ORIGINAL ARTICLE

2:1 Block with Wenckebach Mechanism in Children due to Different Etiologies

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ABSTRACT

Objective: *In children, 2:1 atrioventricular block (AVB) with Wenckebach mechanism is a rare entity.*

Methods: *In seven children, 2:1 AVB with Wenckebach mechanism was detected. The clinical features of these children were retrospectively evaluated.*

Results: *All the patients were asymptomatic. In all, concomitant first-degree atrioventricular (AV) block and/or periodic AV Wenckebach block suggested the presence of 2:1 block with Wenckebach mechanism. In three patients, this conclusion was supported by the demonstration of improved AV conduction with enhanced sinus rates during treadmill test or atropine administration. In two of the patients, intracardiac electrophysiological was performed and showed a prolonged atrium-His interval. Four patients had congenital or acquired heart disease. During a median follow-up duration of 14.4 months, no significant event was observed.*

Conclusion: *In children, 2:1 AV block with Wenckebach mechanism seems a relatively benign process.*

Keywords: 2:1 Atrioventricular block, bradycardia, children, Wenckebach.

INTRODUCTION

In 2:1 atrioventricular block (AVB), a ventricular complex follows every second atrial complex. The atrial rate (the time between the onset of consecutive P waves interval) and the P wave to R wave interval interval of the conducted beat are normal. It is usually due to Mobitz I mechanism (block in the atrioventricular [AV] node) (1). Although the occurrence of 2:1 block due to Mobitz I mechanism had been reported in adults (2), no study on children had been reported. In this paper, we reported our experiences with seven children with 2:1 AVB due to Mobitz I mechanism.

SUBJECTS AND METHODS

The databases of the division of Pediatric Cardiology were analysed and the list of the children with a diagnosis of 2:1 AVB due to Mobitz I mechanism was found. The clinical characteristics of the children were analysed retrospectively in terms of their demographic features, present diseases, clinical presentations, diagnostic methods and follow-up results.

RESULTS

A total of seven children were found to be diagnosed as having 2:1 AVB due to Mobitz I mechanism. Their median age at diagnosis was 2.5 ± 4.8 years (range 2.5–15 years). All but one was female. The individual clinical characteristics of the patients are given in Table 1. In two of the patients, electrophysiological study was performed (Table 2).

Four patients were referred to our clinic for different reasons: evaluation for low heart rate detected during examination (n = 2), easy fatigability (n = 1), Mobitz type II AVB in Holter recording (n = 1), and first attack of acute rheumatic fever (ARF) (n = 1). Two patients were diagnosed on follow-up evaluations for rheumatic heart disease (n = 1) and previous cardiac surgery (n = 1), and 2:1 AV block was detected on the first admission in six patients, on the postoperative sixth month control in one

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Table 1: Individual clinical characteristics of the patients

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7
Age at diagnosis (Y)	3	7	15	13	2, 5	5	7
Gender	F	M	F	F	F	F	F
Clinical presentation	Low heart rate	Routine control for operated VSD + ASD	Arthritis	Routine control for RHD	Fatigue, murmur	2:1AVB in ECG	Low heart rate
Echocardiography	Normal	Operated VSD + ASD	ARF, aortic and mitral regurgitation	RHD, aortic and mitral regurgitation	Normal	Mild valvular pulmonary stenosis	Normal
Electrocardiography	FDAVB	RBBB	FDAVB	FDAVB	2:1AVB	FDAVB	WB + 2:1 AVB
24-hour ECG monitorisation	FDAVB + WB + 2:1 AVB	WB + 2:1 AVB	FDAVB + WB + 2:1 AVB	FDAVB + WB + 2:1 AVB	FDAVB + WB+ 2:1 AVB	FDAVB + WB+ 2:1 AVB	FDAVB + WB + 2:1 AVB
Follow-up duration (Mo = months)	9.7	14.4	38.1	66.8	No follow-up	No follow-up	11.7
Electrophysiological study	Available	Available	NA	NA	NA	NA	NA

Y = years; F = female; M = male; VSD = ventricular septal defect; ASD = atrial septal defect; RHD = rheumatic heart disease; AVB = atrioventricular block; ECG = electrocardiography; ARF = acute rheumatic fever; FDAVB = first-degree atrioventricular block; RBBB = right bundle branch block; WB = Wenckebach block; NA=not available.

Table 2: Electrophysiological study's results in two patients

Patient no.	AV node Wenckebach point (ms)	AH interval (ms)	HV interval (ms)
1	300	156	30
2	570	128	50

AV = atrioventricular; AH = atrial-His; HV = His-ventricular.

(Pt 2) and on the sixth month control after the first attack of ARF in one (Pt 4) patient.

