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Pneumocephalus with Headache during Spinal Anesthesia

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Pneumocephalus is not an uncommon occurrence following air pneumoencephalography,¹ pneumomyelography,² or brain surgery, particularly when nitrous oxide is used.³ While air usually is reabsorbed after 2 days, in some patients it may take up to 7 days.⁴ Also, dural tap for spinal anesthesia has been suggested as a possible cause of pneumocephalus,⁵ but it has not been documented. This case provides evidence that pneumocephalus can result from spinal anesthesia and a small volume of air.

REPORT OF A CASE

A 61-year-old man, weight 63 kg, height 185 cm, was hospitalized for more than 2 months, receiving treatment for a chronic right trochanteric bursal infection. He was classified as ASA physical status III on the basis of malnutrition, anemia (Hct 25%), stable angina, a previous myocardial infarction, chronic obstructive pulmonary disease, and albumin 2.9 (normal range 3.5-5.2 g/dl) with normal serum electrolytes. Because of low back pain, several myelograms had been performed. Medication included morphine, hydroxyzine, and nitroglycerin. A trochanteric bursectomy with debridement and a gluteal thigh flap had been done with hypobaric spinal anesthesia. He was scheduled for a flap debridement and closure.

Another hypobaric spinal anesthesia was planned, using 7 ml sterile distilled water containing 7 mg tetracaine and 0.2 mg epinephrine. Because of the relatively large volume of local anesthetic solution, the technique to be used requires the removal of approximately an equal amount of cerebrospinal fluid (CSF) before its injection.⁶

After iv fluids had been started and one unit of whole blood infused, the patient was placed in the left lateral position. A 26-g single-use spinal needle was inserted into the subarachnoid space via L3-4 vertebral interspace. CSF dripped slowly from the needle, but only 0.5 ml of it could be aspirated. In an effort to obtain a free

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flow of CSF, 0.4 ml of air was injected through the needle. This maneuver usually clears whatever is occluding the bevel of the spinal needle and allows the withdrawal of CSF.⁶ However, after injecting the 0.4 ml of air and rotating the needle 90 degrees three times, only another 0.5 ml CSF was withdrawn. Because the desired amount of CSF (6–7 ml) was not obtained, the needle was withdrawn. It then was reinserted into the subarachnoid space between the L2–3 vertebral interspace and CSF again appeared at its hub. But aspiration produced less than 0.2 ml CSF. Therefore, 0.4 ml of air was injected through the needle, but only another 0.2 ml of CSF was obtained. The needle then was rotated 90 degrees three times. After each rotation, 0.4 ml air was injected, but attempts to withdraw CSF after the three air injections produced only another 1 ml CSF.

By this time the dura had been punctured twice and a total of 2.0 ml of air had been injected into the subarachnoid space, which resulted in withdrawal of only 2.2 ml, not the sought-after 6–7 ml of CSF. Furthermore, the patient was complaining of a moderately severe right-sided headache. Therefore, a hyperbaric solution (1.2 ml 1% tetracaine [12 mg], 1.2 ml of 10% dextrose [120 mg], and 0.2 mg epinephrine [0.2 ml of 1:1,000]), which requires no removal of CSF prior to its injection, was administered.⁶ Immediately, the patient was placed supine so as to assure anesthesia of his right hip. He then complained of a bifrontal headache.

After 20 min he was placed in a semi-left lateral decubitus position for surgery. Except for the persistent headache, anesthesia and surgery were uneventful. At the end of the procedure he was taken to the recovery room and placed supine. The head of the bed was elevated to 30 degrees. In this position his headache became biparietal. A roentgenogram of the head showed the 2 ml air around the stalk of the pituitary (fig. 1). His headache resolved in 2 days.

DISCUSSION

Although a spinal needle's bevel lies in the subarachnoid space, CSF may not appear at the needle's hub. Even if it does, attempts to aspirate CSF may be unsuccessful. This is more likely to result with a small-gauge needle (25–26) as compared with one with a large gauge (19–22), and with a single-use (disposable) as compared with a reusable needle. The reasons for this are not known definitely. One explanation may be that frequently the stylets of single-use needles do not precisely match their bevels. Therefore, a small piece of tissue could be cored out during placement, which, when the stylet is withdrawn, occludes the opening in its bevel.

When under such circumstances CSF is not obtained but the needle's bevel was felt to have traversed both the ligamentum flavum and the dura, one of the authors (D.C.M.), rather than withdrawing the needle, routinely has injected 0.4–0.8 ml, and on occasion up to 2 ml, of air through the needle to clear whatever might have been occluding its bevel. Although for 43 years no sequelae have resulted from the injection of air, this case indicates that 2 ml can result in a pneumocephalus with cephalalgia.

