Diagnostic use of Adenosine for Atrial Flutter with Regular Tachycardia

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CASE REPORT

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Abstract:
Background: Supraventricular tachycardia is the commonest type of narrow complex regular tachycardia seen in an emergency room, which can easily be diagnosed by surface ECG and acutely managed by Adenosine injection. A 59 years old male smoker was presented with palpitation with a pulse rate of 220/min with mild hemodynamic compromise. ECG confirmed narrow complex regular tachycardia, and the initial working diagnosis was established as Supraventricular Tachycardia (SVT) in the emergency room.

Case Presentation: As standard practice, adenosine was given, which failed in terminating the tachycardia but by creating a transient atrioventricular block, slowed down ventricular rate, and sawtooth-shaped P waves of atrial flutter were exposed. In contrast to the expectations, in this case of narrow complex regular tachycardia of supraventricular origin, adenosine could not establish the sinus rhythm but confirmed the diagnosis of atrial flutter with the regular rate with fixed A-V block.

Conclusion: Instead of therapeutic use, adenosine has been proven to be of diagnostic value, which can be used when the diagnosis of narrow complex tachycardia is in doubt, however with some cautions.

Keywords: Adenosine, Atrial flutter, Supraventricular tachycardia, Narrow complex tachycardia, Atrioventricular block, ECG.

1. INTRODUCTION

Paroxysmal Supraventricular Tachycardia (PSVT) is caused by activation of the reentry circuit, utilizing either accessory conduction or dual Atrio Ventricular (A-V) nodal pathway, named as AtrioVentricular Reentrant Tachycardia (AVRT) or AtrioVentricular Nodal Reentrant Tachycardia (AVNRT), respectively. Both have been effectively managed in Emergency Room (ER) by common A-V nodal blocking drugs, verapamil, diltiazem, beta-blockers in the past [1]. Currently, adenosine is the mainstay of acute management of supraventricular tachycardia (SVT) because of its high success rate and very few side effects. It is preferred because of its quick onset of action and very short half-life < six seconds; bradycardia or pause lasts only seconds before terminating the tachycardia [2]. It is safe with minimal side effects and limited contraindications. Other narrow complex tachycardias like Atrial Fibrillation (AF), ectopic atrial tachycardia, and Atrial Flutter (AFL) have been effectively differentiated from PSVT with their irregular rhythm and distinct P wave morphology and managed appropriately. It is rare to find an alternative diagnosis of narrow complex tachycardia for PSVT when the rhythm is perfectly regular. Without proper diagnosis, the management remains ineffective and inadequate. It remains a challenge for the emergency room physicians to reach the correct ECG diagnosis and treat it appropriately. If the proven standard treatment with adenosine fails, then it becomes necessary to find the alternative mechanism of narrow complex regular tachycardia for appropriate management.

2. CASE REPORT

A 59 years old patient was brought to Emergency Room (ER) via an ambulance with a history of palpitation with a very fast heart rate for the last 4 hours. He also experienced chest pain with radiation to arms and sweating without any blackout. He gave no history of similar palpitation with tachycardia. He was non-diabetic, non-hypertensive, non-hyperlipidemic with

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no family history of coronary artery disease. The only coronary risk factor was smoking. He was fully conscious and well oriented, having mild dizziness, with a pulse rate at 220/min, feeble but regular, and BP of 96/70 mm Hg. ECG showed regular narrow complex tachycardia with a rate of 220/min (Fig. 1). His initial working diagnosis established in the emergency room was Paroxysmal Supraventricular Tachycardia (PSVT), thus he received an intravenous dose of 6 and 12 mg of adenosine but without restoration of the sinus rhythm. Meanwhile, he became hypotensive and hemodynamically unstable after the second dose of adenosine. Furthermore, synchronized DC cardioversion at 50 joules was successful in gaining normal sinus rhythm, with immediate improvement in hemodynamics. ECG post cardioversion revealed inferolateral marked ST depression suggestive of ischaemia, probably secondary to fast heart rate (Fig. 2). Cardiac markers Troponin I and CK/MB were abnormally elevated.

A detailed review of the rhythm recordings during adenosine injection from a defibrillator revealed interesting information. After adenosine injection, atrioventricular (A-V) block transiently increased, ventricular rhythm became irregular with slow ventricular rate along with a long pause of ventricular complexes, which clearly showed underlying sawtooth-shaped atrial flutter P waves (Fig. 3). Adenosine could not terminate narrow complex regular tachycardia, a look-alike of SVT, but exposed the underlying classical atrial flutter (AFL) with sawtooth P waves, which ruled out the diagnosis of PSVT and confirmed the diagnosis of atrial flutter with 1:1 atrioventricular conduction. Narrow complex, regular tachycardia; with a very fast rate of 220/min and regularity and invisible P waves was difficult to differentiate from SVT. Once the diagnosis of atrial flutter was made, planning immediate and long-term treatment became easy. The choice of specific antiarrhythmic therapy became clear and managed with beta-blocker and amiodarone.

