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, hydroxyamphetamine, 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.

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. However, after injecting the 0.4 ml of air and rotating the needle 90 degrees three times, only another 0.5 ml CSF was withdrawn. Because the desired amount of CSF (6–7 ml) was not obtained, the needle was withdrawn.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 hypertonic 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. 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 bitemporal. 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 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 then 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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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. However, in the second report the authors did not find an increased sensitivity to d-tubocurarine. 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. Recently, the use of the new intermediate-acting nondepolarizing relaxant atracurium has been reported in six patients with myasthenia gravis. 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.

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