ral catheters. Furthermore, patients should be told to contact the anesthesia department immediately if they encounter any difficulty during catheter removal.

Quang Dieu De Tran MD FRCPC

Aida Gordon MD FRCPC

Juan Francisco Asenjo MD

Juan Carlos de la Cuadra-Fontaine MD

Montreal General Hospital, McGill University Health Centre, Montreal, Canada

E-mail: de_tran@hotmail.com

References

- 1 Wilson JL, Brown DL, Wong GY, Ebman RL, Cahill DR. Infraclavicular brachial plexus block: parasagittal anatomy important to the coracoid technique. *Anesth Analg* 1998; 87: 870–3.
- 2 Lee BH, Goucke CR. Shearing of a peripheral nerve catheter. *Anesth Analg* 2002; 95: 760–1.
- 3 Offerdahl MR, Lennon RL, Horlocker TT. Successful removal of a knotted fascia iliaca catheter: principles of patient positioning for peripheral nerve catheter extraction. *Anesth Analg* 2004; 99: 1550–2.
- 4 MacLeod D. Knotted peripheral nerve catheter (Letter). *Reg Anesth Pain Med* 2003; 28: 487–8.
- 5 Hubner T, Gerber H. Knotting of a catheter in the plexus brachialis. A rare complication (German). *Anaesthesist* 2003; 52: 606–7.

Effectiveness of bolus landiolol on paroxysmal atrial tachycardia

To the Editor:

Landiolol is a β -adrenergic receptor antagonist with a short elimination half-life which has recently been developed.^{1,2} We and others have documented its efficacy as a β -adrenergic receptor antagonist, when administered as an iv bolus.^{3,4} Here, we show that an elderly patient with paroxysmal atrial tachycardia was successfully treated with bolus landiolol iv.

An 84-yr-old male patient (161 cm, 68 kg) was scheduled for repair of a right femoral fracture under spinal anesthesia. His preoperative electrocardiogram showed a complete right bundle-branch block, and he had a history of palpitations. Holter monitoring demonstrated frequent supraventricular arrhythmias, and these were successfully treated with the class Ia antiarrhythmic agent cibenzoline 150 mg·day⁻¹ before surgery. Spinal anesthesia was performed using isobaric bupivacaine 15 mg at L3/4. Thirty minutes later, he abruptly became tachycardic (190 beats·min⁻¹) and was

FIGURE Electrocardiogram: (a) before spinal anesthesia; (b) immediately before the administration of landiolol; (c) nine minutes after initial administration of landiolol 5 mg iv (total 15 mg iv for nine minutes).

treated with cibenzoline 70 mg iv over two minutes. Until that time, his blood pressure and heart rate had been stable (140–160/90–100 mmHg and 110–115 beats·min⁻¹, respectively). However, the tachycardia did not respond to this treatment. We subsequently administered three boluses of landiolol 5 mg iv (over ten seconds each). After a cumulated 15 mg iv dose of landiolol, his heart rate decreased to 95 beats·min⁻¹, normal sinus rhythm (Figure), without any hypotensive episode (blood pressure 135/90 mmHg). The remainder of the anesthetic was uneventful, whereas two hours after surgery, he again suffered a similar episode of tachycardia, for which cibenzoline 30 mg iv was ineffective. In this instance, iv volume replacement therapy including blood transfusion gradually restored normal heart rate.

Bolus landiolol (0.1–0.3 mg·kg⁻¹ iv) is effective to prevent tachycardia in response to tracheal intubation without affecting blood pressure.³ For our patient, we administered the higher dose of landiolol to treat the tachyarrhythmia. This drug was effective without inducing hypotension even in such an elderly patient. Importantly, the arrhythmia we managed was insensitive to a class Ia antiarrhythmic agent, indicating that landiolol can be used as an alternative when tachyarrhythmia is refractory to conventional therapy.

Hiroiyuki Kinoshita MD PhD
 Tetsuya Kakutani MD
 Kazuhiro Mizumoto MD PhD
 Yoshio Hatano MD PhD
 Wakayama Medical University, Wakayama, Japan
 E-mail: hkinoshi@pd5.so-net.ne.jp

References

- 1 Muraki K, Nakagawa H, Nagano N, et al. Effects of ONO-1101, a novel beta-antagonist, on action potential and membrane currents in cardiac muscle. *J Pharmacol Exp Ther* 1996; 278: 555–63.
- 2 Sasao J, Tarver SD, Kindscher JD, Taneyama C, Benson KT, Goto H. In rabbits, landiolol, a new ultra-short-acting beta-blocker, exerts a more potent negative chronotropic effect and less effect on blood pressure than esmolol. *Can J Anesth* 2001; 48: 985–9.
- 3 Yamazaki A, Kinoshita H, Shimogai M, et al. Landiolol attenuates tachycardia in response to endotracheal intubation without affecting blood pressure. *Can J Anesth* 2005; 52: 254–7.
- 4 Nishina K, Mikawa K, Yonemoto Y, Sugimoto Y. The efficacy of bolus administration of landiolol for attenuating tachycardia in pheochromocytoma. *Anesth Analg* 2004; 98: 876–8.

Mean arterial blood pressure estimation and its limitation

To the Editor:

Mean arterial blood pressure (MAP) has clinical and physiologic significance in both the representation of perfusion pressure and its utilization in the calculation of hemodynamic variables. The accurate MAP is defined as the zero frequency (direct current) component following Fourier analysis of the arterial waveform,¹ or as the time-weighted integral of the instantaneous pressures derived from the area under the curve of the pressure-time.² However, clinicians have yet to find an easier way that may be applied in clinical practice. Some researchers continue to investigate more accurate MAP estimation methods.^{2–4}

Even though we sometimes forget the limitations in using these equations,⁵ we should keep in mind that they will not have the same MAP if they have different arterial pressure waveform morphologies, no matter what are the causes of the differences.¹ The following is an example.

We analyzed a patient's direct arterial blood pressure data, which was continuously checked by an anesthesia monitor, sampled at 250 Hz, and stored in

FIGURE Different mean arterial pressures (MAP) of one patient. The X-axis is arbitrary time; the Y-axis is blood pressure in mmHg. Both readings have the same systolic and diastolic pressures, but have a 10 mmHg difference in MAP.

a computer through analogue output. The data length was about one hour. We divided the data in two-second intervals, so the total data sections numbered around 1,800. In each section, we calculated the mean using the Fourier transformations by a computer software program (Matlab®, Natick, MA, USA). The maximum difference of MAP within the same systolic arterial pressure and diastolic arterial pressure pairs was sought. We then compared the two waveforms with the maximum MAP difference. The MAP differences were originated mainly from, in my case, an early reflected wave (Figure). However, there may be other sources of waveform differences, for example, the existence of a dicrotic notch, high inotropic pressure pulse,⁶ and a double dicrotic notch.

As clinicians, we need an easily calculable determinant of MAP, but we should understand its limitations as applied to clinical practice, especially where the arterial waveform could be different from the one used to derive the simplified equation. Factors which may alter arterial waveform, and hence MAP determination include increasing age, atherosclerosis, and changes in blood volume status.

Wonsik Ahn MD
 Young Jin Lim MD
 Seoul National University Hospital, Seoul, South Korea
 E-mail: aws@snu.ac.kr