Ventricular Ectopies Beats

This article discuss various aspects of ventricular ectopic beats as well as electrocardiographic changes associated with ventricular ectopic beats.

Keywords: Ectopic beats, SA node, Electrocardiograph

Normally the heart is stimulated by the impulse arising in sinoatrial node. If the focus of stimulation is other than SA node, it is called an ectopic beat i.e. heart beat arising from an abnormal focus. When the abnormal focus is in the ventricle, it is called ventricular ectopic beat.

The differentiation of ventricular ectopic beats are described in Table 1. Sometimes differentiation may be difficult from surface ECG alone. Some patient may have supraventricular as well as ventricular ectopies. (Fig 1e)

Premature beat v/s escape beat
When the ectopic beat occurs prematurely (earlier than the scheduled next sinus beat) it is called premature beat (Fig 2a). It is not useful for circulation and can be treated if indicated. If the ectopic beat occurs later than the scheduled next sinus beats, it is called an escape beat (Fig 2b). Escape beats are useful for maintaining circulation whenever there in a longer sinus pause. Escape beat do not need to be suppressed.

<table>
<thead>
<tr>
<th>Table 1: Differentiation of ventricular ectopic beat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preceding P wave</td>
</tr>
<tr>
<td>Abnormal or absent</td>
</tr>
<tr>
<td>ORS duration</td>
</tr>
<tr>
<td>exception- BBB in sinus rhythm</td>
</tr>
<tr>
<td>aberrant conduction</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

AUTHOR PROFILE
SR Mittal
Head, Dept. of Cardiology, St. Francis Hospital, Ajmer, Rajasthan
Origin of ventricular ectopics beats

Ventricular ectopic beats can arise from any part of either ventricle. Those arising from left ventricle or left side of interventricular septum take RBBB configuration (rsR' configuration in lead V1 and qRS configuration in lead V6) (Fig 3a). In presence of anterior myocardial infarction, left ventricular ectopics produce QR deflection in leads V1 to V4 (Fig 3b). Ectopics arising from right ventricle or right side of interventricular septum, take LBBB configuration (rs configuration in lead V1 and RsR' configuration in lead V6) (Fig 3c). Ectopics arising from right ventricular outflow tract have LBBB morphology with inferior axis (LBBB morphology in lead V1 with tall monophasic R in leads II, III and aVF) (Fig 3d). Identification can be useful because RVOT ectopics respond to beta-blockers, calcium channel blockers and radio frequency ablation. Ectopics arising from right ventricle can be a manifestation of arrhythmogenic RV cardiomyopathy which can be excluded only by detailed echocardiographic evaluation and MRI. Ectopics arising from other areas may have variable shapes.

Configuration

Ventricular ectopics having identical configuration arise from same focus (unifocal or uniform) (Fig 4a). If configuration is changing, they may be bifocal (two foci) (Fig 4b) or multifocal (multiple points of origin) (Fig 4c). Same focus can also produce different configuration (multiform) due to varying intraventricular conduction.

Coupling interval

Interval between ectopic beats and previous sinus beat is known as coupling interval. Ectopics arising from the same focus usually have fixed coupling interval (Fig 5a). Reentry is the usual underlying mechanism in such cases. Those arising from different foci can have different coupling intervals (Fig 5b). Ectopics due to increased automaticity of single focus can also have different coupling intervals. However, the interval between such ectopics is either fixed or multiple of a fixed interval (Parasystole). Coupling interval can be very short- R of ectopic beat falling on T wave of
previous sinus beat (R on T phenomenon). On the other end of spectrum the coupling interval may be long and ectopic may appear after initiation of P wave of next sinus beat (late diastolic ectopics) (Fig 5c). Late diastolic ventricular ectopics can fuse with the QRS of next sinus beat producing fusion beat (QRS configuration of the fusion beat is formed partly by QRS of sinus beat and partly by QRS of ectopic beat).