3. DISCUSSION

Adenosine is an endogenous purine nucleoside that causes transient atrioventricular nodal block [3]. It is effective in terminating paroxysmal supraventricular tachycardias, where the Atrioventricular (A-V) node is an essential part of the reentry circuit, which either utilizes a dual Atrio-Ventricular (AV) nodal pathway or an accessory pathway including that of Wolff Parkinson’s White syndrome. Adenosine has been established as a drug of choice for the acute treatment of supraventricular tachycardia in current practice. Other A-V nodal blocking drugs are used only when adenosine is either contraindicated or ineffective. Adenosine has been chosen because of its rapid onset of action as well as the rapid offset of its transient effects on circulation due to its extremely short half-life [4].

Intravenous adenosine depressed both sinus rate and AV conduction in humans, but it had no effect on Atrial Flutter (AFL), Atrial Fibrillation (AF), or ventricular tachycardia [5, 6]. A majority of episodes of supraventricular tachycardia are due to reentry circuits involving the atrioventricular node, a situation where adenosine would be expected to restore sinus rhythm [7]. At times adenosine causes severe bradycardia transiently but without any significant side effects. Rarely, adenosine has been used as a diagnostic agent to differentiate between supraventricular tachycardia with aberration versus ventricular tachycardia, both with wide QRS (VT) [8, 9]. A paradoxical doubling of heart rate from 150 to 300/min in narrow complex regular tachycardia has been reported very occasionally after adenosine injection, explained by an increase in sympathetic tone [10]. The potential of a trial flutter to increase atrioventricular conduction from 2:1 to 1:1 with increase sympathetic tone may explain its association with cardiac arrest, particularly in children with congenital heart disease [11]. Atrial flutter has been noted as a common arrhythmia after Mustard repair for the transposition of the great arteries and has also been associated with sudden death, and it has been recommended that a DC defibrillator should be kept ready before injecting adenosine, especially in children [12]. Adenosine may have an adverse effect in such patients because of enhanced atrioventricular conduction secondary to sympathetic activation [13]. In practice, it should be avoided in operated patients with congenital heart disease and in children who have a higher sympathetic drive for safety reasons.

Immediately after adenosine administration in AFL or AF, a transient slowing of ventricular response has been reported [14]; however, adenosine has been rarely used for diagnostic help in clinical practice. Similarly, in our patient with a fast ventricular rate of > 200 beats/min, flutter waves were not visible at all, and it was a real diagnostic challenge but after the administration of adenosine and momentary slower ventricular rate with the same fast atrial rate, flutter waves were easily seen (Fig. 3), and thus correct diagnosis was established.

The differential diagnosis in our patient of narrow QRS regular tachycardia of > 200/min, with no discernable “P” waves, with rests between AVRT (Atrio-Ventricular Reentrant) utilizing concealed Accessory pathway retrogradely, Atrial tachycardia, or Atrial Flutter (AFL) was made. Valsalva procedures have been used to terminate PSVT or in AFL to increase AV block at least transiently for confirming the diagnosis, however, it did not work in our patient. This case confirmed the importance of continuous rhythm recording during slow A-V conduction, adenosine injection, or Valsalva maneuver. Adenosine injection increased A-V block transiently and by reducing ventricular rate, disclosed the underlying classical atrial flutter sawtooth ‘P’ waves. This confirmed the diagnosis of atrial flutter with 1:1 atrioventricular conduction and very rapid regular ventricular rate on presentation. His aggravated sympathetic drive probably was due to excessive smoking, pain in the abdomen, or otherwise was contributing to accelerated A-V conduction. To our knowledge, adenosine has hardly been used for diagnostic purposes in rhythm disorders in current clinical practice though advocated in guidelines [14, 15]. In patients with a heart rate of less than 180/min, where sudden acceleration and doubling heart rate are risks of hemodynamic compromise, a DC defibrillator should be kept ready.
Fig. (1). Narrow complex regular tachycardia on admission.

Fig. (2). Normal sinus rhythm after D.C. cardioversion.

Fig. (3). Saw-tooth atrial flutter waves seen with slow ventricular rate/pause after injecting adenosine.
CONCLUSION

Atrial flutter can be easily diagnosed with irregular rhythm or typical flutter waves but if the rhythm is regular when P waves are not discernable with a very fast ventricular rate, it is almost impossible to differentiate it from supraventricular tachycardia. Adenosine with its proven therapeutic action has been used successfully in the acute management of paroxysmal supraventricular tachycardia. However, with our experience supported by guidelines, it can be used for its diagnostic capabilities in challenging cases of other narrow complex tachycardias.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

Not applicable.

CONSENT FOR PUBLICATION

Written informed consent was obtained from the patient.

STANDARDS OF REPORTING

CARE guidelines were followed.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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