Junctional ectopic tachycardia and late recovery of postoperative complete heart block in a young adult

Thibaut Moulin, MD,* Ségolène Rouffiac, MD,* Amine Chaouch, MD,* Guner Emirali, MD,† Thierry Folliguet, MD, PhD,† Nicolas Lellouche, MD, PhD*

*From the *Department of Cardiology, AP-HP, University Hospital Henri Mondor, Créteil, France, and †Department of Cardiac Surgery, AP-HP, University Hospital Henri Mondor, Créteil, France.*

Introduction

Junctional ectopic tachycardia (JET) is an automatic tachyarrhythmia arising from the atrioventricular (AV) node and/or proximal His bundle area. It has been described as a potential life-threatening complication following cardiac surgery for congenital heart disease (CHD) in children.[1,2] Sharing the same anatomical substrate, several reports described an association between JET and postoperative complete heart block (CHB), specifically after correction of septal defect in children.[3,4] We present here the management and timeline of a case of postoperative CHB associated with transitory JET, preceding late recovery of AV conduction without pacemaker implantation in a young adult.

Case report

A 21-year-old woman, known for restrictive perimembranous ventricular septal defect (VSD) since childhood, was hospitalized in our cardiology unit for right-sided infective endocarditis with persistent fever, methicillin-susceptible *Staphylococcus aureus* bacteremia, voluminous tricuspid valve (TV) vegetation associated with severe TV regurgitation, and multiple septic pulmonary embolism. Electrocardiogram (ECG) at admission showed sinus tachycardia with normal PR interval and QRS complex morphology.

Following multidisciplinary discussion in "Endocarditis Team" meeting, the patient underwent urgent surgical bioprosthetic TV replacement (valve Carpentier-Edwards Perimount Magna Ease 27 mm) associated with VSD closure with direct suture. Immediate postoperative ECG showed third-degree AV block with 70 beats per minute (bpm) narrow QRS complex escape rhythm (Figure 1). At day 1 postsurgery, while the patient was conscious and weaned from mechanical invasive ventilation, she presented a supraventricular tachycardia at 205 bpm with poor hemodynamic tolerance (hypotension and hyperlactatemia) and no effect of intravenous adenosine injection. Diagnosis of automatic JET was based on the following arguments: postoperative context and regular narrow QRS complex tachycardia with AV dissociation (Figure 2). After failure of intravenous amiodarone (300 mg) and beta-blocker (landiolol 0.2 mg/kg) injection, oral ivabradine administration (5 mg) finally led to a slowing of the tachycardia to 125 bpm, resulting in a significant hemodynamic improvement. At day 3 postsurgery, the JET persisted with a heart rate of 115 bpm under ivabradine 7.5 mg twice a day and oral amiodarone 800 mg/day (Figure 3).

KEY TEACHING POINTS

- Postoperative junctional ectopic tachycardia (JET) can occur after cardiac surgery for congenital heart disease in adulthood. This life-threatening complication should be known by the adult physician community, as it may require specific therapeutics.
- In this adult case of postoperative JET, oral administration of ivabradine was the most effective treatment after failure of intravenous amiodarone and beta-blocker.
- The occurrence of JET in the setting of postoperative complete heart block could predict future recovery, even late, of atrioventricular (AV) conduction.
- This report presents the timeline of a case of late recovery of AV conduction following cardiac surgery but cannot serve as evidence supporting systematic strategy of prolonged monitoring without permanent pacing.

KEYWORDS Heart block; Atrioventricular block; Supraventricular tachycardia; Junctional ectopic tachycardia; Cardiac surgery; Congenital heart disease; Ventricular septal defect; Tricuspid valve replacement, infective endocarditis

(Heart Rhythm Case Reports 2023;9:898–901)

Address reprint requests and correspondence: Dr Thibaut Moulin, AP-HP, Hôpital Henri Mondor, Service de Cardiologie, 51 avenue du Maréchal de Lattre de Tassigny, 94000 Créteil, France. E-mail address: thibautmoulin6@gmail.com.

