Wolff-Parkinson-White Syndrome with Gradual Transition from Type A to Type B

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SUMMARY

This report documents a case which showed type A, type B and intermediate patterns of pre-excitation on different days. A vagotonic maneuver and digitalis induced a type A pattern, while exercise, atropine and isoproterenol caused a type B pattern of activity. A gradual transition from type A to B was demonstrated with vectorcardiograms. Despite the variations in the QRS morphology, the direction of the initial vector was not altered and was directed straight anteriorly. In this case, an accessory pathway may be located in the posterior paraseptal region or the lateral free wall of the left ventricle, and a variable size of pre-excited area may have caused type A and type B patterns of pre-excitation.

Additional Indexing Words:
The sites of pre-excitation Fusion beats Initial vector
Vagotonic maneuver Exercise Digitalis Atropine Isoproterenol

The most widely accepted classification of Wolff-Parkinson-White (WPW) syndrome is the Rosenbaum type A and type B, based upon whether the maximum QRS forces in right precordial leads are predominantly anterior or posterior. In this classification, the sites of pre-excitation are thought to be mainly on the left side in type A and the right side in type B. By contrast, the direction of the delta vector has been reported to provide more useful information for the localization of pre-excitation.

In WPW syndrome, the delta wave reflects an initially depolarized myocardium due to conduction of excitation over an accessory pathway and the remainder of the QRS complex results from the fusion of the excitation over both normal atrioventricular and accessory pathways. Depending upon the
size of the pre-excited area, a considerable variation in the QRS complex is frequently observed in a single person. However, a change from type A to type B in the same person has rarely been reported. A case reported here displayed QRS complexes which showed a gradual transition from type A to type B, without a change in the direction of the delta vector.

**Case Report**

A 49-year-old woman was admitted to the hospital because of palpitation and chest discomfort characterized by a sudden onset. The first episode occurred at age 45 and she had a few episodes per year. The symptoms persisted for 10 to 20 min and subsided spontaneously. Since the age of 48, the episodes increased both in frequency and duration and medication was required. The physical examination was within normal limits except for a rapid heart rate. Laboratory examination was negative and roentgenograms of the chest revealed a normal heart and lungs.

The electrocardiogram on admission showed paroxysmal supraventricular tachycardia with normal QRS complexes. Ocular pressure converted the tachycardia into normal sinus rhythm. On reversal to normal sinus rhythm, the electrocardiogram showed a type A pattern of pre-excitation with positive QRS complexes and delta waves in lead V1 (Fig. 1-A). By contrast, the electrocardiogram recorded 14 months previously showed a type B pat-
tern of pre-excitation with small positive and deep negative deflections in lead V1 (Fig. 1-B). Digitoxin always prevented the occurrence of the attacks. Several months later, the electrocardiograms showed a number of the intermediate patterns between type A and type B of pre-excitation (Fig. 1-AB).

The effects of exercise on QRS morphology are shown in Fig. 2. On the day when an intermediate pattern of pre-excitation was observed, a Master's

![Exercise](https://via.placeholder.com/150)

Fig. 2. Partial normalization of the QRS complexes during exercise. After the exercise, the QRS complexes changed from type B to type A pre-excitation configuration, associated with a shortening of the PQ interval and an increase in the QRS duration.

![Vectorcardiograms](https://via.placeholder.com/150)

Fig. 3. Vectorcardiograms demonstrate the gradual transition from type A to type B patterns of pre-excitation. AB: before intervention, CDE: atropine sulfate (1 mg s.c.), FG: isoproterenol (1 μg/min i.v.), H: procainamide (200 mg i.v.).
two-step test was performed. Immediately after the exercise, the QRS complex showed a type B pattern of pre-excitation, and then gradually changed from a type B to a type A pattern. This change was associated with a shortening of the PQ interval and an increase in QRS duration. However, the polarity of the delta waves was positive in the right precordial leads throughout the process.

