

## CASE REPORT

# Multifocal Atrial Tachycardia in 2 Children

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The incidence of multifocal atrial tachycardia (MAT) is very low and accounts for less than 1% of supraventricular tachycardia in infants and children. In this report, the clinical characteristics, medical treatment and outcome of MAT in 2 children are described. The first patient presented with tachycardia and respiratory failure since the day after birth. First, he received amiodarone, propranolol, and digoxin and then amiodarone alone. The heart rhythm converted to sinus rhythm 2 weeks after hospitalization. Although nonsustained MAT was occasionally observed when the infant suffered from pulmonary infection, the frequency of recurrent MAT decreased as the infant grew up. The second patient was a 5-year-old girl. She had congenital heart disease with double outlets of right ventricle (DORV), patent ductus arteriosus, coarctation of aorta, and ventricular and atrial septal defects. She underwent total correction at the age of 4 years. MAT was noted 3 months after the operation with the presentation of congestive heart failure. The heart rate slowed down and returned to normal sinus rhythm within several hours after amiodarone use. The symptoms and signs of congestive heart failure also disappeared. The patient took amiodarone regularly, and no tachycardia was detected during the follow-up period. MAT is considered to be a relatively benign arrhythmia with likely good outcome if there is no severe underlying illness. It can be well controlled under appropriate drugs, and a long period of follow-up is suggested. If pharmacologic intervention is required, we suggest that amiodarone may be an excellent choice. [*J Chin Med Assoc* 2006;69(9):439–443]

**Key Words:** children, multifocal atrial tachycardia

## Introduction

Multifocal atrial tachycardia (MAT) occurs more commonly in adults, especially the elderly associated with chronic obstructive pulmonary disease. In infants and children, the incidence of MAT is very low, accounting for less than 1% of supraventricular tachycardia. MAT is characterized by electrocardiographic findings including: (1) multiple (at least 3) distinct P-wave morphologies; (2) irregular P–P intervals; (3) isoelectric baseline between P-waves; and (4) occasionally rapid ventricular rate.<sup>1</sup> More than 50% of children are asymptomatic or mildly ill at diagnosis. It is a relatively benign disease, and long-term health depends mostly on the underlying conditions. In this report, the clinical characteristics and outcome of MAT in 2 cases are described. After appropriate medical treatment, their heart rates

