

Report

Experience with Epidural and Spinal Anesthesia in a Patient with Severe Bilateral Stenosis of the Internal Carotid Arteries Who Underwent Resection of the Transverse Colon

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We describe a 74-year-old man with cancer of the transverse colon and severe bilateral stenosis of the internal carotid artery who underwent a colectomy. Magnetic resonance imaging and angiography revealed 95% stenosis of the left internal carotid artery and 50% stenosis of the right internal carotid artery. The patient was scheduled to undergo resection of the transverse colon. Because there was a risk of cerebral ischemia during surgery, the patient received spinal and epidural anesthesia rather than general anesthesia. Blood pressure decreased transiently during the operation, but immediately responded to bolus injections of ephedrine and phenylephrine. The bispectral index was monitored to evaluate the intraoperative awareness level, and transcutaneous cerebral oxygen saturation was monitored to assess regional cerebral blood flow. These values changed little during surgery. After surgery, there was no evidence of a new stroke or neurologic symptoms. In this patient with advanced cerebrovascular disease, spinal and epidural anesthesia was useful because it allowed consciousness and neurologic symptoms to be monitored and contributed to the maintenance of stable hemodynamics, as well as the prevention and early detection of cerebral infarction during surgery.

Key words: internal carotid artery stenosis, resection of transverse colon, anesthetic management

Introduction

Stenosis of the internal carotid artery is responsible for about 20% of all cases of cerebral infarction and transient cerebral ischemia¹⁾. In recent years, the westernization of dietary patterns in Japan has led to an increased prevalence of internal carotid stenosis. We describe our experience with a patient who had severe bilateral stenosis of the internal carotid arteries and cancer of the transverse colon. He was scheduled to undergo resection of the transverse colon and received a combination of epidural and spinal anesthesia to allow monitoring of consciousness and neurologic symptoms during surgery.

Case report

A 74-year-old man was admitted to the department of internal medicine in Tokyo Women's Medical University Medical Center East because of dysarthria. A computed tomographic scan of the head revealed cerebral infarction in the territory of the left middle cerebral artery. During treatment for cerebral infarction, anemia developed, and lower gastrointestinal endoscopy was performed. Cancer of the transverse colon was diagnosed, and the patient was scheduled to undergo resection of the transverse colon. On admission, the height was 167 cm, and the body weight was 63 kg. Magnetic resonance imaging and angiography showed about 90%

