

# Incessant Ectopic Atrial Tachycardia and Tachycardia-related Cardiomyopathy: Therapeutic Options and Potential for Cure

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## Abstract

*Incessant ectopic atrial tachycardia (IEAT) is a rare cause of cardiomyopathy. Cardiomyopathy is reversible by curative ablation using surgery or radiofrequency current. We report our experience with 5 patients with IEAT. Three patients presented with palpitations and were diagnosed to have paroxysmal supraventricular tachycardia (2 patients) and atrial flutter with 1:1 conduction (1 patient), but 2 presented insidiously with congestive cardiac failure. All the initial echocardiograms showed left ventricular dysfunction. The patients underwent electrophysiological studies which confirmed the diagnosis of IEAT. The first patient had surgical cryoablation and the other patients had successful radiofrequency catheter ablation. Follow-up for 2 to 7 years has shown no recurrences. All patients had significant improvement in left ventricular function on echocardiography. In conclusion, curative ablation by surgery or radiofrequency current is safe and effective. Because of its low morbidity, radiofrequency catheter ablation should be the treatment of choice for IEAT, especially if complicated by tachycardia-related cardiomyopathy.*

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**Key words:** Myocardial dysfunction, Radiofrequency catheter ablation, Reversible

## Introduction

Incessant ectopic atrial tachycardia (IEAT) is a rare and insidious arrhythmia which is frequently misdiagnosed and if untreated, leads to 'exhaustion' of the myocardium and result in tachycardia-related cardiomyopathy.<sup>1,2</sup> Early strategies to manage this problem such as pharmacological therapy to either block the atrioventricular node or suppress the ectopic focus and ablation of the atrioventricular node to isolate the atrium electrically followed by ventricular pacing, were all met with partial success. Due to its automatic nature, DC cardioversion was uniformly unsuccessful. Furthermore the underlying arrhythmia was not cured. Radiofrequency catheter ablation is now recognised as the treatment of choice for symptomatic reentrant atrioventricular nodal and accessory pathway-mediated tachycardias.<sup>3-7</sup> Various other atrial arrhythmias that have been subjected to ablation by catheter techniques include intra-atrial reentrant tachycardia,<sup>8</sup> sino-atrial nodal reentry,<sup>9</sup> atrial flutter<sup>10</sup> and even the maze procedure for chronic atrial fibrillation.<sup>11</sup> We report our experience in managing 5 patients with IEAT who were

refractory to medical therapy and who developed tachycardia-induced cardiomyopathy, 4 of whom underwent radiofrequency catheter ablation.

## Materials and Methods

Five consecutive patients who presented to the Department of Cardiology, National Heart Centre from 1990 to 1995 were included in the analysis. The patients presented with either palpitations or congestive cardiac failure for varying periods of up to 2 years. All the patients underwent initial clinical evaluation and assessment, and had electrocardiograms showing narrow complex tachycardia with either abnormal or 'absent' (buried) P waves. Transthoracic echocardiography showed left ventricular 'dysfunction of varying degrees. The patients were then put on at least one antiarrhythmic medication. Two patients were also given concomitant antifailure drugs. The patients were then given the option of diagnostic confirmation and curative therapy once it was clear that there was failure of drug therapy and that there was significant left ventricular dysfunction.

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Informed consent was obtained and diagnostic electrophysiological study was performed with the patient in the post absorptive and mildly sedated state with intravenous midazolam and fentanyl. Quadripolar 6F electrode catheters (Mansfield, Watertown, MA) were positioned in the high right atrium, His bundle, right ventricular apex and the coronary sinus. Mapping was done with either a 'halo' catheter (Cordis-Webster) or with an octapolar ablation catheter. Electrical stimulation was delivered by a programmable stimulator (Bloom Assoc, Reading, PA) with a pulse duration of 2 ms at approximately twice the diastolic threshold and recorded on an electrophysiological recorder (Prucka Inc.). IEAT was diagnosed during electrophysiological study by standard criteria including:

- prolonged or incessant episodes of rapid atrial rhythm with variations of rate,
- abnormal P wave axis and/or morphology during tachycardia and endocardial activation sequence inconsistent with a sinus origin,
- inability to initiate or terminate the tachycardia using programmed electrical stimulation, and
- exclusion of atrioventricular nodal or accessory pathway mediated tachycardias by the usual means.<sup>12</sup>

The first patient underwent electrophysiological studies followed by intraoperative atrial mapping with a hand-held probe on a beating heart to determine the earliest site of atrial activation consistent with the site of ectopic activity. That focus was then destroyed by cryoablation. In the subsequent 4 patients, the abnormal ectopic focus was located by finding the point of earliest activation of the atrium before the surface P wave. In 3 patients, a pace map was also created by overdrive pacing at the presumed ectopic site and compared to the electrocardiogram in tachycardia to look for concordance in the P waves. When the site of pathology was localised, radiofrequency energy was applied from the tip of the ablation catheter as a continuous unmodulated sine wave output from an electrosurgical unit at 500KHz (Radionics RFG-3C, Burlington, MA) and a large indifferent skin electrode at the left scapular region, stopping if there was a rise in impedance.

