Junctional Rhythm Preoperatively and During General Anesthesia for Oral and Maxillofacial Surgery

Naotaka Kishimoto, DDS, PhD, Ikue Kinoshita, DDS, and Yoshihiro Momota, DDS, PhD

Department of Anesthesiology, Osaka Dental University, Osaka, Japan

We report a case of junctional rhythm that occurred both preoperatively and later during a portion of general anesthesia. A 19-year-old woman was scheduled to undergo bilateral sagittal split ramus osteotomy after being diagnosed with a jaw deformity. Preoperative electrocardiography (ECG) revealed a junctional rhythm with a slow heart rate (HR). At 90 minutes after anesthesia induction, local anesthesia with 10 mL of 1% lidocaine and 1:100,000 adrenaline was administered. A junctional rhythm appeared 15 minutes after the local anesthesia. We believe that the atrioventricular nodal pacemaker cells accelerated because of the increased sympathetic activity due to the adrenaline. On the preoperative ECG, the junctional rhythm with slow HR appeared as an escaped beat caused by slowing of the primary pacemaker. Therefore, we think that the preoperative junctional rhythm and the junctional rhythm that appeared during general anesthesia were due to different causes. Understanding the cause of a junctional rhythm could lead to more appropriate treatment. We therefore believe that identifying the cause of the junctional rhythm is important in anesthetic management.

Key Words: Junctional rhythm; Arrhythmia; Atrioventricular node; General anesthesia; Adrenaline.

Junctional rhythm is a common arrhythmia that may appear during the perioperative period. It is diagnosed, usually transiently, in about 20% of patients under general anesthesia.¹⁻³ We report our experience with a case in which junctional rhythm was observed preoperatively and again during general anesthesia. We hypothesize that these episodes were due to different causes.

CASE REPORT

A 19-year-old woman (height 159 cm, weight 50 kg) was scheduled to undergo bilateral sagittal split ramus osteotomy after being diagnosed with a jaw deformity. There were no abnormalities on the standard preoperative testing as performed in Japanese dental hospitals, including laboratory blood tests, chest radiography, and spirometry.

However, the 12-lead electrocardiography (ECG) performed about 1 month before the surgery revealed

bradycardia (heart rate [HR] 48 beats per minute [bpm]), junctional rhythm (retrograde inverted P wave in leads II, III, aVF), and a short PR interval (0.117 seconds) (Figure 1). The patient was asymptomatic, with no history of dizziness, fainting, nausea, or exercise limitation. She had no other adverse past medical history and was otherwise healthy. Her preoperative blood pressure was 114/71 mm Hg. Under these circumstances, we decided to proceed with the surgery without further cardiac investigation. No premedication was given, and the patient, although she appeared somewhat nervous, walked into the operating room. ECG before induction of anesthesia showed sinus tachycardia (HR 111 bpm).

General anesthesia was induced with a target-controlled intravenous infusion of propofol 6 µg/mL, an infusion of remifentanyl at 0.3 µg/kg/min, and a bolus of rocuronium 30 mg. After mask ventilation was performed for 3 minutes with oxygen 6 L/min, nasotracheal intubation was performed. General anesthesia was maintained with air 5 L/min, oxygen 1 L/min, target-controlled intravenous infusion of propofol 4.5–5.0 µg/mL, remifentanyl 0.1–0.15 µg/kg/min, and a bolus of fentanyl 250 µg. At 40 minutes after induction of anesthesia, local anesthesia with 12 mL of 1% lidocaine and 1:100,000 adrenaline was administered. Left inferior alveolar nerve block was established first, followed by infiltration anesthesia to the patient's left mandibular

Received July 4, 2016; accepted for publication September 21, 2016.

Address correspondence to Dr Naotaka Kishimoto, Department of Anesthesiology, Osaka Dental University, 1-5-17 Otemae, Chuo-ku, Osaka 540-0008, Japan; kishimoto@cc.osaka-dent.ac.jp.

