The management of frontobasal injured patients: The neurosurgeon's point of view

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SUMMARY

Among the numerous post-traumatic rhinorrhea complications of skull base fractures and severe craniofacial injuries, rhinorrhea is a common one. This can be divided into two clinical types depending on the time of onset: acute and delayed. In this paper is analyzed the experience of the last decade in surgical treatment of both forms of posttraumatic rhinorrhea. There are controversies in the management of different problems such as meningitis, extend of fracture and concomitant injuries. The recomended preoperative investigations are different in the two types of rhinorrhea, and the value of methods such as high resolution CT, intrathecal CT cisternography, MRI and nasal endoscopy is discussed here. Absolute indications for surgery are persistent fistula, meningitis, largely extended fracture and delayed rhinorrhea. During surgery if intracranial hypertension or hydrocephalus is present, it should always be treated by shunting. In our series only an intracranial combined extra- and intradural approach has been used, and the value of different sealant materials is also reported. Finally, postoperative complications and outcome are discussed. A brief review is also included about the controversial prophylactic administration of antibiotics.

KEY WORDS

posttraumatic rhinorrhea - management - intradural sealing

INTRODUCTION

Skull base fractures and craniofacial injuries are often combined with frontobasal brain contusions, brain lacerations, haematomas, epileptic fits and also cerebrospinal fluid leakage. We will treat only the most common of these, posttraumatic rhinorrhea. There are two forms of CSF leakage from the skull base: rhinorrhea and otorrhea. Both are usually post-traumatic. Otorrhea occurs usually in longitudinal fractures of the petrous bone and only if the tympanic membrane is perforated. Almost as a rule, otorrhea subsides spontaneously and does not pose any special medical problem. If the tympanic membrane remains intact, the fluid may pass to the nasopharynx by way of the Eustachian tube, resulting in rhinorrhea.

Post-traumatic rhinorrhea can be divided into acute or delayed forms, depending on the time of appearance. The pathology, radiological investigation, sequalae and management of these are quite different and this point will be discussed later. Most investigators report a 2 to 3 percent incidence of post-traumatic rhinorrhea in closed head injury (7, 11, 13). Caldicott and colleagues (1) found a ten-to-one ratio in

adults in comparison with children. The decreased risk in infants is due to:
1. Increased skull flexibility,
2. Lesser incidence of frontal impacts and head injuries in this age group,
3. Lack of pneumatization of the air sinuses.

COMMON SITES OF LEAKAGE. As would be expected, the commonest sites for post-traumatic fistula development are basilar fractures in thin areas of the skull, near the paranasal sinuses or the mastoid air cells. Typical locations include the frontal fossa-cribriform plate region. It has to be mentioned that fractures tend to occur at the junction of the ethmoid labyrinth and cribriform plate, or through the fovea ethmoidalis rather than the cribriform plate itself (12). Other common locations include the temporal fossa-sphenoid wing region and petrous bone. In addition, patients with posterior wall frontal sinus fractures have the potential for the development of CSF leakage through the frontal ethmoid duct.
DIAGNOSIS: Frequently, it is difficult to confirm that a patient does have a CSF leakage. The patient's history for trauma may be distant and unclear, the leakage may be extremely subtle, or the patient may simply present with meningitis without a clear or obvious cause. It also can be difficult sometimes to separate and identify various types of secretions. For example, nasal secretions can be CSF or can be the result of upper respiratory tract infections, normal nasal physiology, or trauma.
The identification of CSF is relatively straightforward when clear fluid runs out of the nose when the head is flexed forward, as in a patient with a history of trauma and frontal fractures. Patients may experience an associated headache if the leak is significant. They may also report a salty taste in the mouth, which reflects the sodium chloride content of the CSF. If the fluid is mixed with blood or serous products, it can be difficult to identify the CSF accurately. Because blood products and CSF differ in density they migrate differently through such materials as cotton bed linens. Thus the "double ring" sign suggests the presence of a leak but does not, however, confirm it
CONFIRMATION OF LEAK. When the source of clear fluid dripping from the nose is uncertain the primary distinction to be made is between CSF and nasal secretions. Several tests may be helpful for this, such as *Dextrostix* (glucose is present only in CSF, false positive result in blood products and lacrimal fluids), *Beta2 transferrin* (only present in CSF, need though sophisticated equipment and skilled personnel). Additional examinations such as *plain skull films* (fluid level into an air sinus. Differential diagnosis from haematoma and sinusitis should be done) and *nuclear medicine tests* (radioactive cisternography may be misleading and inaccurate especially with inactive leaks. These methods are not popular any more). *High resolution Computed Tomography is* probably the most commonly used and potentially most accurate method for identifying the site of CSF fistula. *Intrathecal contrast enhanced Computed Tomography is* the most accurate diagnostic test but often gives a false negative in cases of inactive leak. The role of MRI is to be established in the near future. Finally *nasal endoscopy* by direct visualization of the fistula site is useful, when the fistula cannot be identified with any of the standard methods but there is strong clinical evidence of rhinorrhea. An otorhinolaryngologist can directly visualize a leak, involving the ethmoid bone, the sphenoid bone or the cribriform plate.
MANAGEMENT. Factors influencing the treatment plan include:

- Chronology of leak
- Site of fistula
- Size and amount of leakage
- Presence of accompanying infection

As a general conception, it is always preferable to treat CSF fistulas with as minimally invasive a technique as possible. However, com-

mon sense dictates that larger leaks or leaks that are more chronic in nature are not likely to heal with conservative measures and may need operative intervention.

Conservative treatment consists of bed rest with head elevation 10 to 20 degrees from the horizontal, to decrease the intracranial pressure. Additionally, the patient is given stool softeners and is instructed to avoid straining during bowel movements. An adjuvant to bed rest is the use of continuous external spinal drainage. A catheter is placed intradurally and connected with a system employed for spinal anesthesia. Shapiro and Scully reported a 94% success rate for the technique (14) and Mc Callum and colleagues demonstrated successful closure of the fistula in 11 out 12 patents (10.)

Therefore, all patients with acute trauma and secondary cerebrospinal fluid leakage are treated with bed rest and head-of-bed elevation as the treatment of choice. This is attempted for approximately 5 to 7 days. If significant leakage occurs after this time, a lumbar drain is placed and left in for 5 to 7 days. Larger leaks have a more difficult time closing with simple bed rest alone.

In patients with basilar skull fractures and CSF leakage, the combination of bed rest and lumbar drainage if needed, results in the closure of the vast majority of CSF fistulae. In recent literature only 2 to 5% of patients with post-traumatic rhinorrhea need more aggressive treatment (2). It must be emphasized that bed rest and/or lumbar drainage do not work in patients who present with more chronic types of CSF fistula. Because of the chronic nature of these fistulae, it's very unlikely that conservative treatment will be successful.

If the fracture is complicated by meningitis, there is a relative risk of recurring infections and surgical repair may be considered. Finally, surgical repair may be suggested, in cases of compound, comminuted, depressed, largely extended cranio-facial fractures (the so- called "fracas craniofaciaux") where spontaneous healing is considered unlikely and risk of infection is high.

Indications for surgery are:

- Persistent or recurrent fistula
- Meningitis
- "Fracas craniofaciaux"
- Delayed CSF leak

Surgical approaches can be classified as *intracranial* or *extracranial.* In the former, the basic principle is to close the bone defect and dura, and to provide adequate barriers to allow sealing. Intracranial techniques can be divided into extradural and intradural approaches, or a combination of both. The extracranial approach is performed by ENT surgeons, through the nasal cavity by direct vision, microscope, or recently endoscopy. The principle is to confirm the site of leakage and to pack the sinus.

