in our three patients, in whom we used 2–3 mg morphine, does not confirm that this represents the appropriate subdural dose. We recommend that the anesthesiologist exercise caution when faced with uncertainty regarding the location of the catheter.

REFERENCES


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Dapsone-induced Methemoglobinemia and Pulse Oximetry

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Dapsone, a sulfonamide derivative, has been used in the treatment of malaria, leprosy, and dermatitis herpetiformis, and most recently in the prophylactic treatment of Pneumocystis carinii pneumonia in patients infected with the human immunodeficiency virus (HIV). 1–3 Side effects associated with the use of dapsone include the development of methemoglobinemia. 1,2 This report relates an incident of methemoglobinemia secondary to dapsone presenting as an intraoperative decrease in the pulse oximeter hemoglobin oxygen saturation (SpO2). In this patient, the methemoglobinemia was treated with methylene blue administered intravenously, with a subsequent increase in the SpO2 and decrease in the methemoglobin (MetHb) level.

CASE REPORT

A 60-yr-old woman with a history of transient ischemic attacks and carotid stenosis presented for a right carotid endarterectomy. Her past medical history included a left carotid endarterectomy in 1985, coronary artery disease with an old myocardial infarction, dermatitis herpetiformis, and cigarette smoking. She denied a history of shortness of breath or chest pain and described tolerance of moderate levels of exercise. Preoperative medications included oral metoprolol 25 mg three times per day and furosemide 40 mg, dapsone 100 mg, and aspirin 325 mg every day. Laboratory studies included a hemoglobin concentration of 11 g/dl; electrocardiogram revealed an old anterolateral myocardial infarction; chest x-ray demonstrated no active disease; and echocardiogram showed normal left ventricular function with mild ventricular dilatation.

The morning of surgery, the patient received oral diazepam 5 mg, metoclopramide 10 mg, and ranitidine 150 mg. Upon arrival in the operating room, the patient was calm and responsive to verbal commands. After placement of routine monitors, including a pulse oximeter probe (Nellcor DS-100A) placed on the right index finger, and with the patient breathing room air, the pulse oximeter (Nellcor N-100) displayed an SpO2 of 90%. The patient denied the presence of dyspnea. Oxygen 4 l/min by nasal cannulae increased the SpO2 to 93%. A catheter was inserted into a radial artery, and a blood gas determination revealed a PaO2 of 184 mmHg. After denitrogenation with 100% ox-

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Drug-induced methemoglobinemia has been associated with a number of agents, including local anesthetics, sulfonamides, nitrites, antimalarials, sodium nitroprusside, and dapsone. Normally less than 1% of the total hemoglobin, MetHB is an oxidation product of hemoglobin in which the heme iron is oxidized from the ferrous (Fe²⁺) to the ferric (Fe³⁺) state, preventing the formation of a reversible complex with oxygen and impairing the unloading of oxygen to tissues. In normal individuals, dapsone produces a dose-related increase in MetHb levels by a process of reduction of oxyhemoglobin and molecular oxygen to superoxide anions and hydrogen peroxide, chemical agents which then produce MetHb. MetHb levels exceeding 10% may lead to peripheral cyanosis. Concentrations greater than 35% produce symptoms of weakness, headache, or shortness of breath, and concentrations exceeding 70% may be fatal.

A MetHb level of 5% was reported by Eisenkraft in a patient who received dapsone after an unexpected decrease in the room air SpO₂ was found. His patient was not treated with methylene blue and recovered without incident. Intraoperative benzocaine-induced methemoglobinemia with MetHb levels of 26% that required treatment with methylene blue has been reported.

