

## Inappropriate Sinus Tachycardia: A Case Study

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### Abstract

Inappropriate Sinus Tachycardia (IST) is a benign syndrome where the sinus heart rate is inexplicable higher than expected, and with associated symptoms of palpitations that can often be distressing and debilitating. The heart rate at rest can often exceed 100 bpm, with minimal activity that produces substantial, swift sinus rate acceleration. IST has often misinterpreted as appropriate sinus tachycardia and Postural Orthostatic Tachycardic Syndrome (POTS). This article presents a brief review of the topic surrounding IST and a clinical case description of a seventeen-year-old Afro-Caribbean male with a history of palpitations associated with light-headedness. IST should be a condition diagnosed following the exclusion of other causes of sinus tachycardia.

**Keywords:** *IST; Inappropriate Sinus Tachycardia; Sinus Tachycardia; Palpitations*

### Background

Inappropriate Sinus Tachycardia (IST) is a mysterious syndrome characterised by sinus heart rates that are inexplicably higher than expected with minimal physical exertion, and with a prolonged recovery period. IST may also be associated with symptoms of fatigue, pre syncope, palpitations, weakness and dizziness [1,2]. Epidemiologically 1.2 per cent of the population are estimated to have IST, either symptomatic or asymptomatic [2]. The syndrome is defined as having a sinus heart rate exceeding 100 bpm when sedentary (with a mean 24-hour heart rate on holter monitors exceeding 90 bpm not due to primary causes) [2]. IST is a diagnosis of exclusion of other causes of sinus tachycardia, which are temporal with explainable causes [1]. There are some known diseases associated with IST, which include intrinsic Sino Atrial (SA) node over activity, beta-adrenergic hypersensitivity, decreased autonomic influence and impaired neurohormonal modulation [2]. The prognosis is good with no reported deaths/life limiting complications, stroke, MI or tachycardiomyopathy [1,2].

### Tests to aid diagnosis of IST:

- A complete history, physical exam, and 12-lead ECG
- Complete blood counts and thyroid function studies
- A 24-hour holter monitoring
- Urine/serum drug screening
- Autonomic testing (tilt table test)
- Treadmill exercise testing.

Explainable causes of sinus tachycardia must be excluded (Table 1) and appropriately treated in the first instance [1-4].

Differential diagnosis	Tests to confirm exclude
Substance misuse (illicit drugs)	Urine test
Anticholinergics/medications (beta-blocker withdrawal, (tricyclic antidepressants, asthma and COPD etc.)	General practitioners prescription/electronic/paper medical records 12 lead ECG
Interventions (previous cardiac ablation)	Past medical history 12 lead ECG
Anaemia (deficiency of red cells or haemoglobin)	Complete blood count and haematocrit
Pheochromocytoma (adrenal gland tumor)	Transferrin saturation (TS), serum ferritin level, and liver function tests
Hyperthyroidism (overactive thyroid)	TSH, T3, T4 levels
Volume depletion (fluid loss)	Physical examination/medical history/haematocrit
Fever (viral infection)	Physical examination/medical history 12 lead ECG
Anxiety disorder/psychiatric conditions	Physical examination/medical history 12 lead ECG
Cardiomyopathy (enlarged heart)	Echocardiogram 12 lead ECG
Postural Orthostatic Tachycardic Syndrome (POTS)	Head up tilt table > 30 bpm increase in heart rate from recumbent to standing maintained for > 30 sec without OH
Orthostatic Hypertension (OH)	Systolic blood pressure decrease of at least 20 mm Hg or a diastolic blood pressure decrease of at least 10 mm Hg within three minutes of standing
Supra Ventricular Tachycardia (SVT)	12 lead ECG during tachycardia event

**Table 1:** Common causes of explained sinus tachycardia, the differential diagnosis are listed and the confirmatory test to exclude or confirm diagnosis.

### Treatment

Following the diagnosis of IST, Ivabradine an If current blocker and has been shown to have beneficial effects with some patients [5,6]. A dramatic and generally well-tolerated effect on heart rate. At doses of 5- 7.5 mg twice daily, the drug slows the heart rate by 25 - 40 bpm [1,2].

