Cerebrospinal fluid rhinorrhoea: diagnosis and management

Allan Abuabara

DDS, Specialist in Dental and Maxillofacial Radiology, Health Division, Joinville City Hall, Joinville, Santa Catarina, Brazil

Correspondence:
Dr. Abuabara
Rua Quintino Bocaiúva, 102, apto 206,
Joinville, SC, Brazil. 89204-300;
E-mail: allan.abuabara@gmail.com

Received: 25-07-2006
Accepted: 30-01-2007

Indexed in:
-Index Medicus / MEDLINE / PubMed
-EMBASE, Excerpta Medica
-SCOPUS
-Indice Médico Español
-IBECS

Abuabara A. Cerebrospinal fluid rhinorrhoea: diagnosis and management. Med Oral Patol Oral Cir Bucal 2007;12:E397-400.

ABSTRACT
A cerebrospinal fluid (CSF) rhinorrhoea occurs when there is a fistula between the dura and the skull base and discharge of CSF from the nose. CSF rhinorrhea or liquorrhoea commonly occurs following head trauma (fronto-basal skull fractures), as a result of intracranial surgery, or destruction lesions. A spinal fluid leak from the intracranial space to the nasal respiratory tract is potentially very serious because of the risk of an ascending infection which could produce fulminant meningitis. This article reviewed the causes, diagnosis and treatment of CSF leakage. A PUBMED search of the National Library of Medicine was conducted. CSF leak most commonly occurs following trauma and the majority of cases presenting within the first three months. CSF rhinorrhoea have significantly greater incidence of periorbital haematoma. This suggests that patients with head injuries and features of periorbital haematoma are at greater risk of unobserved dural tear and delayed CSF leakage. In the presence of a skull base fracture on computed tomography and a clinical CSF leak, there is no need for a further confirmatory test. In cases where a confirmatory test is needed, the beta-2 transferrin assay is the test of choice because of its high sensitivity and specificity. A greater proportion of the CSF leaks in the patients resolved spontaneously. CSF fistulae persisting for > 7 days had a significantly increased risk of developing meningitis. Treatment decisions should be dictated by the severity of neurological decline during the emergency period and the presence/absence of associated intracranial lesions. The timing for surgery and CSF drainage procedures must be decided with great care and with a clear strategy.

Key words: *Liquorrhoea, rhinorrhoea, cerebrospinal fluid, head injury.*

CONCEPT
Surgical management of multiple traumatized patients with head trauma is highly individualized and depends on a number of factors including etiology, intracranial pressure, concomitant injuries, patient age and the possibility of an interdisciplinary procedure. Severe head and neck trauma are often connected with fractures of the frontal skull base or nasoethmoido-orbital complex and cerebrospinal fluid (CSF) leakage (1). CSF leak is an escape of the fluid that surrounds the brain and spinal cord, from the cavities within the brain or central canal in the spinal cord. A CSF rhinorrhoea occurs when there is a fistula between the dura and the skull base and discharge of CSF from the nose. A spinal fluid leak from the intracranial space to the nasal respiratory tract is potentially very serious because of the risk of an ascending infection which could produce fulminant meningitis (2). CSF leaks have been associated with about a 10% risk of developing meningitis per year (3).

CSF rhinorrhea commonly occurs following head trauma (fronto-basal skull fractures) or as a result of intracranial surgery. Others conditions include paranasal sinuses along with osteomyelitis of the adjacent bone, congenital anomalies of the brain and its coverings such as meningoceles or meningoencephaloceles, and destruction lesions along the skull base (4). Pituitary tumors cause erosion of the sella turcica floor and are frequently associated with CSF rhinorrhea (5). This article reviewed the causes, diagnosis and treatment of CSF leakage. A PUBMED search of the National Library of Medicine was conducted.

EPIDEMIOLOGY
CSF rhinorrhea can be divided in traumatic and non-traumatic: the traumatic group can be divided in accidental and

iatrogenic. The non-traumatic group is associated to brain tumors (intracranial and extracranial tumors, cholesteatoma, or tuberculoma are know to erode the bone directly) (6), skull base congenital defects and meningoceles or meningoencephalocles (7).

CSF leak most commonly occurs following trauma (80-90 % of cases) and the majority of cases presenting within the first three months. Other etiologies include: postoperative defect (10 %), spontaneous leak (3-4 %), tumor, and inflammation (8). Usually the fracture involves some portion of the anterior cranial fossa floor with the leaks occurring through the cribriform plate or ethmoid sinus roof into the nose. Another frequently seen anterior fossa fracture site is the posterior wall of the frontal sinus through which CSF can escape into the nose via the nasofrontal duct. Less common are middle cranial fossa fractures that can cause leakage to the nose via the sphenoid sinus or eustachian tube (2). Nontraumatic cerebrospinal fluid fistulae tend to occur less frequently, and most of them are related to diseases that cause increased intracranial pressure or local skull destruction. Such conditions include hydrocephalus, tumors, osteomyelitis of the skull and brain cysts. Congenital defects of the skull can also serve as the source of fistulae, usually occurring in the anterior cranial fossa (2).

