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Diagnosis of Aortic Valve Vegetation and Perforation by Echocardiography

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The echocardiographic manifestation of aortic valve vegetation was first reported in 1973 [1, 2] and it was soon proved that echocardiography is an useful tool to detect or to confirm the presence of bacterial endocarditis. Recently Gopal, Lee and Weissler [3] reported the echocardiographic manifestation of ruptured aortic valvular leaflets in seven patients. The echocardiographic findings in patients with ruptured aortic valve, as they concluded, could not be differentiated from the shaggy echoes of patients with aortic valvular vegetations.

Here we present the echocardiographic findings in one patient with operation-proved aortic valvular vegetation and one patient with operation-proved aortic valve rupture. Another patient with similar echocardiographic findings but not operated yet is reported too.

All three patients showed evidences of aortic regurgitation on physical examination. At echocardiographic studies all three patients revealed high frequency fluttering of anterior mitral valve leaflet and exaggerated movement of inter-ventricular septum. The most characteristic echocardiographic finding is a shaggy echo at aortic root during diastole in all three patients, which was proved at operation to be aortic valve vegetation in one patient and perforation of aortic cusps in another patient. The third patient does not receive operation to date.

Echocardiography is an useful non-invasive method in the detection of aortic valve perforation or vegetation as cause of aortic regurgitation.

It is a common agreement that echocardiography has become a non-invasive diagnostic tool in the field of cardiology. Furthermore left ventricular function in term of velocity of circumferential fiber shortening and ejection fraction have been determined quantitatively with the application of echocardiography [4]. Recently, peculiar echocardiographic findings in aortic valve vegetation [5] and aortic valve perforation [3,6] have been described in publications. In this report, echocardiographic findings are described in patients with aortic valve perforation or aortic valve vegetation, and the significance of high frequency oscillation in

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the aortic root is discussed.

Materials and Methods:

The observations reported herein were made on three patients (Table I).

The first patient (Case I) was hospitalized at Cathay General Hospital on Jan. 16, 1978. She received aortic valve replacement on Jan. 30, 1978 and discharged on Feb. 7, 1978. This patient demonstrated grade IV aortic insufficiency and grade II mitral regurgitation with elevation in the left ventricular enddiastolic pressure (44 mm Hg).

The second patient (Case II) was hospitalized at Cathay General Hospital on Feb. 14, 1978, discharged on Feb. 28, 1978, and operated on Feb. 16, 1978, with repairment of ventricular septal defect and aortic valvular replacement. She underwent right and left cardiac catheterization, left ventricular cineangiogram and aorto-cineangiogram. This patient demonstrated grade III aortic insufficiency, grade I mitral regurgitation and ventricular septal defect with left ventricular end-diastolic pressure of 12mm Hg.

The third patient (Case III) was hospitalized at Cathay General Hospital on Dec. 14, 1977 and discharged on Dec. 16, 1977. This patient underwent right and left cardiac catheterization with the findings of left ventricular end-diastolic pressure (26mm Hg) and grade II-III aortic insufficiency.

"M mode" echocardiograms were performed at Cathay General Hospital with the machine of Echo IV (Electronic for Medicine) and 2.25-MHz transducer of 1.3cm diameter. All echocardiograms were recorded with continuous strip chart recorder at paper speed (50mm/sec.) by means of time gain compensation. The technique of recording the echocardiogram of the aortic root leaflets. was similar to that described by Gramiak and Shah (7; 8). The interpretations of all the pathological findings were made from Department of Pathology (National Taiwan University Hospital).

Results

The echocardiograms in figure 1,2 are recordings of our first patient (Case I) with aortic valvular vegetations documented by pathology. The echoproducing mass can be seen on the aortic valve from several different views. The peculiar echocardiographic features is that the valve leaflets at diastole are more echoproducing than normal.

Figure 4 is an echocardiogram from patient I (Case I), fine vibration of anterior mitral leaflet and exaggerated motion of interventricular septum is noted.

Figure 5 is an echocardiogram from a patient with rupture of aortic valve (Case II). In aortic root, at systole high frequency fine oscillation is seen at right aortic valve leaflet and noncoronary aortic valve leaflet. At diastole, echoproducing mass with fine oscillation and separation is found.

