

- in a child with Duchenne muscular dystrophy. *Pediatrics* 71:118-119, 1983
9. Kibuchi H, Morio M, Shinozaki M, Ishihara S: Statistical considerations of malignant hyperthermia in Japan. Second International Symposium on Malignant Hyperthermia. Edited by Aldrete AJ, Britt BA. New York, Grune and Stratton, 1977, pp 483-498
  10. McPherson E, Taylor Jr CA: The genetics of malignant hyperthermia: evidence for heterogeneity. *Am J Med Gen* 11:273-285, 1982
  11. Gronert GA: Malignant hyperthermia. *ANESTHESIOLOGY* 53:395-423, 1980
  12. Schulte-Sasse U, Eberlein HJ: Die maligne Hyperthermie. *Anesthetist* 32:141-157, 1983
  13. Wintrobe M: *Clinical Hematology*, seventh edition. Philadelphia, Lea and Febiger, 1979, pp 779-793
  14. Beutler E: *Glucose-6-phosphate dehydrogenase deficiency, The Metabolic Basis of Inherited Disease*, fourth edition. Edited by Stanbury JB, Fredrickson DS, Wyngaarden JB. New York, McGraw-Hill, 1978, pp 1430-1451
  15. Eaton JW, Brewer GJ: *Pentose phosphate metabolism. The Red Blood Cell*, VI, second edition. Edited by Surgenor D. New York, Academic Press, 1974, pp 435-471
  16. Cohen G: Unusual defense mechanisms against  $H_2O_2$  cytotoxicity in erythrocytes deficient in glucose-6-phosphate dehydrogenase or tocopherol, *Erythrocyte Structure and function*. Edited by Brewer, GJ. New York, Alan R. Liss, 1975, pp 685-698
  17. Leipzig RM, Brewer GJ, Kruckeberg WC: Superoxide and G-6-PD-type hemolysis, *Erythrocyte Structure and Function*. Edited by Brewer GJ. New York, Alan R. Liss, 1975, pp 711-726
  18. Jacob HS: *Dysfunctions of the red cell membrane, The Red Blood Cell*, VI, second edition. Edited by Surgenor D. New York, Academic Press, 1974, pp 285-289
  19. Schanus E, Glass R, Lovrien R: Molecular basis for malignant hyperthermia involving erythrocyte glutathione peroxidase. *Fed Proc* 38:571, 1979
  20. Schanus EG, Lovrien RE, Taylor CA: Malignant hyperthermia in humans: Deficiencies in the protective enzymes systems for oxidative damage. *Prog Clin Biol Res* 97:95-111, 1982

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## Treatment of a Subarachnoid-Cutaneous Fistula with an Epidural Blood Patch

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Lumbar cerebrospinal fluid (CSF) drainage is used in neurosurgical procedures to drain excess CSF away from the surgical wound in order to provide better surgical exposure. Further, the incidence of CSF leaks following transphenoidal surgery can be decreased by continuing this drainage through the early postoperative period.<sup>1</sup> A patient is described who had lumbar CSF drainage and developed a subarachnoid cutaneous CSF fistula that was treated with an epidural blood patch.

### REPORT OF A CASE

A 33-year-old woman who had infertility and galactorrhea underwent a transphenoidal excision of a prolactin-secreting pituitary microadenoma. Anesthesia was induced with thiopental iv and maintained with isoflurane and nitrous oxide in oxygen. Endotracheal intubation was facilitated with pancuronium, and additional doses of fentanyl and pancuronium were administered iv as required. Then the patient was turned onto her left side, placed in a flexed position, and a Cordis® lumbar drainage catheter was inserted at L3-4. A 14-gauge Touhy needle and a nonkinkable silastic catheter that passes through the needle and is left in the subarachnoid space were used. The catheter then can be connected to a closed drainage bag or drained as needed by aspiration with a syringe.

During the surgery, which took about 4 h, 60 ml CSF was aspirated

through the catheter. The surgery was uneventful, and the trachea was extubated at the end of the procedure. The lumbar drainage catheter was left in the subarachnoid space to help prevent a CSF leak postoperatively.<sup>2</sup> Following an uncomplicated postoperative course, the catheter was removed 5 days after surgery. At this stage she was taking cortisone acetate 37.5 mg/day po and variable amounts of desmopressin (DDAVP) according to urine output.

After removal of the catheter, a CSF leak persisted that exited at the skin through the original lumbar puncture hole. Over the next 3 days, the CSF leak continued and was especially troublesome during straining in the bathroom or with everyday activity. Cerebrospinal fluid specimens were taken daily and examined for any signs of infection. These remained negative until the leak was controlled.

