Paroxysmal Ventricular Tachycardia with Second Degree V-A Block and Reciprocal Rhythm

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An instance of paroxysmal ventricular tachycardia with retrograde conduction is presented. This occurred in a patient in the terminal stage of arteriosclerotic heart disease. The electrocardiograms obtained during this period, representative portions of which are illustrated, were unique in that reciprocal beats and fusion beats were noted; the latter being unusual because of the origin and site of fusion of the impulses. A hitherto unreported abnormality of the retrograde P wave is also described and illustrated.

The occurrence of paroxysmal ventricular tachycardia exhibiting second degree V-A block with the Wenckebach phenomenon is a rarity in clinical electrocardiography. It is the purpose of the present report to add another case in which this arrhythmia was associated with reciprocal rhythm and to cite an abnormality of the retrograde P wave that has been hitherto undescribed.

Material

The following representative electrocardiograms were taken during the last three days before death in the case of a 76 year old physician who was admitted to the hospital because of severe congestive failure secondary to arteriosclerotic heart disease. Until the last twenty-four hours before death, the patient remained conscious and alert. His course in the hospital was complicated by frequent episodes of paroxysmal ventricular tachycardia. Treatment with digitalis was instituted with extreme caution in order to avoid conversion of the arrhythmia to ventricular fibrillation. All attempts to control the arrhythmia with quinidine, both orally and intravenously, were futile. He was questioned during the paroxysms of ventricular tachycardia, but no symptoms that might have been attributed to the change in cardiac rhythm were noted by him.

Several long strips both of the sinus rhythm and the ventricular tachycardia were taken. The interpretation arrived at and illustrated by the portions of the electrocardiograms shown are based on careful analysis of these longer strips. The paroxysms were, in general, characterized by the following features:

1. Abrupt Change in the Electrical Axis of QRS. It is well known that the shift of the electrical axis as illustrated in figure 1 may be altered, among other things, by aberrant ventricular conduction initiated either by supraventricular conduction defect, intraventricular block or by an idioventricular pacemaker. In figure 1 the electrical axis of QRS during the sinus rhythm is −65 degrees, while during the paroxysms it is +115 degrees.

2. V-A Block. As the paroxysms of tachycardia were being recorded instances were noted in which 1:1 retrograde conduction occasionally occurred (fig. 2). This was the exception rather than the rule, the more frequent occurrence being retrograde conduction with second degree V-A block and progressive prolongation of the R-P interval, i.e. the Wenckebach phenomenon (figs. 3 and 4). In figure 3 it can readily be seen that no constant relation between the ventricular beats and the retrograde P wave exists owing to the V-A block that is present. The R-P interval becomes progressively longer (from 0.19 second to 0.30 second)
and finally an auricular beat is missing, giving rise to 8:7 retrograde conduction. In figure 4 essentially the same mechanism is depicted except that here the retrograde conduction varies from 6:5 to 5:4.

3. Reciprocal Beats and Fusion Beats. During the paroxysms of tachycardia three types of ventricular complexes are seen; the first being of idioventricular origin characterized by a prolonged QRS complex occurring at a regular rate of 143 per minute; the second, occurring prematurely, showing complexes of normal QRS duration and identical in contour with the sinus beats at the time of sinus rhythm (fig. 5); the third having a contour and QRS duration intermediate between the first and second types

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**Fig. 1.** Representative tracings of Leads I and III during sinus rhythm and paroxysmal ventricular tachycardia showing the marked change in electrical axis of QRS from $-65$ degrees to $+115$ degrees.

**Fig. 2.** Paroxysmal ventricular tachycardia (Lead II) with 1:1 retrograde conduction. Rate 143.

**Fig. 3.** Paroxysmal ventricular tachycardia (Lead II) showing partial retrograde heart block (8:7 conduction) and exhibiting the Wenckebach phenomenon. Examples are shown of a reciprocal beat, fusion beat, and the changing size of the P waves. The mechanism is illustrated in the diagram below the electrocardiogram. The values for the R-R intervals are written horizontally; the values for the R-P intervals diagonally. Retrograde impulses are indicated by broken lines; re-entrant impulses by solid lines. RB and FB indicate the reciprocal beat and fusion beat respectively. S-A indicates the impulse spread between the sinus node and auricles. A-V indicates the impulse spread between the auricle (A) and the ventricle (V). Discussed in text.
and occurring at the time when an idioventricular beat is expected. The ‘premature’ beats occurred 0.03 second earlier than the expected idioventricular beats and occurred throughout the records only after the longest R-P intervals; for that reason they were interpreted as reciprocal beats due to re-entry of the delayed retrograde impulse. The following idioventricular beat was characterized by a shortened retrograde conduction time, measuring 0.18 to 0.20 second. The possibility that the ‘premature’ beats were merely nodal premature systoles was considered. This possibility was discounted when it was realized that they occurred only when a reciprocal beat was expected. These beats with a QRS complex intermediate between that of the idioventricular beats and that of the reciprocal beats are best accounted for by assuming fusion of the idioventricular impulse occurring at the expected time with a reciprocal impulse expected because of the long R-P interval preceding that beat. These fusion beats are identical in origin and site of fusion with those described as unusual instances of fusion of two impulses of identical origin in a case of Malinow and Langendorf.4

4. Double Re-Entry. Of particular interest were some instances (fig. 4) where a fusion beat was followed by a reciprocal beat indicating that re-entry to the ventricles occurred twice in succession, i.e. the re-entrant impulse performed a second re-entry; since there is a retrograde P wave between the fusion beat and the reciprocal beat we have clear evidence for the second re-entry in the A-V junction. It would be impossible to explain the retrograde P wave by retrograde conduction of the idioventricular impulse which fuses with the first reciprocal impulse in the ventricles and is prevented from reaching the A-V junction. Such multiple re-entry, true reciprocal rhythm and not merely isolated reciprocal beats, is most unusual in the human heart.6, 7

5. Varying Size of the Retrograde P Wave. In all the tracings of the tachycardia in which the Wenckebach phenomenon was present, the retrograde P wave became progressively larger. This is adequately seen in figures 3 and 4 where the depth of the retrograde P wave increases as the R-P interval lengthens, so that the P wave inscribed before the dropped auricular beat appears as the largest. No adequate
explanation can be offered at the present time for this rarity. It was at first considered by us that the variation in size was due to the superimposition of the P wave on the T wave. This does not seem probable for the T waves of those beats (reciprocal, fusion and idioventricular) which showed no retrograde conduction were practically isoelectric. Therefore, they could not account for the change in the P-wave size. The most probable explanation for this phenomenon is that it is an unusual occurrence of aberrant retrograde conduction, manifested by progressively more bizarre and prolonged P waves, and is associated with the Wenckebach phenomenon.

CONCLUSIONS

A case of paroxysmal ventricular tachycardia occurring in an elderly white man with severe arteriosclerotic heart disease is described. The tachycardia was considered to be noteworthy because of the following characteristics:

1. Second degree V-A block with the Wenckebach phenomenon.

2. The occurrence of both reciprocal beats and fusion beats during the tachycardia. The latter were unusual in that the origin of the fusing impulses and the site of their fusion was within the ventricles.

3. Evidence of re-entry occurring twice in succession; constituting a miniature circus movement.

4. A progressively increasing depth of the retrograde P waves which has, as far as can be ascertained, never been previously reported. At present no adequate explanation for this rare occurrence can be offered except that it may be due to aberrant retrograde conduction associated with the lengthening R-P interval (Wenckebach phenomenon).

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