



Review Article

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Changing P Wave Morphology- A Focus on Multifocal Atrial Tachycardia

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Abstract

Multifocal atrial tachycardia is an uncommon atrial tachyarrhythmia. It usually occurs in the elderly and critically ill patients, frequently associated with underlying chronic obstructive pulmonary disease. It is uncommon for loss of atrioventricular conduction of each P wave and as a result, multifocal atrial tachycardia should be distinguished from atrial fibrillation. Multifocal atrial tachycardia, wandering atrial pacemaker, atrial fibrillation, and atrial flutter with variable conduction are the irregularly irregular rhythms commonly encountered on an electrocardiogram. It is important to recognize the difference between these as the management differs significantly. Treatment for multifocal atrial tachycardia is directed at the inciting disturbance. Maintaining electrolyte balance especially plasma potassium and magnesium levels may prevent the occurrence of multifocal atrial tachycardia.

Keywords: Multifocal atrial tachycardia, Wandering atrial pacemaker, Atrial arrhythmia, P wave morphology.

INTRODUCTION

Multifocal atrial tachycardia (MAT) is characterized by irregular and chaotic atrial activity at atrial rates between 100 to 180 beats per minute (bpm).[1,2] MAT is a supraventricular tachyarrhythmia that usually occurs in elderly individuals with underlying pulmonary disease exacerbations.[1] Usually, all the P waves in a normal electrocardiogram (ECG) have identical morphology suggestive of a constant fashion of atrial activation. When the electrical impulses originate from different foci, other than the sinoatrial node, the manner of atrial activation becomes variable from beat-to-beat producing P waves of different configurations. [1,3,4]

The exact mechanism of MAT is unclear. The mechanism of MAT appears to be related to the abnormal automaticity from different atrial sites.[1,2] The ECG in MAT shows a rapid atrial rate with multiple P wave morphologies.[5] The electrical impulses originate from different atrial foci leading to chaotic atrial activation producing atrial tachycardia. Hence, the morphology of the P wave changes from beat-to-beat. Three different types of P wave configurations may be observed on an ECG.[1,2,5] Ectopic P waves originate from the atria, are upright but they differ in morphology from the sinus P waves. The retrograde P waves are junctional in origin and are inverted. The P waves with a configuration that is intermediate between an ectopic P wave and a sinus P wave are the fusion waves.[1,3,5-7].

Etiology

Some of the inciting factors for MAT are listed in the table 1. [Ref: 1-4,8,12,15,16]

Precipitating factors for multifocal atrial tachycardia:
Pulmonary disease exacerbations such as chronic obstructive pulmonary disease
Respiratory tract infection such as pneumonia
Pulmonary embolism
Catecholamine surge such as that seen in sepsis
Metabolic disturbances such as hypokalemia, hypomagnesemia, hypoxemia, hypercapnia
Cor pulmonale, congestive heart failure
Theophylline toxicity, Digitalis toxicity
Coronary artery disease, acute myocardial infarction
Alcohol intoxication

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Clinical findings

MAT may be asymptomatic. Patients will have a rapid and irregular pulse. MAT itself is usually asymptomatic and patients present with symptoms of the underlying disease. [1,3,8]

Characteristic ECG findings in MAT include the following:

- a. Varying P-P intervals, varying P-R intervals, or irregular R-R intervals.
- b. Varying P wave morphology from beat-to-beat with at least three different morphological forms of the P wave in addition to those from the sinus node.
- c. The atrial rate is greater than 100 bpm.
- d. A P wave precedes every QRS complex.
- e. The P waves are separated by isoelectric intervals. [1,5, 7-10]

Some Critical ECG distinctions:

Frequent atrial premature complexes (APCs) originating from numerous atrial foci constitute MAT. APCs are also known as atrial premature contractions or atrial extrasystoles. [1,5,7,9]

Features of APC on an ECG are as follows:

1. An upright P wave that occurs prematurely, earlier than the expected sinus P wave.
2. The P wave morphology is abnormal due to being ectopic.
3. The morphology of the QRS complex following the ectopic P wave is normal.
4. A compensatory pause following the APC occurs due to momentary inhibition of the sinoatrial node automaticity. [1,3,5,7-10]

In MAT, it may be not possible to identify the dominant sinus P wave and the ventricular rhythm is irregular due to varying premature atrial impulses and blocked atrial beats. It must be noted that it is possible to identify the dominant sinus P wave in multiple APCs occurring frequently during the sinus rhythm. [5,7-9] This is important to identify to differentiate MAT from multiple APCs occurring during the sinus rhythm.[7-10]

It is interesting to note that wandering atrial pacemaker (WAP) rhythm and MAT differ only with the heart rate wherein WAP has an atrial rate less than 100 bpm and MAT has an atrial rate greater than 100 bpm.[10,11] In the WAP rhythm, as the name suggests, pacemaker wanders with the impulses originating from sinoatrial node to atrium, and to the atrioventricular junction with a changing focus. Hence, the P waves on an ECG are that of differing configurations.[10-13]

WAP is differentiated from sinus arrhythmia with the fact that heart rate variability is from beat-to-beat and not phasic. Also, in sinus arrhythmia, the P wave morphology and the P-R interval are constant. WAP is a benign ECG abnormality often observed in asymptomatic individuals. No active treatment is required for an incidental finding of WAP in asymptomatic patients.[11-14]

As the ventricular rate is irregular in MAT, it resembles atrial fibrillation. However, clear definite P waves can be identified in MAT while the P waves are absent or replaced by only fibrillatory waves in atrial fibrillation.[9,10,15,16]

Treatment

Treatment of MAT is directed towards correcting the inciting disturbance such as treating the chronic obstructive pulmonary disease exacerbation, improving oxygenation, and correcting electrolyte

disturbances.[1,6,8,16] Per the 2015 ACC/AHA/HRS guidelines for the management of adult patients with supraventricular tachycardia, intravenous Verapamil or Metoprolol may be used for acute treatment of MAT as a class IIa recommendation.[17]

If the MAT is persistent, then atrioventricular nodal blockade with Verapamil may be considered.[18,19] Usually Verapamil is given as 5 mg intravenous at a rate of 1 mg per minute and may repeat after 20 minutes if needed. Calcium gluconate 1 g intravenous administered five minutes prior to administration of verapamil may help lower drug-induced hypotension without affecting Verapamil's antiarrhythmic effect.[1,6,18-20]

In the absence of chronic obstructive pulmonary disease, primary pulmonary disorder, bronchospasm, or congestive heart failure; metoprolol or esmolol may be used.[3,8,16,18,20] Amiodarone may be used for refractory MAT. Cardiac glycosides such as Digoxin or atrioventricular nodal blocker such as a beta blocker or non-dihydropyridine calcium channel blocker for rate control may be useful in situations where MAT persists despite treatment of the underlying illness or rarely for hemodynamic instability secondary to MAT. However, this rarely leads to resolution of MAT. [6,18-21]

CONCLUSION

MAT usually occurs in elderly patients with underlying pulmonary disease and the characteristic ECG findings include irregular R-R interval with three or more different P wave morphologies, and an atrial rate greater than 100 bpm. The treatment is aimed at correcting the inciting disturbance. It is important to note that MAT, though an uncommon arrhythmia, when encountered during a critical illness, needs therapy directed towards correcting the underlying illness with a little role of antiarrhythmic agents. MAT not just mimic atrial fibrillation but may degenerate to atrial fibrillation. It carries a high mortality rate. Treating the precipitating factors, improving the pulmonary status, withdrawing the offending agents, correcting electrolyte imbalances, and oxygen supplementation are the mainstay of management.

Conflict of interest

The authors declare no conflict of interest.

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