https://doi.org/10.1016/j.hrcr.2023.09.014

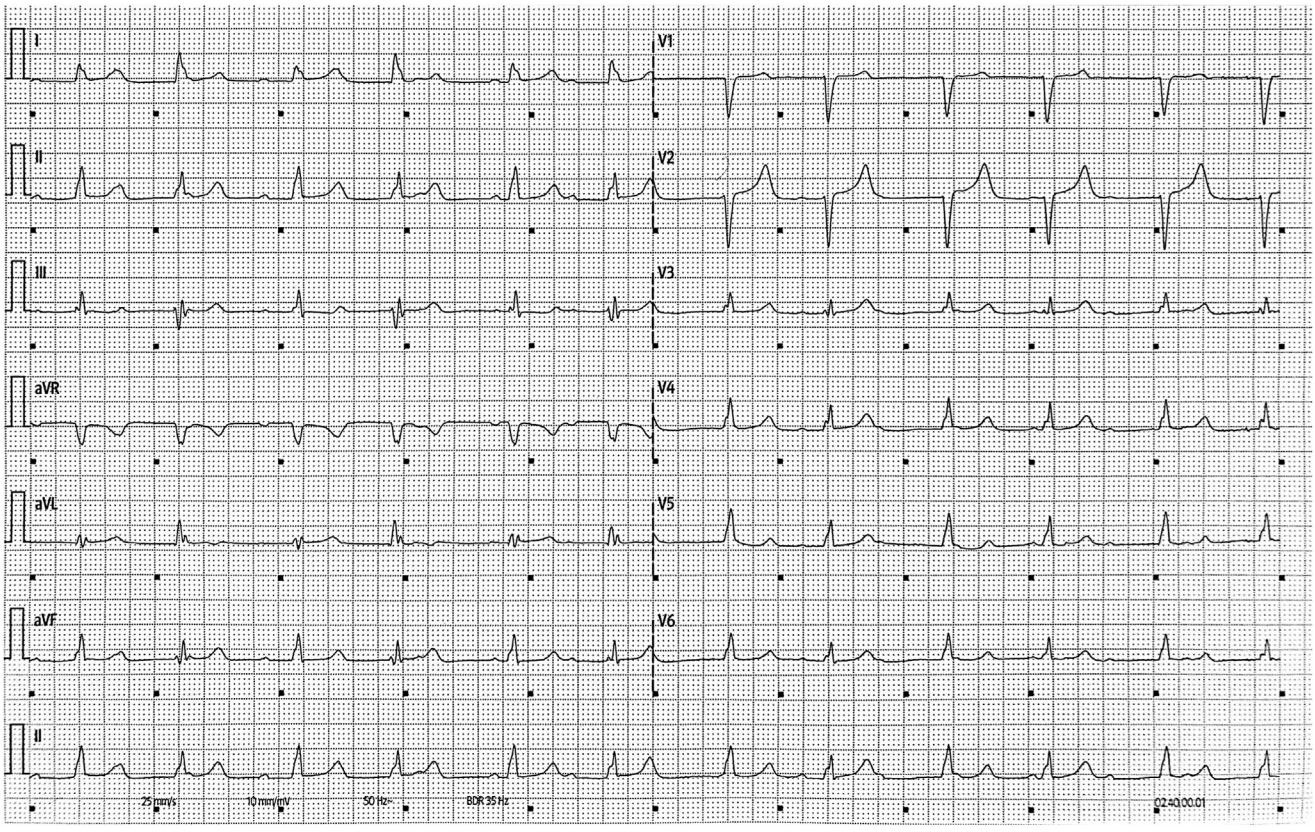

Figure 1 Postoperative electrocardiogram (day 0). Third-degree atrioventricular block with narrow QRS complex escape rhythm at 70 beats/min.

