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Review

Endoscopic repair of cerebrospinal fluid rhinorrhoea

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ABSTRACT

Goal: The purpose of this review was to look at the success rate of transnasal endoscopic repair of CSF rhinorrhoea and the impact of patient factors, repair techniques and adjuvant treatment.

Material and methods: A literature search was performed on PubMed, Medline and Cochrane Central databases, independently by two of the authors, of all studies reporting the outcomes of CSF rhinorrhoea repair, published until the 1st June 2014, using keywords *Cerebrospinal fluid leak, CSF leak, CSF fistula, CSF leak or fistula repair, endoscopic sinus surgery or ESS complications*. Sixty-seven papers were included for the review.

Result: The repair of CSF rhinorrhoea has rapidly evolved over the past 30 years. Prior to the advent of the endoscopic approach, craniotomy was used for repairs, which carried a variable success rate and morbidity. More recently, there have been several case series and reports that describe various endoscopic methods and materials for repair, with mean success rate of 90% (range: 60–100%). The most common site of CSF leak is the ethmoid roof/cribriform plate region. Traumatic CSF leak, in particular iatrogenic, is still the most common cause. Imaging with CT and MRI remains the gold standard for localisation of CSF leaks. The sphenoid sinus is the most common location for CSF leak repair failure. Lumbar drains and antibiotics are used as adjuvant therapy to endoscopic repair, but their benefits are not clear; intrathecal fluorescein can be used to aid location of CSF leak, but should be reserved for more complex cases. Further work into graft materials used and adjuvant treatment is needed to make any meaningful conclusions about their efficacy.

Conclusion: The literature demonstrates that endoscopic repair of CSF rhinorrhoea is safe and effective, with a very low complication rate. It has almost completely replaced the older open techniques.

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1. Introduction

Cerebrospinal fluid (CSF) rhinorrhoea is a consequence of a breakdown of the layers of the arachnoid membrane, dura matter, the bony skull base and periosteum, and the nasal mucosa [1]. Persistent CSF leaks are usually divided into non-traumatic and traumatic. Non-traumatic causes include spontaneous or congenital CSF leaks, and leaks caused by intracranial or skull base tumours causing skull base erosion [2]. Traumatic leaks are more common and can be iatrogenic (secondary to anterior skull base and endoscopic sinus surgery [ESS]) or due to non-iatrogenic skull base trauma. Less than 1% of ESS is complicated with CSF rhinorrhoea but it represents a common cause of traumatic CSF leak [3].

The most common clinical manifestation of CSF leak is clear, unilateral rhinorrhoea, exacerbated by bending over or performing a Valsalva maneuver [4]. The presence of headache should make the clinician suspicious of raised intracranial pressure or intracranial pathology [5]. Diagnosis can be confirmed by the laboratory analysis of CSF markers such as Beta-2 transferrin, which is a sensitive and specific marker [6].

Most cases of traumatic CSF leak will settle with conservative treatment but persistent CSF leak usually necessitates a surgical solution. The repair of CSF rhinorrhoea has rapidly evolved over the past 30 years. Prior to the advent of the endoscopic approach, craniotomy was used for repairs, which carried a variable success rate and relatively high morbidity [5]. Wigand described the first use of the endoscopic approach to repair CSF leak in 1981. Since then, there have been several case series and reports that describe various endoscopic methods and materials for repair, with success rates varying between 60% and 100%, averaging around 90% [7].

The purpose of this review is to look at the success rate of transnasal endoscopic repair of CSF rhinorrhoea and the impact of patient factors, repair techniques and adjuvant treatment.

A search was performed of all studies reporting the outcomes of CSF rhinorrhoea repair, published until the 1st June 2014. The search was performed using a keyword search strategy on PubMed,

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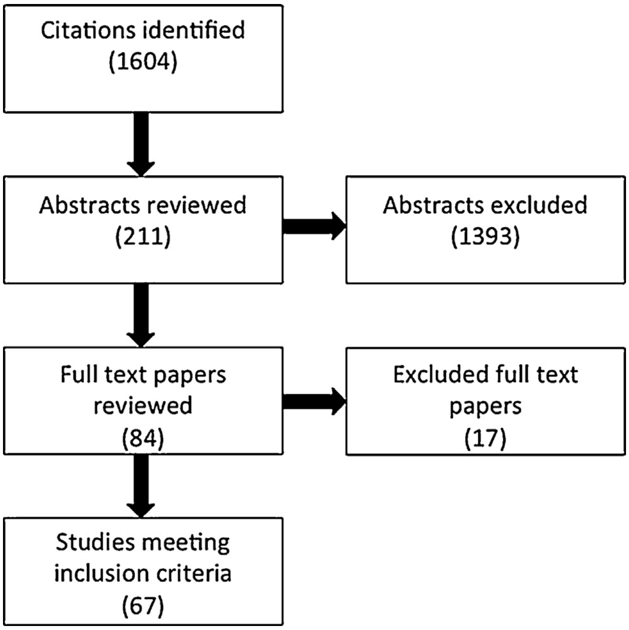

Fig. 1. Search strategy used to obtain studies suitable for review.