**Frequency (Fig 6)**
- Ectopics alternating with sinus beat- Bigeminy
- Ectopics occurring after two sinus beats- Trigeminy
- Ectopics occurring after three sinus beats- Quadrigeminy

There is some paradox in nomenclature. Although, by nomenclature, quadrigeminy appears more serious, the frequency of ectopics is less than in bigeminy or trigeminy. Frequency of ectopics is highly variable and varies significantly from time to time and day to day. Average load can be determined only by prolonged ambulatory monitoring.

**Repetitiveness**
Ventricular ectopics can recur one after the other. When they occur in group of two, they are called couplets (Fig 7a). In case of couplet, R of second ectopic may fall on T of first ectopic (Fig 7a). In case of couplets, QRS configuration of second ectopic may be slightly different from the first (Fig 7b) probably due to partial aberration in ventricular conduction because of incomplete repolarization following first ectopic. “Triplet” suggests occurrence in group of three (Fig 7c) By definition, occurrence of 3 to 30 ectopics in succession is called non sustained ventricular tachycardia. (Fig 7d)
ST segment and T wave
These are directed away from the QRS of the ectopic. ST segment may be deformed by next normal sinus P wave (having configuration of sinus P wave) (Fig 8a). Sinus P wave following a ventricular ectopic may occur earlier than its scheduled time (Ventriculo phasic sinus arrhythmia) (Fig 8a).
- Retrogradely conducted P wave (configuration different from sinus P wave) (Fig 8b)
- Retrograde conduction may occur regularly or occasionally.

Change in ECG following a ventricular ectopic beat
Compensatory pause
Pause following an ectopic is usually longer than the sinus cycle length (Fig 9a). It is called compensatory pause. It is highly variable even with unifocal ectopics and depends on several factors including previous cycle length, coupling interval, retrograde conduction of ventricular ectopics to atria and sinus node, blocking of next sinus P wave etc. (Fig 9b) Sometimes, there may be no significant compensatory pause (interpolated ectopics) (Fig 9c). In patients with sick sinus syndrome, there may be abnormally long compensatory pause. In some cases of interpolated ectopics compensatory pause may follow the sinus beat after the ectopic (Postponed compensatory pause) (Fig 9d). This is usually due to blocking of the second P wave following the ectopics.

P wave
Ventricular ectopic may be followed by an atrial or junctional ectopic beat with abnormal P wave configuration.

PR interval
PR interval of next sinus beat may be prolonged due to partial retrograde depolarization of A-V node by the ventricular ectopic (Fig 11a) (concealed conduction). Sometimes next P wave may be blocked even when occurring after T wave (Fig 11b). This suggest impaired AV conduction.

QRS of next sinus beat
It may show broadening due to aberrant conduction (Fig 12a) or fusion of sinus beat with second ectopic (Fig 12b). In patient with BBB in sinus rhythm, QRS complex following
the compensatory pause may sometimes become normal. (Fig 12c). This phenomenon suggests that the BBB is rate dependent and disappears following the longer compensatory pause (relative bradycardia).

**T wave polarity**
T wave polarity of the sinus beat following a ventricular ectopic beat may change due to aberrant ventricular conduction (Fig 13).

**U wave**
‘U’ wave may invert in the sinus beat following the ventricular ectopic beat. It is considered as suggestive of underlying ischaemia.

Clinical significance¹²³
- Incidence of ventricular ectopics increases with advancing age.
- Clinical significance does not depend on morphology, prematurity or repetitiveness.
- Patients with underlying heart disease, systolic failure and active ischaemia are more susceptible to development of ventricular fibrillation.

![Fig. 10: Ventricular ectopic followed by functional beat](image)

![Fig. 11: Concealed conduction and impaired AV conduction](image)

![Fig. 12: QRS complex following the compensatory pause](image)

![Fig. 13: T wave polarity of sinus beat](image)

- In more than 50% cases VT/VF start without any warning arrhythmia.
- Polymorphic nonsustained VT is more likely to degenerate into VF.
- Ectopics appearing during exercise do not adversely affect prognosis. Those appearing during recovery are more significant from point of view of adverse prognosis.

References