B-R Sinus node modification, surgical ablation, and sympathetic denervation are not recommended as a part of routine care for patients with IST but have been performed with subsequent pacemaker insertion in 30 per cent following ablation [1,2].

### Clinical Case Study

Presenting to the Accident and Emergency department (A&E) with symptoms of palpitations and light-headedness while sitting in car. The patient was a seventeen-year-old male of Afro-Caribbean heritage born in the UK; height 182 cm; weight 71 kg; social smoker; mod alcohol consumption; no prescribed medication. He denies illegal substance abuse and has a past medical history of minor childhood muscular skeletal injuries. Family history: father died 54 years old (normal ECHO); Uncle died 27 years old both from unknown cause to the patient.

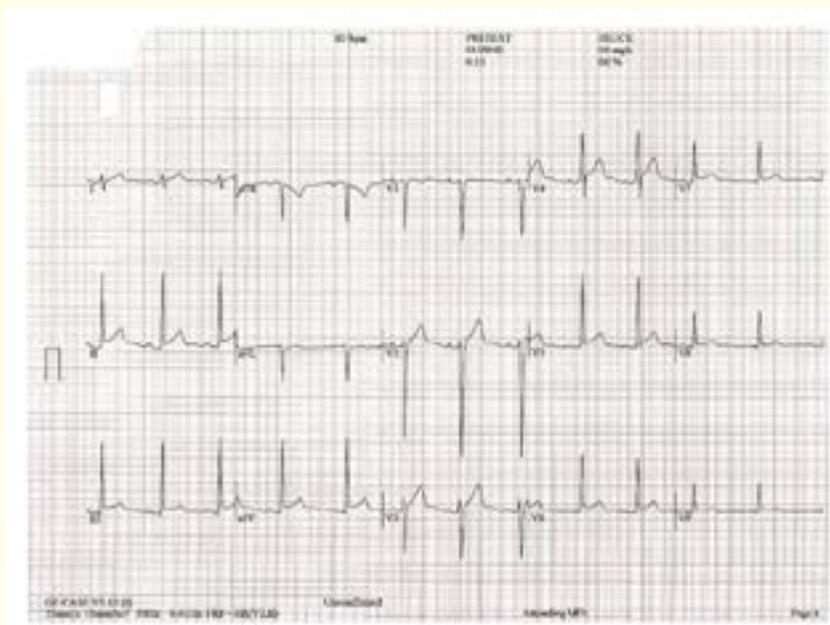
Tests performed on admission:

- ECG: normal 12 lead with early repolarisation.
- Blood tests: reported normal findings.

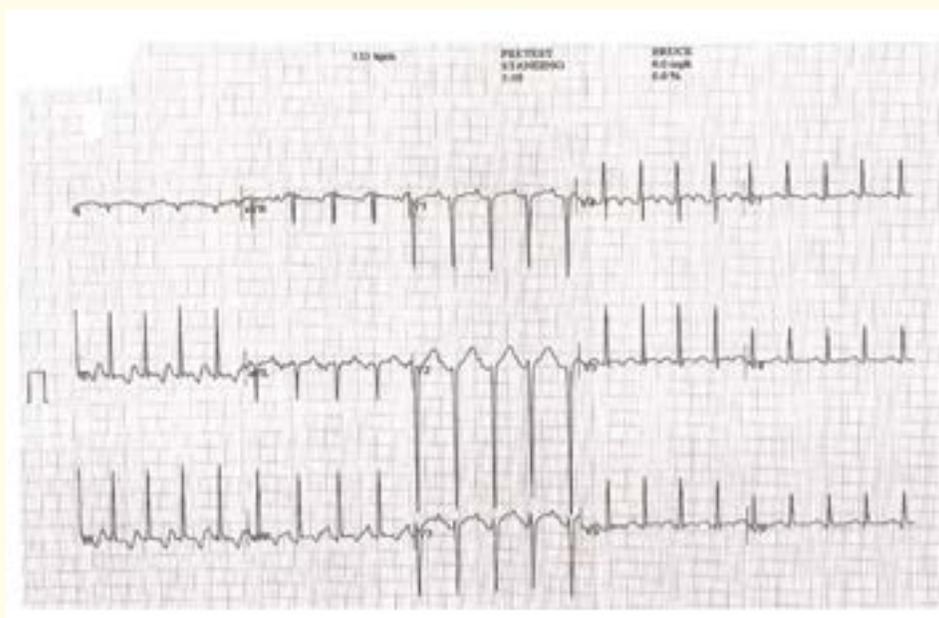
Further tests organised by the cardiologist after discharge and before clinic follow-up appointment:

- Echocardiograph (ECHO) which reported normal findings, with an Ejection Fraction (EF) of 60%.

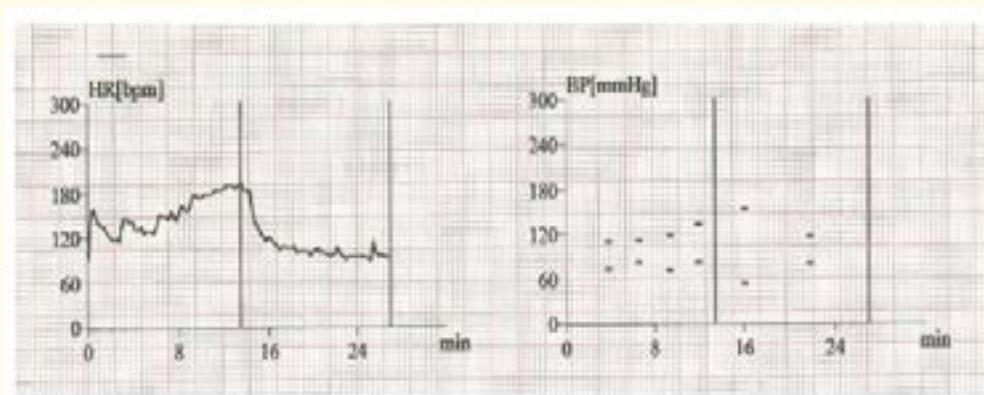
- Exercise Tolerance Test (ETT) showed an exaggerated tachycardic response to exercise characterised by a sudden increase in heart rate (133 bpm) to a maximum of 165 bpm from supine (80 bpm) and a sharp increased heart rate at the commencement of each stage (Figure 1-3).



**Figure 1:** 15 lead ECG supine (limb lead in torso positions altering cardiac axis), Sinus rhythm (80 bpm) with early repolarisation.



**Figure 2:** 15 lead ECG standing, sinus tachycardia (133 bpm) with non-specific inferior lateral T wave abnormalities.



**Figure 3:** Exercise test results. Left panel showing heart rate graph with exaggerated chronotropic heart rate response. Supine 76 bpm and on standing 133 bpm to a maximum of 165bpm slowly descending before exercise begins then rapidly spiking at the beginning of each exercise stage. Right panel shows normal haemodynamic response pre and during exercise.

## Discussion

Inappropriate Sinus Tachycardia (IST) is a clinical syndrome that is not well understood and often either misdiagnosed for another crossover syndrome or missed completely. Diagnosis should only be made after following a logical process of eliminating reversible causes of explainable sinus tachycardia. Simple universally accessible standard testing using 24-hour heart monitoring, exercise tolerance test and head up tilt table tests can be useful to diagnose IST. Interventions must always endeavour to minimise or eliminate symptoms that can be debilitating in extreme cases. The use of ivabradine should be considered, although it is not licenced for use in IST. The modification of “funny cell” automaticity within the Sino Atrial (SA) node with ivabradine use seems to point toward a possible mechanism for future research. Treating IST with SA node ablation is not recommended and may cause more long-term harm than good.

## Conclusion

Inappropriate sinus tachycardia is a diagnosis after ruling out other causes of sinus tachycardia and palpitations in otherwise healthy patients. Treating this group of IST patients can be difficult and should be considered for symptom relief. There are no known reports of IST patient suffering adverse cardiac events due to IST.

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