Fain et al. (9) presented a classification of trauma to the cranial base, based on observation in 80 cases. There were five types. Type I: involves only the anterior wall of the frontal sinus. Type II: involves the face (craniofacial disjunction of the Lefort II type or crush face) and extend upward to the cranial base and, in occurrence, to the anterior wall of the frontal sinus, because of the facial retrusion. Type III: involves frontal part of the skull and extend down to the cranial base. Type IV: is a combination of types II and III. Type V: involves only ethmoidal or sphenoidal bones. CSF leak is unfrequent in types II, and transitionnal, if it occurs; but it often occurs in types III, IV and V which include in every case a dural tear. Correct diagnosis facilitates treatment. Fractures of types I and II can be fully treated by maxillo-facial surgeons, whereas for types III, IV, and V, they need the help of a neuro-surgeon.

CLINICAL PICTURE AND PATHOGENESIS

CSF rhinorrhea after intracranial or intranasal surgery is a known potential complication with significant morbidity and mortality. Accurate identification of the site of CSF leakage is necessary for a successful surgical repair. The most reliable methods of distinguishing between a traumatic or neoplastic lesion and a spontaneous CSF rhinorrhea are high-resolution computed tomography (CT) and magnetic resonance (MR) tomography (10). MR imaging is reserved for defining the nature of soft tissue i.e. inflammatory tissue, meningoencephalocele or tumor (11). In MR images we can find brain herniation into the ethmoid or frontal sinuses (12). CT with or without intrathecal contrast and preoperative nasal endoscopy are frequently used to preoperatively localize the site of the leak (13).

CSF rhinorrhoea have significantly greater incidence of periorbital haematoma. This suggests that patients with head injuries and features of periorbital haematoma are at greater risk of unobserved dural tear and delayed CSF leakage. Frontal and ethmoid fractures in particular are also associated with CSF leakage (14). Radiographic exams like simple skull X rays are quite ineffective. However it can demonstrate indirect signs like fractures and pneumoencephalus (7). Various combinations of planar tomography and CT, contrast-enhanced CT cisternography, and radionuclide cisternography, and, more recently, MR cisternography have been used in the diagnosis of CSF leak. Radionuclide cisternography and contrast-enhanced CT cisternography techniques require injections into the intrathecal space, most often via lumbar puncture. Although cisternography has minimal inherent risks, such as infection and lumbar CSF leak, it significantly increases expense and adds patient discomfort. Radionuclide studies do not provide precise anatomic localization of CSF leaks (15). Stone et al. (15) suggest that high-resolution CT is a useful screening examination for the initial workup of CSF rhinorrhea or otorrhea. When the clinical and imaging findings coincide, further evaluation using CT cisternography and radionuclide cisternography is often unnecessary. Computerized cisternography and radionuclide cisternography should be used if MR imaging is contraindicated or if a clinically and biologically proven CSF fistulae is not visualized by CT or MR imaging (8).

Diagnosis through nasal inspection and performance of laboratory tests of the fluid can be conducted. In some cases, there is contamination of the material with blood or other secretions, so the test with beta-2 transferrine becomes mandatory (7). Beta-2 transferrin is a carbohydrate-free (desialated) isoform of transferrin, which is almost exclusively found in the CSF (16) and blood or nasal secretion does not disturb the test (17). Beta-2 transferrin is not present in blood, nasal mucus, tears or mucosal discharge. This protein was first described by Irjala et al in 1979 (18). Intense research over the last decade has validated its characteristics and value in clinical use as a specific CSF marker (19). Beta-2 transferrin was reported to have a sensitivity of near 100% and a specificity of about 95% in a large retrospective study (20).

Detection of glucose in the sample fluid using Glucostix test strips has been a traditional method for detection of the presence of CSF in nasal and ear discharge. Glucose detection using Glucostix test strips is not recommended as a confirmatory test due to its lack of specificity and sensitivity (19). Interpretation of the results is confounded by various factors such as contamination from glucose-containing fluid (tears, nasal mucus, blood in nasal mucus) or relatively low CSF glucose levels (meningitis) (19). Studies have shown (21) that glucose can be detected in airways secretions from people with diabetes mellitus, stress hyperglycaemia and people with nasal epithelial inflammation due to viral colds.