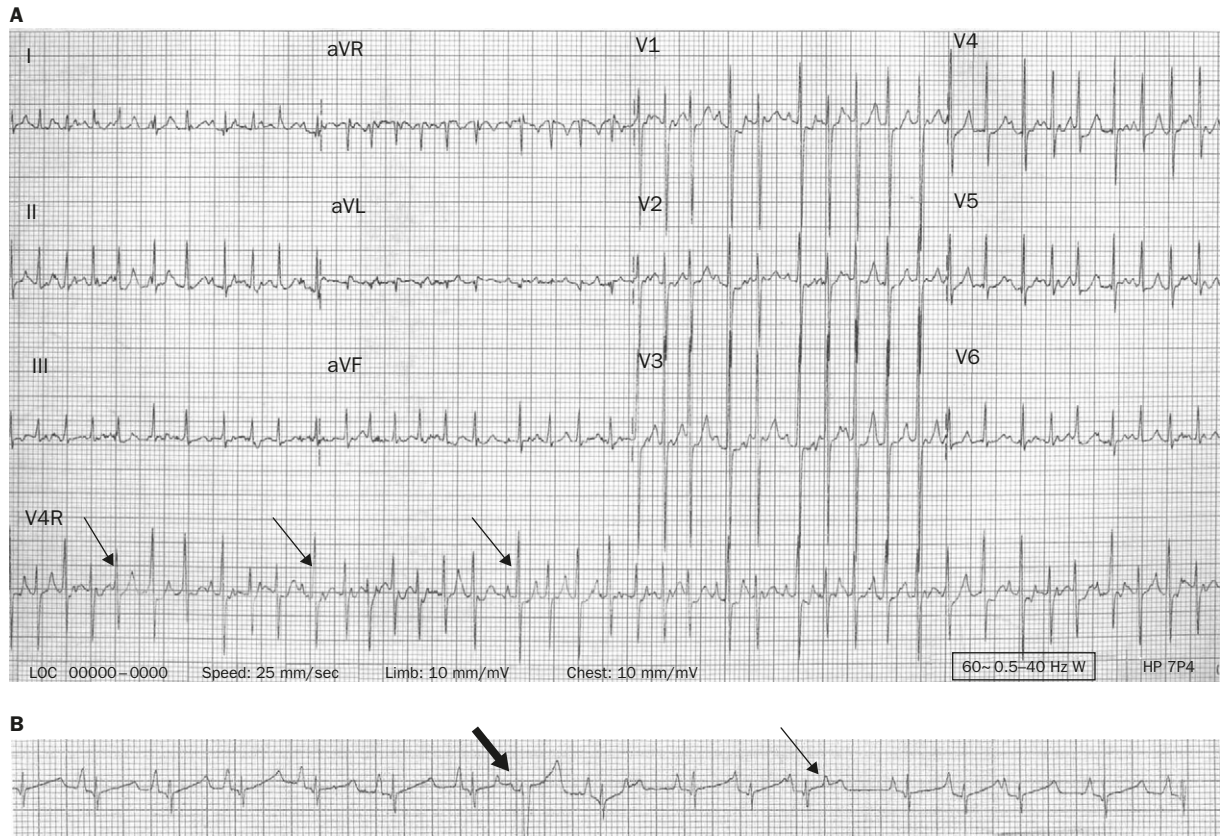
decreased and symptoms improved. However, complete resolution of MAT may take time and is related to the underlying illness, such as pulmonary infection and congenital heart disease after undergoing open heart surgery.

## Case Reports

### Case 1

A 1-year-old boy was found to have MAT since the first day after birth. This full-term infant with normal prenatal examinations had no remarkable birth history. Rapid heart rate higher than 200 beats/minute and respiratory distress were noted the day after birth, and he continued to suffer from repeated episodes of pneumonia and lung collapse during hospitalization.

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**Figure 1.** (A) Lead V4R electrocardiogram (ECG) on admission showed the characteristics of multifocal atrial tachycardia, including 3 different P-wave morphologies (arrows), irregular rapid atrial rhythm (different P-P intervals), and variable ventricular conduction (different P-R intervals). (B) Two weeks after admission, lead II ECG showed normal sinus rhythm. However, premature atrial contraction with aberrant conduction (thick arrow) and blocked AV conduction (thin arrow) were also occasionally observed.

Under the impression of supraventricular tachycardia, oral amiodarone 10 mg/kg/day in 2 divided doses, digoxin 0.005 mg/kg/day in 4 divided doses, and propranolol 2 mg/kg/day in 4 divided doses were prescribed. He was then referred to our institution with the hopes of removing the endotracheal tube and stopping mechanical ventilation.

Bronchoscopy was performed initially to exclude airway anomalies, and the results showed bilateral vocal cord palsy and laryngomalacia. The endotracheal tube was removed successfully during hospitalization. Echocardiography demonstrated no structural heart disease. The electrocardiogram (ECG) showed typical characteristics of MAT, with irregular heart beats, usually 200–250 beats/minute (Figure 1A). Propranolol and digoxin were discontinued immediately after diagnosis. The frequency of MAT gradually decreased, and sinus rhythm was finally achieved after 2 weeks of hospitalization (Figure 1B).

Because no sustained tachycardia was observed after discharge, amiodarone was discontinued 6 months later. However, nonsustained MAT could still be

observed occasionally when the infant suffered from pulmonary infection. Over a period of 16 months of follow-up, no further tachycardia event has been observed in the recent 6 months.

