An algorithm for the management of CSF rhinorrhoea illustrated by 36 cases*

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SUMMARY *The diagnosis of cerebrospinal fluid (CSF) rhinorrhoea should be established beyond reasonable doubt before surgical intervention is embarked upon. It is important not to miss the diagnosis in view of the real potential complication of meningitis if it is left untreated. We describe a management algorithm which centers around the selective use of nasal endoscopy, immunofixation of beta$_2$ transferrin, high resolution coronal CT scans, and fluorescein lumbar puncture. This management strategy is illustrated with 36 cases. We have developed a minimally invasive endoscopic technique to repair CSF leaks, and in 30 patients we had a success rate of 93% after one procedure.*

Key words: cerebrospinal fluid, endoscopy, paranasal sinuses, rhinorrhoea, surgery

INTRODUCTION

Cerebrospinal fluid (CSF) rhinorrhoea may arise from a variety of pathologies and whilst trauma and iatrogenic causes are the commonest reasons, spontaneous leaks comprise a significant proportion encountered (Ommaya et al., 1968). There is a high risk of developing meningitis, with all the associated morbidity and potential mortality with reported rates varying between 5.6% (Leech et al., 1973) and 60% (Eljamel & Foy, 1991), and the annual risk of developing meningitis of 9.8% per year has been estimated (Nandapalam, 1996). It is for this reason that successful closure of these defects is an important issue in both neurosurgical and otorhinolaryngological practice.

Historically CSF leaks have been repaired by an intracranial approach. This has the advantage of directly visualising the fistula from above, and assessing any co-existing intracranial pathology. Its disadvantages are those of a craniotomy with retraction on the frontal lobes causing a high incidence of anosmia, possible cerebral oedema and intracranial haemorrhage with resulting morbidity and mortality. Failure rates of up to 40% have been quoted for this method of repair (Park et al., 1983).

The extracranial approach proved a successful alternative to the intracranial route and became popular in the 1970s and 80s. Success rates of 81-100% are reported (Hubbard et al., 1985 and Yessenow & McCabe, 1989, respectively). These techniques were associated with less morbidity from the procedure, and became the preferred surgical option (Tolley & Brookes, 1992).

The advent of endoscopic nasal surgery has given the rhinologist a minimally invasive avenue of access to the anterior cranial fossa. The first reported case of endoscopic endonasal closure of a cerebrospinal fluid (CSF) leak was by Wigand (1981), who repaired a CSF leak he had noticed intra-operatively. Since then several authors have published their operative techniques for endoscopic repair of CSF rhinorrhoea (Stankiewicz, 1987; Papay et al., 1989; Mattox and Kennedy, 1990; Dodson et al., 1994; Hao, 1996, Hughes et al., 1997; Wormald and McDonogh, 1997). All techniques rely on accurate identification of the site of the fistula and the placement of a graft, either free or pedicled, over the defect.

To date there have been three large series reported in the literature (Gjulic et al.,1996; Burns et al., 1996; Lanza et al., 1996). We present our own experience of 36 patients referred to a tertiary referral centre with CSF rhinorrhoea over the last 5 years. Over this period we have developed our preoperative assessment and present an algorithm for the management of CSF rhinorrhoea.

METHODS

A retrospective review of 36 patients was carried out. All of these patients had been referred to a single rhinologist who supervised their subsequent management. One case occurred intraoperatively, and was repaired during the same procedure. The patients were assessed, if possible, in the outpatient department where rigid nasal endoscopy was performed. The vast majority of patients had a high resolution coronal CT scan (HRCT). The rhinorrhoea was tested for immunofixation of beta$_2$ transferrin.

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We performed a preoperative fluorescein lumbar puncture if there is any doubt as to the origin of the leak, and it is an essential investigation if the HRCT gives no indication where the leak originates from, or if there is a suspicion of more than one leak. We use 1ml of 5% fluorescein mixed with 10 ml of CSF injected intrathecally. This is undertaken 2 hours prior to operation with the patient placed 10 degrees head down until surgery.

