J Anesth (1995) 9:185–187

Journal of
Anesthesia

Clinical reports

Unusual circulatory responses in a case of acute idiopathic pandysautonomia

MASASHI KAWAMOTO, KENGO NISHIOKA, FUMIHIKO UESUGI, AYA KOBAYASHI, and OSAFUMI YUGE

Department of Anesthesiology and Critical Care Medicine, Hiroshima University School of Medicine, 1-2-3 Kasumi, Minami-ku, Hiroshima, 734 Japan

Key words: Pandysautonomia, Heart rate variability

Introduction

Acute idiopathic pandysautonomia (AIP) is usually manifested as a depletion of peripheral nerve fibers anatomically and as an unusual autonomic reflex functionally [1,2]. As the disorder is infrequent, it has not been given much consideration by anesthesiologists. During isoflurane general anesthesia, we observed a unique pressure-heart rate relation against repeated manipulations of an inflatable tourniquet and vasoactive agents. We analyzed the power spectra of the cardiographic R-R intervals to clarify the reason for these unusual circulatory responses.

Case report

A 23-year-old man weighing 53 kg was scheduled to receive an autologous transplantation of vascularized bone from the right femur to the left humerus because of pseudoarthrosis of the left humerus. Preoperatively, he had low-grade fever, nausea, constipation and diarrhea, anhidrosis, and frequent orthostatic hypotension with syncope. There were no abnormal findings in routine laboratory examinations. When he was 19 years old, he was diagnosed with AIP [3], as autonomic function tests had disclosed low-grade fever, hypalgesia of the limbs, impaired tendon reflexes, nausea, constipation and diarrhea, anhidrosis, orthostatic hypotension with syncope, absence of vasopressor effects on cold pressor test, no overshoot with the Valsalva maneuver, low plasma levels of norepinephrine at rest, no norepinephrine response on tilting, and impaired response to a small dose of norepinephrine infusion, suggesting a sympathetic post-ganglionic anomaly. The parasympathetic nervous functions were assumed to be intact. Microscopic examination revealed depletion of small myelinated and unmyelinated fibers with axonal degeneration on the sural nerve biopsy specimen, which corresponded with the sensory and autonomic disturbances. He was medicated thereafter with midodrine, an α_1–agonist.

After premedication with hydroxyzine 50 mg and atropine 0.5 mg, a peripheral venous line was secured and a radial arterial catheter was placed in the operating room. Routine patient monitors such as rectal temperature, ECG, and pulse oximeter were started. Hemodynamic recording was begun onto a digital data recorder. General anesthesia was intravenously induced with fentanyl 0.4 mg, midazolam 3 mg, and thiopental 150 mg, followed by vecuronium 5 mg to facilitate endotracheal intubation. After induction was completed, artifical ventilation was initiated with 66% N_2O in O_2 and isoflurane ranging from 0.5% to 1.0%. Endtidal CO_2 was maintained within 30–35 mmHg. Hypotension below 80 mmHg systolic arterial pressure (AP) was subjected to pressor treatment. Inflatable tourniquets were attached on the right upper arm and the left thigh for bloodless surgery.

Against hypotension after induction (Fig. 1), repeated bolus injections of ephedrine, 20 mg in total, were given, by which no pressor effect was shown (Fig. 2). Phenylephrine, 0.1 mg, was effective. On each tourniquet release (Fig. 2), ephedrine and/or phenylephrine were given. Intraoperative manipulation of the arm tourniquet was repeated twice and the leg tourniquet thrice. The arm tourniquet inflation lasted 110 min and 20 min. Continuous infusion of dopamine 3 $\mu g \cdot kg^{-1} \cdot min^{-1}$ raised the heart rate (HR) by 10 bpm and systolic

Address correspondence to: M. Kawamoto
Received for publication on September 5, 1994; accepted on October 28, 1994

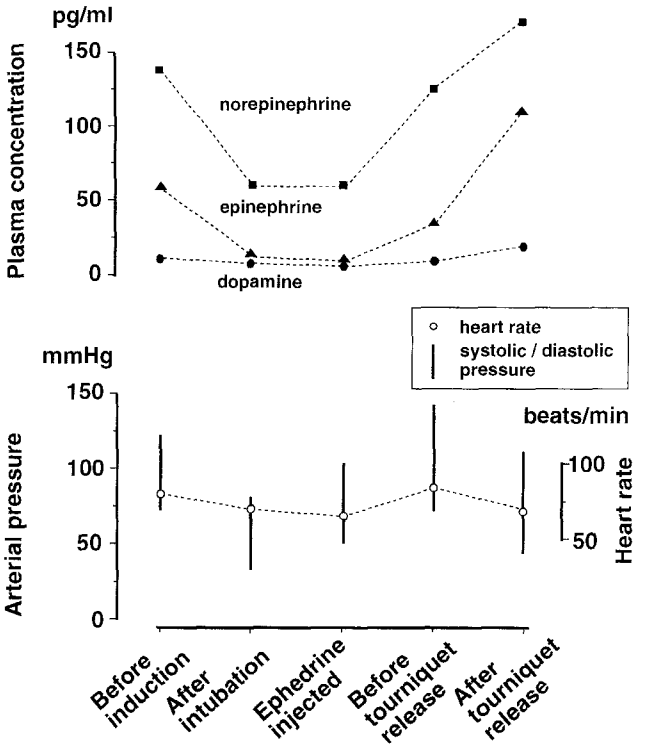

Fig. 1. Changes in plasma catecholamine levels (*upper part*) and circulatory variables (*lower part*)

