A 15-year-old boy was referred to our outpatient clinic for the evaluation of palpitations. They started 2 years ago, happening daily after light exercise. When exercise was continued, he noted acceleration of palpitations and onset of dyspnea. Those complaints were reason to reduce exercise as much as possible. The use of a β-blocking agent (metoprolol), prescribed by his general physician, resulted in less palpitations but they still appeared during exercise.

Physical examination revealed no abnormalities; an echocardiogram was normal. During hospital admission, he was found to be in tachycardia most of the day, indicating an incessant form of a narrow QRS tachycardia.

The electrocardiogram in Figure 1 shows a change from sinus rhythm to a narrow QRS tachycardia on starting light exercise. Figure 2 illustrates what happened with his heart rate during exercise on the bicycle.

Questions
1. What kind of tachycardia is initiated after an increase in sinus rate?
2. Does the marked increase in rate during exercise tell you the most likely mechanism?
3. What will be the preferred management?

Discussion
1. In Figure 1, sinus rhythm acceleration is followed by a tachycardia with the same QRS complex as during sinus rhythm but with different P waves. P waves are now inverted in the inferior leads and leads V2 through V6. During the tachycardia, the RP interval is longer than the PR interval, a so-called long RP tachycardia. The differential diagnosis of a long RP tachycardia consists of (a) low atrial tachycardia, originating in or close to the interatrial septum; (b) short/long atrioventricular nodal reentrant tachycardia; and (c) atrioventricular tachycardia using a slowly conducting accessory atrioventricular (AV) pathway for ventriculioatrial conduction, also known as permanent junctional reentrant tachycardia (PJRT).
2. As shown in Figure 2, there was marked acceleration of the tachycardia rate during exercise on the bicycle. The incessant nature and the shown mode of tachycardia initiation with marked rate acceleration during exercise have never been reported in patients with short/long atrioventricular nodal reentrant tachycardia. That leaves us with the differential between low atrial tachycardia and PJRT. In that situation, as discussed in one of our previous cases, the effect of carotid sinus massage (CSM) or adenosine administration during the tachycardia can be helpful.1 While in atrial tachycardia CSM produces AV block with more P waves than QRS complexes, it terminates PJRT in 1 of the 2 sensitive decrementally conducting structures in the tachycardia circuit, the AV node or the AP. In our patient, CSM resulted in prolongation of both the PR and the RP interval with termination of the tachycardia in the AV node, leading to the diagnosis of PJRT.
3. An incessant PJRT frequently leads to tachycardia-induced dilated cardiomyopathy. Although after a 2-year history our patient still had normal left ventricular dimensions and contractility, he is at high risk of developing this complication. With β-blockade his PJRT was under control at rest but immediately reappeared during exercise. Those findings made him a good candidate for catheter ablation of his concealed, decrementally conducting AP. After the demonstration of advancement of atrial activity over the AP during the tachycardia by an induced ventricular premature beat at the time of His bundle refractoriness, his AP was localized posteroseptally and ablated.

Reference
Figure 1  Initiation of a long RP tachycardia during acceleration of sinus rhythm. The PP interval of the 4 sinus beats is indicated. The QRS of the last conducted sinus beat is followed after an interval of 320 ms by a P wave negative in leads II, III, aVF, and V₂ through V₆. That P wave is conducted to the ventricle after 160 ms.
Figure 2  The rate behavior of permanent junctional reciprocal tachycardia (PJRT) during exercise. A tachycardia rate of 150 beats/min at rest accelerates to 214 beats/min, with a marked shortening of both the RP and the PR interval. The drawing on the right side shows the tachycardia circuit with atrioventricular (AV) conduction over the AV node-His pathway and ventriculoatrial (VA) conduction over a decrementally conducting concealed accessory VA pathway, aka = also known as; AP = accessory pathway; CMT = circus movement tachycardia.