

IMAGES IN CARDIOVASCULAR ULTRASOUND

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Bifid Cardiac Apex in an Old Woman

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Running title: Bifid Cardiac Apex

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16 During the embryonic development of the heart, the two ventricles develop as independent
structures on the two sides of the primitive plate. Normally, the two ventricles merge together at
18 the apex and their cavities are separated by a bridge formed by muscle fibers (interventricular
septum). An apical cardiac notch indicates the developing interventricular septum, and normally
20 disappears later during organogenesis.¹⁾ Bifid cardiac apex arises when this process is abnormal,
resulting in a defective union of the two ventricles at the apex and persistence of the cardiac
22 notch. Bifid cardiac apex is a common finding in sea mammals like whales and manatees,
however this abnormality is very rare in humans.^{1,2)} Only few cases have been reported in the
24 literature, most of which were accompanied by additional congenital cardiac abnormalities.¹⁻⁴⁾

We are presenting the images of a 73 year-old woman with bifid cardiac apex who was
26 admitted in our Department with palpitations, dizziness and diaphoresis. Her past medical history
included a transient ischemic attack 5 years ago. Cardiac examination revealed regular rate and
28 rhythm with normal heart sounds, without any murmurs. The systemic physical examination
was unremarkable. Chest X-ray was clear with a normal cardiac silhouette. ECG revealed
30 minimal ST-T depression on precordial leads. Ambulatory ECG showed an episode of slow
ventricular tachycardia at 105 bpm with a duration of 20 seconds and four shorter ventricular
32 runs. Transthoracic 2D and contrast echocardiography (Fig. 1, Movies 1,2,3) demonstrated a
cleft-like small chamber between the left and right ventricles (bifid left ventricle) with normal
34 systolic function, similar thickness to normal myocardium, and normal perfusion. The right
ventricle seemed hypoplastic with adequate systolic function. The atria were of normal size. No
36 additional heart abnormality was detected with echocardiography. Considering the above
findings, the lack of a history of coronary artery disease or myocardial infarction, and the
38 absence of Q waves on ECG, we feel that our finding represents true bifid left ventricle / bifid

cardiac apex, and that the possibility of ventricular pseudoaneurysm or aneurysm due to prior
40 myocardial infarct related to coronary artery disease is extremely unlikely. Further investigation
with a cardiac MRI was suggested, but the patient refused any further tests and was discharged
42 on antiarrhythmic and anticoagulant therapy.

Bifid cardiac apex is a very rare developmental abnormality of the heart in humans, and its
44 clinical significance and impact on survival is currently unknown. There has been some
controversy whether this abnormality is a potential source of embolism or arrhythmias. Very few
46 patients with bifid cardiac apex have been reported in the literature so far. In a case series of 3
patients, two patients died shortly after birth and one during early adulthood, but all 3 patients
48 had additional severe and multiple congenital heart defects.¹⁾ A bifid apex was confirmed with
autopsy in a 11-year old boy who died suddenly while he was playing, presumably due to
50 malignant arrhythmia.⁴⁾ However, this boy also had an aberrant right coronary artery with high
take-off from the ascending aorta and slit-like orifice, and therefore the role of the bifid cardiac
52 apex for his sudden cardiac death was unclear.⁴⁾ Two additional cases of bifid apex have been
reported in young patients with additional congenital heart defects, without any data regarding
54 their follow-up.^{2,3)} Interestingly, a bifid cardiac apex without any additional congenital heart
defect has been confirmed with autopsy in a young adult who died from combined drug
56 toxicity.⁵⁾

Our image illustrates a rare case of a bifid cardiac apex in an elderly woman without significant
58 symptoms, and implies that this rare developmental abnormality of the heart may not be very
malignant when no additional congenital cardiac abnormalities are present.

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74 **Figure legend:**

76 Fig. 1. Transthoracic echocardiography: Apical four-chamber view before (top) and after
(bottom) intravenous injection of ultrasound contrast shows a bifid left ventricle and a
78 hypoplastic right ventricle.

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SUPPLEMENTARY MOVIE LEGENDS

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Movie 1. Transthoracic echocardiography: Two-dimensional four-chamber view.

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Movie 2. Transthoracic echocardiography: Two-dimensional four-chamber view with color flow.

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Movie 3. Transthoracic echocardiography: Two-dimensional four-chamber view after

86 intravenous injection of ultrasound contrast showing a bifid left ventricle and a hypoplastic right ventricle.