In order to demonstrate more clearly the changes in the morphology and the fixed initial forces of the QRS complexes, vectorcardiograms were recorded using several drugs (Fig. 3). Before the interventions, the QRS loop was initially inscribed straight anteriorly and slightly to the left, associated with conduction delay, and then written entirely anteriorly and to the left (Fig. 3-AB). The anterior orientation of the QRS loop is responsible for the upward deflections in the right precordial leads of the electrocardiogram and typical patterns of type A pre-excitation. Atropine gradually shifted the orientation of the QRS loop inferiorly and to the left (Fig. 3-CDE). The changes were enhanced by isoproterenol (Fig. 3-FG). In Fig. 3-G, the QRS loop is located entirely posteriorly, inferiorly and to the left, and it is responsible for the small positive and deep negative deflections in the right precordial leads and the patterns of type B pre-excitation. Regardless of variations in the orientation of the QRS loop, the initial vector (up to 20 msec after onset) in the horizontal plane was directed straight anteriorly by approximately +80 degrees (Fig. 4). Procainamide completely normalized the QRS loop and the conversion developed suddenly (Fig. 3-H).

Fig. 4. The direction and magnitude of the initial forces of the QRS complexes up to 20 msec. The letters A through H are identical to Fig. 3.
DISCUSSION

Surgical division of an accessory pathway\(^{9,10}\) requires precise knowledge of the sites of pre-excitation. His bundle recordings\(^{11}\) and epicardial mapping\(^{4}\) are available for this purpose. However, conventional electrocardiograms and vectorcardiograms are also useful in clinical practice to identify the approximate localizations of pre-excitation because they are non-invasive methods. Although Rosenbaum's classification into type A and type B has been useful, epicardial mapping studies have revealed its shortcomings and the classification has been modified by numerous workers.\(^{2,12,13}\)

According to Rosenbaum's classification, conversion from type A to type B in the same person would suggest two different sites of pre-excitation. However, an epicardial mapping study demonstrated that the pre-excitation of the left posterior paraseptal region causes both type A and type B patterns.\(^{4}\) In an experiment involving ventricular fusion beat,\(^{14}\) electrical stimulation of the posterior paraseptal region and the lateral free wall of the left ventricle caused both type A and type B patterns of pre-excitation, according to the coupling interval between the atrial and ventricular stimulation. When the coupling interval is shortened and the pre-excited area is increased, QRS complexes show type A patterns of pre-excitation. By contrast, when the coupling interval is increased, QRS complexes show type B patterns of pre-excitation. The same finding was reported in a clinical case during programmed electrical stimulation of the left ventricle.\(^{8}\) During basic atrial pacing, the introduction of increasingly premature test stimuli caused a type A pattern of pre-excitation in a patient with a type B pattern of pre-excitation. The common findings in these studies are that 1) type A patterns of pre-excitation were accompanied by a longer QRS duration, whereas type B patterns displayed a shorter QRS duration and 2) the initial forces of the delta vector did not change, despite the marked variations in QRS morphology. In this respect, the direction of the delta vector has been emphasized to be more useful for the recognition of the sites of pre-excitation.

In this case, a vagotonic maneuver and digitalis caused greater degrees of pre-excitation. These manipulations probably either slow atrioventricular nodal conduction or shorten the refractoriness in the accessory pathway. This results in the appearance of type A pre-excitation. On the other hand, exercise, atropine and isoproterenol decreased the degree of pre-excitation by facilitation of atrioventricular nodal conduction, resulting in the appearance of type B pre-excitation. Furthermore, the initial force of the QRS loop (up to 20 msec) was not altered and directed straight anteriorly, despite
variations in the QRS morphology. These findings suggest that an accessory pathway may be located in the posterior paraseptal region or the lateral free wall of the left ventricle, and a variable size of the pre-excited area may have caused a type A or a type B pattern of pre-excitation.

REFERENCES