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Case Reports

Multifocal Atrial Tachycardia in a 9-Month-Old Infant: A Case Report with Therapeutic Insights

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Abstract

Background: Supraventricular tachycardia is the most common arrhythmia in infants, with an estimated prevalence between 1/250 and 1/1000. Multifocal Atrial tTachycardia (MAT), a rare subtype accounting for less than 1% of supraventricular tachycardia in infants and children, is characterized by multiple atrial foci, variable P-wave morphologies, and irregular ventricular response. When incessant, MAT may lead to tachycardia-induced cardiomyopathy and congestive heart failure. This report describes a 9-month-old infant with MAT and left ventricular dysfunction, emphasizing diagnostic challenges and therapeutic strategies.

Case Illustration: A previously healthy 9-month-old female infant presented for urgent evaluation due to progressive dyspnea and tiredness during breastfeeding, which had begun approximately two months earlier and worsened in the last two weeks. Her mother noted perioral cyanosis during crying and feeding. On examination, she was tachypneic (60 breaths/min), tachycardic (180 bpm), and mildly dehydrated. Transthoracic echocardiography revealed a dilated left ventricle with moderate systolic dysfunction (ejection fraction 35%). A 12-lead electrocardiogram demonstrated multifocal atrial tachycardia with at least three distinct P-wave morphologies and irregular R-R intervals, and Holter monitoring confirmed an incessant pattern (>30% of the day). Three synchronized direct current cardioversion attempts (0.5, 1.0, and 1.23 J/kg) failed to restore sinus rhythm. Intravenous amiodarone was initiated (loading dose 5 mg/kg over 1 hour, followed by 10 mcg/kg/min), later transitioned to oral therapy (5 mg/kg/day). Within 48 hours, sinus rhythm was restored, heart failure symptoms resolved, and follow-up echocardiography showed improved ejection fraction (55%). Propranolol (1 mg/kg/day) and digoxin (5 mcg/kg/day) were added for rate control. The patient was discharged asymptomatic after one week, with no relapse at 6-month follow-up.

Conclusions: MAT is a rare cause of supraventricular tachycardia in infants and may present with congestive heart failure due to tachycardia-induced cardiomyopathy. Incessant forms are typically defined by an arrhythmia burden greater than 30% of the day on Holter monitoring. Failure of direct current cardioversion is a hallmark of MAT, reinforcing the role of pharmacologic management. Early recognition and rate and rhythm control with agents such as amiodarone, propranolol, and digoxin can lead to rapid recovery of left ventricular function and an excellent prognosis in infants without structural heart disease.

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Keywords: Multifocal atrial tachycardia, infant, supraventricular tachycardia, rate control.

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Introduction

Supraventricular Tachycardia (SVT) is the most common arrhythmia encountered in infants, with an estimated prevalence between 1/250 and 1/1000.[1] Multifocal Atrial Tachycardia (MAT), a subtype of SVT, is characterized by multiple atrial foci firing irregularly, leading to variable P-wave morphologies and irregular ventricular rates.[1] While rare in pediatrics, MAT can lead to tachycardia-induced cardiomyopathy if incessant. This report describes a case of MAT in a 9-month-old infant, highlighting diagnostic challenges and effective medical management.

Case Illustration

A 9-month-old female infant presented for urgent medical evaluation due to shortness of breath (dyspnea) and tiredness during breastfeeding, which began approximately two months prior. Over the last two weeks, the symptoms worsened. Her mother also noticed some cyanosis around the lips during simple activities, such as crying or drinking.

On physical examination, the infant was tachypneic (respiratory rate 60 breaths/min), tachycardic (heart rate 180 bpm), and showed signs of mild dehydration. Echocardiography revealed a dilated left ventricle with moderate systolic dysfunction (ejection fraction 35%). Electrocardiography (ECG) demonstrated multifocal atrial tachycardia with varying P-wave morphologies and irregular R-R intervals. Holter monitoring confirmed that MAT was incessant, occupying >30% of the day.

A series of synchronized cardioversions (three consecutive shocks at 0.5, 1.0, and 1.23 Joules/kg) failed to revert the arrhythmia. Intravenous amiodarone was initiated (loading dose 5 mg/kg over 1 hour, followed by 10 mcg/kg/min infusion). After 24 hours of intravenous amiodarone infusion, the oral formulation was initiated (maintenance 5 mg/kg/day). Within 48 hours, sinus rhythm was restored, with resolution of symptoms and improved ejection fraction (55%) on follow-up echo. Propranolol (1 mg/kg/day) and digoxin (5 mcg/kg/day) were added for rate control. The patient was discharged asymptomatic after one week, with no relapse at 6-month follow-up.