Endoscopic repair was carried out by the senior author (NSJ) using a free graft usually from the ipsilateral inferior turbinate, although fascia lata was used for closing defects in the sphenoid, and conchal cartilage was harvested to support larger defects. Mucosa is removed from around the edges of the defect and an underlay technique is attempted when placing the graft, in some instances this is not possible and an onlay technique is used. Nasal packing with bismuth and iodoform paste is used to ensure the graft does not become displaced and is left in situ for 10 days. The majority of patients are discharged the following day on oral antibiotics for 10 days (co-amoxiclav). We only used a lumbar drain in one case (see below) and do not use fibrin glue.

RESULTS

In total 36 patients with CSF rhinorrhoea were referred to our department. Four resolved with conservative management and 32 with surgical intervention. Thirty were repaired by an endoscopic approach, one of whom required three endoscopic procedures, another required an anterior craniotomy. Two were electively repaired by an extracranial approach as the defects were in the roof of the frontal sinus and adequate access could not be achieved endoscopically. The majority of leaks were spontaneous or iatrogenic (see Table 1).

The sizes of defect ranged from 2 mm by 2 mm, to 25 mm by 25 mm, the commonest site of the leak was the sphenoid (see Table 2). The age range of patients was 10-74 years (mean= 49.2). High resolution coronal CT (Figure 1) was performed in

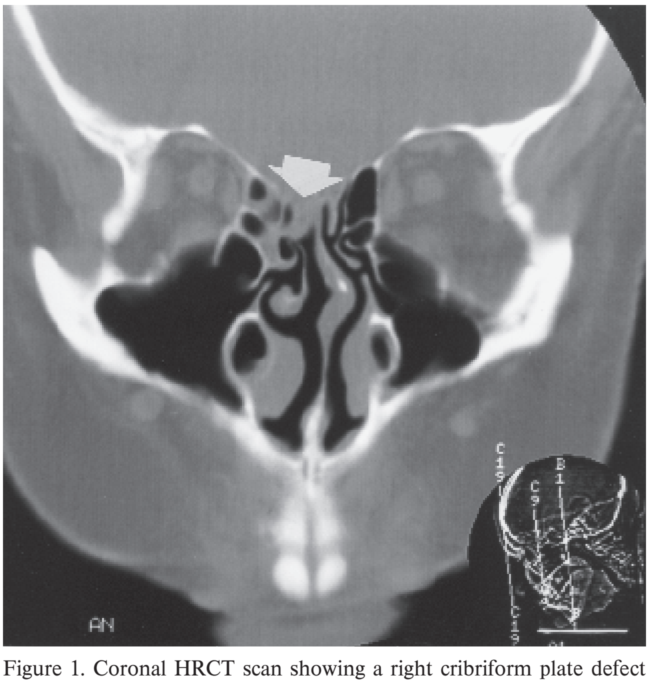

Figure 1. Coronal HRCT scan showing a right cribriform plate defect with a small encephalocoele.

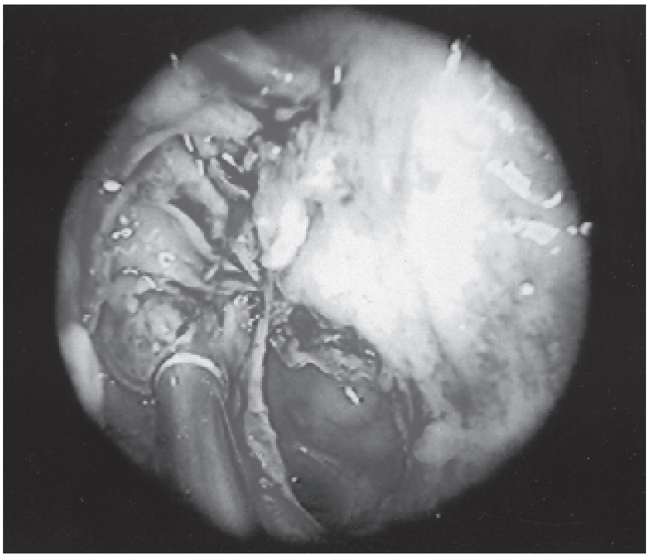

Figure 2. Endoscopic view of a right posterior ethmoidal defect, fluorescein can be seen coming through the defect. Note the sphenoid sinus medial to the defect.

Table 1. Cause of CSF leaks.