Anesth Prog 64:165–167 2017 | DOI 10.2344/anpr-64-03-08
© 2017 by the American Dental Society of Anesthesiology

Figure 1. Lead II from a preoperative 12-lead electrocardiogram. The patient's heart rate was 48 beats per minute when the retrograde inverted P wave appeared.

buccal gingiva and left leading edge of the coronoid process. After mandibular split and plate fixation of the left mandibular ramus, 10 mL of the same local anesthetic was administered to the right side using the same method as previously. At 15 minutes after the second injection of local anesthesia, ECG revealed a junctional rhythm. It reverted to normal sinus rhythm 3 minutes later. This pattern (junctional rhythm followed by normal sinus rhythm) then appeared repeatedly every few minutes for the next 30 minutes (Figure 2). During this period, the HR and systolic and diastolic blood pressures were 78–92 bpm, 95–105 mm Hg, and 45–55 mm Hg, respectively. About 1 hour after administration of the second round of local anesthesia, the junctional rhythm disappeared.

DISCUSSION

Junctional rhythm appears when there is (a) high vagal tone; (b) slowing of the primary atrial pacemaker, usually the sinoatrial (SA) node; (c) acceleration of a subsidiary pacemaker; (d) atrioventricular (AV) or SA block; or (e) a combination of causes (b) and (d).^{4,5} Breslow et al⁶ reported a case in which an accelerated junctional rhythm (ventricular rate >60 bpm) during general anesthesia returned to sinus rhythm following intravenous injection of propranolol (a nonselective β -adrenergic blocking agent). They suggested that the accelerated junctional rhythm resulted from acceleration of AV nodal pacemaker cells, as noted in cause (c),

above. The increased automaticity of AV nodal cells is mediated by increased sympathetic activity. Breslow et al⁶ presumed that the junctional rhythm returned to normal sinus rhythm because the SA node regained electrical preeminence resulting from propranolol-suppressed sympathetic activity. Kunimatsu⁷ reported 2 cases of accelerated junctional rhythm induced by adrenaline contained in a local anesthetic administered under general anesthesia. Kunimatsu⁷ suggested that adrenaline may affect AV conductivity.

In the present case, local anesthetic containing adrenaline was administered before the appearance of the accelerated junctional rhythm. We believe that the AV nodal pacemaker cells accelerated because of the increased sympathetic activity due to the adrenaline, as noted in cause (c), above, causing the accelerated junctional rhythm to appear. In contrast, junctional rhythm with a slow HR appeared on the preoperative 12-lead ECG as escaped beats because of slowing of the primary pacemaker, as noted in causes (a) and (b), above. Therefore, we think that the preoperative junctional rhythm and the junctional rhythm that appeared during general anesthesia were due to different causes. We did not know why the patient's primary pacemaker was slow preoperatively. Although it is possible that the patient had some type of SA node disease, we were unable to confirm this, as no cardiac investigation other than 12-lead ECG was conducted preoperatively because the patient was asymptomatic with good blood pressure. Should this patient require surgery under general anesthesia in the future, however,

Figure 2. Electrocardiogram, lead II, during general anesthesia. (A) Normal sinus rhythm changed to a junctional rhythm (normal P wave converted to a retrograde inverted P wave). Heart rate was 85 beats per minute (bpm). (B) Junctional rhythm changed to normal sinus rhythm (retrograde inverted P wave converted to a normal P wave). Heart rate was 80 bpm.

we recommend that she undergo more extensive cardiac investigation.

