CASE REPORT

Bigeminal sandwiches galore

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A long run of PVCs “sandwiched” in between the sinus beats resulting in an almost doubling of the heart rate—interpolated PVCs in bigeminy—is described. This case illustrates three interesting aspects of interpolated PVCs. Although they are not uncommon, long runs of interpolated PVCs in bigeminy are rare findings. In this case, the arrhythmia had a duration of 3 minutes. Second, it illustrates the “age-old wisdom” of partial retrograde conduction. Also, even though the arrhythmia resulted in an almost doubling of the heart rate, the patient remained asymptomatic.

KEYWORDS

Holter monitoring; interpolated PVC; partial retrograde conduction

1 | BACKGROUND/INTRODUCTION

Premature ventricular contractions (PVCs) are common findings in ambulatory ECG monitoring. When a pattern of a normally conducted sinus beat followed by an extrasystole is repeated, the rhythm is labeled “bigeminy.” Bigeminal PVCs are common, but mostly the PVCs are accompanied by a full compensatory pause, thereby not affecting the heart rate. In this case, we describe an arrhythmia observed during ambulatory ECG monitoring, with PVCs “sandwiched” in between the sinus beats resulting in an almost doubling of the heart rate—interpolated PVCs in bigeminy. This case illustrates three interesting aspects of interpolated PVCs. Although they are not uncommon, longer runs of interpolated PVCs in bigeminy are rare findings. In this case, the arrhythmia had a duration of 3 minutes. Second, it illustrates the “age-old wisdom” of partial retrograde conduction. Also, even though the arrhythmia resulted in an almost doubling of the heart rate, the patient remained asymptomatic.

2 | CASE PRESENTATION

A 79-year-old woman was referred for ambulatory ECG monitoring due to symptoms of palpitations. She had a history of hypertension and intestinal carcinoid and had previously been treated for toxic goiter. A treatment attempt with metoprolol had been terminated due to bradycardia.

3 | ECG ANALYSIS

Resting ECG showed no significant abnormalities. During the 24-hr ambulatory ECG recording no ventricular tachycardias or pathological bradyarrhythmias were observed. About 600 PVCs were present during 24 hr. In the evening, a period of normal sinus rhythm was suddenly followed by almost doubling of the heart rate (from 73/min to 135/min) for 3 min (Figure 1).

During this tachycardia, PVCs were “sandwiched” in between the sinus beats—interpolated PVCs in bigeminy. In the sinus beats preceding the arrhythmia, the PR interval measured 230 ms. During the arrhythmia there were no clearly discernible P waves preceding the normal QRS complexes, indicating that the sinus-elicited P wave is “hidden” by the large amplitude T wave, and that there is a further prolonged PR interval.

Interpolated PVCs were described more than 100 years ago by Karel Frederik Wenckebach (1864–1940) (Wenckebach, 1899). Regarding interpolated PVCs, Richard Ashman in 1930 stated that “in order to explain interpolated ventricular beats...it is necessary to suppose that the retrograde impulse from the ventricle is blocked at some time point on its path back to the auricle.” He argued that, because of the rare occurrence of aberration after interpolation, this block occurs in “the main stem of bundle or the AV node itself” (Ashman, 1930). When PVCs are present, the resulting heart rate depends on how the

FIGURE 1 Ambulatory ECG recording at 25 mm/s, 10 mm/mV. A normal sinus beat is followed by paired beats consisting of alternating normal sinus beats and interpolated PVCs. Note the absence of discernible P waves during the tachycardia

FIGURE 2 Ambulatory ECG recording at 25 mm/s, 10 mm/mV. If an interpolated PVC is partially conducted retrogradely into the AV-node, the following sinus impulse may be slightly delayed, giving rise to a PR prolongation and increased RR interval between the sinus beats. Here, the RR interval preceding the paired beats measures 926 ms, whereas the RR interval of the sinus beats encompassing the PVC measures 985 ms. There is no discernible P wave at its expected position in the sinus beat following the PVC, indicating PR prolongation

extrasystole interferes with the following sinus impulse. Most often, the PVC inhibits the following sinus-elicited beat because the refractory period in the AV node produces a “full” compensatory pause. Less often, the PVC gives rise to a “resetting” of the sinus node due to retrograde conduction through the AV node and the atria. Interpolated PVCs are prone to appear during bradycardia since it is not possible for the sinus impulse to continue to be propagated and to elicit ventricular depolarization during higher heart rates (Cohen & Singer, 1995). Rarely, the sinus impulse still manages to conduct despite the PVC, both through the AV node and the ventricles, and an interpolated PVC occurs. The ventricular impulse may conduct partially into the AV node, giving rise to a prolonged PR interval of the ensuing sinus impulse (Ashman, 1930; Schamroth, 1967).

In this case, prolongation of the PR interval was indicated by the absence of a P wave in its expected position. The RR intervals of the

sinus beats encompassing the interpolated PVCs increased initially compared to RR intervals in the sinus beats preceding the arrhythmia. The slowed conduction due to partial retrograde conduction was more distinct in other interpolated PVCs in the recording (Figure 2).

In 1953, Katz and Langendorf described a phenomenon related to the interpolation of PVCs, with an excessively long PR interval in the postextrasystolic beat giving rise to a dropped subsequent beat due to a very short RP interval, the so called “postponed compensatory pause” (Katz, Langendorf, & Cole, 1944; Langendorf, 1953). Many years later (2006), Castellanos, Brenes, Chirinos-Medina, & del Carpio (2006) argued that this was a misnomer, since interpolated PVCs, by definition, do not have a compensatory pause.

Interpolation most often occurs in sinus bradycardia (Sandøe & Sigurd, 1991), but in this case the arrhythmia occurred during normal sinus rhythm. Interpolated PVCs in bigeminy gave rise to an almost doubling of the heart rate. Despite the doubled heart rate, the patient did not report any symptoms during the episode of interpolated ventricular bigeminy. Symptoms of PVCs are related to their hemodynamic effects. For example, a PVC with a compensatory pause may increase the filling time of the left ventricle and the patient may feel the increased stroke volume, or it may impede adequate LV filling causing a reduction in stroke volume (Otsuji et al., 1993; Park et al., 2015). One may speculate that the reason why the patient did not experience any symptoms during the sudden doubling of the heart rate was that the PVCs resulted in a pulse deficit which caused the subjective feeling of “unchanged” heart rate. Most interpolated PVCs are clinically silent, but a recent study indicated that interpolation may play a role in the genesis of PVC-induced cardiomyopathy (Olgun et al., 2011).

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