The use of dapsone in the prophylactic treatment of Pneumocystis carinii pneumonia in HIV-infected patients is associated with an overall toxicity (anemia, methemoglobinemia, neutropenia) of 10–13%. The number of patients with Pneumocystis carinii pneumonia requiring treatment with dapsone is likely to increase as the HIV epidemic continues to spread. After the presence of hypoxia has been ruled out, an unexpectedly low SpO₂ in a patient treated with dapsone should suggest the possibility of methemoglobinemia. The diagnosis should be confirmed by multiwavelength oximetry, because neither blood gas analysis nor pulse oximetry is capable of detecting and measuring MetHb. The increasing incidence of HIV infection and concomitant use of dapsone increase the likelihood in these patients of methemoglobinemia. The ubiquitous use of intraoperative pulse oximetry may permit early diagnosis and treatment. Checking levels of MetHb and initiating early treatment may benefit HIV patients with dapsone-induced methemoglobinemia, especially those suffering from anemia or pulmonary infection.

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Computerized Tomography–guided Stellate Ganglion Blockade

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Anesthetic injections for the blockade of the sympathetic innervation of the head, neck, and upper extremity are typically made at the level of the transverse process of either the C6 or C7 vertebrae.¹ ² These injections are termed “stellate ganglion blocks” because of the assumption that the site of action of the anesthetic solution is the stellate ganglion. Recent work has cast doubt on this belief by showing that solution injected by these techniques probably fails to reach the ganglion,³ which lies posteriorly in the chest on the head of the first rib.⁴ Methods of positioning the needle tip directly at the ganglion have been described,¹ but are problematic because of the risk of injury to or injection into adjacent structures. Inferior to the C6 level, the vertebral artery is anterior to the transverse processes, making more possible the injection into the basilar system with prompt seizures after small doses.⁵ Similarly, the dome of the lung is in the immediate area of needles directed to the stellate ganglion.

Whereas fluoroscopy shows only bony features, computerized tomography (CT) also images nerves, vessels, and lung, allowing accurate needle placement and detailed observation of the spread of injected solution, and has been used clinically for celiac plexus⁶ and lumbar sympathetic⁷ blockade. We report a case in which CT imaging was used for direct injection of the stellate ganglion when circumstances precluded blockade by more customary means.

CASE REPORT

The patient, a 56-yr-old woman, had a 10-yr history of degenerative disc disease and spondylosis at multiple cervical levels, resulting in electromyography–documented left C6 and C7 radiculopathy. Left upper extremity pain persisted despite four operations on the cervical spine, including a cervical fusion by a left anterior approach. However, the pain that returned after her last operation was of a different quality, which she described as diffusely burning throughout the arm distal to the shoulder, independent of neck position or limb use. She reported generalized weakness of the left upper extremity and coolness of the left hand compared to the right. Her medications included doxepin, propranolol, diazepam, and propoxyphene. Her hands and arms appeared normal; reflexes and strength were normal; and a previously noted decreased tactile sensitivity in the radial two digits was confirmed. No allodynia was identified. The left middle finger skin temperature was 26.1°C, compared to 28.4°C on the right.

To determine the sympathetic contribution to her pain, 1% lidocaine 10 ml was injected at the left anterior tubercle of the C6 vertebra by an anterior paratracheal approach, but no Horner’s syndrome, warming of the hand, or pain relief resulted. After a repeat injection a week later also failed to produce any evidence of sympathetic block or pain relief, a paratracheal injection of the same dose was made at the C7 level, also without success. Therefore, a CT-guided direct injection of the stellate ganglion was performed a week later, with the approval of the institutional review board.

With the patient’s head and neck in a neutral position and her arms at her side, CT images of the lower cervical and upper thoracic vertebrae was obtained using a 9800 Hi-light Advantage System (GE Medical Systems, Milwaukee, WI) at 170 mA, 120 kV, scan time = 3 s, and slice thickness = 3 mm. An inplane spatial resolution of 0.31 mm was achieved by using a 16-cm field of view and a 512×512 imaging matrix. The table was moved to the level that produced an image of the stellate ganglion at the head of the first rib, and the laser light was used to identify the skin in this plane. From the CT image, a needle insertion site was selected that would avoid vascular structures (fig. 1), and the distance from the midline reference was transferred to the skin. No lung was apparent on the CT image at this level.

A 25-G needle was inserted to a depth (2 cm) and at an angle determined from the CT image (fig. 1), and another image was made to

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