

Potential complications of the S.E.T. TubeTM are expected to be similar to those of any endotracheal tube. During this study the S.E.T. TubeTM was used exclusively via the nasotracheal route. Oral intubation is possible, but the speech quality would likely be decreased.

The patient's ability to speak was found to be most helpful to the nursing staff. Although the patients were acutely ill and elected not to speak frequently, their use of the speaking function of the S.E.T. TubeTM was routine and prompted by either the patient's requests or inquiries from the hospital staff or family members. The patients as well as their families seemed less apprehensive when communication by speech was made available.

In conclusion, the S.E.T. TubeTM successfully allows the intubated patient to consistently produce self-activated speech with little or no ill effects.

REFERENCES

1. Lawless CA: Helping patients with endotracheal tubes and tracheostomy tubes communicate. *Am J Nurs* 75:2151-2153, 1975
2. Obier K, Haywood LJ: Enhancing therapeutic communications with acutely ill patients. *Heart Lung* 2:49-53, 1973
3. Wu WH, Suh CW, Turndorf H: Use of the artificial larynx during airway intubation. *Crit Care Med* 2:152-154, 1974
4. Summers J: The use of the electrolarynx in patients with temporary tracheostomies. *J Speech Hear Disord* 38:335-338, 1973

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Benign Intracranial Hypertension and Anesthesia for Cesarean Section

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Benign intracranial hypertension (BIH) is defined as a syndrome of elevated intracranial pressure without clinical, laboratory, or radiologic evidence of a focal lesion or hydrocephalus.¹⁻⁶ The four criteria of BIH are as follows: 1) elevated intracranial pressure, *i.e.*, cerebrospinal fluid (CSF) pressure above 200 mmH₂O; 2) normal CSF composition; 3) no alteration in the state of consciousness; and 4) absent focal intracranial lesions.

During pregnancy, BIH is rare,⁷⁻⁹ with only three cases of recurrence reported.^{7,8,10} With pregnancy, the symptoms worsen in 50% of the cases and invariably resolve after abortion or delivery.^{11,12} Therefore, a female with an active disease should be advised to delay pregnancy until all signs and symptoms have abated. Worsening of the condition during pregnancy rarely requires termination of pregnancy provided adequate therapy is used. Vaginal delivery is not contraindicated, despite CSF pressure elevation during uterine contractions.^{13,14}

The anesthetic management of the obstetric patient with BIH rarely has been described. Palop *et al.* reported two cases of delivery under epidural anesthesia.¹⁵ Powell¹⁶

briefly described one case of cesarean section under general anesthesia. Koontz *et al.*¹² reported seven cases, five of whom delivered under pudendal nerve block or local anesthetic infiltration and two under spinal anesthesia. The headache resolved in all cases within 72 h of delivery. However, the details of anesthesia were lacking. For this reason and because of the paucity of reports of anesthesia in BIH, we report these two cases.

REPORT OF TWO CASES

Patient 1. This patient was a gravida 2, para 1, 31-year-old, weighing 91 kg and she was 155 cm tall. She began having headaches at the age of 22 years. At that time the headaches were severe, unrelieved by analgesics, and lasted for weeks. She was seen by a neurologist, who ordered an EEG and a computerized axial tomography of the brain, both had negative results.

She did well for 6 years. Then, during her first pregnancy the headaches recurred, warranting examination by a neurologist and a neuroophthalmologist at the 13th week of gestation. Fundus examination showed bilateral papilledema, moderate enlargement of ophthalmic veins, absent venous pulsations, and minimal enlargement of the blind spot with pupillary flare. Her corrected vision, visual fields, intraocular pressure, and slit lamp examination were normal and stayed unchanged throughout pregnancy. Computerized axial tomography of the brain was unremarkable. Lumbar puncture revealed an opening pressure of 340 mmH₂O, and the diagnosis of BIH was established. She was treated with repeated lumbar punctures during the course of pregnancy. At 41 weeks gestation she was admitted to another hospital with the diagnosis of fetal demise. Owing to the floating and high position of the vertex, the closed cervix, and insistence of the patient not to go through induction and labor, a primary cesarean section under general anesthesia was performed. Following delivery, the headaches and papilledema subsided, and CSF pressure was normal 2 months postpartum.