Figure 6 is an echcardiogram from a patient with rupture aortic valve (Case II), in diastole echo-producing mass with fine oscillation is evident in mid-aortic portion.

Figure 7 is an echocardiogram from a patient with rupture aortic valve (Case II), vibration of anterior mitral leaflet and exaggerated motion of interventricular septum is clearly seen.

Figure 8 is an echocardiogram from a patient with clinical suspection of either aortic valve perforation or aortic valve vegetation (Case III), at diastole echoproducing mass with high frequency fine oscillation is evident in midportion of aortic root, both ant. and post. wall of aortic root moves excessively to the point — it looks like high frequency fine

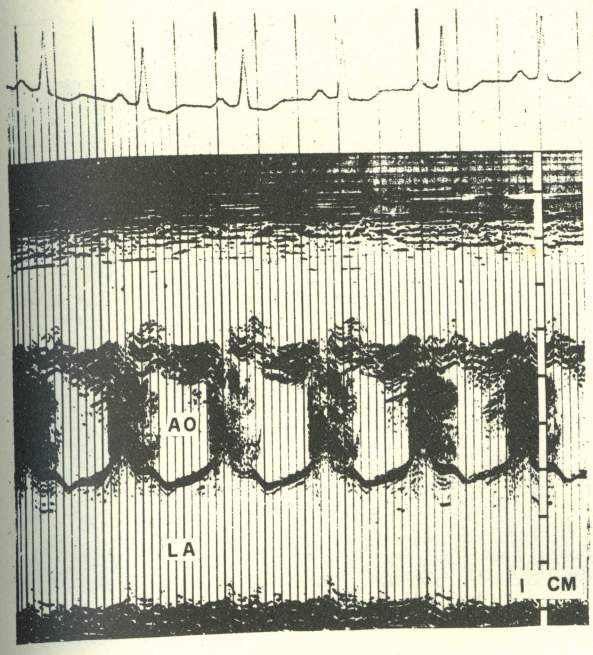

Fig 1

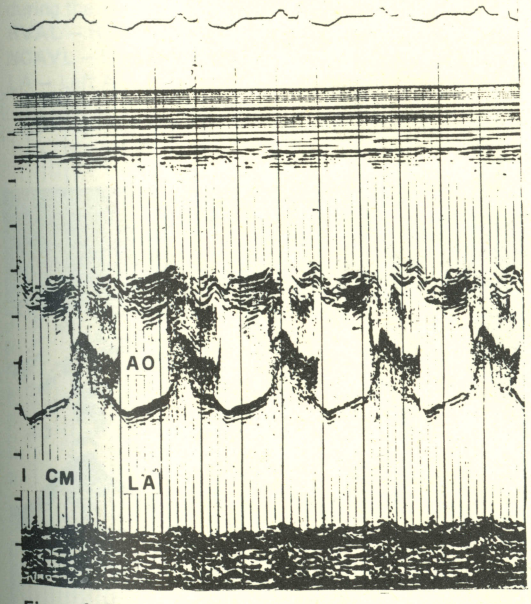

Fig 2

Figure 1, 2:
Two aortic root echogram from the same patient (Case I) with aortic valve vegetation. The features of echo-producing mass at diastole varied, it is dependent on the angle of transducer & how the ultrasonic beam struck the valve.
AO – Aortic Root
LA – Left Atrium

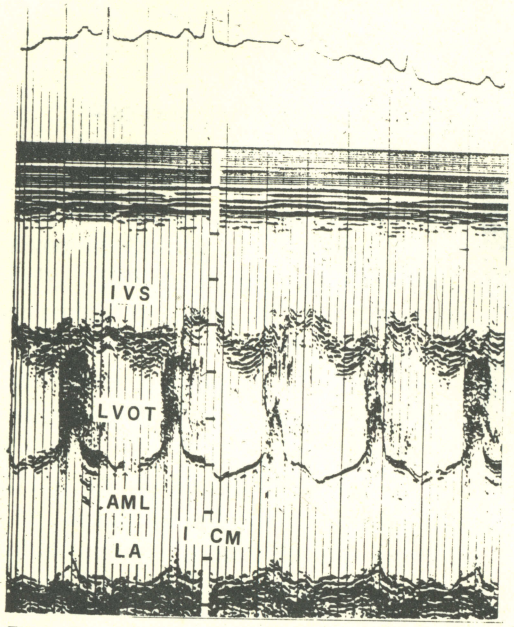

Figure 3.