Discussion

The MAT, also known as chaotic atrial tachycardia, is defined as a tachycardia with at least three morphologically distinct P-waves.[2] It is also characterized by irregular P-P, R-R, and P-R intervals, as well as an isoelectric baseline between the P-waves.[2] This arrhythmia usually lasts for minutes to hours, with a normal sinus rhythm between episodes. Incessant arrhythmias are typically those that persist for >30% of the day on Holter monitoring.[2] Children older than 1 year rarely have documented MAT.[3] It accounts for <1% of supraventricular tachycardia in infants and children, with most series showing a clear predominance in infants.[3] Another interesting aspect of MAT refers to its coexistence with atrial fibrillation or Atrial Flutter (AFL).[4] This was observed in the present case (Figure 2B).[4]

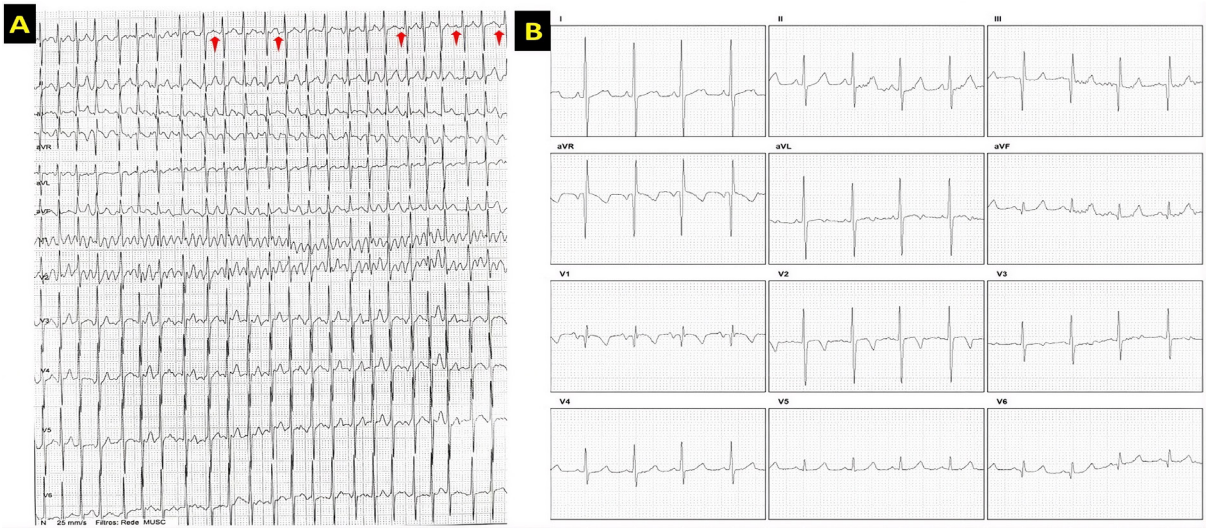

Figure 1. (A) The 12-lead electrocardiogram obtained at admission shows multifocal atrial tachycardia (MAT) with at least three distinct P-wave morphologies (A, red arrows, Lead I). (B) The 12-lead electrocardiogram obtained during follow-up showed a normal sinus rhythm.

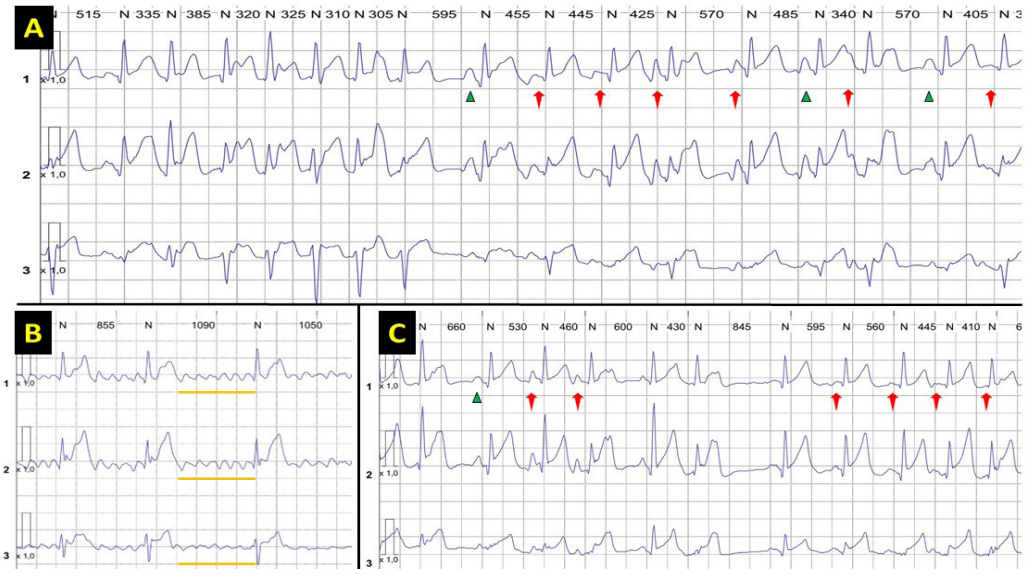

Figure 2. (A and C) The 24-hour Holter monitoring shows MAT (red arrows) with sinus beats (green arrowheads) and periods of atrial flutter (B).

