

Omentum graft for intractable subdural empyema

GENE H. BARNETT, MD AND HARRY K. MOON, MD

■ A subdural empyema developed in a young man after craniotomy for evacuation of a hematoma in a sylvian fissure arachnoid cyst and the subdural space. Despite prolonged systemic and subdural antibiotic administration and a debridement of the subdural space, infection persisted, as evidenced by persistent fever, an elevated white blood cell count, and an extremely low cerebrospinal fluid glucose level. The infection was cured after a second debridement operation where microsurgically revascularized free omentum was used to obliterate the cyst and to cover the cerebral hemisphere in the craniotomy defect. The use of vascularized free omentum may prove useful in cases of refractory cranial wound infection and cerebrospinal fluid fistulas.

□ INDEX TERMS: CASE REPORTS; OMENTUM; SUBDURAL EMPYEMA □ CLEVELAND CLIN J MED 1989; 56:311-315

INTRACRANIAL subdural empyemas (SDEs), which account for 15% to 20% of intracranial abscesses, most commonly result from parameningeal infections or trauma.¹ SDE may also arise as a complication of craniotomy.² Antibiotic therapy and early diagnosis by computed tomography (CT)³ have substantially improved the prognosis of SDE,⁴ but successful therapy often requires surgical debridement in conjunction with pharmacotherapy.⁵⁻⁷ Despite aggressive surgical and antibiotic treatment, SDE frequently results in permanent neurologic deficits or death.⁸

We report a case of subdural empyema that arose as a complication of craniotomy, in which conventional therapy failed to resolve the infection. Transposing microsurgically revascularized omentum to the empyema cavity obliterated the dead space of the cyst, stopped a persistent cerebrospinal fluid (CSF) leak, and provided a

barrier between the skin and the surface of the brain. These factors led to the rapid cure of the infection.

CASE REPORT

A 16-year-old boy was in good health until six months prior to hospitalization, when a generalized tonic clonic seizure disorder developed. A CT scan of his head at the time showed a large arachnoid cyst occupying the left sylvian fissure and a small left temporal lobe. His seizures were controlled with phenobarbital and he did well until one month prior to hospital admission when he had a severe headache associated with nausea and vomiting. His headache resolved after three days; however, it abruptly recurred two weeks later and persisted despite use of one gram of acetaminophen every three hours. Magnetic resonance (MR) imaging showed regions of high signal on T1- and T2-weighted images consistent with hematoma in the subdural space and cyst cavity.

A left frontotemporoparietal craniotomy was performed for evacuation of the hematoma and marsupialization of the arachnoid cyst. At the time of surgery, a bridging vein across the cyst was found to be a source of

From the Departments of Neurological Surgery (G.H.B.) and Plastic and Reconstructive Surgery (H.K.M.), The Cleveland Clinic Foundation. Submitted Jan 1988; accepted March 1988.

Address reprint requests to G.H.B., Department of Neurosurgery, The Cleveland Clinic Foundation, One Clinic Center, 9500 Euclid Avenue, Cleveland, Ohio 44195.

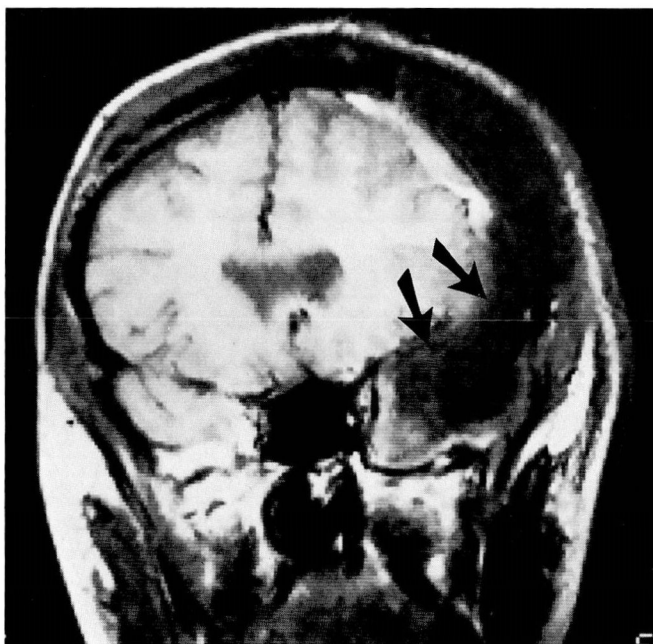


FIGURE 1. Coronal MR image (1.5 Tesla, TR=600, TE=32 ms) obtained before omental transposition, showing wound empyema (arrows) involving the sylvian arachnoid cyst.

bleeding and this was coagulated. His immediate post-operative course was unremarkable; on the second post-operative day, he complained of severe headache and his wound was noted to be bulging. A CT scan demonstrated a subgaleal hematoma; however, the intracranial compartment appeared benign. His headache worsened and he became hemiparetic and mute. He was taken to the operating room where hematomas were found in the subgaleal, extradural, and subdural spaces. The stump of the superficial temporal artery was bleeding and was presumed to be the source of the hematomas, which had dissected through these compartments. The clots were evacuated and hemostasis obtained.

