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Correspondence

Electrical velocimetry elucidates the hemodynamics of hypertension caused by indigo carmine

To the Editor:

In a recent letter to the *Journal of Clinical Anesthesia*, pulse contour analysis was used to observe an increase in systemic vascular resistance (SVR) caused by intravenous (IV) indigo carmine [1]. In this letter the use of electrical velocimetry (a type of impedance cardiography) describes a similar response in another patient.

An anxious 34 year old, G11 P10 woman presented in labor for repeat cesarean section. Her medical history and laboratory values were unremarkable. At 09:25 a combined spinal epidural was performed with intrathecal bupivacaine 12 mg, fentanyl 25 μg, and morphine 100 μg. The epidural catheter was never injected. Cutaneous block to cold sensation was achieved to the T5 level, and a vigorous infant was delivered at 09:56.

When the patient was informed that surgery would be prolonged due to bladder injury, she became more anxious and she and her husband insisted that she be put to sleep, despite the fact that she felt no pain. Intravenous fentanyl 75 μg, propofol 170 mg, and succinylcholine 120 mg were administered, and at 11:18 the trachea was intubated. Anesthesia was maintained with 70% nitrous oxide in oxygen and midazolam 2.0 mg was administered at 11:22. No potent inhaled agents were used. At 11:30 IV indigo carmine 5 mL was given for visualization of the ureteral orifices at

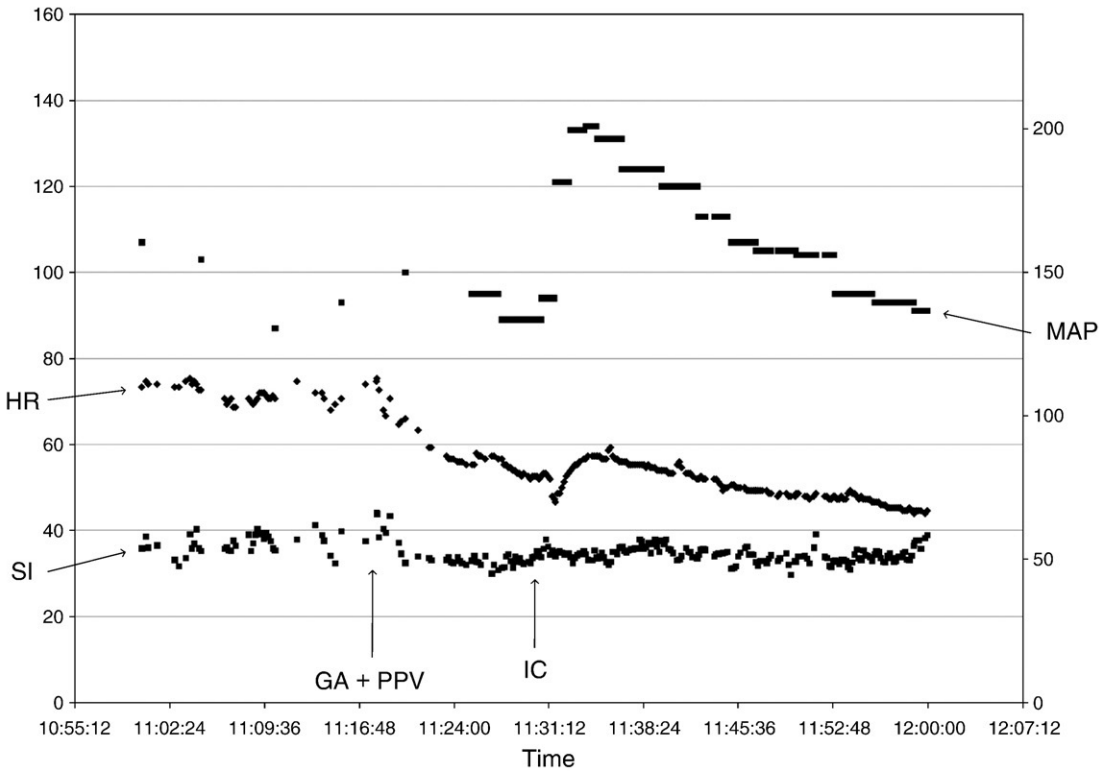

Fig. 1 Mean arterial pressure [MAP (mmHg) right scale], heart rate [HR (beats/min) left scale], and stroke index [SI (mL/beat.m^2) left scale] with general anesthesia (GA), positive pressure ventilation (PPV), and indigo carmine (IC).

