Biventricular Enlargement/ Hypertrophy

SR MITTAL

Abstract
Electrocardiographic diagnosis of early biventricular hypertrophy is difficult because opposing forces of hypertrophy of two ventricles cancel each other. In presence of voltage criteria of LVH, right axis deviation, clockwise rotation, signs of right atrial overload and R/s ratio greater than 1 in V1 suggest biventricular hypertrophy. Tall R with deep S in leads V2 to V4 with combined amplitude greater than 60 mm (Katz Wachtel sign) also suggests biventricular hypertrophy. This sign is common in children with ventricular septal defect and pulmonary artery hypertension. These signs have high specificity but low sensitivity.

INTRODUCTION
ECG diagnosis of early biventricular hypertrophy (BVH) is difficult because normally greater left ventricular forces require much greater degree of right ventricular hypertrophy, before it can manifest on ECG. This is because opposing forces of hypertrophy of two ventricles cancel each other. Further, intraventricular conduction defects, accompanying hypertrophy of either ventricle also affect electrocardiographic diagnosis of ventricular hypertrophy. Several criteria are used for diagnosis of biventricular hypertrophy.

(1) ETIOLOGY
Common causes include
- Mitral regurgitation with pulmonary artery hypertension. This is common with rheumatic etiology.
- RVH from any cause with systemic hypertension/ gross aortic regurgitation/ mitral regurgitation.
- Cardiomyopathy.

(2) SPECIFIC CRITERIA
(A) In the presence of voltage criteria of left ventricular hypertrophy (LVH), one or more of the following findings suggest BVH.4
- Right axis deviation.
- Clockwise rotation- shift in precordial transition zone to left (Figure 1).
- Deep S in V5, V6
- Signs of right atrial overload

Dr. SR Mittal is Head, Department of Cardiology at Mittal Hospital and Research Centre, Ajmer, Rajasthan
• Tall R in right precordial leads
• R/S ratio greater than 15 (Figure 1, 2, 3).

Caution-
• Asthenic individuals may have LVH voltage criteria in absence of true LVH
• Emphysema and obesity may mask LVH voltage criteria.

(B) Katz Wachtel phenomenon

Tall R with deep S in leads V1 to V4 with combined amplitude greater than 60mm (Figure 4, 5, 6). It is more likely to occur in children with ventricular-septal defect or AV- canal defect with pulmonary artery hypertension. In these conditions, left ventricular volume overload is associated with right ventricular pressure overload. Standard criteria have high specificity but low sensitivity.

(3) NON-SPECIFIC CRITERIA

Most of the patients do not fulfil standard criteria because effects of enlargement of one ventricle cancel the effects of enlargement of another ventricle. Several subtle ECG findings may also suggest early LVH.

• Right axis deviation with – qR configuration in V5V6 (Figure 7) or
  - Predominant R in V5V6 but not fulfilling LVH voltage criteria or
Figure 5. Electrocardiogram from a case of Ventricular septal defect (VSD) with pulmonary artery hypertension showing incomplete RBBB with tall RS (>60 mm) in leads V₃ to V₅ (Katz-Wachtel sign).

Figure 6. Electrocardiogram from a case of A-V canal defect with pulmonary artery hypertension showing SISIIII, counter clockwise loop (q in I and aVL), prominent R in lead V₁, with tall RS in lead V₁ (70 mm) and V₆ (80 mm) (Katz Wachtel sign).

Figure 7. Electrocardiogram from a case of VSD with right ventricular outflow tract obstruction showing right axis deviation, prominent R in lead V₁ and qR in leads V₅V₆.

- RS in V₁ and very deep S in V₂ ² ⁶ (Figure 8, 9) or
- Prominent R with ST-depression in lead V₁, V₆ suggestive of LVH (Figure 10) or
- Left atrial enlargement (Figure 11,12) (Except in mitral stenosis).

Caution-
Left inferoposterior hemiblock should not be wrongly interpreted as right axis deviation.
- S₁S₂S₃ with prominent R or qR in V₁V₆
- Tall equiphasic RS in leads V₁, V₆ not fulfilling criteria of 60 mm (Figure 13)
Tall R in right as well as left precordial leads. These criteria are less specific but more sensitive.

REFERENCES

MCQs

Biventricular enlargement / hypertrophy

Q.1. Which ECG findings suggest biventricular enlargement?
(A) LVH +LAD
(B) LVH + RAD
(C) LVH + Clockwise rotation
(D) LVH + Counter clockwise rotation

Q.2. Which ECG findings do not suggest biventricular enlargement?
(A) LVH + deep S in V5, V6
(B) LVH + Tall R in V1
(C) LVH + right atrial overload
(D) LVH + right atrial overload

Q.3. Katz-Wachtel phenomenon is seen in
(A) Leads V3R to V1
(B) Leads V2 to V4
(C) Leads V7 to V8
(D) Leads I and aVL

Q.4. In Katz-Wachtel phenomenon R + S amplitude should be more than
(A) 30 mm
(B) 40 mm
(C) 50 mm
(D) 60 mm

Q.5. Katz-Wachtel phenomenon is commonly seen in
(A) VSD + PAH
(B) AV canal defect with PAH
(C) LV to RA shunt
(D) TOF + AR

Q.6. Which ECG finding are not suggestive of biventricular hypertrophy?
(A) R in V1 + qR in V6
(B) R in V1 + S in V5
(C) R in V1 + deep S in V5
(D) RAD + left atrial overload

Q.7. Causes of right axis deviation -
(A) RVH
(B) Left postero-inferior fascicular block
(C) Left antero-superior fascicular block
(D) RBBB

Q.8. Causes of voltage criteria of LVH
(A) Asthenic individuals
(B) Emphysema
(C) Obesity
(D) Pericarditis

Answers: