BIGEMINY IN VENTRICULAR INTERPOLATION

The occurrence of a premature beat between two consecutive conducted sinus beats is termed an interpolated premature systole or extrasystole. An interpolated premature ventricular systole can affect the conduction of the subsequent sinus beat by concealed retrograde penetration into the His-Purkinje system or AV node or both. This retrograde concealed penetration can result in a prolongation of the PR interval, with normal or aberrant intraventricular conduction of the first postextrasystolic sinus beat. The aberrant intraventricular conduction of the first postectopic sinus beat may mimic the occurrence of ventricular couplets (two premature ventricular beats in a row). Rarely the interpolated ventricular extrasystole may effect the conduction of the second postectopic sinus beat by prolonging its PR interval or altering its intraventricular conduction. The complete block of the second postectopic sinus beat, following an interpolated ventricular extrasystole, has been termed "postponed compensatory pause."

The following presentation describes an unusual form of group beating in which interpolated premature ventricular beats give rise to a bigeminal pattern. In this bigeminal pattern the first premature beat is an interpolated ventricular extrasystole, and the second premature beat is a conducted sinus beat. Dependent on the intraventricular conduction pattern of the second postectopic sinus beat, alternation between premature wide (ventricular extrasystole)
and premature narrow QRS complexes (conducted sinus beat), or alternation between two premature wide QRS complexes (ventricular extrasystole and aberrantly conducted sinus beat) are seen.

**Case Report**

The ECGs are rhythm strips taken from a tape of continuous dynamic ECG monitoring recorded in modified lead V1. Figure 1 (panel A) shows sinus rhythm with PP intervals varying from 0.80 to 0.90 second, and the PR interval is 0.20 second. After the second sinus beat, there is a premature ventricular complex (left bundle-branch block morphology). The first postectopic sinus beat conducts to the ventricle with a PR interval of 0.70 second, and the second postectopic sinus beat conducts to the ventricles with a PR interval of 0.24 second. This pattern repeats itself at the end of this panel. Variations on this group beating are also observed, where the premature, narrow QRS is followed by another premature ventricular extrasystole that is also interpolated (Fig 1, panel B). Occasionally, the second postectopic sinus beat conducts to the ventricle, with right bundle branch block aberration giving the appearance of a ventricular bigeminy with alternating left and right bundle-branch block morphology (Fig 1, panel C).

The following explanation is proposed for these findings (Fig 2). During sinus rhythm, AV conduction occurs through both fast and slow AV nodal pathways, reaching the ventricles through the fast pathway. The premature ventricular impulse (V) penetrates retrograde into the AV node, rendering the antegrade fast pathway refractory for conduction of the first postectopic sinus impulse, which is then conducted through the slow pathway, resulting in a greatly prolonged PR interval (Fig 2, panel A and B). The second postectopic sinus beat is conducted through the fast pathway with normal intraventricular conduction. When the second postectopic sinus beat is conducted with a slightly shorter PR interval, aberrant intraventricular conduction with right bundle-branch block pattern is present (Fig 2, panel C).

An alternative explanation for these findings would be that the first postectopic sinus beat is blocked and is followed by a junctional escape beat giving the appearance of ventricular interpolation. This possibility is less likely, since the occurrence of interpolation is dependent on the RnP interval (Rn refers to the onset of the QRS of the interpolated ventricular extrasystole, and P refers to the first postectopic beat) of the first postectopic sinus beat. This is shown in Figures 1 and 3. In Figure 1 (panels A, B, and C) at RnP intervals of 0.18 to 0.28 second, the first postectopic sinus beat is followed by narrow QRS complexes. In Figure 3 at shorter RnP intervals of 0.14 to 0.16 second the first postectopic sinus beat is followed by a complete compensatory pause. The dependence of interpolation on the RnP interval suggest that these beats are not escapes, but conducted beats.

The greatly prolonged PR interval of the first postectopic sinus beat needs further explanation. The PR prolongation may reflect deep retrograde penetration of the ventricular extrasystole into the AV node, with persistence of refractoriness until the arrival of the first postectopic sinus beat or result from conduction through an antegrade slow pathway, having the antegrade fast pathway rendered refractory by the previous premature ventricular beat. Observing the RnP and PR relationships one may diagnose the presence of dual AV nodal pathway by noticing a sudden change in PR interval with little or no change in RnP interval. In the analysis of this case, the RnP and PR intervals only revealed long PR intervals, and no definite conclusion could be drawn. Analyzing the RnP and PR relationships of 30 consecutive interpolated premature ventricular beats obtained from ten separate Holter records, it was found that the RnP intervals varied from 0.16 to 0.46 second (mean ± 2 SD; 0.33 ± 0.18), and the PR varied from 0.16 to 0.52 second (0.30 ± 0.22). The PR interval in this case was 0.70 second, exceeding the 0.52 second (mean ± 2 SD) observed in other cases and suggesting the presence of a slow antegrade conducting AV nodal pathway.

**Discussion**

The occurrence of ventricular interpolated beats

![Figure 2](https://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21199/)

![Figure 3](https://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21199/)
depends on the sinus rate and the retrograde penetration of the ventricular beat into the AV conduction system. Slow sinus rate favors interpolation. Less penetration favors faster conduction of the first postectopic sinus beat. An inverse relationship been the R_P (R refers to the onset of the QRS of the interpolated ventricular ectopic beat, and P refers to the first postectopic sinus beat), and PR interval of the first ectopic sinus beat has been described.\(^1\) The shorter the R_P interval, the longer the resultant PR interval becomes. In the present report, marked prolongation of the PR interval of the first postectopic sinus beat resulted in a shortening of RR intervals following the second postectopic sinus beat, giving rise to a bigeminal pattern. In this bigeminal pattern the first premature beat is a ventricular extrasystole, and the second premature beat is a conducted sinus beat with unchanged or aberrant intraventricular conduction. When intraventricular conduction of the sinus beat is normal, the bigeminal pattern consists of alternation between premature wide and narrow QRS complexes (Fig 1, panel A). When intraventricular conduction of the sinus beat is aberrant, the bigeminal pattern consists of alternation between premature wide QRS complexes of changing morphology (right and left bundle-branch block). The marked PR prolongation responsible for this pattern of group beating may be a resultant of conduction through a slow antegrade pathway.

REFERENCES

2 Langendorf R. Ventricular premature systoles with postponed compensatory pause. Am Heart 1953; 46:401-4