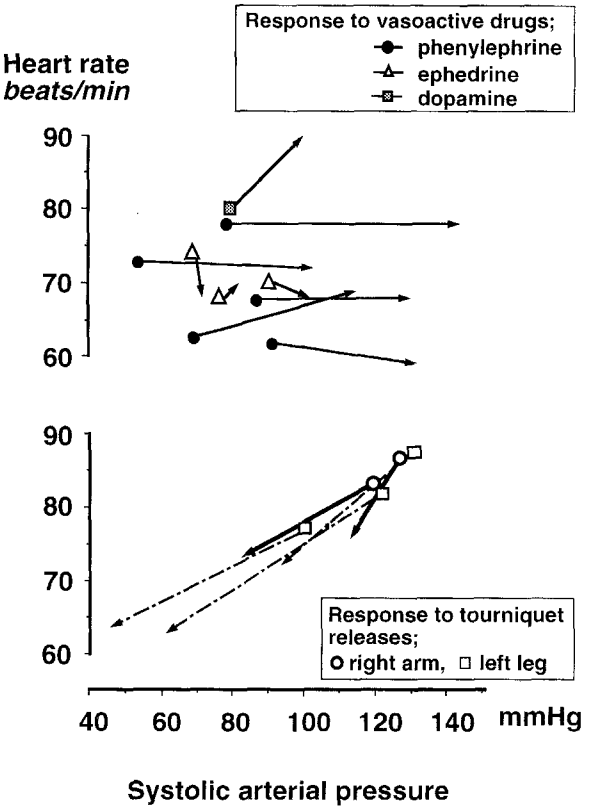

Fig. 2. Changes in pressure-heart rate relation in response to administration of vasoactive agents (*upper part*) and leg and arm tourniquet releases (*lower part*). Arm tourniquet was released twice and thigh tourniquet thrice. Changes in values are shown by arrows

AP by 20 mmHg. No hypotension was observed thereafter.

Arterial blood samples were taken to determine the plasma catecholamine levels (Fig. 1). With a warming blanket, his body temperature was kept between 36.0°C and 36.9°C throughout the procedure. Intraoperative fluid balance was 5380 ml of lactated Ringer's solution infused, blood loss was 280 ml, and urine output was 1780 ml. His recovery from anesthesia was uneventful except for hypertension up to 180 mmHg systolic AP and tachycardia to 110 bpm on extubation. Infusion of dopamine was then ceased. His recovery was uneventful and he was transferred to an orthopedic ward. The anesthetic management lasted for 10.5 h.

Power spectral analysis of R-R intervals was made according to the previous report [4]. Continuously recorded 256-s ECG data were played back and digitized at 500 Hz to make R-R interval tachograms, which were sampled at 4 Hz and subjected to power spectral analysis using fast Fourier transformation. Under the spectral curve area at each low (Lo: 0.01–0.15 Hz) and high (Hi: 0.15–0.4 Hz) frequency bands were integrated to ascertain sympathetic and parasympathetic nervous activity, respectively. Their common logarithm and Hi:Lo ratio were calculated to show the relative balance of the cardiac autonomic nervous system (CANS). The following was shown to have occurred intraoperatively by this method: increased parasympathetic nervous activity, decreased sympathetic activity, and increased Hi:Lo ratio suggesting vagotonia (Fig. 3).

Discussion

Postganglionic fibers of sympathetic efferent pathways are depleted in AIP. Thus, sympathetic nerve dysfunction will play an important role in clinical manifestations, such as postural hypotension without changes in heart rate leading to orthostatic syncopal episodes, intestinal and urinary dysfunction leading to constipation with diarrhea and urinary retention, loss of sweating, and ocular abnormalities. Complete vagal and almost complete β-sympathetic nerve dysfunction of the heart may lead to postural hypotension and fixed rate tachycardia [1,2].