### Case 2

A 5-year-old girl with an uneventful birth history began to have the symptom of shortness of breath at the age of 1 month. She was diagnosed to have double outlets of right ventricle (DORV), coarctation of aorta (CoA), patent ductus arteriosus (PDA), atrial septal defect (ASD), and ventricular septal defect (VSD) at our hospital. She underwent a first surgical operation (repair of CoA, PDA ligation, and pulmonary artery banding) 2 weeks after admission, and the second operation for total correction of DORV was performed 4 years later. Chylothorax occurred after the second operation, but resolved after conservative treatment. Postoperative echocardiography showed minimal residual VSD about 0.3 cm in diameter. The patient was discharged 2 months after the operation in a stable condition.





**Figure 2.** (A) Electrocardiogram (ECG) on admission showed 3 different types of P waves (arrows). Irregular rapid atrial rhythm, variable rapid ventricular conduction, and wide QRS complex due to right bundle branch block (RBBB) were also noted. (B) After amiodarone use, normal sinus rhythm with RBBB was demonstrated.

No arrhythmia was observed before total correction. Preoperative ECG showed normal sinus rhythm (NSR), incomplete right bundle branch block, right axis deviation, and right ventricular hypertrophy. One month after the operation, ECG disclosed NSR, complete right bundle branch block (CRBBB), and left axis deviation. However, shortness of breath occurred suddenly 3 months after discharge. Irregular rapid heart beat, cardiomegaly with pleural effusion, and hepatomegaly were noted on admission. ECG showed MAT with irregular heart beats up to 150–200 beats/minute (Figure 2A). Amiodarone 5 mg/kg was given intravenously over 1 hour, and then her heart rhythm converted to sinus rhythm (100–110 beats/minute) (Figure 2B). Maintenance dose of oral amiodarone 10 mg/kg/day in 2 divided doses started afterward. ECG showed NSR and CRBBB during the follow-up period of 4 months. She continued to take amiodarone 6 mg/kg everyday, and has been without tachycardia since.

## Discussion

With only about 100 cases having been reported over the past 3 decades, MAT is a relatively rare arrhythmia in children. Although its actual incidence is difficult to assess, the incidence in neonates was found to be 0.02% after screening the standard ECGs among 3,383 apparently healthy newborn infants.<sup>2</sup> MAT usually occurs in chronically ill elderly with obstructive pulmonary disease, atherosclerotic heart disease, or diabetes mellitus.<sup>3-5</sup>

The majority of children with MAT are healthy infants under 1 year of age; a few may have mild to life-threatening cardiorespiratory disease. About 40% of patients have structural heart diseases (SHD), another 40% have no other conditions beside MAT, and the rest have a variety of other conditions.<sup>6-14</sup> These anatomic anomalies include secundum-type ASD, hypertrophic cardiomyopathy, PDA, tetralogy

of Fallot, endocardial thickening, with the most severe case including atrioventricular septal defect, pulmonary atresia, total anomalous pulmonary venous return, single ventricle, s/p central shunt, and pulmonary artery augmentation.<sup>6</sup>

The association of MAT attack with respiratory illness has been demonstrated in previous publications.<sup>15-17</sup> In our first patient (Case 1), MAT usually recurred with pulmonary infections, and the frequency gradually decreased after improvement of pulmonary infection. He was free of MAT when followed up at clinics. Moreover, this patient had airway anomalies (bilateral vocal cord palsy and laryngomalacia) that may cause frequent pulmonary infections. The review conducted by Wu et al<sup>15</sup> found that a surprisingly high percentage of patients with MAT (17 out of 22 infants) have respiratory illness. Rhinovirus and respiratory syncytial virus are supposed to be the pathogens.<sup>16,17</sup> Bradley et al<sup>6</sup> have suggested that pulmonary disease influences the electrophysiologic properties of the heart, resulting in abnormal automaticity and further MAT. With more understanding about their causal relationships, the mechanism of MAT could be further elucidated.

Bisset et al<sup>8</sup> reported 3 cases of MAT after surgery, although a small portion among MAT patients, which all involved incision of the right atrium. The periods from surgery to MAT onset were 16 days, 13 days, and 6 months, respectively. All 3 patients received digoxin before surgery and were free of arrhythmia finally. In this report, Case 2 had MAT 3 months after the operation. Initially, she was symptomatic at diagnosis, but quickly converted to sinus rhythm after amiodarone use. It is proposed that MAT may not be so difficult to control if it occurs after cardiac surgery.