Cause of leak	Number of patients
Spontaneous	9
Post craniotomy	7
Traumatic	5
Post transphenoidal hypophysectomy	5
Post headlight nasal polypectomy	4
Post endoscopic sinus surgery	3
External ethmoidectomy	1
Idiopathic skull base erosion	1
Encephalocoele	1

Table 2. Site of CSF leaks.

Site of leak	Number of patients
Sphenoid	11
Cribriform plate	9
Ethmoid	9
Frontal	3
Lamina lateralis	2
Encephalocoele	1
Anterior skull base carcinoma	1

32 cases, showing the defect in 26 (81.25%). Fluorescein Lumbar Puncture (Figure 2) was performed in 12 cases with 1 failure due to previous spinal surgery. Out-patient nasal endoscopy was performed in 33 cases, showing the defect in 12 (36.36%) cases. $Beta_2$ transferrin was performed in 18 cases, all being positive (100%) i.e. there were no false negatives.

Endoscopic repair was performed in 30 cases with 2 failures (93.3%). In the first patient that failed, nasal endoscopy revealed the graft to be in situ with CSF leaking around it. On reexplora-

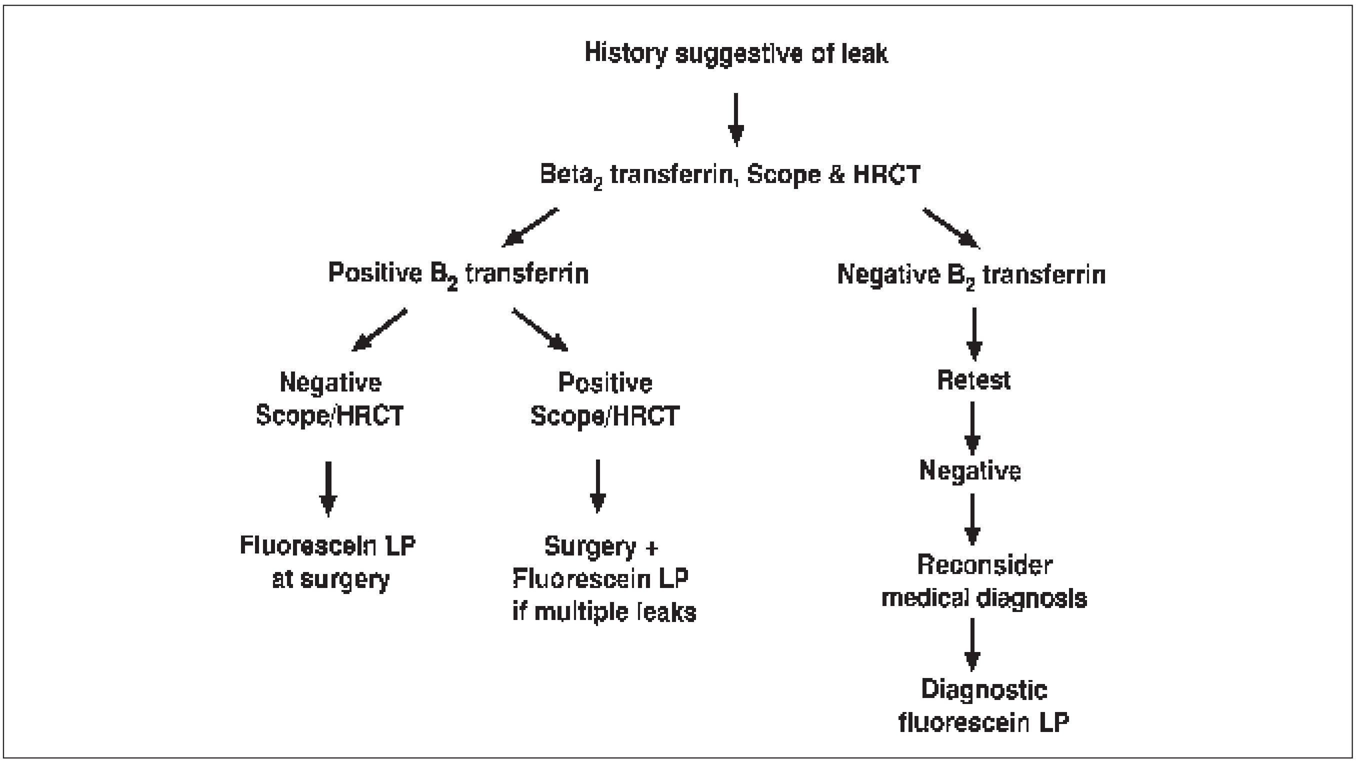

Figure 3. Algorithm for CSF Leak Presenting to Outpatients.

