

M-MODE ECHOCARDIOGRAPHY IN THE DIAGNOSIS OF EBSTEIN'S ANOMALY OF THE TRICUSPID VALVE

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SUMMARY

M-mode echocardiograms of six patients with a diagnosis of Ebstein's anomaly and confirmed by cardiac catheterization were reviewed. All the patients (5 females and 1 male) were Caucasians with their ages ranging from one day to twenty-six years. The tricuspid valve was easily located in all the echocardiographic studies. There was a 45 to 100 msec. delay in tricuspid valve closure as compared to the mitral valve closure, in all patients. The amplitude of the anterior tricuspid valve was found to be greater than the amplitude of the anterior mitral valve in all but one case. Paradoxical septal movement type A was observed in four cases. None of the cases had a right ventricular end diastolic diameter that was larger than the left ventricular end diastolic diameter. The study found that it was extremely difficult to specifically diagnose Ebstein's anomaly with M-mode echocardiography alone, as each case has not been able to meet with all the criteria for diagnosis, described by various investigators.

INTRODUCTION

Ebstein's anomaly of the tricuspid valve is characterised by downward displacement into the right ventricle of the septal and posterior leaflets of

the tricuspid valve. Cardiac catheterization and right atrial angiocardiology are usually done to confirm the suspected diagnosis, but these procedures are invasive. The use of M-mode echocardiography in the diagnosis of Ebstein's anomaly of the tricuspid valve was first described by Lunstrom in 1969. Since then, the echocardiographic characteristics of this condition have been further clarified.^{1,2,3,4,5,6}

The aim of this study was to assess the reliability of using M-mode echocardiography for the diagnosis of Ebstein's anomaly.

MATERIALS AND METHODS

Six Caucasian patients were included in the study. There were five females and one male aged between one day and twenty-six years. The diagnosis of Ebstein's anomaly was confirmed by cardiac catheterization. One patient had an atrial septal defect and another had a patent ductus arteriosus.

Standard M-mode echocardiograms, with simultaneously recorded electrocardiograms were made with an Irex 101 echocardiograph, with paper speeds of 50 and 75 mm/sec on darkroom developed paper. Measurements of the echocardiographic studies were averaged over three to five cardiac cycles. End-diastolic diameters of the right and left ventricles were measured at the onset of the first deflection of the QRS complex of the simultaneously recorded electrocardiogram, as recommended by the American Society of Echocardiography.⁷ In one patient, an electrocardiogram was not recorded due to the technical difficulties in examining a fidgety child

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TABLE I
ECHOCARDIOGRAPHIC MEASUREMENTS IN PATIENTS WITH
EBSTEIN'S ANOMALY

Case No.	Sex	Age	Weight (Kg.)	RVEDD (mm)	LVEDD (mm)	ECG-QRS interval (Msec.)	Cath. proven	Associated cardiac lesions
1	F	1 day	2.43	12	14	-	Yes	PDA
2	F	3 days	3.20	11	14	100	Yes	None
3	F	5.5 years	16.0	21	40	100	Yes	ASD
4	F	12 years	43.2	20	38	120	Yes	None
5	M	15 years	45.6	22	32	80	Yes	None
6	F	26 years	58.0	35	35	120	Yes	None

RVEDD	-	Right ventricular end diastolic diameter	Cath.	-	Cardiac catheterization
LVEDD	-	Left ventricular end diastolic diameter	PDA	-	Patent ductus arteriosus
ECG	-	Electrocardiogram	ASD	-	Atrial septal defect

and measurements for the ventricles were made just before the onset of anterior systolic movement of the posterior wall.