## Results

There were 3 female and 2 male patients with an average age of 31.4 years (range 16 to 44) at presentation, 3 patients presented with palpitations and 2 presented with congestive cardiac failure (Table I). All the patients were symptomatic for up to 2 years before electrophysiological study. All patients had left ventricular function assessment by echocardiography which revealed varying degrees of left ventricular dysfunction (ejection fraction of 16% to 45%). All patients had incessant tachycardia on the electrocardiogram (Fig. 1) and during electrophysiological study (Fig. 2). The initial diagnosis at presentation was unspecified 'supraventricular tachycardia' in 2 patients, atrial flutter with 1:1 conduction in 1 patient, sinus tachycardia with peripartum cardiomyopathy in 1 patient and idiopathic dilated cardiomyopathy in 1 patient before the correct diagnosis was suspected and later confirmed at electrophysiological study. The first patient had a left atrial focus and the remaining 4 had right atrial foci. The first patient underwent intraoperative mapping of the left atrium with surgical cryoablation and the subsequent patients with right atrial foci all had radiofrequency catheter ablation. Three of the 4 patients had successful procedures at first attempt during radiofrequency catheter ablation. One patient went into sinus rhythm during the electrophysiological studies and the tachycardia could not be induced even with isoproterenol. It is likely that the focus was inadvertently traumatised during electrode placement. He had a repeat successful procedure 2 weeks later when his cardiac rhythm reverted to sustained tachycardia. At 3 to 6 months follow-up, all the patients remained asymptomatic in sinus rhythm and repeat echocardiography showed that the patients had significant improvement of their left ventricular function ( $P = 0.014$ ). None of the patients required anti-failure therapy after successful catheter ablation. The patients have been followed up for 2 to 7 years and have not had recurrences of their tachycardia.

## Discussion

IEAT is a rare arrhythmia which presents a diagnostic and therapeutic challenge. The diagnosis can be elusive

TABLE I: CHARACTERISTICS OF PATIENTS WITH INCESSANT ECTOPIC ATRIAL TACHYCARDIA

No.	Age/Sex	Drugs used at pre-Rx	Duration of symptoms	Initial diagnosis	LVEF pre-Rx	LVEF post-Rx
1	44/M	Dig, Dil, AF	2 years	Dilated CMP	16%	45%
2	35/F	Dig, Ve, Ppl,	1.5 years	SVT	40%	56%
3	35/F	Dig, AF	1 year	Peripartum CMP	25%	60%
4	27/F	Ve	2 months	SVT	40%	63%
5	16/M	Ve, Ppl, Fl, Amio	4 months	Atrial flutter	45%	50%

AF: anti-failure therapy; Amio: amiodarone; CMP: cardiomyopathy; Dig: digoxin; Dil: diltiazem; F: female; Fl: flecainide; LVEF: left ventricular ejection fraction; M: male; Ppl: propranolol; Rx: ablative treatment; SVT: supraventricular tachycardia; Ve: verapamil

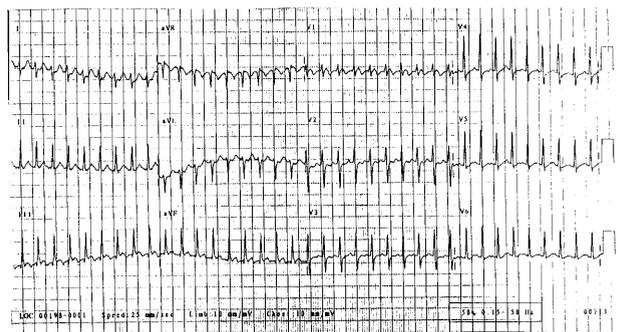


Fig. 1. A 12-lead electrocardiogram showing incessant atrial tachycardia.