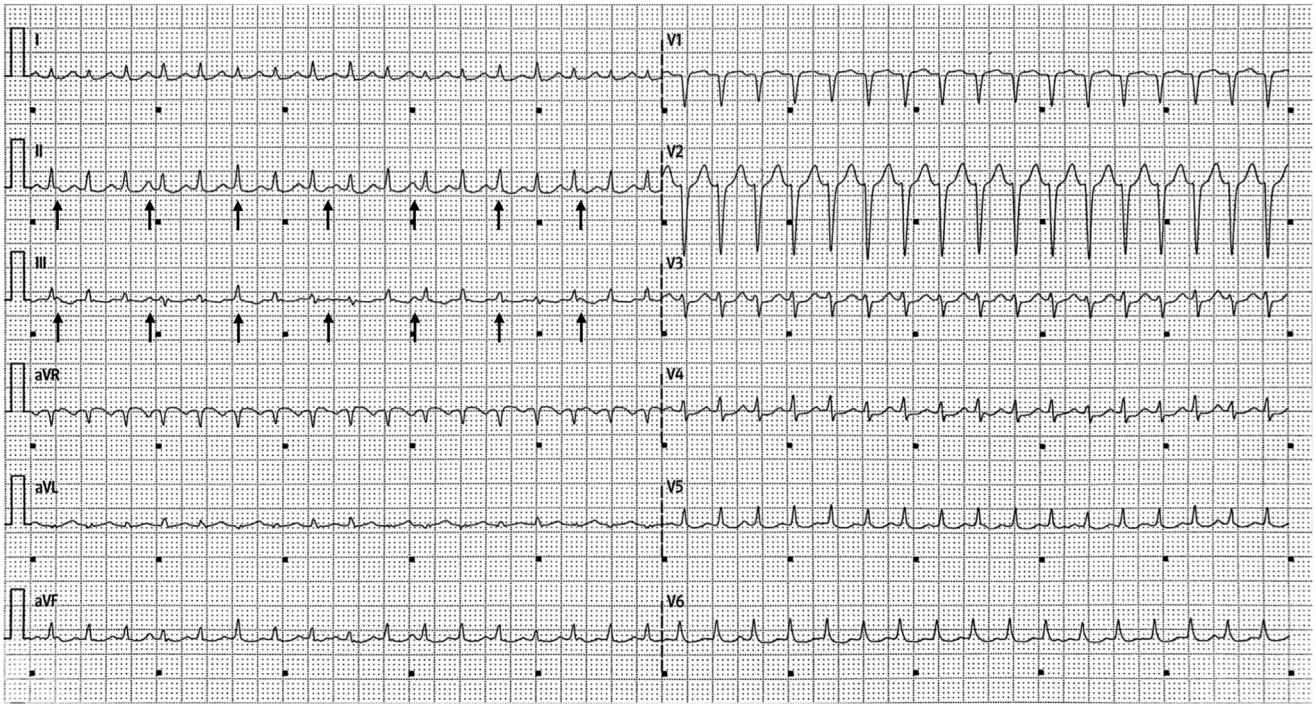

Figure 2 Electrocardiogram of junctional ectopic tachycardia (day 1). Regular narrow QRS complex tachycardia at 205 beats/min with atrioventricular dissociation. Black arrows indicate P waves.

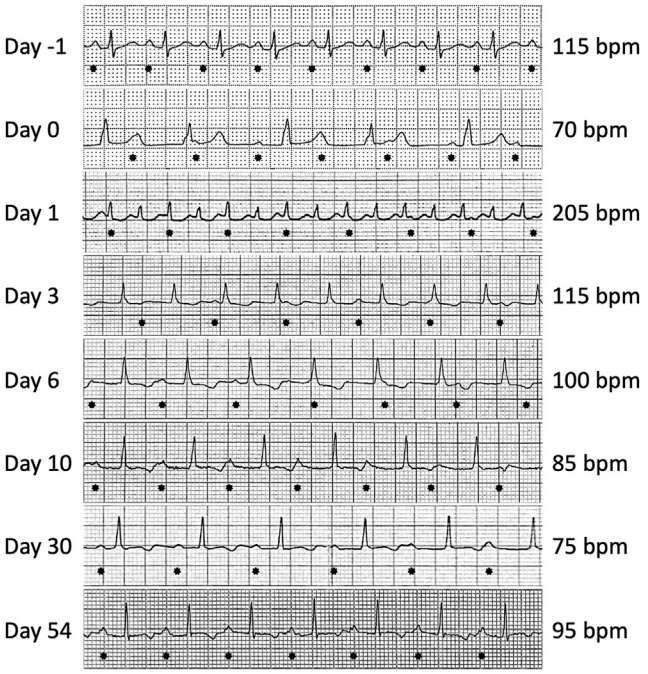

Figure 3 Evolution of electrocardiography (ECG). All ECG samples show lead II. Day 0 designates the day of surgery. Black stars indicate P waves.

The patient was discharged from intensive care unit on day 4. Antiarrhythmic therapy was progressively decreased as the tachycardia slowed. Amiodarone was stopped and ivabradine reduced to 5 mg twice a day on day 4. Accelerated junctional rhythm progressively slowed from 110 to 80 bpm between day 4 and day 11, with persistent AV dissociation (Figure 3). From day 12, monitoring showed persistent third-degree AV block with stable junctional escape rhythm between 70 and 80 bpm. Ivabradine was stopped on day 13 with no recurrence of tachycardia.