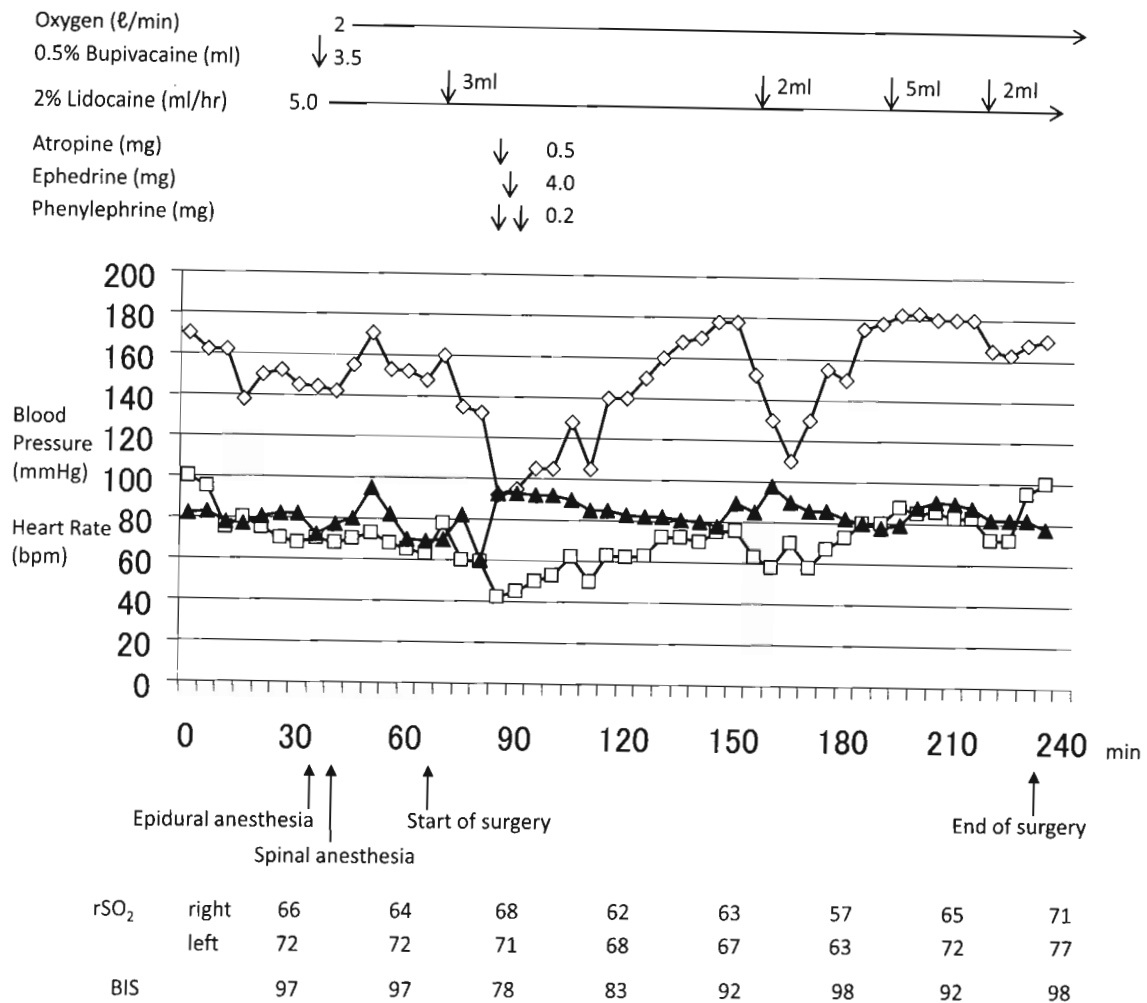


Figure Diagrammatic representation of the course of anesthesia
 rSO₂: regional cerebrovascular oxygen saturation, BIS: bispectral index score.
 ◇—systolic blood pressure, □—diastolic blood pressure, ▲—heart rate

stenosis of the left internal carotid artery and about 50% stenosis of the right internal carotid artery. Prothrombin time (PT)—International normalized ratio (INR) showed 1.5. Oral warfarin (3 mg/day), given to treat the bilateral stenosis of the internal carotid arteries, was switched to a continuous intravenous infusion of heparin in preparation for surgery. Heparin was discontinued 6 hours before operation.

Premedication with atropine sulfate (0.5 mg) was administered intramuscularly. The activated clotting time (ACT) on entry to the operation room was 147 seconds. An epidural catheter was inserted between the 10th and 11th thoracic vertebrae and advanced 8 cm superiorly in right lateral position. Epidural anesthesia was started with 2% lidocaine (5 ml/hr). Subsequently, a 25-gauge spinal needle

was inserted between the second and third lumbar vertebrae, and 3.5 ml of 0.5% plain bupivacaine was injected into the subarachnoid space to establish a fourth thoracic nerve block, which was confirmed by pinprick test. The course of anesthesia is diagrammatically shown in Figure. During surgery, the systolic blood pressure fluctuated around 150 mmHg. Transient hypotension developed, but resolved immediately after bolus intravenous injections of ephedrine, atropine and phenylephrine. The arterial partial pressure of carbon dioxide (PaCO₂) was 34 mmHg on intraoperative arterial blood-gas analysis.

To assess the level of consciousness during surgery, bispectral index scores (BIS) were monitored using a bispectral index monitor (Nihonkoden, Tokyo). Cerebral blood flow was evaluated by *in vivo*

論文審査の要旨

本研究の目的は、ヒト臍帯静脈内皮細胞 (HUVEC) に対する単球接着現象における ACE 阻害薬の効果を検討することである。ヒト単球細胞株 (THP-1) をイミダプリラート (IMD) または PBS (-) による前処理後、MCP-1 (100ng/ml) または PMA (250nM) で活性化し、HUVEC に対する THP-1 細胞の接着数を測定した。FACS およびウェスタンブロット法で接着分子の発現レベルの解析を行った。THP-1 細胞を MCP-1 または PMA で活性化すると、HUVEC に対する接着細胞数は増加し ($p < 0.05$)、IMD 前処理 (50nM) で抑制された ($p < 0.05$)。IMD は MCP-1 による THP-1 細胞表面のインテグリン発現増加および MCP-1 または PMA による PKC 活性上昇を制御した。MCP-1 または PMA 刺激で増加した細胞内亜鉛 (Zn) は、IMD 処理により抑制された。Zn ionophore (ZnI) を用いて細胞内 Zn を増加させると、THP-1 細胞接着数は増加し、IMD 前処理でも抑制された。IMD は ZnI による PKC 活性を制御していた。よって、IMD は MCP-1 または PMA による THP-1 細胞の接着増加を抑制し、抗動脈硬化薬としての有効性が示唆された。

