Diastolic dysfunction

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Articles in this section are inspired by, but not based on, real cases to illustrate the importance of knowledge about ECGs in relation to clinical situations in general practice. Management is not discussed in detail.

Janice, aged 74 years, presents having noted recent irregularity of her pulse. During the past week she has experienced about 10 episodes, lasting a few seconds only; she has had no other symptoms.

Janice has longstanding, well-controlled hypertension, diagnosed two decades ago. Her mother died from a 'heart attack' when she was 75 years of age. Janice takes candesartan 8 mg daily, atorvastatin 40 mg daily and fish oil capsules. Examination is unremarkable. An ECG is performed and a 24-hour Holter monitor organised. The ECG is shown in the Figure.

Q1. What does the ECG show?

The ECG below shows broadening and notching of the P wave and some atrial ectopic beats.

Q2. What is the P wave?

The P wave is the first positive deflection on the ECG and represents atrial depolarisation. The normal duration of the P wave is less than 120 msec (less than three small squares on the horizontal axis of the ECG).

The normal P wave is upright in leads I and II and inverted in lead aVR. It is biphasic in V1. It should be under 2.5 mm in amplitude (height) in the limb leads and under 1.5 mm in the precordial leads.

Q3. What are the common P wave abnormalities?

- Bifid P waves (P mitrale) occur in left atrial enlargement (hypertrophy or dilation).
- Peaked P waves (P pulmonale) are seen in right atrial enlargement and hyperkalaemia.
- Flattened P waves occur in myxoedema and hypokalaemia.
- Widened P waves may be due to interatrial block or conduction delay.
- Inverted P waves are seen in ectopics and junctional rhythms.
- Absent P waves occur in atrial fibrillation and sinoatrial arrest with an escape rhythm.

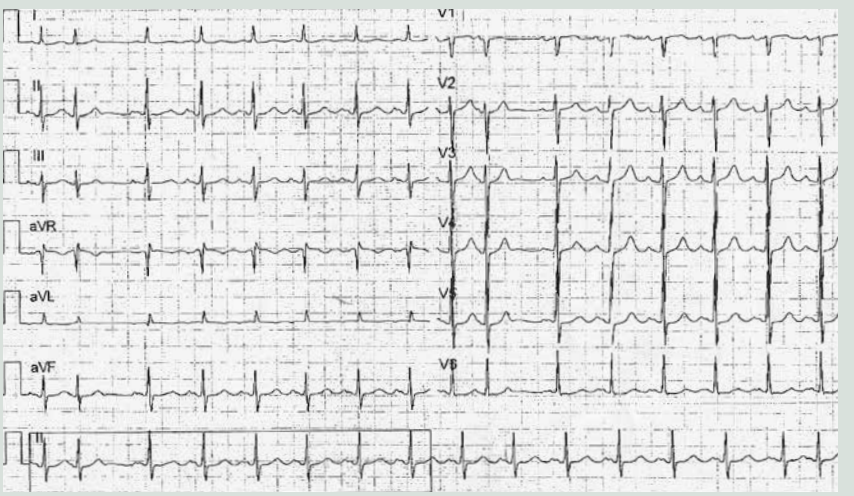

Figure. The patient's 12-lead ECG.
Image courtesy of Dr M. Geoffrey Miller, Consultant Cardiologist, Sydney.

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Q4. What are the ECG signs of diastolic dysfunction?

The P wave is the main electrical wave to occur during diastole. Notching, slurring and broadening of the P wave may be present in diastolic dysfunction and the P wave may also be biphasic. The end of the T wave may also extend into diastole, for example, in cases of long-QT syndrome. U waves may also occur in diastole. These abnormalities may be due to left atrial strain or enlargement, and thus may be an ECG sign of diastolic dysfunction.

Q5. What are the stages of normal diastole?

There are four stages to normal diastole. Isovolumetric relaxation begins with the closure of the aortic valve and ends when the mitral valve opens. Then, directly after this, there is an early, rapid ventricular filling. Low flow occurs mid-diastole and then, finally, there is a late rapid filling in late diastole, which coincides with (or is caused by) atrial contraction.

Q6. What is diastolic dysfunction?

Diastolic dysfunction is the impairment in ventricular relaxation and filling resulting in an increased end-diastolic pressure for the end-diastolic volume. The impairment in ventricular relaxation is due to decreased compliance of the left ventricle.

In pure diastolic dysfunction, the ejection fraction is preserved (i.e. there is no left ventricular, systolic heart failure). Systolic heart failure is always associated with diastolic dysfunction, but the converse is not always true.

If severe, the condition may result in pulmonary congestion and right heart failure. The symptoms of diastolic dysfunction, if present, are due to heart failure and therefore include dyspnoea, orthopnoea and fluid retention.

Q7. What are the causes of diastolic dysfunction?

The risk of diastolic dysfunction increases with age and the condition is very common. Common causes include:

- ischaemic heart disease
- longstanding hypertension
- obesity
- aortic stenosis
- cardiomyopathy (both restrictive and hypertrophic).

Less common causes include:

- haemochromatosis
- constrictive pericarditis
- pericardial effusion
- infiltrative diseases (rarely), e.g. amyloidosis, fibrosis, glycogen storage diseases or sarcoidosis.

Q 8. What is the treatment for diastolic dysfunction?

The underlying cause of the dysfunction should be identified, if possible, and managed. General treatment involves controlling arrhythmias, such as atrial fibrillation, reducing blood pressure, correcting dyslipidaemia and improving coronary artery blood flow. It is particularly important to control heart rate, if this is indicated. The patient should not smoke and alcohol should only be consumed socially and in moderation. Appropriate, regular exercise should be encouraged. ACE inhibitors, angiotensin II receptor blockers and calcium channel blockers are the first-line medications for hypertension and also to improve left ventricular relaxation in diastolic dysfunction.

ACE inhibitors and angiotensin II receptor blockers directly affect ventricular compliance by inhibiting production of, or blocking, angiotensin II receptors. This reduces the risk of ventricular fibrosis from interstitial collagen deposition. Heart failure should be conventionally managed, if it develops.

Outcome

The results of Janice's 24-hour Holter monitor were normal and her pulse rate irregularity corresponded to atrial ectopic beats as expected. Because of her risk factors and family history, stress echocardiography was organised. This confirmed mild to moderate diastolic dysfunction at rest, but there was no ischaemic heart disease unmasked on exertion. No cause was found for the diastolic dysfunction other than longstanding hypertension. Janice was encouraged to exercise regularly, reduce her alcohol intake, have a low salt diet and optimise her weight. **CT**

COMPETING INTERESTS: None.

Key points

- **The P wave is the main electrical wave to occur during diastole.**
- **The risk of diastolic dysfunction increases with age and the condition is very common.**
- **Systolic heart failure is always associated with diastolic dysfunction, but the converse is not always true.**
- **ACE inhibitors, angiotensin II receptor blockers and calcium channel blockers can improve left ventricular relaxation in diastolic dysfunction.**