note that in fetal arrhythmia caused by abnormal sinoatrial pace-making, like atrial flutter etc, the heartbeats are independent from CNS control. Thus, the fetal heart rate variability detected on cardiotocographic tracings is not reflexive of CNS oxygenation and could not be reliably interpreted for evaluation of fetal well-being.

4 | CONCLUSION

Fetal heart rate tracings of SHB fetuses still represent SA node function depending on sympathetic and parasympathetic tone, reflective of fetal hypoxic status. Intrapartum tracings are reliable and could be used to monitor or reassure the fetal well-being. On the contrary, FHR tracings of cases with CHB are independent from SA node impulses, represent solely ventricular rate, not reflective of SA node rate variability and CNS hypoxic status. Therefore, interpretation of FHR tracings of the fetuses with CHB is unreliable to determine fetal well-being. Our study may have clinical impact; as follows: 1) Simple assessment of FHR baseline variability in daily obstetric practice can differentiate SHB from CHB. 2) In cases of SHB, antepartum NST can be reliably used for fetal surveillance. FHR accelerations, either spontaneous occurrence or acoustic stimulation, in spite of bradycardia, can be used to reassure fetal well-being. 3) Intrapartum assessment of FHR variability and accelerations is useful to select cases for safe vaginal delivery.

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CONFLICT OF INTEREST
None declared.

AUTHOR CONTRIBUTIONS
FT involved in conceptualization, fetal echocardiography, manuscript draft, and final approval; SL involved in fetal echocardiography, obstetric management, manuscript editing, and final approval; KS involved in fetal echocardiography, obstetric management, and final approval; KT involved in fetal echocardiography, obstetric management, manuscript editing, and final approval; PJ involved in fetal echocardiography, manuscript editing, and final approval; TT involved in conceptualization, fetal echocardiography, manuscript revising, and final approval.

CONSENT
Obtained.

DATA AVAILABILITY STATEMENT
Data available on request from the authors.

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