Upon awakening the patient recovered limb and speech function. Twelve hours after surgery, he again became hemiparetic and mute. His CT scan at that time showed increased midline shift due to enlargement of the cyst cavity, but no recurrence of the hematoma. A catheter was placed in the subdural space and his hemiparesis immediately improved; however, he remained mute. CSF obtained at the time of catheter placement had many gram-positive cocci and gram-negative bacilli (which were later identified as *Streptococcus* and *Escherichia coli*) and glucose was undetectable. Vancomycin, one gram every eight hours, cefotaxime (Claforan), two grams every four hours, and tobramycin, 100 mg every

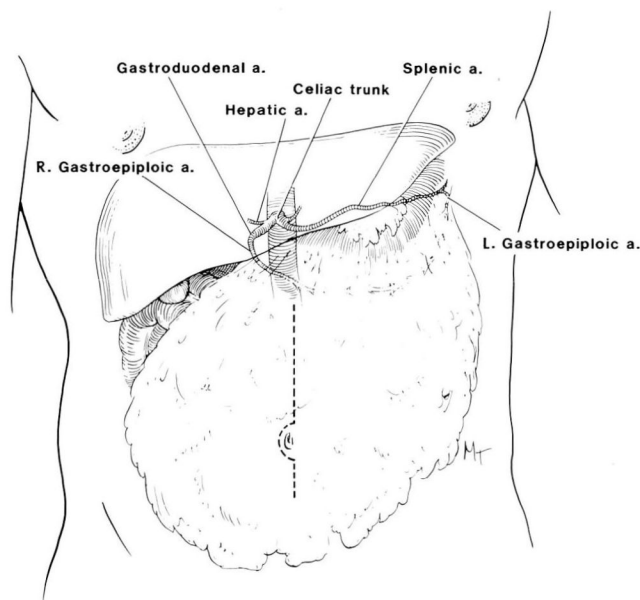


FIGURE 2. Abdominal incision (dashed line) and vascular supply of greater omentum.

eight hours, were given systemically. Four milligrams of gentamicin and 100 milligrams of vancomycin were given in the subdural space daily. Despite four days of this treatment, CSF glucose remained undetectable and there were 8,000 white blood cells/mm³ in his CSF.

He was taken back to surgery, where his bone flap was removed and the intracranial cavity debrided. Large amounts of pus were encountered in the subgaleal and extradural space. The dural flap appeared grossly infected and both this and the free bone flap were removed. The cyst and subdural hematoma bed were filled with soft, yellow, cheesy material which, on culture, grew the same bacteria as his CSF had done earlier. A catheter was placed directly in the arachnoid cyst for CSF drainage and instillation of antibiotics. A lyophilized dural graft was used between the brain and the skin flap as a barrier to CSF leakage. Necrotic regions of his scalp flap and temporalis muscle were debrided as well.

Intrathecal and systemic antibiotics were continued; however, CSF glucose levels remained very low (<20 mg/dL). He remained febrile and had a persistent CSF and systemic glucose leukocytosis. Attempts to clamp his drainage catheter resulted in leakage of large volumes of cloudy CSF from the wound. MR imaging showed a large subdural empyema with extradural and subgaleal extension (Figure 1).