An echogram from the same patient (Case I), echo-producing mass arising from aortic valve leaflets during the period of diastolic phase is recorded at the level of left ventricle out-flow tract.

IVS – interventricular Septum
LVOT – Left Ventricle Out-flow Tract
AML – Anterior Mitral Leaflet
LA – Left Atrium

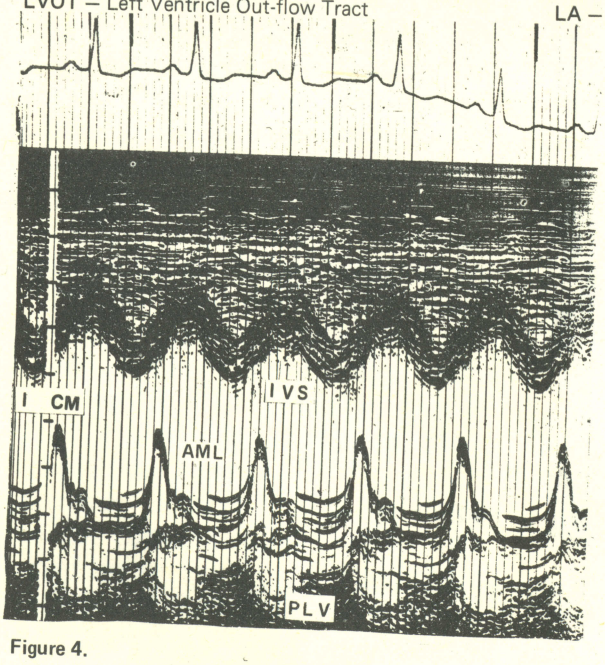

Figure 4.

An echocardiogram of left ventricular cavity from patient I (Case I) with aortic valve vegetation. Notes that excessive systolic excursion of interventricular septum (IVS) (13 mm) & vibration of anterior mitral leaflet (AML).

PLV – Posterior wall of left ventricle

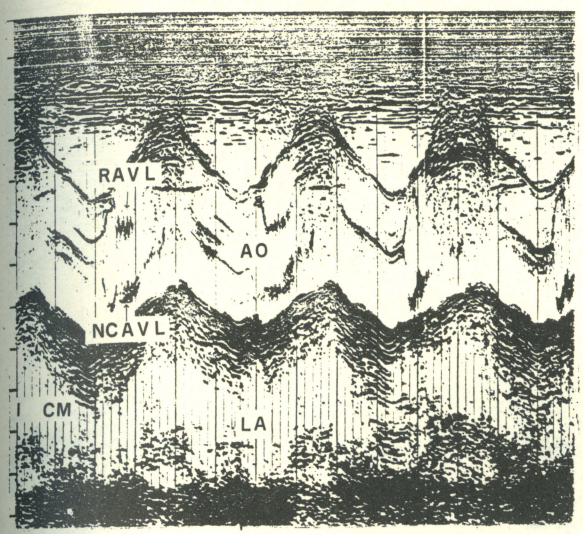

Figure 5.

Echocardiogram of aortic root (AO) from a patient with rupture of arotic valve (Case II), the diameter of aortic root is increased (39 mm). Fine oscillation in the aortic root during the systole & the diastole is noted.