In the presence of a skull base fracture on CT and a clinical CSF leak, there is no need for a further confirmatory test.

In cases where a confirmatory test is needed, the beta-2 transferrin assay is the test of choice because of its high sensitivity and specificity (19).

MANAGEMENT AND PROGNOSIS

Most of CSF leaks close spontaneously within 7 to 10 days (19, 22, 23). Although most trauma-related CSF leaks resolve without intervention, conservative treatment of CSF leaks may lead to bacterial meningitis, therefore surgical closure of leaks or defects at the skull base should be considered treatment of choice to prevent ascending meningitis (24). CSF fistulae persisting for > 7 days had a significantly increased risk of developing meningitis (23). The goal of surgical therapy is repair of the dural defect contributing to the CSF leak (15). The surgical management of CSF leak has changed significantly after the introduction of functional endoscopic sinus surgery in the management of sinusitis. The clear anatomical exposure of the roof of the nasal and the sinus cavities by the endoscope offers the surgeon an opportunity to identify the area of the CSF leak, which enables one to adequately plan the treatment (25).

It is currently accepted that endoscopic intranasal management of CSF rhinorrhea is the preferred method of surgical repair, with higher success rates and less morbidity than intracranial surgical repair in selected cases (13). Endonasal endoscopic approach can be preferred for the closure of uncomplicated CSF fistula, located at the anterior or posterior ethmoid roof and in the sphenoid sinus, due to its minimal postoperative morbidity. Uncomplicated CSF fistula, located at the posterior wall of frontal sinuses can be repaired extradurally with osteoplastic frontal sinusotomy. Intracranial approaches should be reserved for more complicated CSF rhinorrhea which results from extensive comminuted fractures of the anterior cranial base and is accompanied with intracranial complications (26). Anosmia is the most frequent permanent complication mentioned.

The value of antibiotic prophylaxis in patients with CSF leakage is debatable. In a literature review, Brodie (27) concluded that individually, each of the studies evaluated demonstrated no significant difference in the incidence of meningitis with prophylactic antibiotic therapy. The reason for this is that inadequate numbers of patients were available at each institution. Pooling the data from the past 25 years revealed a statistically significant reduction in the incidence of meningitis with prophylactic antibiotic therapy. It is ethically justifiable to keep antibiotic prophylaxis in patients with CSF fistulae until other studies settle the question.

COMPLEMENTARY EXPLORATION

Post-traumatic CSF leaks are uncommon and will usually resolve without surgical intervention. Successful management in refractory cases often involves a combination of observation, CSF diversion, and/or extracranial and intracranial procedures (28). The factors that had a critical influence on outcome are level of consciousness on admission and presence of additional intracranial pathology associated with CSF leakage within cases of traumatic CSF fistulae due to skull base fractures. Patients with CSF leaks that persist greater than 24 hours are at risk for meningitis, and maybe require surgical intervention. Prophylactic antibiotics may be effective and should be considered in this group of patients (29). Treatment decisions should be dictated by the severity of neurological decline during the emergency period and the presence/absence of associated intracranial lesions. The timing for surgery and CSF drainage procedures must be decided with great care and with a clear strategy (22).