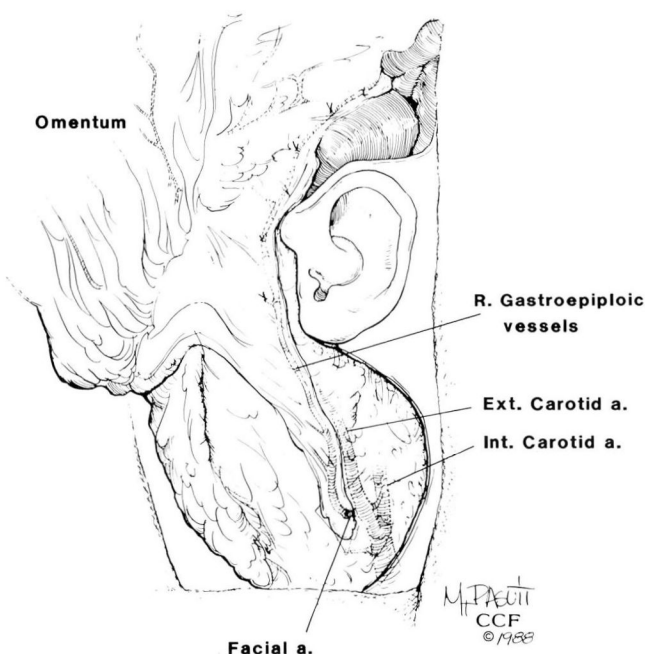


FIGURE 3. Free omentum with vascular pedicle microscurgically anastomosed to the left facial artery and vein.

He was returned to surgery and the craniotomy reopened. The dural graft was removed and the intracranial contents again debrided. A laparotomy was performed and a free omental flap with a vascular pedicle was obtained (Figure 2). His craniotomy incision was extended caudally and the facial artery and vein were exposed. An anastomosis was then created microscurgically between the pedicle of the omental graft and these vessels (Figure 3). The omentum was laid in the cyst cavity and over the cerebral hemisphere. It was tacked in place using 3/0 chromic suture. The skin was then closed using a single layer of vertical mattress sutures. A ventricular catheter was placed in the right frontal horn of the lateral ventricle and the subdural catheter removed.

He was awakened and taken to the Neurosurgical Intensive Care Unit where his antibiotic therapy was continued and his CSF drained at atmospheric pressure. Resolution of his fever, reduction in his leukocytosis, and return of CSF glucose to >50 mg/dL occurred within three days. His ventricular catheter was drained at pressures of 5 mmHg and then 10 mmHg. On the sixth post-operative day, the catheter was clamped and subsequently removed. MR imaging at this time showed

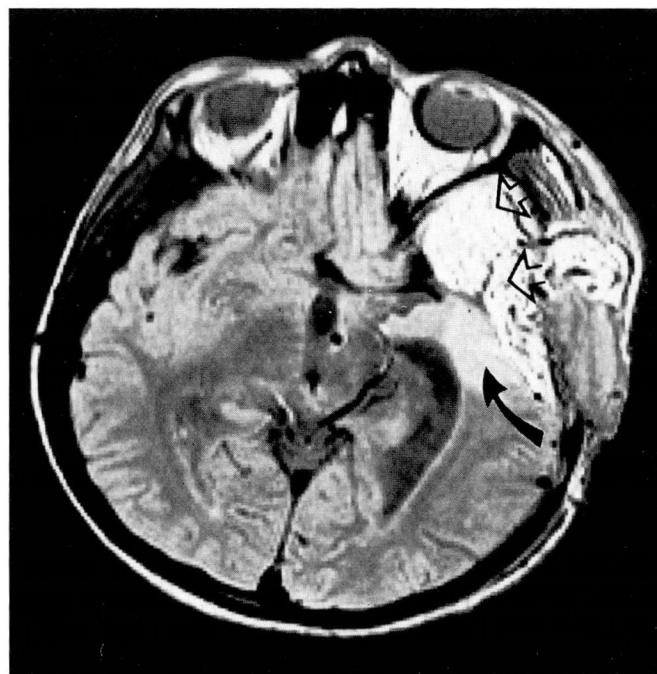


FIGURE 4. Transverse MR image of the head (1.5 Tesla, TR=2010, TE=32 ms) after subdural omental transposition. Note obliteration of dead space (open arrows). Areas of white matter with increased signal (solid arrow) are thought to represent zones of venous infarction due to the patient's empyema.

obliteration of the subdural and cyst space by the omental flap and areas of increased signal in the white matter of the inferior frontal gyrus and the temporal pole that were believed to be areas of venous infarction (Figure 4). He has remained free of fever and has required no further CSF drainage.

DISCUSSION

Before the availability of antibiotics, SDE was associated with a mortality of nearly 90%. Aggressive antibiotic therapy alone has been advocated by some authors as sufficient therapy for SDE⁵⁻⁷; however, it is generally held that early surgical drainage and debridement used in conjunction with antibiotic therapy is the best treatment.^{1,9} Although combined therapy may result in mortality rates as low as 5% or 10%,^{4,9} Arseni et al⁸ have found mortality remaining as high as 25%. The cause of death in these patients often is brain infarction from cerebrovenous thrombophlebitis and inability to control the infection.