PATIENTS, MATERIAL AND METHODS

From all the patients admitted at the Emergency Department of our Institution during the last decade, we selected those who presented with craniofacial injury, closed head injury and rhinorrhea and from this pool of patients we studied those who were treated surgically for early or delayed rhinorrhea. Patients treated for post-surgical or the very rare condition of spontaneous CSF leakage have been excluded from the study.

Patients' case notes and radiology films were revised. For every patient the following were recorded: age, gender, Glasgow Coma Scale on admission, in the case of delayed onset of rhinorrhea time interval from injury, preoperative radiological evaluation, time of surgery from ictus, surgical technique followed and materials used, postoperative radiological control by Computed Tomography and finally, outcome. Additionally, a telephone interview was carried out of all patients who had been discharged

more than a year before the study.Interview points were: (1) *recurrence of rhinorrhea,* (2) *persistent headaches*,(3) episodes of fever, nuchal stiffness, drowsiness, cranial nerves dysfunction or any other medical evidence of *recurrent meningitis*.

Prophylactic antibiotics should not be given blindly to all patients with fractures of the skull base; however, whether prophylaxis should be given to patients with clinical leakage is unclear. Choi and Spann report that there is no significant change in the incidence of meningitis if surgical repair of the dura is performed (3). Eljarnel (4) compared retrospectively two groups of patients with CSF leakage. One group received prophylaxis and the other did not. There was no statistically significant difference in annual risk of meningitis. Interestingly, more cases of gram negative infection and of partially treated meningitis occurred in the treated group. This study, therefore, supports the position that such patients should not be treated with antibiotics. Klastersly and associates (5) performed a controlled, double-blind study to compare antibiotic treatment with placebo use in patients with rhinorrhea. This paper does not support antibiotic prophylaxis; it also does not indicate that prophylaxis is harmful. In our institution, we continue to administer prophylactic antibiotics until a large multi-center randomized prospective trial provides conclusive evidence.

Patients who develop meningitis are treated with the appropriate antibiotic based on a sensitivity test. Once the meningitis has been cured, the CSF fistula site is repaired in an attempt to prevent recurrent leakage or meningitis. Occasionally, the infection and the inflammation can help to close a small fistula. However, one should not assume that a fistula will be obliterated by an infection.

In summary, indications for surgery are: 1) persistent or recurrent fistula, 2) meningitis, 3) compound, comminuted, depressed, largely extended craniofacial fractures.

RESULTS

In total we reviewed 42 patients. The mode of the patient's age in our sample lies in the third decade (table 1), the vast majority are men (female/male ratio 1/5) and most presented with GCS less than 9. Most cases of CSF leakage were identified on clinical grounds at initial presentation or within the first 24 hours. This is true for 90% of these patients (table 2). Patients who presented rhinorrhea within the first 24 hours are named group 1 (total 38 patients). Patients who presented delayed rhinorrhea are named group 2 (total 4 patients). All patients of the latter had a clear history of spontaneously ceased leakage immediately after trauma and presented years later with meningitis. Findings of the first Computed Tomography are summarized on table 3. Commonly, diffuse brain edema is associated with basilar skull fractures and it should be taken into consideration for management.

TIME OF SURGERY 35 out of 38 patients of group 1 (early rhinorrhea) were operated on either on admission or after a 10-15 day interval. The former was indicated by concomitant intracranial lesions such as haematomas or depressed fractures, and the latter is considered as sufficient time for conservative treatment trial and stabilization of general condition in critically ill patients. The rest of the group I (3 out 38) were operated on after an interval of more than 2 weeks because of long stay in the ICU and concomitant injuries from other organ systems.