By the fourth day after removal of the catheter, the rate of CSF leak had decreased, but the leak did not stop completely. It was suspected that the patient had formed a subarachnoid cutaneous fistula. Apart from the discomfort of the constant wetting from the leak, the patient also complained of an uncomfortable feeling in her head, which was not severe enough to limit her activity on the floor while in the hospital. On the 5th day after pulling the catheter out, an attempt was made to seal the leak with an epidural blood patch. The leak was such that when the patient sat up for performance of the blood patch, the stream of CSF flow from the puncture site spurted 25 cm away from her back. Eighteen milliliters of autologous blood was injected into the epidural space at L2-3. Apart from pain during injection of the blood, which was thought to be typical root pain, no problems were encountered. The leak was immediately and permanently controlled.

### DISCUSSION

Despite the ease with which this leak was controlled, a subarachnoid cutaneous fistula represents a major source of discomfort to the patient and a continuous portal of entry for bacterial infection.

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Although postoperative CSF drainage is a valuable aid to the prevention of CSF leaks through the surgical wound, the above case illustrates that it is not without risk and that it should be discontinued as soon after surgery as possible. A safe length of time in terms of prevention of infection and prevention of fistula formation has not been established.

While the use of lumbar subarachnoid continuous drainage postoperatively is common, subarachnoid cutaneous fistula as a complication has not been reported. A subarachnoid CSF fistula has been reported following repeated lumbar puncture for a chronic pain problem. The injected material contained triamcinalone, a known antiinflammatory agent, some of which may have leaked around the needle and been deposited along the tract.<sup>4</sup> Also, subarachnoid cutaneous fistulas are an infrequent complication of many intracranial neurosurgical procedures, especially those involving cranial nerve exposures and approaches to the pituitary gland.<sup>2</sup> Subarachnoid fistulas also have been reported as a delayed complication after trauma.<sup>5</sup> A cutaneous cerebrospinal fluid leak has been described following repeated attempts at extradural block.<sup>7</sup> In this case, the leak stopped spontaneously within 48 h after the patient was advised not to lie on her back. In another report,<sup>8</sup> surgical closure of the dural rent was undertaken in a fistula following spinal steroid injection. Infection with meningitis is a constant threat to these patients, with an incidence of about 6–10%.<sup>1</sup> The patient had a profound leak after a wide-bore silastic catheter (15 ga) had been left *in situ* for a prolonged time.

This patient was taking cortisone acetate as part of her postoperative drug regimen, and the antiinflammatory effects of this steroid may have predisposed her to the development of a fistula.

The rationale and success of epidural blood patch as treatment for persistent CSF leak following dural puncture is well established.<sup>3</sup> Although the leak may have sealed spontaneously, this patient was uncomfortable, at risk for a superimposed infection, and otherwise ready for discharge from the hospital. Because of the extent of the leak and the length of time it had been present, a larger volume of blood than is usually used was injected.

However, 18 ml is not an excessive volume and no difficulties were encountered.<sup>6</sup>

Epidural blood patches are thought to control dural leaks by forming a clot at the dural rent and thereby sealing it. In this case an endothelial tube (fistula) probably extended from the dura through to the skin, thus perpetuating the leak and stopping the CSF from leaking into the epidural space as would usually occur. Possible mechanisms for control of the leak included the fistula being squeezed closed by the pressure of the epidural blood patch or the fistula being disrupted by the epidural blood and then sealed by the formation of clot.

In summary, lumbar subarachnoid CSF drainage is a well-described technique to provide good surgical exposure and prevent postoperative wound fistulae. A case is presented in which this technique resulted in the development of a subarachnoid–cutaneous fistula that was successfully treated with an epidural blood patch.

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#### REFERENCES

1. Horwitz NH, Rizzoli HV: Postoperative complications of intracranial neurological surgery, *Intracranial Neoplasms*. Baltimore/London, Williams and Williams, 1982, pp 35–181
2. McCallum J, Maroon JC, Jannetta PJ: Treatment of postoperative cerebrospinal fluid fistulas by subarachnoid drainage. *J Neurosurg* 42:434–437, 1975
3. DiGiovanni AJ, Galbert MW, Wahle WM. Epidural injection of autogenous blood for postlumbar puncture headache. *Anesth Analg* 51:226–232, 1972
4. Ball CG, D'Alessandro FT, Rosenthal J, Duff TA: An unusual complication of lumbar puncture: A CSF cutaneous fistula. *Anesth Analg* 54:691–694, 1975
5. Liebeskind AL, Herz DA, Rosenthal AD, Freeman LM: Radionuclide demonstration of spinal dural leaks. *J Nucl Med* 14:356–358, 1973
6. Crawford JS: Experiences with epidural blood patch. *Anesthesia* 35:513–515, 1980
7. Jawalekar SR, Marx GF: Cutaneous cerebrospinal fluid leakage following attempted extradural block. *ANESTHESIOLOGY* 54:348–349, 1981
8. Brown BA, Joles OW Jr: Prolonged headache following spinal puncture—response to surgical treatment. *J Neurosurg* 19:349–350, 1962