

Beyond ACLS Protocol - A Rare Case of Refractory Supraventricular Tachycardia Responding Only to a Much Higher Dose of Adenosine

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Abstract

Symptomatic supraventricular tachycardia (SVT) is a common presentation in the Emergency Department which can be a life-threatening condition and this requires immediate intervention. Stable SVTs are commonly treated with Adenosine but adenosine is more effective in AV node-dependant SVTs as it causes transient AV block [1] and causes normalization of the cardiac rhythm. American Heart Association AHA's ACLS protocol recommends 6mg then 12mg (total 18mg) dose for SVTs [2]. However there is limited data as to how much maximum dose can be given for those SVTs that fail to terminate with standard dosing schedule [1]. This case report describes a 30 years old female with symptomatic SVT which failed to revert with normal dosing of adenosine neither with electrical cardioversion nor with multiple antiarrhythmic drugs but responded only to a much higher dose of adenosine.

Keywords: Supraventricular Tachycardia; AVRT (Atrioventricular Re-Entry Tachycardia); AVNRT (Atrioventricular Reentrant Tachycardia); Adenosine; Cardioversion; ACLS (Advanced Cardiac Life Support); AV (Atrioventricular) Block; AHA (American Heart Association); ED (Emergency Department); Refractory; Ursodeoxycholic Acid; WPW Syndrome (Wolf Parkinson White).

Introduction

Supraventricular tachycardias (SVTs) are tachyarrhythmias arising from above the level of Bundle of His. It may be from atria or from AV node and may be regular or irregular.

It is caused by re-entry phenomenon causing increased heart rate and is less likely to be caused by

structurally abnormal heart. The heart rate in SVT is usually around 150-250 beats/min and regular in rhythm. Symptoms of SVT include palpitations, chest discomfort or pain, shortness of breath, lightheadedness, dizziness, nausea and vomiting.

Increased heart rate is frightening to the patient if persisting or recurrent and may cause significant morbidity.

SVTs May be Broadly Classified as Follows

Site of Origin or Propagation	Regular	Irregular
Atria	Atrial tachycardia Atrial flutter	Atrial fibrillation Multifocal atrial tachycardia
AV node	Sinus node reentrant tachycardia AVNRT AVRT	Atrial flutter with variable AV block

Common Types of SVTs can be Classified as Follows

Types	Features
AVNRT ⁽⁵⁾	Most common type of SVT about 50-60% ⁽⁴⁾ Seen in young females Reentry caused by nodal pathways or tracts HR is 118-264/min ⁽⁵⁾ . Narrow complex (QRS<120sec) 2 types: Typical (slow/fast) 90% of all AVNRTs RP interval <PR interval Pseudo R wave in V ₁ Pseudo S wave in I, II, aVf Atypical (fast/slow) 10%
AVRT ⁽⁵⁾	Second most common SVT about 30% cases Seen in younger women and children Reentry caused by accessory pathways HR is 124 – 256/min ⁽⁵⁾ . Narrow complex (QRS<120sec) 2 types: Orthodromic – antegrade conduction through AV node Antidromic – retrograde conduction through AV node Most commonly associated with WPW syndrome Delta waves in ECG
Atrial tachycardia Or Multifocal atrial tachycardia (MAT)	3 rd most common SVT about 10% cases Seen in middle aged Associated with heart failure or COPD In MAT, 3 successive P waves have different morphology

The commonest cause of palpitations in a normal structured heart is AVNRT [3].

Diagnosis is often delayed or misdiagnosed as panic disorder or anxiety disorder.

About 25% of SVTs get reverted with vagal maneuvers like valsalva maneuver or carotid sinus massage [2]. The remainder may require adenosine or electrical cardioversion.

Adenosine [6] is a naturally occurring purine nucleoside and is a short acting antiarrhythmic drug with onset of action 10 seconds and duration of action 10 seconds.

It causes depression of SA node and AV nodal activity and antagonizes c-AMP-mediated catecholamine stimulation of ventricular muscle thereby causing negative chronotropy and negative dromotropy [6].

Adenosine is contraindicated in 2nd and 3rd degree AV blocks and WPW syndrome (Wolf Parkinson White) and must be used with care in asthma and COPD.

Higher dose may be required in caffeine and theophylline users and lower dose (3mg) may be required in carbamazepine and dipyridamole users [2].

Case Study

A 30 years old female presented to ED with c/o palpitations since 4 hours associated with nausea and light headedness. She did not have any chest pain, vomiting, syncope, near syncope, loss of consciousness, or cough.