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論文内容の要旨

〔目的〕

骨粗鬆症の発症予防のためには閉経後に必発する骨量減少を予防することと若年期にできるだけ高い最大骨量 (peak bone mass) を獲得することが重要と考えられている。そこで、本研究では、最大骨量獲得時期を明らかにすることによって、若年期におけるより効果的な介入時期を決定することを目的とした。

〔対象および方法〕

12~30 歳の日本人若年女性ボランティア 1,322 名を対象として横断的調査研究を行った。骨格パラメーターとして身長と体重を、骨パラメーターとして dual X-ray absorptiometry (DXA) により腰椎および大腿骨における骨密度・骨塩量・骨面積を測定した。同時に血液マーカーとしてカルシウム、リン、骨形成マーカーである骨型アルカリフォスファターゼ (bone alkaline phosphatase : BAP), および骨吸収マーカーとして I 型コラーゲン架橋 N-テロペプチド (crosslinked N-telopeptide of type I collagen : NTX) を測定した。すべての測定値は、年齢変化を除外するために 18 歳時の平均値を 100% として標準化の上、解析を行った。

〔結果〕

大腿骨骨密度は 18 歳時に最大値 $0.934 \pm 0.116 \text{g/cm}^2$ が得られた。一方、腰椎骨密度は 29 歳時に最大値 $1.027 \pm 0.095 \text{g/cm}^2$ が得られ、その 99.8% が 18 歳時にすでに獲得されていた。血清カルシウムの年齢変化はほとんど認めず、血清リンは 12 歳から 18 歳の間に 15.1% の低下を認めた。骨代謝マーカーの BAP, NTX については 12 歳から 18 歳にかけて低下を続け、その間の低下率はそれぞれ 73.3%, および 67.6% であった。しかし、BAP と NTX

optical spectroscopy (INVOS), and bilateral regional cerebrovascular oxygen saturation (rSO_2) was continuously monitored using an INVOS-5100 cerebral oximeter (Edwards Lifesciences, Irvine, CA).

BIS transiently decreased several times, but fluctuated between 78 and 98. The rSO_2 of the left and right cerebral hemispheres did not fluctuate greatly from the baseline value. The operation time was 158 minutes, and the duration of anesthesia was 199 minutes. Intraoperatively, the infusion volume was 1,500 ml, the urine volume was 500 ml, and the blood loss was 81 ml. Ropivacaine (0.2%, 5 ml/hr) was continuously administered by epidural catheter for postoperative analgesia.

The epidural catheter was removed on postoperative day 1. Treatment with heparin (18,000 units/day) was resumed 2 hours later. The postoperative course was uneventful, with no evidence of bleeding, cerebral infarction, or other complications. Oral intake was begun on postoperative day 4. No new neurologic abnormalities appeared after surgery. The patient was transferred from the surgical ward to a medical ward to receive treatment for bilateral stenosis of the internal carotid arteries.

Discussion

In patients with stenosis of the internal carotid artery, it is important not to lower the blood pressure during surgery and thereby ensure that cerebral blood flow is maintained. Blood pressure decreased in our patient during surgery, but this was attributed to vagal reflexes caused by traction on the intestine. The blood pressure turned to normal immediately after the administration of sympathomimetic agents. Because a decrease in $PaCO_2$ can reduce cerebral blood flow²⁾, hyperventilation must be prevented. In our patient, anesthetic management was achieved during spontaneous breathing, with no decrease in $PaCO_2$.