Given the good tolerance of the escape rate and the possibility of late recovery of AV conduction, it was collectively decided to delay the implantation of permanent pacemaker. Temporary epicardial pacing electrodes were removed and the patient was transferred to cardiac rehabilitation unit on day 17 with continued 24-hour rhythm monitoring. She did not present any other postoperative complication. Monitoring and iterative ECGs between day 18 and day 53 indicated the persistence of CHB with stable escape rate. Exercise testing on day 51 showed slight acceleration of the escape rhythm from 70 to 85 bpm with exertion. At day 54, ECG showed recovery of AV conduction with normal sinus rhythm at 95 bpm, first-degree AV block, and narrow QRS complex (Figure 3). The patient was discharged from hospital on day 60. At day 95 follow-up visit, ECG finally showed normal sinus rhythm with normal PR interval. After 6-months follow-up, the patient was asymptomatic and did not experience documented recurrence of high-grade AV block or supraventricular tachycardia.

Discussion

JET is a common complication following cardiac surgery for CHD in children. It is caused by abnormal automaticity in the region of the AV node or proximal His bundle. The known risk factors for the occurrence of postoperative JET are operations involving VSD closure, heterotaxy syndrome, use of inotropic drugs, long cardiopulmonary bypass time, high body temperature, and young age.[1–3,5] Occurrence of postoperative JET in adults is uncommon, according to scarce published data. Our case emphasizes that JET can also occur after surgery involving septal defect closure in adulthood and that this complication should be known by adult physicians, as it may lead to severe hemodynamic failure and require urgent specific therapeutics such as antiarrhythmic drugs (amiodarone, beta-blocker, procainamide, and, more recently, ivabradine[6]), sedation, or controlled hypothermia.[1] In our case, oral ivabradine provided an effective slowing of heart rate after failure of intravenous amiodarone and beta-blocker.

An association between JET and postoperative CHB has been commonly described, since both could be the consequence of trauma, ischemia, stretch, or edema in the region.[3] This link has also been noted in other nonsurgical contexts, such as viral myocarditis[7] and congenital JET.[8,9]

In this case, we were able to describe the timeline of late recovery of AV conduction, with a series of ECGs usually not available in patients implanted with pacemaker. Although the optimal duration of monitoring before permanent pacing is not well defined, current guidelines advocate the implantation of permanent pacemaker in case of persistent third-degree AV block following surgical valve replacement or surgery for CHD.[10] Faced with the good tolerance of the escape rate, we collectively decided to extend the duration of in-hospital monitoring before permanent pacing, although no published data provide evidence to support this practice. Nonetheless, late recovery of AV conduction after cardiac surgery is not uncommon. In a meta-analysis of prior studies addressing this endpoint, the rate of recovery ranged from 16% to 42%, with heterogeneity attributable to definition disparities.[11] In the recent study of Kiehl and associates,[12] late recovery of AV conduction, defined as ventricular pacing burden $<10\%$ beyond 1 month postimplant, was observed in 12% of the 301 patients. Pre-existing normal AV conduction, female sex, and transient postoperative conduction were associated with late recovery.[12] Finally, in a study of 72 children who underwent pacemaker implantation for persistent CHB following surgery for CHD, late recovery of AV conduction occurred in nearly 10% of patients at a median time of 41 days, with no late recurrence after a mean follow-up of 4.4 years.[13] However, recovery of AV conduction based on low ventricular pacing burden does not necessarily reflect the possibility of paroxysmal high-grade AV block with potential life-threatening consequences.

Whether the occurrence of JET can predict the recovery of postoperative CHB remains a hypothesis, but this has been suggested in several previous recent publications. Indeed, Ozyilmaz and colleagues[14] reported 4 cases of patients

with early postoperative CHB who subsequently developed JET before recovery of AV conduction (all within the first week). Also, Paech and colleagues[4] showed a significant association between temporary CHB and JET after surgery for CHD. In their study of 1158 operated patients, 56% of those who developed JET had temporary CHB, whereas no JET was reported among patients with permanent CHB. Finally, in the study of Ayyildiz and colleagues,[15] 31 of the 96 patients with postoperative CHB developed JET; of those, 27 had transient CHB and 4 permanent CHB. Based on these data, the expected recovery rate of AV conduction in patients with postoperative CHB associated with JET would be 87%–100%.[4,15] JET would in fact be a marker of transient irritation of the supra-Hisian tissue with integrity of the infra-Hisian region, and therefore could predict future recovery of CHB. Paech and colleagues[4] elegantly compared this phenomenon to what is routinely described during catheter ablation in electrophysiology laboratory, when induction of thermal injury in the supra-Hisian region leads to induction of an accelerated junctional rhythm, whereas ablation in the His bundle/infra-Hisian area leads to permanent AV block without junctional rhythm. Nevertheless, in our case, it must be noted that the delay between the occurrence of JET and the recovery of AV conduction was particularly long, making this hypothesis more uncertain.