When a pneumocephalus is present, abandoning regional anesthesia in favor of general anesthesia may cause adverse effects, such as increased intracranial pressure (ICP) and intravascular gas emboli. Intracranial

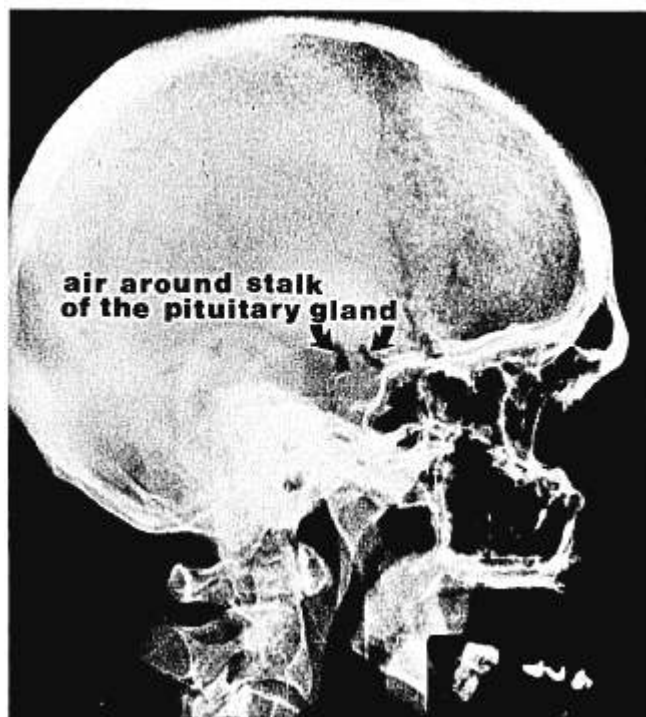


FIG. 1. Roentgenogram taken approximately 2½ h after injecting the local anesthetic solution into the subarachnoid space.

pressure may increase if the patient is allowed to breathe nitrous oxide because nitrous oxide that is dissolved in blood enters the air-containing space more rapidly than nitrogen exits, thereby increasing the volume of the pneumocephalus. Also, the ICP increase caused by the potent inhaled anesthetics will be exaggerated if the volume of injected air exceeds the volume of CSF removed.⁷ Venous gas emboli have been reported when gas in the intracranial CSF space is placed under pressure, presumably because gas emboli pass through the arachnoid granulations into the cerebral venous blood.⁸ Whenever venous gas emboli occur, the possibility of arterial gas embolism also must be considered.

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The Response of Myasthenia Gravis to Atracurium

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Patients with myasthenia gravis generally are believed to have increased sensitivity to nondepolarizing muscle relaxants. However, some authors do not agree with this conclusion. For example, two clinical reports described the response of one myasthenic patient each, receiving steroids and pyridostigmine therapy. In the first, the author concluded that myasthenic patients are quite sensitive to *d*-tubocurarine and require greatly reduced doses.¹ However, in the second report the authors did not find an increased sensitivity to *d*-tubocurarine.² Other authors reported on the use of very small doses of pancuronium 5.0 µg/kg, which produced 90% twitch suppression with uneventful recovery. On the other hand, resistance and early appearance of phase II block have been reported following the administration of succinylcholine.⁴ Recently, the use of the new intermediate-acting nondepolarizing relaxant atracurium has been reported in six patients with myasthenia gravis.⁵⁻⁷ The unique mode of elimination of atracurium may offer an advantage over the previously available long-acting muscle relaxants.

We present two additional case reports of the anesthetic management of two myasthenic patients using atracurium. Our findings are compared with previous reports.

REPORT OF TWO CASES

Case 1. A 64-year-old woman, weighing 76 kg, was scheduled for an elective sigmoid colectomy for diverticulitis. She presented with a 2-year history of myasthenia gravis manifested with bulbar symptoms and progressive limb weakness. She first was diagnosed in 1982 with electromyography and a positive edrophonium test. The patient also had a history of hypertension and insulin-dependent adult-onset diabetes mellitus. Initially she was taking pyridostigmine with improvement of her symptoms. However, increasing gastrointestinal symptoms as well as dysphagia and a questionable history of aspiration of gastric contents caused her physician to begin her on a regimen of steroids, tapering her dose of pyridostigmine to none by January 1983. The patient underwent plasmapheresis in August 1983. She experienced marked improvement of her symptoms. Upon admission, her pulmonary function tests were 85% of normal, with a vital capacity of 2.5 l. Prior computerized axial tomography and chest roentgenography were negative for thymoma. Her prednisone dosage had been decreased to 12 mg per day. Preoperatively, she received 5 mg diazepam, po, 30 U NPH insulin, subcutaneously, and 100 mg hydrocortisone, iv. Anesthesia was induced using a total of 300 µg fentanyl, 10 mg diazepam, and 200 mg thiopental, iv. Force of thumb adduction was monitored in response to ulnar nerve stimulation (0.2 ms at a frequency of 0.15 Hz) at the wrist via two percutaneous needle electrodes using a Grass FT-10® force transducer and a Grass® polygraph. Incremental doses of atracurium 0.065 mg/kg (5 mg) each were given every 4 min until the twitch height was depressed to 5% of control. A total dose of 25 mg (0.33 mg/kg) was required to achieve 95% depression of the control response (fig. 1). Two incremental doses of atracurium, 5.0 mg each, were given further as clinically indicated over the next hour. One hour after induction of anesthesia, halothane was added at an inspired concentration of 1.0%, and up to 20 mg hydralazine was given to control hypertension. After the last 5-mg dose of atracurium, the twitch was allowed to recover spontaneously to 95% of control. The pH was maintained between 7.43 and 7.46, with a PaCO₂ from 33 to 38 mmHg. Serum sodium and potassium concentrations were normal, and blood sugar was 233 mg/dl. The 5-95% recovery time was estimated to be 83 min. The recovery index (25-75% recovery time) was 32 min (fig. 1). Four hours after induction of anesthesia, clinical relaxation was required, and further incremental doses of atracurium to a total of 20 mg were given over the next half hour without complete ablation of the first twitch of the train-of-four. The patient was taken to the intensive care unit 6 h after induction of anesthesia. At this time she was arousable and had a tidal volume of 300 ml.

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