On the basis of the surgical invasion in our patient, it was possible to use general anesthesia or epidural anesthesia with or without spinal anesthesia^{3,4)}. During general anesthesia, monitoring of neurologic symptoms caused by decreased cerebral blood flow is not feasible. If cerebral ischemia occurs, neurologic symptoms cannot be evaluated un-

til recovery from anesthesia, potentially leading to delayed detection of abnormalities^{3,4)}. During epidural anesthesia, spinal anesthesia, or both, consciousness levels and neurologic symptoms can be confirmed intraoperatively. When only spinal anesthesia is used, the duration of anesthesia is limited. The combined use of epidural anesthesia allows additional doses of local anesthesia to be administered, and it is also advantageous for postoperative analgesia. We therefore combined epidural anesthesia with spinal anesthesia. Because patients with stenosis of the internal carotid artery require anticoagulant therapy before and after surgery, this anesthetic procedure was associated with the risk of causing epidural hematoma. We therefore fully informed the patient and his family members about potential risks and expected benefits of the procedure and obtained their informed consent. ACT was measured immediately before epidural puncture; epidural anesthesia then was induced, followed by spinal anesthesia. As compared with general anesthesia, this method facilitates the early detection and prevention of cerebral infarction, but requires the understanding and cooperation of patients.

To monitor the level of consciousness and cerebral blood flow during surgery, we measured BIS and rSO_2 . BIS is an electroencephalographically based index of the depth of anesthesia that can be used to monitor patients for cerebral ischemia^{5,6)}. Estruch-Pérez et al reported⁶⁾ BIS changes in 70 awake patients with and without neurological deficits who underwent carotid endarterectomy (CEA) under regional anesthesia. The mean BIS values were 92.5 ± 5.6 and 84.7 ± 12.3 for patients without and with neurological deficits, respectively ($p < 0.05$). On the other hand, rSO_2 allows the real-time assessment of local cerebral blood flow and is also useful for detecting episodes of cerebral ischemia. Samra et al. reported⁷⁾ changes in bilateral rSO_2 in 99 patients who underwent 100 CEAs with regional anesthesia. The mean (\pm SD) decrease in rSO_2 after carotid occlusion in patients with neurologic symptoms (from $63.2 \pm 8.4\%$ to $51.0 \pm 11.6\%$) was significantly greater ($p = 0.0002$) than that in patients

with no neurologic symptoms (from $65.8 \pm 8.5\%$ to $61.0 \pm 9.3\%$). In our patient, there were no large fluctuations in either BIS or rSO_2 .

In conclusion, the use of a combination of epidural and spinal anesthesia allowed neurological symptoms and consciousness levels to be monitored in a patient with severe cerebrovascular disease who underwent resection of the transverse colon while remaining conscious. This anesthetic procedure can maintain stable hemodynamics and thus facilitates the prevention and early detection of cerebral infarction during surgery.

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高度両側内頸動脈病変を有する患者の横行結腸切除術における麻酔経験

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両側内頸動脈狭窄症を伴う大腸癌患者の横行結腸切除術において、硬膜外併用脊髄クモ膜下麻酔で管理した1例を報告する。〔症例〕74歳、男性。構音障害を主訴に入院。左中脳動脈領域脳梗塞の診断で加療中、貧血を認め、精査で横行結腸癌と診断され、横行結腸切除術が予定された。磁気共鳴画像(magnetic resonance imaging: MRI)、血管造影で左内頸動脈90%狭窄、右内頸動脈50%狭窄を認めた。術中に脳虚血が発生する可能性があり、全身麻酔は選択せず、覚醒下で手術を行う麻酔方法を計画した。第11,12胸椎間より硬膜外カテーテル留置後、脊髄クモ膜下麻酔を施行した。第4胸神経レベルまでの無痛域を得て手術を開始した。術中は意識レベル評価にBispectral Index値を、脳血流評価として経皮的脳内酸素飽和度を測定した。術中これらのモニターで大きな変化は見られなかった。術中、一過性に血圧が低下したが、エフェドリン、フェニレフリンの単回静注ですぐに改善した。術後、神経症状や新たな脳梗塞はみられなかった。〔考察〕高度脳血管病変を有する患者に脊髄クモ膜下硬膜外併用麻酔を覚醒下に行う方法は、神経症状や意識状態を直接評価でき、血行動態の安定も得られ、術中脳梗塞の予防、早期発見という面から有用であると考えられた。〔結語〕両側内頸動脈狭窄症を伴う患者の横行結腸切除術を脊髄クモ膜下硬膜外併用麻酔で覚醒下に行い、安全に管理し得た。