RVAL – Right Aortic Valve Leaflet

NCAVL – Noncoronary Aortic Valve Leaflet

LA – Left Atrium

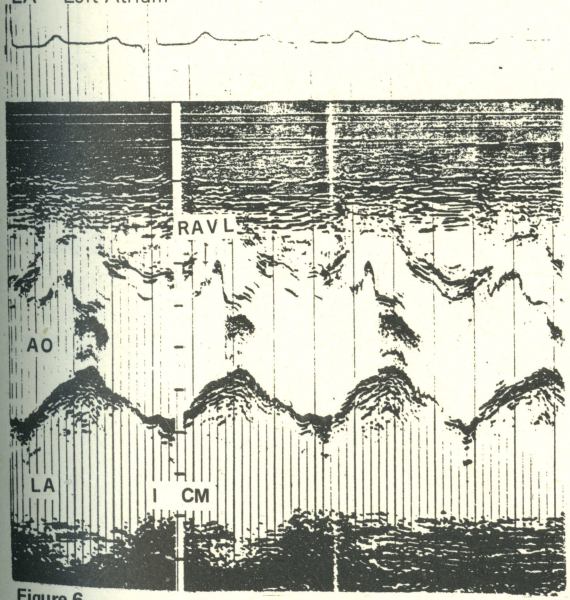

Figure 6.

Echocardiogram of aortic root (AO) from a patient with rupture aortic valve (Case II), at systole only right aortic valve leaflet with fine oscillation is seen, at diastole, echo-producing mass shows somewhat separated & fibrillating. The appearance of echo-producing mass in this figure 6 is different from echo-producing mass in figure 5, again it is dependent on the angle of transducer and how the ultrasonic beam struck the valve.

LA – Left Atrium **RAVL** – Right Aortic Valve Leaflet

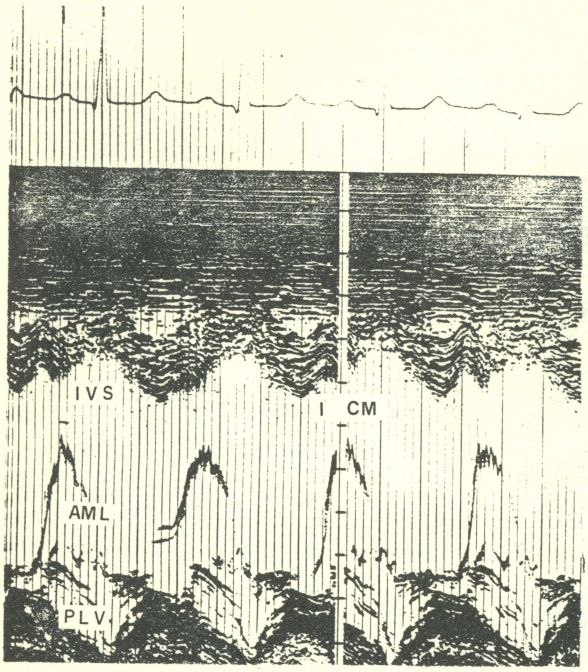

Figure 7.

Echocardiogram of left ventricular cavity from a patient with ruptured aortic valve (Case II), note that the systolic excursion of interventricular septum (IVS) is increased (13 mm), saw tooth appearance of Anterior mitral leaflet (AML) is seen.

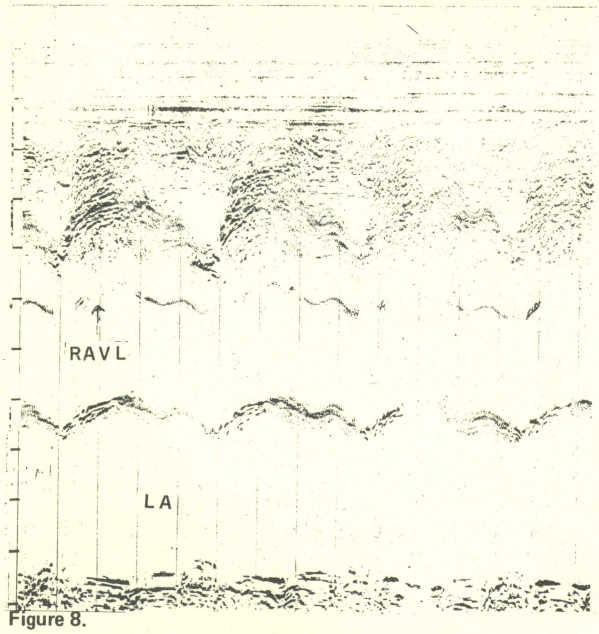

Figure 8.