tion it was noted that healthy mucosa remained around a sizable lateral defect in a laterally aerated extension of the sphenoid and this may explain why the graft had not taken. A second endoscopic repair was performed and a CSF drain was inserted, in order to keep the CSF pressure at 5 cm of H_2O for 48 hours post operation. After initial success a leak was again detected at the 3 month follow up appointment. A further repair with a conchal cartilage graft has been done and the patient is asymptomatic after 9 months follow-up.

The second patient that failed had two attempted endoscopic procedures, both failing at 3 months postoperatively. He required an anterior craniotomy to successfully close the defect. The patient had a small cribriform plate defect and a craniofacial abnormality. Technically both endoscopic operations went well and the reason for failure is not known.

DISCUSSION

We obtained a 93.3% success rate after one procedure, which is comparable with the three other large series of endoscopic closures, Gjulic et al. 96.9%, Burns et al. 83.3% and Lanza et al., 94.9%. All of these are comparable or significantly better than intracranial or other extracranial approaches.

The ability of the defect to be identified by HRCT preoperatively in our series was 81.25% and is in line with other series (range 50 100%, Stafford Johnson et al., 1996). Although MRI has been reported as a superior imaging modality to CT (Eljamel et al., 1995; Schick et al., 1998), with detection rates of up to 100% (Stafford Johnson et al., 1996; Schick et al., 1998), we agree with Lloyd et al., 1994, that high resolution CT is the only imaging necessary.

Testing for the presence of glucose oxidase has poor sensitivity and specificity and is an inadequate test for making a diagnosis of CSF rhinorrhoea (Kosoy et al., 1972 and Hull & Morrow, 1975). We agree with Nandapalan et al., 1996, who say that $Beta_2$ transferrin should be the first line test on anyone suspected of having CSF rhinorrhoea. Due to the possibility of false positive $Beta_2$ transferrin occurring in individuals with inborn errors of glycoprotein metabolism, chronic liver disease or a genetic variant of transferrin (Roelandse et al., 1998), some authors believe that venous blood should be sampled simultaneously at the same time as the rhinorrhoea. However, like others (Porter et al., 1992), we have not followed this practice.

We have found the use of fluorescein lumbar puncture invaluable in highlighting defects, which were not obvious preoperatively by HRCT or MRI, and recommend its use if there is any doubt as to the exact site. Other authors have not found fluorescein as helpful, Lanza et al. 1996, found it useful in 68% of cases he used it in, Wax et al., 1997, found it useful in 57% of cases, and Schick et al., 1998 only found it helpful in 50% of cases. We found fluorescein lumbar puncture helpful in all cases in which we used it.

When fluorescein could not be seen initially we increased the CSF pressure by causing the patient to cough against a cuffed endotracheal tube, and then fluorescein could be seen. One possible explanation why others find it less useful is the failure to inject fluorescein into the correct space, or to allow long enough for the diffusion of fluorescein through the CSF. In one case reported by Wax et al. despite injection of fluorescein, colourless CSF was found at operation. We have had no side effects with intrathecal fluorescein, although are aware that this is a possibility, particularly if it is not injected into the intrathecal space (Burns et al., 1996).

The cause of our CSF leaks was iatrogenic in 56%. This compares with 59% reported by Dodson et al. and 56% by Lanza et al. We do not use prophylactic antibiotics preoperatively in the management of CSF rhinorrhoea. Some authors believe this results in a reduction in the meningitis rate (Brodie, 1997), we disagree with this view (Choi & Spann, 1996), as antibiotic prophylaxis can result in more cases of Gram-negative infection and of partially treated meningitis (Ejamel, 1993).

In summary, we believe the optimal treatment for CSF rhinorrhoea is endoscopic closure where this is accessible. We recommend that this should be performed once CSF has been positively identified by beta$_2$ transferrin and the site of the defect, or defects, have been adequately visualised by a combination of endoscopy, HRCT and fluorescein lumbar puncture.

We present an algorithm for the management of CSF rhinorrhoea (Figure 3).

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