FÍSTULA DE LÍQUIDO CEFALORRAQUIDIANO: REVISÃO DE LITERATURA E RELATO DE CASO

CEREBROSPINAL FLUID FISTULA: LITERATURE REVIEW AND CASE REPORT

RESUMO
Esta é uma revisão da literatura sobre os modelos diagnósticos e terapêuticos das fístulas líquóricas (FL). As FLs são afeções neurocirúrgicas raras que representam uma comunicação entre o espaço subaracnóideo e a fossa nasal ou cavidade auditiva. Podem ser espontâneas, sem etiologia evidente, ou secundárias à cirurgias ou traumatismos da base do crânio. As FLs podem ter um diagnóstico desafiador devido aos seus sinais clínicos (geralmente rinorreia) estarem ausentes ou serem negligenciados pelos pacientes. Este estudo foi elaborado a partir de informações coletadas na Biblioteca Virtual em Saúde (VHL), PubMed e LILACS, excluindo referências duplicadas ao final dos estudos. Os artigos selecionados foram publicados entre 1985 e 2021. A partir da pesquisa realizada, é possível concluir que, embora as FLs sejam uma forma rara de doença neurológica, elas têm sido amplamente relatadas em toda a comunidade médica, com extensas e correspondentes apresentações. Esses achados são de relevância prática direta e corroboram nossa intenção de reunir informações confiáveis a respeito dessa doença. A doença é exemplificada pelo caso de uma paciente de 32 anos com diagnóstico de FL não relacionada a lesões patológicas na base do crânio, anomalias congênitas ou história de trauma ou cirurgias. Os exames de imagem evidenciaram pneumoencéfalo em fossa posterior e cisternas basais com descontinuidade óssea na parede posterior do seio esfenoidal. Este relato de caso tem como objetivo chamar a atenção para uma doença raramente observada na literatura. Essas doenças raras devem ser relatadas, pois podem modificar futuras
táticas cirúrgicas.

**Palavras-Chave:** Fístula de líquido cerebroespinal; Fístula espontânea; Fossa craniana posterior.

**ABSTRACT**

This is a literature review of the diagnostic and therapeutic models of Cerebrospinal Fluid (CSF) fistulas. CSF fistulas are rare neurosurgical afflictions that represent a communication between the subarachnoid space and the nasal fossa or the ear cavity. They can be either spontaneous, without an evident etiology, or secondary to skull base surgery or trauma. CSF fistulas can be of a challenging diagnosis due to its clinical signs (usually rhinorrhea) being absent or neglected by patients. This study was created based on information collected from the Virtual Health Library (VHL), PubMed and LILACS, excluding duplicate references at the end of the studies. Selected articles were published between 1985 and 2021. From the research undertaken, it is possible to conclude that, even though CSF fistulas are a rare form of neurological affliction, it has been widely reported all around the medical community, with extensive and corresponding clinical presentations. These findings are of direct practical relevance and corroborates our intention of summarizing reliable information regarding this disease. This disease is exemplified by the case of a 32 year-old female patient diagnosed with a CSF fistula that was not related to pathological lesions in the skull base, congenital abnormalities or history of trauma or surgeries. Imaging exams evidenced pneumocephalus in the posterior fossa and basal cisterns with bone discontinuity in the posterior wall of the sphenoid sinus. This case report aims to draw attention to an infrequently-seen-in-literature disease. These rare diseases must be reported since they may modify future surgical tactics.

**keywords:** Cerebrospinal Fluid Leak; Spontaneous Fistula; Cranial fossa posterior.

**INTRODUCTION**

CSF fistulas are rare neurological afflictions that represent a communication between the subarachnoid space and the nasal fossa or the ear cavity. They can either be spontaneous, without a evident etiology, or secondary to skull base surgery or trauma. CSF fistulas can be of a challenging diagnosis due to its clinical signs (usually rhinorrhea) being absent or neglected by patients. In this study, we review the present available literature on the subject as well as report the case of a 32-year-old patient with that affliction. It was diagnosed via Computed Tomography (CT). The diagnosis of rare conditions requires careful observation and extensive knowledge of the Imaging methods utilized, especially to identify the level and the segment in which the ailment occurs. Correct diagnosis of
such diseases is important when any surgical intervention is planned, and these rare diseases must be reported since they may modify future surgical tactics².

The intention of this literature review is to summarize reliable information regarding this disease since the understanding of the clinical profile of CSF fistulas as well as the best therapeutic approach will contribute to a better prognosis, with a significant impact on quality of life after correct treatment.

CASE REPORT

A 32-year-old female was referred to the neurosurgical service at our institution with intense pulsatile occipital headache.

The neurological examination evidenced no focal deficits. The patient had no previous diagnoses. She did not have a family history of cerebrospinal fistulas. The patient was not in use of any medications.

**Figure 1** - Computed skull tomography evidencing the bone discontinuity and the cerebrospinal fluid fistula.

She underwent a CT, shown on figure 1, where the images evidenced a pneumoencephalus in the posterior fossa and basal cisterns with a bone discontinuity in the posterior wall of the sphenoidal sinus, indicating a CSF.