More than 90% of pediatric cases present in infancy and some are even diagnosed *in utero* by fetal monitor. Most infants are asymptomatic at diagnosis, even if some have rapid heart rates. Symptomatic patients usually present with symptoms of congestive heart failure such as respiratory distress. Prompt and correct diagnosis is sometimes difficult to make because: (1) it should be the last differential diagnosis of supraventricular tachycardia for its rare occurrence; (2) MAT is very similar to atrial fibrillation due to irregular P-P and R-R intervals; and (3) aberrant ventricular conduction during MAT may resemble nonsustained ventricular tachycardia at high atrial rates. Therefore, Case 1 was transferred to our hospital barely under the impression of supraventricular tachycardia.

In the pediatric population, the mortality rate of MAT was 11% among 105 patients in a previous report.<sup>6</sup> A high prevalence of SHD among the expired

cases was noted, involving different congenital heart diseases.<sup>6,8,10,12,13</sup> Therefore, the severity of anatomic anomalies may not be considered to be the main cause of death. Although no MAT could be detected on ECG records, Yeager et al<sup>10</sup> postulated a possible link between dysarrhythmia and their sudden deaths. It has also been reported that prolonged and refractory MAT contributed to complications and final death.<sup>12,13</sup> Therefore, MAT *per se* may not be so malignant, but an investigation is still obligatory.

The management of MAT remains a big challenge at present. Considering the ineffectiveness of cardioversion in adults and previous experience in children, cardioversion is not recommended.<sup>4,6</sup> The indication of therapy for MAT is symptomatic children with rapid ventricular rate and cardiac decompensation. The reasons include: (1) the unpredictable response to antiarrhythmic drugs; (2) the good tolerability in most children with MAT; and (3) probable self-limiting course of MAT. Both the cases in our report were symptomatic at diagnosis and needed further medical treatment.

A variety of medications have been evaluated and their responses are variable. Digoxin was the first drug to be used.<sup>7</sup> Although ventricular rate could be expected to slow down, conversion to sinus rhythm was not often effective. Digitalis intoxication to death has been reported,<sup>10</sup> so some authors are reluctant to suggest digoxin as a therapeutic agent. Other medications including sotalol, encainide, flecainide, and propafenone have also been tried previously.<sup>14,18-21</sup> However, small sample size and frequent combination with other antiarrhythmic drugs limited the documentation of their effectiveness. Although some cases received propranolol for MAT in combination with other drugs, it was not effective in abolishing atrial arrhythmia induced by sympathetic stimulation in dogs and may be hazardous in infants who experience bradycardia.<sup>10,22</sup> Amiodarone, a newer class III antiarrhythmic drug, has been used alone to treat MAT successfully.<sup>11</sup> However, it was used together with other drugs in most reports.<sup>12-14</sup> Some reports have recommended that amiodarone with or without class I antiarrhythmic drug could be reserved for symptomatic patients with persistent MAT.<sup>6,13</sup>

In this report, Case 1 had MAT even under the combination of 3 drugs. The discontinuance of propranolol and digoxin did not influence the frequency of MAT, which finally disappeared after 2 weeks of hospitalization. Although the effect of amiodarone could not be proved during the first hospitalization in this case, conversion to sinus rhythm after amiodarone use could also be observed during the several

subsequent hospitalizations for pulmonary infection. In Case 2, return to NSR within a couple of hours was achieved and maintained after amiodarone was given. Our experience showed that amiodarone was superior to other drugs for management of MAT. However, time, possibly as long as several months, is needed to reach complete resolution.

In conclusion, MAT is considered to be a relatively benign arrhythmia with likely good outcome if there is no severe underlying illness. It can be well controlled with appropriate drugs, and long-term follow-up is suggested. If pharmacologic intervention is required, we suggest that amiodarone may be an excellent choice.

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