RESULTS

The results are summarised in Tables I and II. In all six patients, tricuspid valve closure followed mitral valve closure; the interval varying between 45 and 100 msec. The right ventricular end diastolic diameter was found to be dilated in four of the patients (for age and weight). In all patients, the right ventricular end diastolic diameter was not found to be greater than the left ventricular end

diastolic diameter. The amplitude of movement in diastole of the anterior tricuspid valve leaflet was found to be greater than the amplitude of the anterior mitral valve leaflet in all but one patient. This patient had a grossly dilated right ventricle. Paradoxical septal movement type A was recorded in four patients, three of whom had dilated right ventricular end diastolic diameters. The early diastolic closing slope (E-F slope) of the anterior tricuspid valve leaflet was reduced in two cases (30-40 mm/sec.). The early diastolic closing slope of the anterior mitral valve leaflet was similarly reduced in one of these two cases. As compared to

TABLE II
ECHOCARDIOGRAPHIC MEASUREMENTS IN PATIENTS WITH EBSTEIN'S ANOMALY

Case No.	aTV		aMV		ATV/AMV	RVEDD/LVEDD	Septal Motion	Delayed closure of T.V. (mm/sec)
	Amplitude (mm)	E-F slope (mm/sec)	Amplitude (mm)	E-F slope (mm/sec)				
1	13	55	7	40	1.86	0.86	Normal	70
2	10	50	7	35	1.43	0.79	Paradoxical	45
3	20	65	22	75	0.91	0.53	Paradoxical	60
4	21	40	19	50	1.11	0.53	Normal	100
5	19	30	18	90	1.06	0.69	Paradoxical	70
6	19	70	18	90	1.06	1.0	Paradoxical	100

aTV	-	anterior tricuspid valve	aMV	-	anterior mitral valve
E-S slope	-	early diastolic closing slope			
ATV/AMV	-	ratio of anterior tricuspid valve over anterior mitral valve			
RVEDD/LVEDD	-	ratio of right ventricular end diastolic over left ventricular end diastolic diameter			
T.V.	-	tricuspid valve			

the closing slope of the anterior mitral valve leaflet, the closing slope of the anterior tricuspid valve leaflet is faster in two cases but slower in four.

DISCUSSION

The anterior tricuspid valve leaflet was easily located in all the echocardiographic studies. Many authors^{1,4,6,8} considered the ability to record the tricuspid valve to the left of the sternum a diagnostic feature of Ebstein's anomaly. Abnormally late tricuspid valve closure has been reported to be another feature diagnostic of Ebstein's anomaly. Yuste *et al*³ in their study of 4 patients with Ebstein's anomaly found that the tricuspid valve closes 4-15 msec. later than the mitral valve. Farooki *et al*⁴ reported that a delay of 30 msec. or more in closure of the tricuspid valve over mitral valve is diagnostic of Ebstein's anomaly. Many authors^{1,6} agree that a delay in closure of the tricuspid valve of 65 msec. or more as compared with that of the mitral valve, is a reliable diagnostic indication of Ebstein's anomaly. In the present study, only four (66.6 percent) of the six patients have a delayed closure of more than 65 msec. of the tricuspid valve over mitral valve. It is interesting to note that Gussenhoven *et al*⁵ in his study of 20 'control' patients with right heart volume overload problems found that 8 (40 percent) of them had such a delay in tricuspid valve closure.

Both Farooki *et al*⁴ and Daniel *et al*⁶ found that they were unable to confirm the diagnostic value of an anterior tricuspid leaflet amplitude greater than that of the anterior mitral leaflet or an increased closing slope of the anterior tricuspid leaflet.

There were some authors^{5,9} who reported that the utilization of two dimensional echocardiography, complementary to M-mode echocardiography in the visualisation of Ebstein's anomaly is of great diagnostic help. They emphasised that two dimensional echocardiography can help increase the accuracy in the diagnosis of the disease.

With the criteria set by the various investigators for the diagnosis of Ebstein's anomaly, coupled with the controversial report,⁵ it is extremely difficult to be specific in the diagnosis of the disease by M-mode echocardiography alone. Perhaps with the help of two dimensional echocardiography, the diagnostic accuracy of echocardiography in this condition can be improved.

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