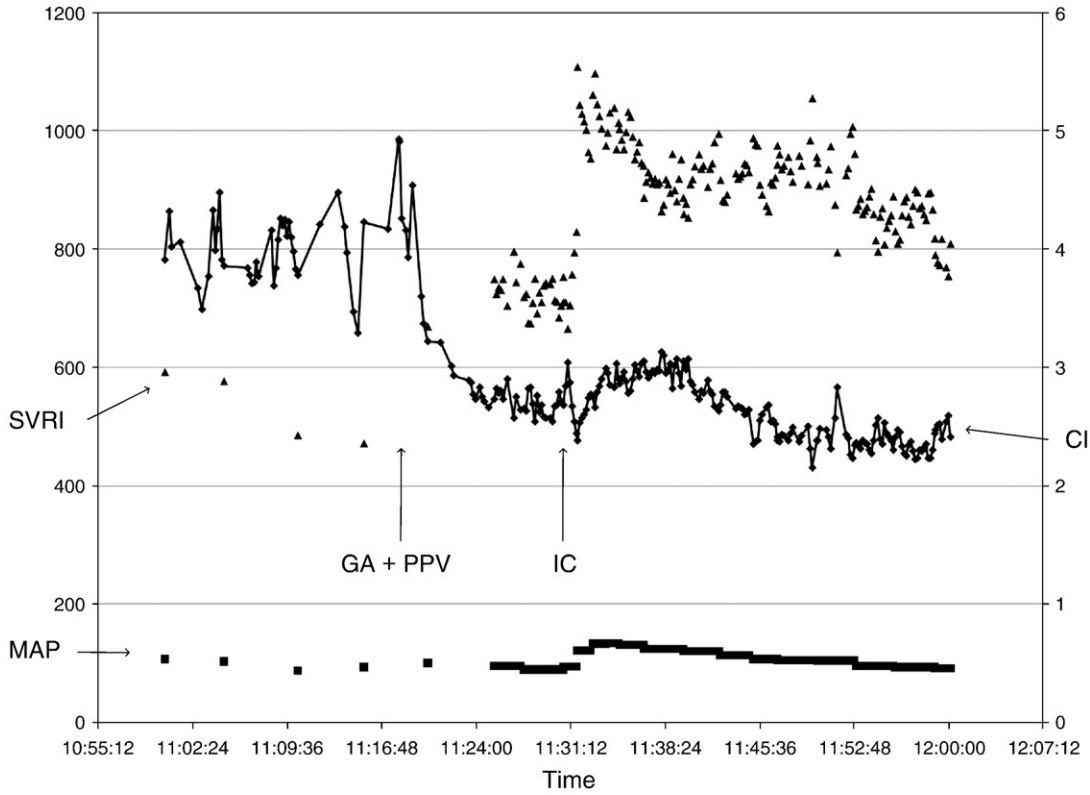

Fig. 2 Mean arterial pressure [MAP (mmHg) left scale], cardiac index [CI (L/min.m2) right scale], and systemic vascular resistance index [SVRI (dyne.cm/sec^5) left scale] with general anesthesia (GA), positive pressure ventilation (PPV), and indigo carmine (IC).

cystoscopy. Subsequent hypertension was treated with propofol 120 mg in divided doses from 11:33 until 11:40.

Figs. 1 and 2, derived from the Aesculon system (Cardiotronic, La Jolla, CA, USA), present the hemodynamics of two events: 1) After induction of general anesthesia, intubation, and positive pressure ventilation, decreases in heart rate (HR), stroke index (SI), and cardiac index (CI) are observed. 2) The administration of indigo carmine is associated with large increases in mean arterial blood pressure (MAP) and systemic vascular resistance index (SVRI), and a small increase in CI.

A previous report [1] showed similar changes in MAP and SVRI, with a CI that decreased only slightly. Cardiac index was apparently maintained in these two young patients with presumed good myocardial function, despite a large increase in the SVR component of afterload. One might speculate that CI was maintained either because of indigo carmine-induced venoconstriction causing enhanced venous return, or because of a positive inotropic effect of indigo carmine. In contrast, Yang et al. [2] reported a 68 year old patient with coronary artery disease and an ejection fraction of 24%, in whom indigo carmine caused a large increase in MAP and SVRI and a decrease in cardiac output from 3.1 to 1.7 L/min, measured with a thermodilution pulmonary artery catheter.

Electrical velocimetry is a relatively new type of impedance cardiography in which the thoracic impedance changes during the cardiac cycle are attributed to changes in blood velocity within the aorta [3]. The area under the calculated velocity-time curve (stroke distance) is multiplied by the estimated aortic diameter to obtain an estimated stroke volume [4]. There have been both favorable [5-7] and unfavorable [8] validation studies of this technology.

Because it is completely noninvasive, requiring only that four electrocardiograph-type patches be applied to the left side of the neck and chest, electrical velocimetry may be useful in alerting clinicians to important hemodynamic trends. More research with this technology is justified.

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References

[1] Archer TL. Like methylene blue, indigo carmine might counteract vasoplegia: hemodynamic evidence obtained with pulse contour analysis. J Clin Anesth 2009;21:544-6.

[2] Yang J, Monk TG, White PF. Acute hemodynamic effects of indigo carmine in the presence of compromised cardiac function. J Clin Anesth 1991;3:320-3.