Echocardiogram of aortic root (AO) from a patient (Case III) with clinical impression of either aortic valve perforation or aortic valve vegetation, at systole only right aortic valve leaflet is seen which is continued with shaggy echoes at diastole. The diameter of aortic root is at the upper limit of normal (36 mm).

LA – Left Atrium

RAVL – Right Aortic Valve Leaflet

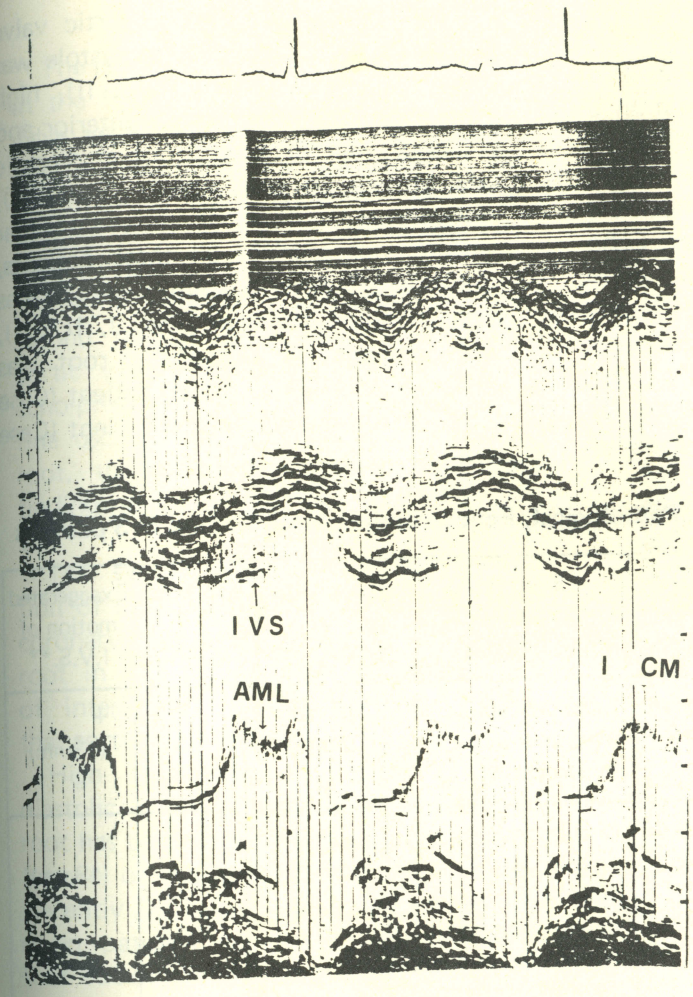

Figure 9.

Echocardiogram of left ventricular cavity from a patient (Case III), systolic excursion of interventricular septum (IVS) is increased (11 mm). Vibration of anterior mitral leaflet (AML) is evident at diastole.

oscillation at distole.

Figure 9 is an echocardiogram from a patient (Case III), vibration of anterior mitral leaflet and exaggerated motion of interventricular septum is again clearly seen.

Table I summarizes the echocardiographic findings of present study. Echo-producing mass at diastole in the aortic root was present in one patient (Case I), echoproducing mass with high frequency fine oscillation at diastole in the aortic root was present in two patients (Case II, Case III), high frequency fine oscillation of right and noncoronary aortic valve leaflet in the aortic root at systole was present in one patient (Case II), high frequency fine oscillation of anterior and posterior wall of aortic root at diastole was present in one patient (Case III), exaggerated motion of interventricular septum was seen in all three patients, vibration of anterior mitral leaflet was seen in three patients (Case I, II, III), the diameter of the aortic root was within normal limit in two patient (Case I, III) and increased in one patient (Case II).