Three years later, she conceived again. During this second preg-

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nancy, the headaches recurred. Ophthalmologic examination showed papilledema with otherwise normal visual function. She became diabetic in the later half of pregnancy and was treated with 10 units regular insulin and 20 units NPH daily.

At 39 weeks gestation, an elective cesarean section was performed under spinal anesthesia. With the patient in the right lateral position, the lumbar puncture was performed at L3-4 using a 22-gauge spinal needle. The CSF was clear and its opening pressure was 250 mmH₂O. A 5-ml sample of CSF was collected for chemical analysis, cytologic examination, and bacterial culture.

Spinal analgesia was achieved by 60 mg of 5% lidocaine in 7.5% dextrose and 0.2 mg epinephrine. The dermatomal level, as determined by pinprick, was T-7 at 2 min and T-4 at 5 and 10 min. The fluid infusion, before lumbar puncture, was 1 l of lactated Ringer's solution. Dextrose infusion 5%, only administered after delivery, was limited to 150 ml per hour. The total fluid intake during surgery, which lasted 90 min, was 1,500 ml of electrolytes, mainly lactated Ringer's solution. The estimated blood loss was 600 ml. The maternal arterial blood pressure was stable throughout surgery with the exception of two episodes of hypotension, with the blood pressure decreasing from 115/72 mmHg to 82/40 mmHg and 84/60 mmHg at 2 and 5 min, respectively, following intrathecal injection of the anesthetic. On each occasion, arterial blood pressure was restored promptly to the normal level with iv injection of a 10-mg increment of ephedrine. A normal male infant weighing 3,220 g with 1- and 5-min Apgar scores of 9 and 9, respectively, was delivered. The time for two and four segments regression of the block below the maximum level was 90 and 120 min, respectively.

The CSF examination showed no white blood cells; dextrose was 45 mg/dl (normal 45-80 mg/dl), protein was 15 mg/dl (normal 15-45 mg/dl), IgG was 2.2 mg/dl (normal 0.7-3.8 mg/dl), and bacterial culture was negative.

Her postpartum course was uneventful, and she was discharged with her baby on the fourth postpartum day. Two months after delivery, the patient had no symptoms of BIH, and ophthalmologic examination was normal with resolution of the papilledema.

Patient 2. This patient was a 32-year-old woman, weighing 106 kg, G2 P0010 (second pregnancy, no full-term delivery, no prematurity, one abortion, and no living children). Her medical history revealed being a BIH patient for 5 years. She had a lumboperitoneal shunt because of her persistent headaches, and she had blurred vision despite medical treatment. Following surgery, her symptoms subsided. She was admitted to the hospital at 33 weeks gestation, with premature spontaneous rupture of the membranes for 24 h and breech presentation. Because of prolonged rupture of membranes, breech presentation, and multiple leiomyomata of the uterus, a lower-segment cesarean section was performed. Anesthesia consisted of rapid-sequence induction with preoxygenation, cricoid pressure, iv injection of 400 mg thiopental followed by 100 mg succinylcholine and endotracheal intubation. Anesthesia was maintained by 60% N₂O and 0.5-1% isoflurane. Neuromuscular blockade, monitored by ulnar nerve stimulation, was achieved by succinylcholine until delivery (total 140 mg iv), followed by atracurium (total 30 mg iv). The baby was delivered as a frank breech with some difficulty in delivering the head because of the fibroids. The induction-delivery and uterine incision-delivery times were 13 and 4 min, respectively. A 2,200-g boy was delivered with 1- and 5-min Apgar scores of 2 and 8, respectively. His trachea was intubated at birth for 8 min before he was transferred to the intermediate care unit. During surgery, the lumboperitoneal catheter was palpated in the left lower quadrant. At the end of surgery, the residual neuromuscular blockade was reversed by 2.5 mg neostigmine and 1.2 mg atropine iv. The postpartum courses of the mother and baby were uneventful, and both were discharged in good condition on the sixth postpartum day.