In infants under 1 year of age, MAT is infrequently documented and is often associated with precipitating factors such as respiratory infections (e.g., bronchiolitis or pneumonia), electrolyte imbalances (particularly hypokalemia or hypomagnesemia), and underlying conditions such as prematurity or perinatal hypoxia.[5-6] These triggers may promote atrial irritability through autonomic nervous system dysregulation or inflammatory responses affecting atrial foci.[5-6] Studies have shown that several patients with MAT have been diagnosed in the context of a respiratory infection.[6] This also occurred in the present case. Although this association was proposed decades ago, little evidence supports a causal relationship.[2]

Atrial flutter involves a macroreentrant circuit typically around the cavotricuspid isthmus in the right atrium, resulting in rapid atrial rates (250-350 bpm) with organized, sawtooth-like flutter waves on ECG, often leading to 2:1 Atrioventricular (AV) conduction and ventricular rates of 150 bpm in infants.[13] In the context of incessant tachycardias like MAT, AFL episodes can precipitate hemodynamic instability, exacerbate congestive heart failure through sustained tachycardia-induced cardiomyopathy, and increase the risk of thromboembolic events due to atrial stasis, particularly if prolonged beyond 48 hours.[14] Subsequent events may include progression to atrial fibrillation, recurrent heart failure, or, rarely in pediatrics, the need for anticoagulation if structural heart disease coexists.[14] In this case, the transient AFL resolved with rate control therapy, underscoring the importance of early diagnosis via Holter monitoring.[4]

In adults, on the other hand, this arrhythmia is more prevalent, particularly in elderly patients with comorbidities, like chronic obstructive pulmonary disease, coronary artery disease, or diabetes mellitus.[7] The prognosis in children without structural heart disease is usually excellent.[7] In patients with left ventricular dysfunction, rate control usually provides rapid and complete resolution, without relapse.[7]

Regarding treatment, there are no randomized trials to support pharmacological treatment in MAT.[2] Direct Current (DC) cardioversion is generally ineffective in MAT due to its multifocal ectopic origin, involving multiple automatic atrial foci rather than a single reentrant circuit amenable to electrical disruption.[8-9] Literature suggests that the immature atrial myocardium in infants may further reduce the efficacy of cardioversion, as the shock fails to suppress all ectopic sites simultaneously, potentially exacerbating atrial stunning or proarrhythmic effects.[8-9] In contrast, medical therapy targeting rate control—such as beta-blockers (e.g., propranolol, which antagonizes beta-adrenergic receptors to decrease sympathetic stimulation, suppress automaticity in ectopic atrial foci, and slow atrioventricular nodal conduction) and digoxin (which enhances vagal tone via Na+/K+-ATPase inhibition, increasing intracellular calcium and prolonging AV nodal refractoriness)—addresses the underlying enhanced automaticity and AV nodal conduction, achieving sustained sinus

rhythm restoration in most pediatric cases without structural heart disease.[10-11] Amiodarone is reported to be effective and superior to other agents for achieving rhythm control in MAT, as it prolongs the action potential duration and refractory period via multiple ion channel blockade (class III effect), while also exhibiting beta-blocking and calcium channel antagonism properties.[12] DC cardioversion failure is a hallmark of this arrhythmia and should not be considered if a correct diagnosis is made.[2,4] In most series, digoxin is the most commonly used medication to slow the ventricular response.[2] Beta-blockers are also excellent options.[11]

Conclusion

MAT accounts for <1% of SVT in infants and often coexists with AFL.[4] While DC cardioversion is ineffective[8-9], rate control with agents such as digoxin, propranolol, and amiodarone yields an excellent prognosis in cases with left ventricular dysfunction, as demonstrated here.[7,10-12]. Early recognition and medical management are crucial to prevent cardiomyopathy.

List of Abbreviations

SVT	Supraventricular Tachycardia
MAT	Multifocal Atrial Tachycardia
ECG	Electrocardiography/ Electrocardiogram
AFL	Atrial Flutter
AV	Atrioventricular
DC	Direct Current
Na^+/K^+-ATPase	Sodium–Potassium Adenosine Triphosphatase

Ethical Clearance

This article was approved by the local ethics committee (Universidade Federal de Santa Maria Ethics Committee, email: cep.ufsm@ufsm.br) – number 7.135.118. Patient Consent Statement: Patient´s responsible provided full written consent.

Publication Approval

All authors are consent to the publication of this manuscript.

Authors Contributions

All authors made substantial contributions according to the ICMJE criteria. Diego Chemello contributed to the conception and design of the work, drafted the manuscript, critically revised it for important intellectual content, and approved the final version to be published. Leticia Hadlich Correa de Barros and Patricia Rodrigues Lemos Cardoso contributed to the conception and design of the work, participated in drafting the manuscript, and approved the final version to be published. Camila Sales Fagundes and Patricia Chagas participated in drafting the manuscript and approved the final version to be published.

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Conflict of Interest

None.

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