Table 1-Clinical, Angiographical, Pathological, Echocardiographical findings in 3 patients

Case Age (Yr) Sex	Angio-graphic findings	Pathology	Echocardio graphic findings	Diameter of aortic root*	Vibration of AML	Exaggerated motion of I.V.S.**
I, 18, Female	AI_{IV}, MR_{II}	Aortic valve vegetation suggestive of rheumatic activity.	Echo-producing mass at diastole in aortic root.	Normal (24mm)	+	+ (13mm)
II, 30, Female	AI_{III}, MR_{I} V.S.D.	Aortic valve-chronic valvulitis and rupture	In aortic root, at systole high frequency fine oscillation on right aortic valve leaflet and noncoronary aortic valve leaflet. At diastole echoproducing mass with fine oscillation and separation.	Increased (39mm)	+	+ (13mm)
III, 36, Male	AI_{II-III}	(–)	At diastole, high fre quency fine oscillation at anterior aortic wall, posterior aortic wall, and center of aortic root.	Normal (36mm)	+	+ (11mm)

AI – Aortic insufficiency
MR – Mitral regurgitation
V.S.D.-Ventricular septal defect
AML – Anterior mitral (valve) leaflet
IVS – Interventricular septum

* Normal range of diameter of aortic root (20mm to 37mm)
** Normal range of amplitude of systolic septal excursion (3mm to 8mm)

Discussion

The peculiar echocardiographic findings in the first patient (Case I) with aortic valve vegetation documented at surgery is echo-producing mass at diastole in the aortic root, this is consistent with the findings of one case reported by Dr. Dillon [1,5]

The characteristic echogram in the second patient (Case II) with rupture aortic valve documented at surgery is echo-producing mass with high frequency fine oscillation at diastole in the aortic root, this is again consistent with the findings reported by Dr. Estevez et al [6]

The systolic high frequency oscillation of right aortic valve leaflet and noncoronary aortic valve leaflet in the aortic root in this second patient (Case II) is of interesting. It may be conceivable that aortic valve leaflet is torn.

High frequency oscillation of the diastolic band of echoes in the aortic root has been suggested as a characteristic feature of rupture aortic valve [6,9]. Recently Dr. Gopal found that among his seven patients of rupture aortic valve, four out of seven demonstrated such high frequency oscillation when those echograms were performed with 2.25 MHZ transducer recording at paper speed of 50 mm/sec. [3]. Our second patient (Case II) also demonstrated such characteristic high frequency oscillation on echogram of aortic root and she eventually turn out to be a case of rupture aortic valve.

The raise a question that whether echocardiography is able to differentiate aortic valve perforation from aortic valve vegetation, the answer may still remain unsettled and await further investigation.

Vibration of anterior mitral leaflet and exaggerated motion of interventricular septum in the chocardiographic findings of our patients is compatible with severe aortic insufficiency. Hemodynamically exaggerated motion of interventricular septum implicates diastolic volume overloading.

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主動脈瓣贅生物及穿孔之超音波心圖診斷

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主動脈瓣贅生物在超音波心圖上之特異顯示，遠在1973年就有人提出報告，隨即超音波心圖便被認爲是在診斷及確定心臟內腺炎之疾病上，爲一有用，有幫忙的工具。最近Gopal，Lee及Weissler報告了7個在超音波心圖上有特異顯示的主動脈瓣穿孔的病例，根據他們所下的結論認爲主動脈瓣穿孔與主動脈瓣贅生物兩種病例在超音波心圖上的顯示極爲相似而無法區別。

在此介紹在超音波心圖上有所特異顯示的例子，其一爲經手術開刀證實爲主動脈瓣贅生物的病例，一爲經手術開刀證實爲主動脈瓣穿孔之病例，另一病例爲在超音波心圖上之變化與前二者相近，雖未經過開刀手術，亦一同在此報告。

這三個病人都被證實爲主動脈瓣閉鎖不全。此三病例之超音波心圖亦都顯示了僧帽瓣前葉有高頻率之振動及心室中隔之過度擺動。三個病例中，最特異的超音波心圖變化乃爲心臟舒張期，在主動脈發現的多粗毛狀的回音圖（超音波心圖）。

超音波心圖在診斷主動脈瓣穿孔或主動脈瓣贅生物之領域上乃爲一有用的，無侵襲性，同時又可得到主動脈瓣閉鎖不全之病因的工具。

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