DISCUSSION

The aim of the treatment for BIH is to control the intracranial pressure to preserve the patient's vision. Repeated lumbar puncture is the method of choice.^{1,4,6} In Weisberg series,⁴ 28 patients had repeated lumbar puncture as the sole form of therapy. Most of his patients had an opening pressure above 300 mmH₂O. Generally, up to 30 ml of fluid is withdrawn to lower the intracranial pressure to normal. The rate of production of CSF is normally 20 ml per hour. This means that this quantity will be reproduced in 90 min.² Surprisingly, patients often notice improvement in symptoms for several days after a single lumbar puncture. The explanations are that a persistent CSF leak may be produced that closes after several days, and/or the transient relief of the elevated pressure may allow compressed intracranial structures to reassume their baseline shape. The fact that lumbar puncture was performed in almost all the patients reported in the literature should allay the fears of an anesthesiologist from using spinal anesthesia in these patients.

In some patients with BIH, repeated lumbar punctures fail to control the increased intracranial pressure. In these refractory cases, a course of steroids for a week often results in clinical improvement because of presumed reduction of brain swelling.^{17,18} Steroids are used during pregnancy without ill effects on the neonates.^{17,18} Acetazolamide (Diamox®) is a carbonic anhydrase inhibitor that reduces cerebrospinal fluid production. This drug is used in some cases either as an alternative to steroids or in combination. A surgical approach is indicated only after medical treatment has failed and the vision is rapidly failing. The method of choice is shunting between the CSF compartment and peritoneal cavity. The most common operation is lumboperitoneal shunting because ventricular shunts may be difficult to perform due to the small ventricles.

A lumbar puncture is not safe in a patient with increased intracranial tension caused by a space-occupying lesion. A sudden decrease in CSF pressure as the result of lumbar puncture may cause considerable herniation of the cerebellar tonsils, leading to pressure on the medulla oblongata. With BIH, the brain tissue as a whole is swollen. Such a uniform swelling plus the natural position of the cerebellar tonsils will prevent herniation and compression of the brain stem. Thus, lumbar puncture in these patients is not only safe but is also beneficial by allowing CSF drainage and reduction of CSF pressure. In fact, lumbar puncture has been the method of choice for treating these patients.

In our first patient, since lumbar puncture was to be performed to measure the CSF pressure and to obtain a sample of CSF for examination, we chose spinal anesthesia. A 22-gauge needle was preferred for lumbar puncture

over a 26-gauge needle, our usual size needle, because it is easier to measure the CSF pressure and to obtain a sample using a larger bore needle, and any persistent leakage after the lumbar puncture due to the large bore of the needle is welcomed in this case.

The spread of a local anesthetic in a patient with an elevated CSF pressure is not known. The dermatomal level achieved in this patient was not different from that in a full-term patient with a normal CSF pressure.¹⁹ Also, the regression of anesthesia in this case was normal.²⁰ Therefore, increased CSF pressure may not be an important factor in determining the spread of a local anesthetic or the duration of spinal anesthesia. Palop *et al.*¹⁵ also found that the spread of local anesthetic following epidural analgesia in two patients with BIH was not different from that in normal patients.

Epidural analgesia is, of course, an alternative to spinal block in a patient with BIH. But, in general, spinal anesthesia is more simple than epidural anesthesia.²¹ One of the main objections to spinal anesthesia, namely postlumbar puncture headache, is not relevant in this case, as the leakage of CSF is welcomed. For a patient with lumboperitoneal shunt, as in the second case, general anesthesia is preferable to spinal analgesia for two reasons. Before a spinal block, a roentgenogram is required to localize the site of entry and position of the lumboperitoneal tube in the subarachnoid space. This is not needed with general anesthesia; thus general anesthesia is simpler and there is no associated risk of fetal exposure to irradiation. Secondly, with spinal analgesia, there is the uncertainty that the local anesthetic injected into the subarachnoid space will be retained and not partially escape to the peritoneal cavity through the shunt, leading to inadequate anesthesia.