SURGICAL TECHNIQUE A standard bicoronal incision is used for very wide and adequate frontal fossa exposure. Skin flap is redressed to the edge of superior orbital ridge preserving superior orbital nerve and vessels. Craniotomy is usually bilateral. Similar to a bicoronal approach, an ipsilateral craniotomy is made, extended low into the frontal fossa and allowing

a direct approach to the cribriform plate-frontal sinus region for management of unilateral fractures. Once the bone flap is elevated, the frontal sinus mucosa is evacuated using a high-speed drill and the sinus cavity is packed by bone fragments or fat or hydroxyapatite. At this stage extradural control of tears can be made and simultaneously reduction of the bone fragments. A dural incision is made and if necessary insertion of the anterior portion of the superior sagittal sinus. By intradural exposure, obliteration of the fistula is made using layers of bone fragments, surgicel, fibrin glue (Beriplast), pericranial tissue or fascia lata, Lyodura or Gore-tex. The latter has been used in seven consecutive cases with excellent results (adherent surface is positioned face to skull and smooth surface face to brain parenchyma).
A flap of pericranial tissue is then folded over the frontal sinus and laid along the floor of the frontal fossa over the cribriform plate region. The posterior edge of pericrania is then tacked to the posterior frontal dura.

Bone reconstruction of the frontal bone and the face using miniplates is the last stage of the procedure.

INTRAOPERATIVE FINDINGS In all patients intraoperative findings correlate with preoperative radiological examination. In group 1 only CT was performed on admission and in group 2 CT, metrizamide CT cisternography and MRI.

OUTCOME The overall result was good in 93% of treated cases when sealing of fistula and safety of procedure are evaluated. The other 7%, corresponds to 3 deaths that occurred in critically ill patients of group 1. 20 patients of group 1 were operated on immediately, 17 with good outcome and there were 3 deaths. In the rest of group 1, 18 were operated on within 2 weeks and all had good recovery and good outcome. All the patients in group 2 had good outcome (100%)

There was, however, relapse in two cases. First, in a 36-year-old male, operated on 2 months after severe head trauma. Rhinorrhea disappeared for one month and then relapsed. A second operation was performed and a contralateral fistula was sealed. In fact during the first operation, the surgeon, having found a large fistula in one side, neglected to check the contralateral side. This patient presented hydrocephalus at the time of the second operation and a shunt was placed. After 10 years follow -up he remains asymptomatic. The second relapse is reported in a 4–year-old girl, 3 years after the first operation. MRI revealed a right sided encephalocele through the cribriform plate. Fluorescein was injected preoperatively through lumbar puncture, and the day of surgery, by a nasal endoscope, the fistula site was confirmed. Transcranial obliteration of the fistula was successful and 3 years later she remains asymptomatic.

REFERENCES

1. Caldicott, W.J.H.1 North J.B. and Simpson, D.A.: Traumatic cerebrospinal fluid fistulas in children. J. Neurosurg., 38: 1, 1973.
2. Choi, D., Spann, R.: Traumatic cerebrospinal fluid leakage: risk factors and the use of prophylactic antibiotics. Br. J. Neurosurg., 1996 Dec., 10: 6, 571-5.
3. Eljamel, M.S.: Antibiotic prophylaxis in unrepaired CSF fistulae. Br. J. Neurosurg., 7: 501, 1993.
4. Lewin, W.: Cerebrospinal fluid rhinorrhea in closed head injuries. Br. J. Surg., 42:1, 1954.
5. McCallum, J., Marron, J.C. and Jannetta, P.J.: Treatment of postoperative cerebrospinal fluid fistulas by subarachnoid drainage. J. Neurosurg., 42: 434, 1975.

6. Mincy, J.E.: Posttraumatic cerebrospinal fluid fistula of the frontal fossa. J. Trauma, 6: 618, 1966.

7. Morley, T.P., Hetherington, R.F.: Traumatic cerebrospinal fluid rhinorrhea and otorrhea, pneumocephalus and meningitis. Surg. Gynecol. Obstet., 104: 88-98, 1957.

8. Raaf, J.: Post-traumatic cerebrospinal fluid leaks. Arch. Surg., 95: 648, 1967.

9. Shapiro, S.A. and Scully, T.: Closed continuous drainage of cerebrospinal fluid via a lumbar subarachnoid catheter for treatment or prevention of carinal/spinal cerebrospinal fluid fistula. Neurosurgery, 30: 241, 1992.

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