REFERENCES

1. Sandner A, Kern CB, Bloching MB. Experiences with the subfrontal approach to manage extensive fractures of the frontal skull base. Laryngorhinootologie 2006;85:265-71.
2. Calcaterra TC, Moseley JI, Rand RW. Cerebrospinal rhinorrhea: extracranial surgical repair. West J Med 1977;127:279-83.
3. Jones NS, Becker DG. Advances in the management of CSF leaks. BMJ 2001;322:122- 3.
4. Muzumdar D, Nadkarni T, Goel A. Spontaneous cerebrospinal fluid rhinorrhea as a presenting symptom of aqueductal stenosis--case report. Neurol Med Chir 2003;43:626-9.
5. Hanel RA, Prevedello DM, Correa A, Antoniuk A, Araujo JC. Cerebrospinal fluid fistula as the presenting manifestation of pituitary adenoma: case report with a 4-year follow-up. Arq Neuropsiquiatr 2001;59:263-5.
6. Ozveren MF, Kaplan M, Topsakal C, Bilge T, Erol FS, Celiker H et al. Spontaneous cerebrospinal fluid rhinorrhea associated with chronic renal failure--case report. Neurol Med Chir 2001;41:313-7.
7. Landeiro JA, Flores MS, Lazaro BC, Melo MH. Surgical management of cerebrospinal fluid rhinorrhea under endoscopic control. Arq Neuropsiquiatr 2004;62:827-31.
8. Iffenecker C, Benoudiba F, Parker F, Fuerxer F, David P, Tadie M et al. The place of MRI in the study of cerebrospinal fluid fistulas. J Radiol 1999;80:37-43.
9. Fain J, Chabannes J, Peri G, Jourde J. Frontobasal injuries and csf fistulas. Attempt at an anatomoclinical classification. Therapeutic incidence. Neurochirurgie 1975;21:493-506.
10. Benedict M, Schultz-Coulon HJ. Spontaneous cerebrospinal rhinorrhea. Etiology--differential diagnosis—therapy. HNO 1991;39:1-7.
11. Lund VJ, Savy L, Lloyd G, Howard D. Optimum imaging and diagnosis of cerebrospinal fluid rhinorrhoea. J Laryngol Otol 2000;114:988-92.
12. Fu Y, Komiyama M, Nagata Y, Tamura K, Yagura H, Yasui T et al. MR findings in traumatic cerebrospinal fluid leakage with special reference to indications of the need for dural repair. No Shinkei Geka 1993;21:319-23.
13. Jones ME, Reino T, Gnoy A, Guillory S, Wackym P, Lawson W. Identification of intranasal cerebrospinal fluid leaks by topical application with fluorescein dye. Am J Rhinol 2000;14:93-6.
14. Choi D, Spann R. Traumatic cerebrospinal fluid leakage: risk factors and the use of prophylactic antibiotics. Br J Neurosurg 1996;10:571-5.
15. Stone JA, Castillo M, Neelon B, Mukherji SK. Evaluation of CSF leaks: high-resolution CT compared with contrast-enhanced CT and radionuclide cisternography. AJNR Am J Neuroradiol 1999;20:706-12.
16. Reisinger PW, Hochstrasser K. The diagnosis of CSF fistulae on the basis of detection of beta 2-transferrin by polyacrylamide gel electrophoresis and immunoblotting. Clin Chem Clin Biochem 1989;27:169-72.
17. Reisinger PW, Lempart K, Hochstrasser K. New methods of diagnosing cerebrospinal fluid fistulas using beta 2-transferrin or prealbumin--principles and methodology. Laryngol Rhinol Otol 1987;66:255-9.
18. Irjala K, Suonpaa J, Laurent B. Identification of CSF leakage by immunofixation. Arch Otolaryngol 1979;105:447-8.
19. Chan DT, Poon WS, IP CP, Chiu PW, goh KY. How useful is glucose detection in diagnosing cerebrospinal fluid leak? The rational use of CT and Beta-2 transferrin assay in detection of cerebrospinal fluid fistula. Asian J Surg 2004;27:39-42.
20. Skedros DG, Cass SP, Hirsch BE, Kelly RH. Sources of error in use of beta-2 transferrin analysis for diagnosing perilymphatic and cerebral spinal fluid leaks. Otolaryngol Head Neck Surg 1993;109:861–4.
21. Philips BJ, Meguer JX, Redman J, Baker EH. Factors determining

the appearance of glucose in upper and lower respiratory tract secretions. Intensive Care Med 2003;29:2204-10.
22. Yilmazlar S, Arslan E, Kocaeli H, Dogan S, Aksoy K, Korfali E et al. Cerebrospinal fluid leakage complicating skull base fractures: analysis of 81 cases. Neurosurg Rev 2006;29:64-71.
23. Brodie HA, Thompson TC. Management of complications from 820 temporal bone fractures. Am J Otol 1997;18:188-97.
24. Bernal-Sprekelsen M, Alobid I, Mullol J, Trobat F, Tomas-Barberan M. Closure of cerebrospinal fluid leaks prevents ascending bacterial meningitis. Rhinology 2005;43:277-81.
25. Anand VK, Murali RK, Glasgold MJ. Surgical decisions in the management of cerebrospinal fluid rhinorrhoea. Rhinology 1995;33:212-8.
26. Tosun F, Gonul E, Yetiser S, Gerek M. Analysis of different surgical approaches for the treatment of cerebrospinal fluid rhinorrhea. Minim Invasive Neurosurg 2005;48:355-60.
27. Brodie HA. Prophylactic antibiotics for posttraumatic cerebrospinal fluid fistulae. A meta-analysis. Arch Otolaryngol Head Neck Surg 1997;123:749-52.
28. Bell RB, Dierks EJ, Homer L, Potter BE. Management of cerebrospinal fluid leak associated with craniomaxillofacial trauma. J Oral Maxillofac Surg 2004;62:676-84.
29. Friedman JA, Ebersold MJ, Quast LM. Post-traumatic cerebrospinal fluid leakage. World J Surg 2001;25:1062-6.