In this case, preoperative interest was focused on the effects of vasoactive agents and circulatory responses against tourniquet manipulations, as repeated tourni-

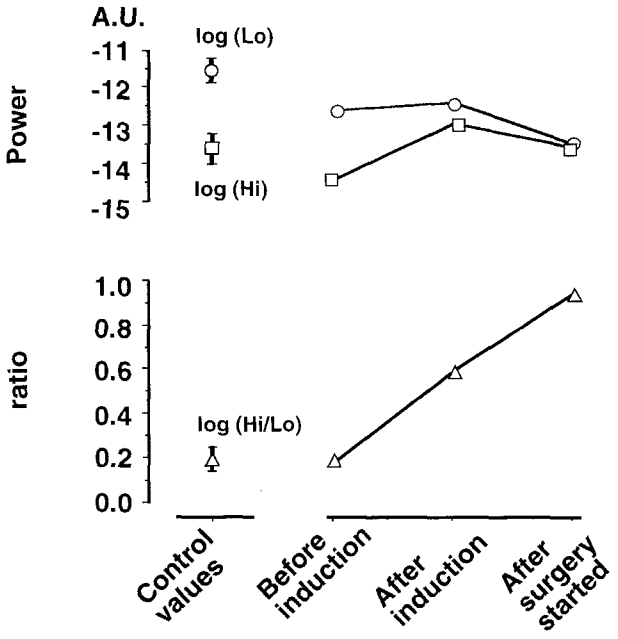

Fig. 3. Changes in spectral components determined by power spectral analysis of heart rate variability. Preoperative control values were obtained from ten patients without circulatory disorders. The values are presented as mean ± SE. A.U., arbitrary unit

quet releases are required in this type of surgery. In normal patients without cardiovascular diseases, circulatory responses against tourniquet release are mainly decreases in AP and less changes in HR [5]. A decrease in AP is most serious in older patients and in patients undergoing long-duration surgery [5]. In this case, hypotension and bradycardia were apparent even after deflation of the arm tourniquet. It was considered that dysfunction of autonomic reflex activity evidenced by anatomical deficiency and degeneration of peripheral nerve fibers would aggravate the circulatory depression after tourniquet release, although normal pressor responses would be somewhat preserved (Fig. 2).

Ephedrine and phenylephrine are commonly used for clinical practice [6]. Ephedrine, a stimulant on both α and β receptors, owes part of its peripheral action to the release of intrinsic norepinephrine. Phenylephrine has a direct stimulating effect on α_1-receptor without effecting β receptor. Throughout the procedure in this case, hypotension after tourniquet release was treated mainly with phenylephrine only, as ephedrine was not effective. Low plasma levels of norepinephrine would be partly due to the ineffectiveness of ephedrine, because ephedrine is a direct adrenergic agonist and an indirect inducer of norepinephrine from peripheral sympathetic neurons (Fig. 1). Bradycardia following phenylephrine was absent. In ordinary responses, ephedrine increases both HR and AP and phenylephrine causes reflex bradycardia. Dopamine was effective in maintaining the circulation by raising HR and AP.

Power spectral analysis of HR variability is useful to show the condition of the cardiac autonomic nervous system during general anesthesia [7]. Although the activity in the CANS is depressed by anesthetics [7,8], the CANS function is preserved to maintain circulation. Increased parasympathetic activity and impaired sympathetic nervous tone were apparent with this spectral analysis [8]. Relatively increased parasympathetic activity in the CANS appearing as Hi:Lo ratio would be another part of the bradycardia mechanism. Namely, we considered that the sympathetic dysfunction would have not responded enough to arm and thigh tourniquet releases.

We suggest that AIP is unique in its responses to vasoactive agents and tourniquet releases during general anesthesia, and that sympathetic dysfunction in the CANS may deteriorate these responses.

References

1. Appenzeller O, Kornfeld M (1973) Acute pandysautonomia. Clinical and morphological study. Arch Neurol 29:334–339
2. Guidi L, Zeppilli P, Sassara M, Ghirlanda G (1981) Alterazioni del controllo autonomotropo cardiovascolare in un caso di pandisautonomia acuta con remissione clinica. G Ital Cardiol 11:1151–1159
3. Sannomiya K, Kudo Y, Mori T, Nakazato O, Okajima T (1989) A case of acute idiopathic pandysautonomia. Rinsho Shinkeigaku 29:895–900
4. Kawamoto M, Tanaka N, Takasaki M (1993) Power spectral analysis of heart rate variability after spinal anaesthesia. Br J Anaesth 71:523–527
5. Jacobsen J, Rorsgaard S, Secher NH (1986) Bradycardia during hypotension following release of a tourniquet in orthopaedic surgery. Acta Anaesthesiol Scand 30:511–514
6. Aviado DM (1959) Cardiovascular effects of some commonly used pressor amines. Anesthesiology 20:71–97
7. Kato M, Komatsu T, Kimura T, Sugiyama F, Nakashima K, Shimada Y (1992) Spectral analysis of heart rate variability during isoflurane anesthesia. Anesthesiology 77:669–674
8. Galletly DC, Westenberg AM, Robinson BJ, Corfiatis T (1994) Effect of halothane, isoflurane and fentanyl on spectral components of heart rate variability. Br J Anaesth 72:177–180