She had similar episode 1 year back when her local physician gave tablet verapamil 120mg which relieved her symptoms and did not recur again. She did not undergo any further evaluation during that episode but has been on verapamil 120mg OD since then.

She took additional dose of verapamil 120mg before coming to the ED but symptoms did not subside.

She was taken to the monitored bed and initial evaluation done.

She was conscious oriented but was tachycardic with PR = 208/min regular and tachypneic with RR = 24/min.

Her oxygen saturation was 98% at room air.

Her BP was 120/80 mmHg and random blood sugar level was 94mg/dl.

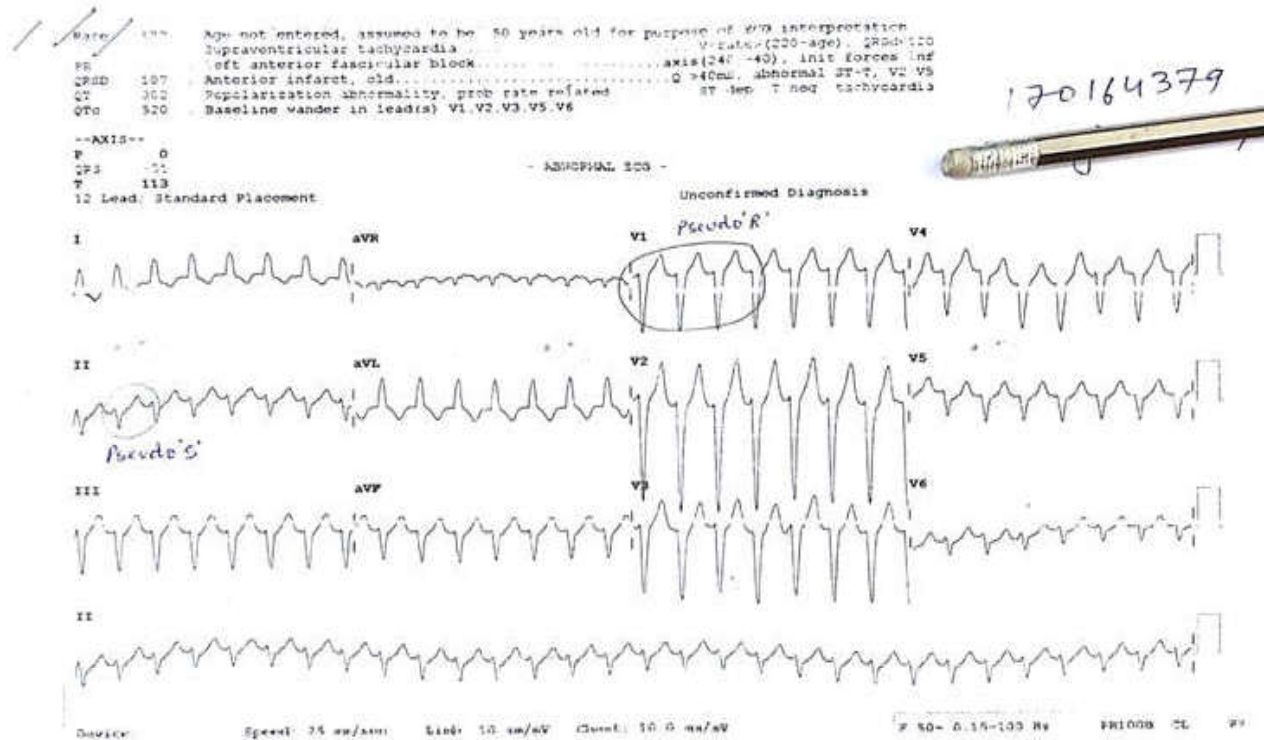
She did not have any pallor, cyanosis, icterus,

jugular venous distension nor peripheral edema.

Cardiac monitor showed narrow complex tachycardia and 12-lead ECG showed SVT with

pseudo R in V₁ and pseudo S in lead II which most likely was atrioventricular nodal reentrant tachycardia (AVNRT).

ECG of the Patient is Shown below.



A large IV canula was inserted in left cubital vein and samples taken for ABG, CBC, KFT, LFT, thyroid profile, serum calcium and magnesium.

Her systemic examination did not reveal anything significant.

After checking for carotid bruit, vagal manoeuvre was done on right side but there was no change in the ECG rhythm.

She was immediately given adenosine 6mg IV stat followed by 20ml NS flush. This did not revert the SVT. Another 12mg of adenosine was pushed through the cubital vein after 3 minutes of the first dose but this also did not revert the SVT.