Palop *et al.*¹⁵ reported the use of epidural anesthesia in two patients with BIH. In our report, the rationale behind using spinal anesthesia is explained and its safe use is illustrated by the first case. On the other hand, the inadvisability of spinal anesthesia and the preference of general anesthesia in a patient with lumboperitoneal shunt is discussed and demonstrated by our second case.

In conclusion, in patients with BIH without lumboperitoneal shunt, spinal block should be seriously considered for anesthesia in cesarean section. For patients with lumboperitoneal shunt, general anesthesia is preferable.

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REFERENCES

1. Ahlskog JE, O'Neill BP: Pseudotumor cerebri. *Ann Intern Med* 97:249-256, 1982
2. Reid AC, Teasdale GM, Matheson MS, Teasdale EM: Serial ventricular volume measurements: Further insight into the etiology and pathogenesis of benign intracranial hypertension. *J Neurol Neurosurg Psychiatr* 44:636-640, 1981
3. Bjerre P, Lindholm J, Glydensted C: Pseudotumor cerebri. A theory on etiology and pathogenesis. *Acta Neurol Scand* 66:472-481, 1982
4. Weisberg LA: Benign intracranial hypertension. *Medicine (Baltimore)* 54:197-207, 1975
5. Johnston I, Paterson A: Benign intracranial hypertension. II CSF pressure and circulation. *Brain* 97:301-312, 1974
6. Bullens C, DeVries W, Van Crevel H: Benign intracranial hypertension. A retrospective and follow-up study. *J Neurol Sci* 40:147-157, 1979
7. Elian M, Ben-Tovin N, Bechar M, Bornstein B: Recurrent benign intracranial hypertension (pseudotumor cerebri) during pregnancy. *Obstet Gynecol* 31:685-688, 1968
8. Nickerson CW, Kirk RF: Recurrent pseudotumor cerebri in pregnancy. Report of 2 cases. *Obstet Gynecol* 26:811-813, 1965
9. Shekleton P, Fidler J, Grimwade J: A case of benign intracranial hypertension in pregnancy. *Br J Obstet Gynecol* 87:345-347, 1980
10. Kassam SH, Hadi HA, Fadel HE, Sims W, Jay WM: Benign intracranial hypertension in pregnancy: Current diagnostic and therapeutic approach. *Obstet Gynecol Surv* 36:314-321, 1983
11. Greer M: Benign intracranial hypertension: III. Pregnancy. *Neurology (Minneapolis)* 13:670-672, 1963
12. Koontz WL, Herbert WNP, Cefalo RC: Pseudotumor cerebri in pregnancy. *Obstet Gynecol* 62:324-327, 1983
13. Marx GF, Scheinberg L, Romney S: Anesthetic management of the parturient with intracranial tumor. *Obstet Gynecol* 24:122-126, 1964
14. Hopkins EL, Hendricks CH, Gibils LA: Cerebrospinal fluid pressure in labor. *Am J Obstet Gynecol* 93:907-916, 1965
15. Palop R, Choed-Amphai E, Miller R: Epidural anesthesia for delivery complicated by benign intracranial hypertension. *ANESTHESIOLOGY* 50:159-160, 1979
16. Powell JL: Pseudotumor cerebri and pregnancy. *Obstet Gynecol* 40:713-718, 1972
17. Henry SD, Jacques S: Benign intracranial hypertension in pregnancy. *JACEP* 8:323-325, 1979
18. Donaldson JO: *Neurology in Pregnancy*. Philadelphia, WB Saunders, pp 171-175, 1975
19. Abouleish E: Subarachnoid block, Pain control in obstetrics. Philadelphia, JB Lippincott, 1977, pp 305-341
20. Chambers WA, Littlewood DG, Logan MR, Scott DB: Effect of added epinephrine on spinal anesthesia with lidocaine. *Anesth Analg* 60:417-420, 1981
21. Abouleish E, Bourke D: Concerning the use and abuse of test doses for epidural anesthesia. *ANESTHESIOLOGY* 61:344-345, 1984