Obviously, we lack long-term data on nonimplanted patients after late recovery of AV conduction following cardiac surgery, since almost all patients are implanted before 2 weeks of persistent CHB. Given the risk of recurrence of high-grade AV block or progressive deterioration of AV conduction, close and long-term follow-up is mandatory. Finally, the optimal management of these patients is unclear, but the report of a single case with good outcome does not support a systematic prolonged monitoring strategy without permanent pacing.

Conclusion

We present a rare case of JET associated with postoperative CHB preceding late recovery of AV conduction in a young adult. Although uncommon in adults, JET is a life-threatening complication following cardiac surgery that should be known by the adult physician community. Finally, this report may reinforce the hypothesis that in the presence of CHB following cardiac surgery, occurrence of JET may predict future recovery of AV conduction.

Funding Sources: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Disclosures: The authors have no conflict to disclose.

References

1. Hoffman TM, Bush DM, Wernovsky G, et al. Postoperative junctional ectopic tachycardia in children: incidence, risk factors, and treatment. Ann Thorac Surg 2002;74(5):1607–1611.
2. Mildh L, Hiippala A, Rautiainen P, Pettilä V, Sairanen H, Happonen JM. Junctional ectopic tachycardia after surgery for congenital heart disease: incidence, risk factors and outcome. Eur J Cardiothorac Surg 2011;39:75–80.
3. Walsh EP, Saul JP, Sholler GF, et al. Evaluation of a staged treatment protocol for rapid automatic junctional tachycardia after operation for congenital heart disease. J Am Coll Cardiol 1997;29:1046–1053.
4. Paech C, Dähnert I, Kostelka M, Mende M, Gebauer R. Association of temporary complete AV block and junctional ectopic tachycardia after surgery for congenital heart disease. Ann Pediatr Cardiol 2015;8:14–19.
5. Dasgupta S, Shalhoub K, El-Assaad I, et al. Clinical risk prediction score for postoperative accelerated junctional rhythm and junctional ectopic tachycardia in children with congenital heart disease. Heart Rhythm 2023. S1547-5271(23)00221-7.
6. Arvind B, Kothari SS, Juneja R, et al. Ivabradine versus amiodarone in the management of postoperative junctional ectopic tachycardia: a randomized, open-label, noninferiority study. JACC Clin Electrophysiol 2021;7:1052–1060.
7. Maiers JA, Ebenroth ES. Junctional ectopic tachycardia following complete heart block associated with viral myocarditis. Pediatr Cardiol 2006;27:367–368.
8. Dubin AM, Cuneo BF, Strasburger JF, Wakai RT, Van Hare GF, Rosenthal DN. Congenital junctional ectopic tachycardia and congenital complete atrioventricular block: a shared etiology? Heart Rhythm 2005;2:313–315.
9. Laurent M, Almange C, Biron Y, et al. Junctional ectopic tachycardia in a young woman with chronic complete heart block. Am Heart J 1986;111:597–599.
10. Kusumoto FM, Schoenfeld MH, Barrett C, et al. 2018 ACC/AHA/HRS guideline on the evaluation and management of patients with bradycardia and cardiac conduction delay. Heart Rhythm 2019;16:e128–e226.
11. Steyers CM, Khera R, Bhave P. Pacemaker dependency after cardiac surgery: a systematic review of current evidence. PLoS One 2015;10:e0140340.
12. Kiehl EL, Makki T, Matar RM, et al. Incidence and predictors of late atrioventricular conduction recovery among patients requiring permanent pacemaker for complete heart block after cardiac surgery. Heart Rhythm 2017;14:1786–1792.
13. Batra AS, Wells WJ, Hinoki KW, Stanton RA, Silka MJ. Late recovery of atrioventricular conduction after pacemaker implantation for complete heart block associated with surgery for congenital heart disease. J Thorac Cardiovasc Surg 2003;125:1291–1293.
14. Ozyilmaz I, Ergul Y, Ozyilmaz S, Guzeltas A. Junctional ectopic tachycardia in late period after early postoperative complete atrioventricular block: messenger of return to normal sinus rhythm?: explanation with four case series. J Electrocardiol 2017;50:378–382.
15. Ayyildiz P, Kasar T, Ozturk E, et al. Evaluation of permanent or transient complete heart block after open heart surgery for congenital heart disease. Pacing Clin Electrophysiol 2016;39:160–165.