Cardiologist on-call was immediately called who advised inj diltiazem 15+15 = 30mg IV which also did not revert the SVT.

After the above medications, the patient started feeling dizzy and BP was found to be 60 mmHg systolic.

Since she became unstable with hypotension, electrical cardioversion was done with 50J then with

100J but that too did not revert the SVT.

Senior cardiologist was called-in and inj Amiodarone 150mg given IV over 10 mins but that did not revert the SVT either.

Eventually she regained normal sinus rhythm with another dose of adenosine of 18mg IV after which she remained in normal sinus rhythm and her blood pressure increased to 130/70 mmHg.

Her symptoms of palpitations and lightheadedness also subsided. She did not have any side effects of adenosine like bronchospasm or flushing.

Her VBG report showed ph = 7.312, pO₂ = 32.5, Pco₂ = 52.3, HCO₃ = 25.7, Na⁺ = 144, K⁺ = 4, Ca⁺ = 1.17, lactates = 2.6. She was started on infusion of Amiodarone @ 60mg/hr and was then shifted to CCU (Cardiac Care Unit) for further management.

Course in the Hospital and Outcome

A diagnosis of refractory SVT - AVNRT was made and amiodarone infusion was initiated @ 60mg/hour in the ED.

Echocardiography showed EF 64% and no RWMA. CXR showed no abnormality.

She was started on Diltiazem 30mg PO BD, Amiodarone 200mg BD then OD, Ursodeoxycholic acid 300mg TDS.

Her blood investigations showed normal Complete blood count, normal electrolytes, normal kidney function tests, normal liver function tests, normal thyroid function tests.

The patient later underwent radiofrequency ablation of an accessory pathway.

She was discharged in a stable condition after 4 days of hospital stay.

During the entire stay in hospital she did not have any further symptoms nor did she have any arrhythmia on cardiac monitoring.

On further follow up in cardiology OPD after 1 week she was found to be stable.

Discussion and Therapeutic Considerations

This case report illustrates a 30 years old female who presented with refractory SVT which was not reverting with normal dosing of adenosine (6mg, 12mg) nor with multiple antiarrhythmic drugs like amiodarone, diltiazem nor with electrical cardioversion with maximum energy but her SVT reverted only to a subsequent higher dose of adenosine (18mg), total 36mg.

As discussed above, higher dose may be required in caffeine and theophylline users and lower dose (3mg) may be required in carbamazepine and dipyridamole users [2].

In our case, when asked retrospectively, she mentioned that she had consumed 3-4 cups of coffee that day and was under some stress due to her office work.

This caffeine intake and stress could explain the triggering of SVT and requirement of high dosage of adenosine.

As per the ACLS guidelines [2], when the tachycardia with a pulse is unstable, meaning the presence of any of 1) hypotension SBP<90mmHg, 2) altered mental status, 3) signs of shock, 4) ischemic chest discomfort, 5) acute heart failure, the treatment of choice is electrical cardioversion. Therefore we tried to electrically cardiovert the patient when the BP fell down to 60mmHg but still there was no response.

Antiarrhythmic drugs like Amiodarone and Diltiazem were started to keep her heart rate under control.

Ursodeoxycholic acid was also started in consultation with the Cardiologist as it has shown some anti-arrhythmic properties via preventing ICP-associated cardiac conduction slowing and development of reentrant arrhythmias, although the cellular mechanism is still not clearly known.

Conclusion and Limitations

About 75% of SVTs can be terminated with pharmacological cardioversion, that is by adenosine and usually it gets reverted by the standard dosing of 6mg and then 12mg as per the ACLS protocol 2015 CPR/ECC guidelines of American Heart Association.

However in some refractory cases, additional doses may be required as seen in our case. Some known causes for this refractoriness is caffeine intake and some drugs like theophylline as discussed above.

Why should an emergency physician be aware of this deviation from the standard dosing of adenosine? This is because there is no confirmed data as to how much dose of adenosine can be given for refractory SVTs and very few cases do respond to a higher dose. This is also evidenced by one study⁽¹⁾ by Bailey AM whose study was published in Journal of Emergency Medicine in 2016 where the patient responded to a very high dose of adenosine.

Prior to 2015 ACLS guidelines, the standard dose was 6mg, 12mg, 12mg but in 2015 guidelines, the 3rd 12mg dose was removed from SVT management.

Our intention is only to make the emergency physicians aware of situations where the standard dosing of adenosine may not be sufficient for SVT termination. However a bigger study is required to come to any conclusion.

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