and requires a high index of suspicion. In our study, 2 patients presented with cardiac failure and were initially thought to have peripartum cardiomyopathy and idiopathic dilated cardiomyopathy, respectively. Subsequently it was realised that the patients remained in incessant tachycardia despite adequate therapy of the heart failure and were then suspected to have tachycardia-induced cardiomyopathy. One patient was thought to have reentrant supraventricular tachycardia because she reverted to a 2:1 block after intravenous verapamil mimicking sinus rhythm. She was thus referred to our department as a case of paroxysmal supraventricular tachycardia. Another patient was thought to have peripartum cardiomyopathy and it seems that this arrhythmia may be related to pregnancy.<sup>13</sup> IEAT may also be associated with factors such as previous atrial surgery,<sup>14</sup> myocarditis<sup>15</sup> and cardiac transplantation<sup>16</sup> but it is idiopathic in most cases.

The diagnosis of IEAT should be considered when a 12-lead electrocardiogram during the tachycardia shows the presence of discernible P waves which are separate from the QRS complexes. Classically, the RP/PR ratio is greater than 1, giving rise to the term "long RP tachycardia". The other possible differentials for a long RP tachycardia are atypical atrioventricular nodal reentry or orthodromic atrioventricular reentry utilising a slowly conducting or decremental accessory pathway.

IEAT can cause significant mortality and morbidity. The incessant or near incessant nature of the tachycardia leads to 'overworking' of the myocardial cells and ultimately to contractile dysfunction. Many theories have been put forward to explain this phenomenon including increased cytoskeleton protein abundance or messenger-ribonucleic acid and reorientation of cardiocyte cytoarchitecture<sup>17</sup> and changes in myocyte electrical events and ionic flux (calcium channel function).<sup>18</sup> Besides tachycardia-related cardiomyopathy, sudden death due to ventricular fibrillation<sup>19</sup> has also been reported.

Antiarrhythmic drug therapy to control the ectopic focus is almost always unsuccessful and atrioventricular node ablation has the undesirable result of leaving

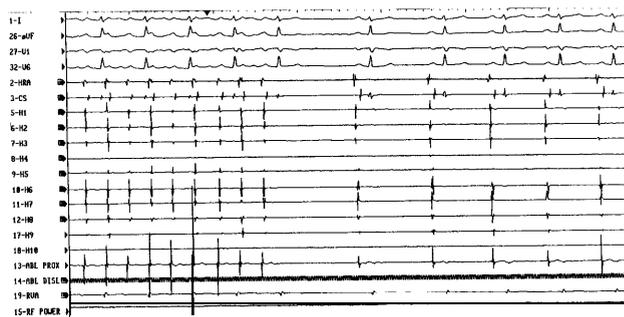


Fig. 2. Electrogram showing incessant atrial tachycardia (I, aVF, VI and V6 represent surface electrocardiographic leads; HRA: high right atrial electrograms; CS: coronary sinus; P: proximal; D: distal; H1 to H10 represent recording from the Halo catheter in the right atrium; Abl: ablation electrogram; RVA: right ventricular apex; RF power indicates radiofrequency power delivery).

the patient pacemaker dependent, while leaving the focus intact.

As drug and atrioventricular nodal ablation therapy is unsatisfactory in such patients, ablation of the ectopic focus is the method of choice. Cure of the arrhythmia will lead to resolution of the cardiomyopathy and restoration of normal left ventricular function. We have shown that radiofrequency catheter ablation is a viable technique in managing these patients with good success and low recurrence rates. In cases that are not amenable to catheter ablation, recourse to surgical ablation is always an option. Surgery may be used for patients with more diffuse pathologies of the atria that would require large areas of ablation (such as saccular aneurysms of the atria) or inaccessible sites in the left atrium.<sup>20</sup> Despite the relatively thin wall of the atrium, the procedure of radiofrequency catheter ablation can be performed safely, as is the experience with other centres.<sup>20-22</sup> However, care should be taken so that the amount of energy applied is controlled and is terminated as soon as there is a rise in impedance.

Of the two main mapping techniques described,<sup>23</sup> we have found that identifying and ablating the area of earliest activation was more suitable than pace mapping as the patients were all in incessant tachycardia making it difficult to overdrive pace them. Furthermore, the P waves on the surface electrocardiogram were not always clearly seen and were frequently buried in the QRS complexes making comparison difficult.

In conclusion, IEAT is a rare and sometimes elusive condition with the potentially devastating consequences of tachycardia-induced cardiomyopathy. In view of its low morbidity and high success rates in suitable cases, radiofrequency catheter ablation should be the therapy of choice for such patients.

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