[3] Osypka MJ, Bernstein DP. Electrophysiologic principles and theory of stroke volume determination by thoracic electrical bioimpedance. AACN Clin Issues 1999;10:385-99.
[4] Archer TL, Funk DJ, Moretti E, Gan TJ. Stroke volume calculation by esophageal Doppler integrates velocity over time and multiplies this "area under the curve" by the cross sectional area of the aorta. Anesth Analg 2009;109:996.
[5] Tomaske M, Knirsch W, Kretschmar O, et al; Working Group on Non-invasive Haemodynamic Monitoring in Paediatrics. Cardiac output measurement in children: comparison of Aesculon cardiac output monitor and thermodilution. Br J Anaesth 2008;100:517-20.
[6] Zoremba N, Bickenbach J, Krauss B, Rossaint R, Kuhlen R, Schälte G. Comparison of electrical velocimetry and thermodilution techniques for the measurement of cardiac output. Acta Anaesthesiol Scand 2007;51:1314-9.
[7] Schmidt C, Theilmeier G, Van Aken H, et al. Comparison of electrical velocimetry and transoesophageal Doppler echocardiography for measuring stroke volume and cardiac output. Br J Anaesth 2005;95:603-10.
[8] Heringlake M, Handke U, Hanke T, et al. Lack of agreement between thermodilution and electrical velocimetry cardiac output measurements. Intensive Care Med 2007;33:2168-72.

Spinal cord injury without severe pain in an awake patient during computed tomography-guided celiac plexus block

To the Editor:

Celiac plexus block, which has been widely used for intra-abdominal cancer pain, is usually performed by insertion of a needle using a paravertebral approach. If an obstacle is encountered, the needle may be inserted through the intervertebral disc [1]. The inadvertent insertion of a needle into the spinal cord during computed tomography (CT)-guided celiac plexus block, which fortunately caused no severe pain, is presented.

A 60 year-old man with unresectable advanced pancreatic cancer was referred to the pain clinic. The patient had severe right back pain and he refused to take morphine because of nausea and vomiting. CT-guided celiac plexus block by the posterior approach was planned. The patient was placed in a prone position on a CT table. CT indicated that it would be difficult to insert a needle by the paravertebral approach to the right anterolateral wall of the aorta or retrocrural space, because the needle could enter the pleural cavity. Therefore, a left-sided block using the paravertebral approach at the level of the L_1 vertebra was performed. After a CT image was obtained, needle entry site and depth, insertion course, and blocking point were all determined using implemented software. When the needle tip was positioned in the left retrocrural space, 5 mL of 2% lidocaine (mixed with contrast medium) was injected. Repeat CT showed that contrast medium extended only within the left retrocrural space, and there was no pain relief. Therefore, a trans-intervertebral disc block was performed by placing the needle tip to the right anterolateral wall of the aorta or retrocrural space. After local anesthesia, a 22-gauge needle was inserted uneventfully until the needle was inserted up to half of the length of the desired depth. The CT scan at this point showed that the needle was penetrating the spinal cord (Fig. 1). The needle was removed immediately and the procedure abandoned. The patient had felt light numbness in the right inguinal area for a day, and the symptoms disappeared on the next day without any permanent neurologic complications.

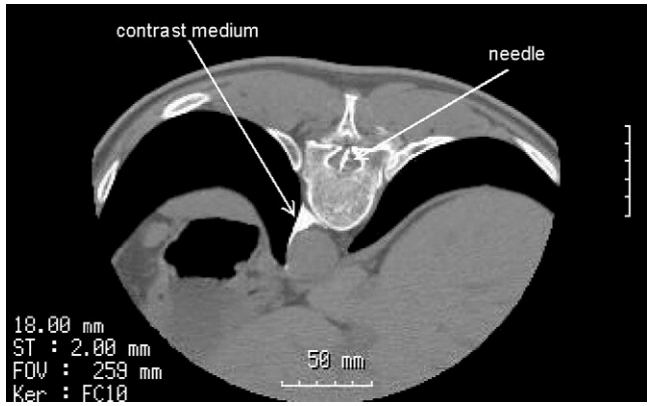

Fig. 1 Computed tomography (CT) of the L1 area. A needle, which was inserted from the right side to perform a celiac plexus block, was inadvertently inserted into the spinal cord. The spread of contrast medium of the first injection through the left-sided needle remained only in the left retrocrural space.

A fully awake patient may not feel severe pain, even if a needle is inadvertently inserted into the spinal cord. Pounder et al. [2] reported that patients describe neither pain nor paresthesia during percutaneous cervical cordotomies. Severe neurological damage associated with spinal cord damage might have occurred if a neurolytic agent had been injected. A CT–guided trans-intervertebral disc block is useful, especially in patients in whom the paravertebral approach is difficult due to obstruction (organs or tumor) preventing optimal needle insertion [3]. Neverthless, there is a potential risk of spinal cord injury without causing severe pain.

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References

[1] Ina H, Kitoh T, Kobayashi M, Imai S, Ofusa Y, Goto H. New technique for the neurolytic celiac plexus block: the transintervertebral disc approach. Anesthesiology 1996;85:212-7.
[2] Rathmell JP, Gallant JM, Brown DL. Computed tomography and the anatomy of celiac plexus block. Reg Anesth Pain Med 2000;25:411-6.
[3] Pounder D, Elliott S. An awake patient may not detect spinal cord puncture. Anaesthesia 2000;55:194.