Medline/Old Medline and Cochrane Central databases independently by two of the authors (S.S. and J.B.). The following keywords were used: *Cerebrospinal fluid leak, CSF leak, CSF fistula, CSF leak or fistula repair, endoscopic sinus surgery or ESS complications*. The reference lists of the manuscripts were also reviewed to identify further studies.

To meet the inclusion criteria for the study, studies were required to be full text articles in English, with documented follow-up to assess success rate and greater than 5 cases included. Studies were excluded if the CSF leak repair was performed during the initial surgery for iatrogenic CSF rhinorrhoea. Fig. 1 summarises the search strategy used.

The literature review identified 84 full text papers initially. However, 17 of these papers were excluded due to CSF leak being repaired at time of initial surgery, no endoscopic repair and inadequate number of patients. Therefore, 67 papers were included for our review. The total number of cases of CSF leak repairs was 2000 within the included 67 papers [1–49].

2. Patient factors

Psaltis et al. have reported an equal prevalence of traumatic and non-traumatic causes for CSF rhinorrhoea, and in fact report that the most common cause for traumatic CSF leaks is iatrogenic and for non-traumatic is spontaneous leaks [7]. This is in contrast to older studies that report that traumatic CSF leaks are more common. The increase in non-traumatic leaks can be explained by the increasing BMI of the Western population, which is a known risk factor for non-traumatic leaks. The cause for a higher proportion of iatrogenic CSF leak may be due to decreasing direct head trauma as a result of better road safety measures [7]. However, in our review we found that out of 1715 CSF leak repairs that reported aetiology, 1038 cases (61%) were traumatic.

The literature reports that the ethmoid roof and sphenoid sinus are the most common locations for iatrogenic CSF leaks as the ethmoid roof is the most common site that can be accidentally punctured during endoscopic sinus surgery [9]. Transphenoidal surgery places patients at high risk of CSF rhinorrhoea postoperatively. Non-iatrogenic traumatic CSF leak is mostly associated with the frontal sinus or cribriform plate, as these structures are most at risk during direct head trauma [10]. This review of the literature found the ethmoid roof to be the most common site for CSF leak in the literature, possibly reflecting the high incidence of iatrogenic CSF leak.

3. Repair technique

Pooling the data from 2000 cases of primary CSF leaks within the papers included in the study the success rate was 90.1%. These results compare favourably to a previous systematic review from 2012 that quotes a success rate of 90.6% with primary CSF leak repairs, and 96.6% with secondary CSF leak repairs [7]. An older, smaller systematic review from 2000 also quotes a similar success rate [3]. This is superior to quoted success rates using craniotomy and extracranial methods to repair CSF leaks, such as that reported by McCormack et al. of 86% [8]. There is also increased morbidity associated with these techniques. Therefore, the trend over the last 30 years has been for the more invasive open techniques to be replaced by safer endoscopic approaches.

There is considerable variability in the literature with regards to the materials used for CSF leak repairs, and their success. A previous systematic review was unable to determine the adequacy of different graft materials [7]. In the papers included in this review, there is considerable heterogeneity in methods of repair. Graft materials for repair include turbinate grafts, nasoseptal mucosal grafts and flaps, cartilage grafts, fascia lata, porcine small intestine submucosal graft, acellular dermis and radial forearm free flap [8,12,13,18,30,47]. It is however difficult to make any conclusions with regards to success rates with different materials. Different techniques are also described including sandwich grafts and three layer closure but again the efficacy of one technique against another cannot be analysed due to limited data and numbers.

Psaltis et al. have previously reported the most common site for repair failure is the sphenoid sinus in 48% of cases, followed by the ethmoid roof/cribriform plate at 41%, possibly reflecting difficulties in accessing the sphenoid sinus endoscopically to facilitate adequate repair [7]. In this review, it was not possible to analyse the most common sites of repair failure, as there was such a low incidence of failures.

There is an increasing trend to move away from the use of computed tomography (CT) cisternograms or to only reserve this for cases that are low output CSF leaks, where previous imaging has failed to identify the precise location [7]. The more recent studies describe the use of combined CT and magnetic resonance imaging (MRI) and the literature quotes a sensitivity of detecting CSF leak of 97% using this modality [30]. When used individually, CT and MRI have quoted sensitivity of around 90% [48]. As previously reported, the most common imaging modality used to identify CSF leaks in this review was CT imaging.

4. Adjuvant treatment

Intrathecal fluorescein aids diagnosis of the location of CSF leak but is not licensed for this use, however its use is nonetheless quite common [49]. There are serious side effects from this medication, which can include cardiac arrhythmias, seizures and even death. Adjuvant therapies used for the repair of CSF leaks include lumbar drains and antibiotics. The use of lumbar drains is also quite common, mainly reserved for cases involving raised intracranial pressure and large defects. The usual practice reported is to insert the lumbar drain in the operating theatre preoperatively and keep the drain closed until the final stage of repair, to aid localisation of the leak site [2]. Some papers also report the use of lumbar drains in order to prevent risk of CSF rhinorrhoea and report significant reduction in the rate of intraoperative CSF leak from 41%

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