Junctional rhythm is a benign arrhythmia that usually does not require treatment.^{1–3} Severe hypotension, however, may occur because of decreased ventricular filling caused by loss of contraction of the atrium (atrial kick) when a low nodal junctional rhythm appears during general anesthesia, especially in association with bradycardia.¹ Low nodal junctional rhythm is what appears when the impulse reaches the ventricle first and then the atrium (P wave following the QRS complex or “lost” in the QRS complex).³ The junctional rhythm that appeared during general anesthesia in this case was a high nodal rhythm. High nodal junctional rhythm is what appears when the impulse reaches the atrium before the ventricle (P wave preceding the QRS complex).³ Therefore, the atrial kick is maintained, although it may not be ideally coordinated with ventricular contraction, and the patient’s blood pressure usually remains stable. As our patient was hemodynamically stable, we decided that treatment for this junctional rhythm was unnecessary, and it did, in fact, resolve on its own. There was a report, however, of a case in which high nodal junctional rhythm suddenly changed to low nodal junctional rhythm during general anesthesia.¹ Therefore, it is necessary to carefully observe the P wave position for changes when a junctional rhythm appears. If the patient becomes symptomatic, or, if under anesthesia, exhibits significant hypotension or signs of heart failure, advanced cardiovascular life support protocols⁸ recommend atropine boluses or dopamine or adrenaline infusions. Under anesthesia, other medications such as ephedrine can be considered. We deemed treatment for preoperative and intraoperative junctional rhythms with bradycardia unnecessary as the patient was asymptomatic in both instances.

It has been reported that junctional rhythm can occur with some severe systemic diseases (eg, acute myocardial infarction, unstable angina pectoris, sick sinus syndrome, acute rheumatic fever) and the use of some drugs (eg, digitalis intoxication, following long-term verapamil therapy).^{9,10} Therefore, it is necessary to consider these factors when a junctional rhythm appears, especially if it was not noted preoperatively. Certainly, potent inhalation anesthetics and other anesthetics that suppress sympathetic activity may be causative.

In conclusion, we experienced 2 episodes of junctional rhythm in a patient during the perioperative period that we hypothesize derived from different causes. Understanding the cause of a junctional rhythm could lead to more appropriate treatment, if needed. For example, ephedrine or atropine can be used to treat a junctional rhythm in the presence of a slow HR,³ whereas propranolol or β 1-selective blocker (eg, esmolol) may be effective if an accelerated junctional rhythm appears that requires treatment. We therefore believe that it is important to identify the cause of the junctional rhythm prior to treatment, if possible.

REFERENCES

1. Asakura Y, Mizuno T, Kandatsu N, Fujiwara Y, Akashi M, Komatsu T. Severe hypotension during the development of low-nodal junctional rhythm. *Acta Anaesthesiol Scand*. 2009;53:404–405.
2. Fujiwara Y, Asakura Y, Shibata Y, Nishiwaki K, Komatsu T. A marked decrease in heart rate variability associated with junctional rhythm during anesthesia with sevoflurane and fentanyl. *Acta Anaesthesiol Scand*. 2006;50:509–511.
3. Hillel Z, Landesberg G. Electrocardiography. In: Miller RD, ed. *Miller’s Anesthesia*. 7th ed. Philadelphia, Pa: Churchill Livingstone; 2010:1357–1386.
4. Galindo A, Wyte SR, Wetherhold JW. Junctional rhythm induced by halothane anesthesia: treatment with succinylcholine. *Anesthesiology*. 1972;37:261–262.
5. Gamble YD, Lutin WP, Mathew OP. Non-sinus bradyarrhythmias in very low birth weight infants. *J Perinatol*. 2007;27:65–67.
6. Breslow MJ, Evers AS, Lebowitz P. Successful treatment of accelerated junctional rhythm with propranolol: possible role of sympathetic stimulation in the genesis of this rhythm disturbance. *Anesthesiology*. 1985;62:180–182.
7. Kunitatsu T. Two cases of atrioventricular junctional rhythm induced by administration of regional injection of epinephrine. *Acta Anaesthesiol Scand*. 2004;48:928.
8. Sinz E, Navarro K; American Heart Association. Advanced cardiovascular life support: provider manual. Dallas, Tex: American Heart Association; 2011.
9. Sumida M, Isawa E. Analysis of atrio-ventricular junctional rhythm during general anesthesia [in Japanese]. *J Jpn Soc Clin Anesth*. 1994;14:499–507.
10. Walker WS, Winniford MD, Mauritsen DR, Johnson SM, Hillis LD. Atrioventricular junctional rhythm in patients receiving oral verapamil therapy. *JAMA*. 1983;249:389–390.