Omental transpositions have proven to be quite effective in the management of mediastinal sepsis after

median sternotomy¹⁰⁻¹² and infection of hip replacements.¹³ Although omentum can scavenge bacteria within the peritoneal cavity, it has been speculated that much of the infection-controlling property of omental graft in these settings is due to its obliteration of dead space, generous blood supply, and ability to adhere to and granulate surfaces to which it is applied.¹² Regardless, the infection bed must be debrided and free of gross purulence as grafts may not survive or "take" when placed into a bed of gross purulence.

The use of omental transpositions in neurosurgical practice is not without precedent. Levander and Asard,^{14,15} Wennerstrand and Levander,¹⁶ and Andersson et al¹⁷ have reported on the abilities of the greater omentum to absorb CSF, speculating upon its use in the treatment of hydrocephalus. The use of omental grafts to repair large defects of the skull was first described by Browning et al¹⁸ in 1979 and since then, omental transpositions have been used in cranial repairs for electrical trauma,^{19,20} mechanical trauma,²¹ thermal burns,²² and tumor surgery.^{23,24} The use of omental grafts to provide a collateral blood supply to regions of cerebral ischemia has been studied extensively in animals,²⁵⁻²⁹ successfully used to treat Moya Moya disease,³⁰ and used as a treatment for cerebral ischemia in humans.³¹⁻³³ To our knowledge, ours is the first report of use of omentum in the

treatment of subdural empyema and CSF leakage that was refractory to antibiotic and conventional surgical techniques.

It may be argued that the use of a lyophilized dura graft may have perpetuated the infection in our patient. The decision to use this was based on the need for a CSF barrier as the required skin debridement would not allow a watertight skin closure. We believe that the omental transposition was successful in resolving the infection because of its highly vascular nature, obliteration of dead space, and arrest of CSF leakage.

The use of a revascularized free omental flap may pose some problems for our patient in the future. First, a cosmetic cranioplasty to repair his bony defect may be made more difficult by the presence of omentum and its vascularized pedicle in the craniotomy defect. Also, a substantial weight gain could, theoretically, produce enlargement of the omental graft that could act as a mass lesion. Regardless, use of a revascularized free omental graft proved lifesaving in this case and should be considered in other cases of intractable subdural empyemas or infections of cystic intracranial cavities.

ACKNOWLEDGMENTS

We wish to thank Darlene Straub and Phyllis Brunner for their assistance in the preparation of this manuscript.

REFERENCES

1. Khan M, Griebel R. Subdural empyema: a retrospective study of 15 patients. *Can J Surg* 1984; 27:283-285, 288.
2. Tokunaga Y, Inoue M, Ishizaka H, Koga H, Kawano T, Mori K. [Encapsulated subdural empyema—a case report with special reference to CT findings and operative indications.] *No Shinkei Geka* 1985; 13:433-436.
3. Zimmerman RD, Leeds NE, Danziger A. Subdural empyema: CT findings. *Radiology* 1984; 150:417-422.
4. Fenner T, Kasic P. Endokranielle Komplikationen bei Sinusitis. *HNO* 1983; 31:415-419.
5. Mauser HW, Ravijst RAP, Elderson A, van Gijn J, Tulleken CAF. Nonsurgical treatment of subdural empyema: A case report. *J Neurosurg* 1985; 63:128-130.
6. Leys D, Destee A, Petit H, Warot P. Management of subdural intracranial empyemas should not always require surgery. *J Neurol Neurosurg Psychiatry* 1986; 49:635-639.
7. Leys D, Destee A, Combelles G, Rousseaux M, Warot P. Les empyèmes sous-duraux intracrâniens: trois observations. *Sem Hop Paris* 1983; 59:3347-3350.
8. Arseni C, Ciurea AV, Ciurea AM. Subarachnoid empyemas. Considerations in connection with 55 cases. *Zentralbl Neurochir* 1984; 45:28-39.
9. Hockley AD, Williams B. Surgical management of subdural empyema. *Childs Nerv Syst* 1983; 10:294-300.
10. Seguin JR, Loisanse DY. Omental transposition for closure of medial sternotomy following severe mediastinal and vascular infection. *Chest* 1985; 88:684-686.
11. Pearl SN, Dibbell DG. Reconstruction after median sternotomy infection. *Surg Gynecol Obstet* 1984; 159:47-52.
12. Lee AB Jr, Schibmert G, Shaktin S. Total excision of the sternum and thoracic pedicle transposition of the greater omentum: useful stratagems in managing severe mediastinal infection following open heart surgery. *Surgery* 1976; 80:433-436.
13. Mendes D, Kahn M, Ibrahim IM, Sussman B, Fox R, Dardik H. Omental protection of autogenous arterial reconstruction following femoral prosthetic graft infection. *J Vasc Surg* 1985; 2:603-606.
14. Levander B, Asard PE. Lumbo-omental shunt for drainage of cerebrospinal fluid—an experimental study in dogs. I. The transport of cerebrospinal fluid from the lumbar subarachnoid space, studied by 169Yb-DTPA and a gamma camera. *Acta Neurochir (Wien)* 1978; 43:1-11.
15. Levander B, Asard PE. Lumbo-omental shunt for drainage of cerebrospinal fluid—an experimental radionuclide study in dogs. II. Evaluation of transport routes from lumbar subarachnoid space to venous blood. *Acta Neurochir (Wien)* 1978; 43:251-262.
16. Wennerstrand JR, Levander BE. Lumbo-omental drainage of cerebrospinal fluid. A new experimental shunting procedure. *Acta Chir Scand* 1974; 140:91-94.
17. Andersson H, Holmgren E, Wennerstrand J. On a free autologous graft of the greater omentum for spinal CSF drainage. *Z Kinderchir* 1986; 41(Suppl 1):22-24.
18. Browning FSC, Eastwood DS, Price DJE, Kester RC. Scalp and cranial substitution with autotransplanted greater omentum using microvascular anastomosis. *Br J Surg* 1979; 66:152-15.
19. Sun YH, Tsao DS, Ma RL, et al. Use of autogenous omentum for grafting electrical injury affecting the scalp and skull. *Burns Incl Therm Inj* 1985; 11:289-292.
20. Caffee HR. Scalp and skull reconstruction after electrical burn. *J Trauma* 1980; 20:87-89.
21. Arnold PG, Irons GB. One-stage reconstruction of massive craniofacial defect with gastrointestinal free flap. *Ann Plast Surg* 1981; 6:26-33.
22. Sun YH, Wang SH, Cao DX, Wang NZ, Ma RL. Early treatment of