Electrocardiography and Holter findings at the diagnosis of 2:1 AVB are given in Table 3. 2:1 AVB was present in the surface ECG in two patients and in Holter recordings in all the patients. In one patient (Pt 3), non-sustained 2:1 AVB episode was detected on Holter recording that was applied for a study (3). In all the remaining patients, longer periods of 2:1 AVB episodes were present in Holter recordings. No pauses longer than 2 seconds were detected.

In three patients, 1:1 AV conduction was observed during the advanced stages of treadmill test (with narrow QRS in two, and with wide QRS due to postoperative right bundle branch block in one). In one patient with sustained 2:1 block, AV conduction returned to 1:1 conduction after atropine administration. In the remaining three patients, any test for the evaluation of AV conduction during increased heart rate was not available (due to the short attack of 2:1 AVB in one, and very short investigation period in two patients).

In two patients, control follow-up visits were not available. In the remaining five patients, the median follow-up period was 14.4 months. During this period, no

Table 3: Electrocardiography and Holter findings from the diagnosis of 2:1 atrioventricular block

Patient no.	Surface electrocardiography		Holter	
		Rhythm	SDNN	Longest RR
1	FDAVB	FDAVB, Wenckebach block, 2:1 AVB	67	1429
2	NSR, RBBB	Wenckebach block, 2:1 AVB	278	2000
3	NORMAL	Wenckebach block, 2:1 AVB	57	1070
4	FDAVB	FDAVB, Wenckebach block, 2:1 AVB	101	1640
5	2:1 AVB	FDAVB, Wenckebach block, 2:1 AVB	115	1671
6	FDAVB	FDAVB, Wenckebach block, 2:1 AVB	100	1500
7	Wenckebach block, 2:1 AVB	FDAVB, Wenckebach block, 2:1 AVB	306	1980

SDNN = standard deviation of NN intervals; FDAVB = first degree atrioventricular block; AVB = atrioventricular block; NSR = normal sinus rhythm; RBBB = right bundle branch block.

new 2:1 AVB episodes were observed in repeated Holter recordings in two patients. In one, only first degree AVB and Wenckebach block episodes were observed. In two patients, sustained 2:1 AVB episodes were continued. None of the patients had new and significant symptoms.

DISCUSSION

Mobitz Type I second degree AVB (Wenckebach block or phenomenon) is generally a benign AV conduction problem, and there is a progressive lengthening of the PR interval culminating in a dropped ventricular beat (1).

Mobitz Type II second degree AVB is usually caused by the conduction block within the His-Purkinje system. This conduction abnormality is shown on the ECG as a sudden failure of a P wave to conduct to the ventricle, with no change in the PR interval either before or after the non-conducted P wave (4).

In 2:1 AVB, a ventricular complex follows every second atrial complex. The atrial rate and the PR interval of the conducted beat are normal. These are usually due to Mobitz I mechanism (block in AV node), particularly when associated with normal QRS complexes, but His bundle recording may be necessary to determine whether the block occurs in the upper AV node or at the level of His bundle, in occasional cases (1). Diagnostic clues to the site of block include the following: concomitant first-degree AV block, periodic AV Wenckebach, or improved conduction (1:1) with enhanced sinus rates of sympathetic input suggesting a more proximal interruption of conduction (*ie*, Mobitz type I mechanism); concomitant bundle-branch block, fascicular block, worsened conduction (3:1, 4:1, *etc*) with enhanced sympathetic input localized the site of the block more distally (Mobitz type II mechanism) (5).

In all of our patients, concomitant first-degree AV block and/or periodic AV Wenckebach block suggested the presence of 2:1 block with Wenckebach mechanism. In three patients, this conclusion was supported by the demonstration of improved AV conduction (1:1) with enhanced sinus rates during the treadmill test or atropine administration.

In two of our patients, the 2:1 AVB was sustained, and one had a previous cardiac surgery with complete RBBB. In these patients, the intracardiac electrophysiological study suggested the presence of a suprahisian conduction delay. In the electrophysiological study, normal atrial-His (AH) interval values in children ranged from 50 to 120 milliseconds, and normal His-ventricular (HV) interval values ranged from 25 to 50 milliseconds. A prolonged AH interval indicated a conduction delay in the AV node, and a prolonged HV interval suggested a conduction delay in the His-Purkinje system (6). In our patients, AH intervals were 150 and 128 milliseconds. We could not find any information about the prognosis of 2:1 AVB with Wenckebach mechanism in children. Our limited data suggested a good prognosis for these patients at least during the mid-term follow-up.

CONCLUSION

The findings of the study suggested that the clues indicating a Wenckebach mechanism in children with 2:1 AVB could be obtained by noninvasive techniques. In children with sustained 2:1 AVB intracardiac electrophysiological study could help the differentiation, and the prognosis seemed good.

AUTHORS' NOTE

Concept—NC, HO; design—HK, FL; supervision—NC; materials—HO; data collection and/or processing—HK, FL; analysis and/or interpretation—NC; literature search—NC; writing manuscript—NC; critical reviews—NC, HO.

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