- burned scalp and skull. *Chin Med J [Engl]* 1984; **97**:755–757.
23. Benzel EC, LeBlanc KA, Hadden TA, Willis BK. Management of a large skull defect utilizing a vascularized free omental transfer. *Surg Neurol* 1987; **27**:223–227.
24. Barrow DL, Nahai F, Tindall GT. The use of greater omentum vascularized free flaps for neurosurgical disorders requiring reconstruction. *J Neurosurg* 1984; **60**:305–311.
25. Azzena GB, Campus G, Mameli O, et al. Omental transposition or transplantation to the brain and superficial temporal artery—middle cerebral artery anastomosis in preventing experimental cerebral ischaemia. *Acta Neurochir (Wien)* 1983; **68**:63–83.
26. Pau A, Sehrbundt Viale E, Turtas S. Effect of omental transposition on to the brain on the cortical content of norepinephrine, dopamine, 5-hydroxytryptamine and 5-hydroxyindoleacetic acid in experimental cerebral ischaemia. *Acta Neurochir (Wien)* 1982; **66**:159–164.
27. Pau A, Sehrbundt Viale E, Turtas S, Viale GL. Cerebral water and electrolytes in experimental ischemia following omental transposition to the brain. *Acta Neurochir (Wien)* 1980; **54**:213–218.
28. Cucca GS, Papavero L, Pau A, Sehrbundt Viale E, Turtas S, Viale GL. Effect of omental transposition to the brain on protein synthesis in experimental cerebral ischemia. *Acta Neurochir (Wien)* 1980; **51**:253–257.
29. De Riu PL, Falzoi A, Papavero L, Rocca A, Viale GL. Local cerebral blood flow after middle cerebral artery occlusion in rabbits following transposition of omentum to the brain. *J Microsurg* 1980; **1**:321–324.
30. Karasawa J, Kikuchi H, Kawamura J, Sakai T. Intracranial transplantation of the omentum for cerebrovascular moyamoya disease: a two-year follow-up study. *Surg Neurol* 1980 **14**:444–449.
31. Ni MS, Zou XW, Xie KM, Zhao YP. Free omental autotransplant to brain surface in ischemic cerebrovascular disease. *Chin Med J [Engl]* 1983; **96**:787–789.
32. Li JT. [Combined use of an intracranial omental pedicled graft and extracranial-intracranial arterial anastomosis in the treatment of ischemic cerebrovascular disease—report of 2 cases.] *Chung Hua Shen Ching Ching Shen Ko Tsa Chih* 1983; **16**:29–30.
33. Liu DK. [Transplantation of a free omentum for revascularization in cerebral ischemic stroke.] *Chung Hua Shen Ching Ching Shen Ko Tsa Chih* 1983; **16**:20–22.