She later underwent endoscopic surgery. During the operation, a dural lesion was found in the clivus region, confirming the hypothesis.
Figure 2 - Patient image during procedure.

DISCUSSION

CSF is a plasma or serum ultrafiltrate that contains electrolytes, carbohydrates, and proteins. This fluid, which is found in the cerebral ventricles and the cranial/spinal subarachnoid space, provides physical support and buoyancy for the brain and spinal components. CSF also helps to maintain cerebral tissue homeostasis by eliminating metabolic waste and regulating the brain’s Chemical environment. The choroid plexus in the lateral, third, and fourth ventricles produces CSF. It travels from the lateral ventricles to the third ventricle via the foramen of Monro, then to the fourth ventricle via the aqueduct of Sylvius, and finally to the subarachnoid space via the foramen of Magendie and foramina of Luschka.

CSF circulates between the arachnoid and arachnoid villi, which protrude into the dural venous sinuses, and is reabsorbed into the venous system. Adults have an average CSF volume of 140 mL, and because the body creates 0.33 mL of CSF per minute, it regenerates its CSF volume three times a day. Because CSF is a serum ultrafiltrate, any abnormalities in serum will be mirrored in CSF (i.e., hyperglycemia). The vascular pulsations found in CSF are caused by changes in cerebral blood flow that are connected to cardiac output. This results in widespread brain volume fluctuations. Furthermore, large branches of the Willis circle are found in the subarachnoid area and are thought to play a role in this phenomena.

Although CSF leaks are uncommon, they are associated with morbidity such as general malaise and headache. More importantly, they can result in potentially fatal complications such as
meningitis. As a result, they necessitate a thorough and timely evaluation and treatment. When the bony cranial vault and its underlying dura are breached, CSF leaks occur. Such leaks can be classified as either traumatic or nontraumatic in nature. Traumatic causes are further classified as surgical and nonsurgical, with surgical causes classified as planned (as in failure of reconstruction following a planned dural resection) or unplanned (as a complication following an ethmoidectomy)⁴.

Non-traumatic CSF leaks can be classified as high or normal pressure leaks, with tumors occupying either subclass due to mass effect in the high-pressure group or direct erosive effect on the skull base in the normal-pressure group. If no cause can be found, the leak may be classified as idiopathic; however, true idiopathic leaks are uncommon with careful history taking, physical examination (including nasal endoscopy), and radiologic evaluation⁴.

Approximately 80% of CSF leaks are caused by nonsurgical trauma, 16% by surgical procedures (although this number is increasing), and the remaining 4% are nontraumatic (table 1). More than half of the traumatic leaks are visible within the first two days, 70% within the first week, and nearly all within the first three months⁵⁶. Delayed presentation can be caused by wound contraction or scar formation, necrosis of bony edges or soft tissue, slow edema resolution, tissue devascularization, posttreatment tumor retraction, or progressive increases in intracranial pressure (secondary to brain edema or other process). Traumatic CSF leaks, like most maxillofacial trauma, are most common in young males and complicate 2% of all head traumas and 12% to 30% of all basilar skull fractures⁷.

<table>
<thead>
<tr>
<th>Causes</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>nonsurgical trauma</td>
<td>80%</td>
</tr>
<tr>
<td>surgical procedures</td>
<td>16%</td>
</tr>
<tr>
<td>nontraumatic</td>
<td>4%</td>
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Because of the dura’s strong adherence to the anterior basilar skull, anterior skull base leaks are more common than middle or posterior leaks. The sphenoid sinus (30%), frontal sinus (30%), and ethmoid/craniiform sinus (23%) are the most common sites of CSF rhinorrhea following accidental trauma. Temporal bone fractures resulting in a CSF leak can cause CSF otorrhea or rhinorrhea via egress thought the Eustachian tube with an intact tympanic membrane. Although a rare complication of functional endoscopic sinus surgery (FESS), the procedure is frequency makes it a significant cause of CSF leaks⁸.

In terms of surgical trauma, the most common sites of CSF leak following FESS are the ethmoid/crinoform sinus (80%), followed by the frontal sinus (8%), and the sphenoid sinus (4%). Because of the high number of pituitary tumors treated via transsphenoidal approach, the sphenoid sinus (67%) is
the common site of CSF leak after neurosurgical procedures.

High-pressure leaks account for roughly half of all nontraumatic leaks, with tumor obstruction accounting for more than 80% of all cases. The remainder is caused by either benign intracranial hypertension (BIH) or hydrocephalus; however, recent studies suggest that BIH may play a greater role in idiopathic or “spontaneous” CSF leaks. One theory is that in patients with occult elevated CSF pressure, intermittent CSF leak acts as a release valve, allowing the elevated pressure to be decompressed. Once the leak has been resolved, either by normalization of CSF pressure with an intermittent leak or surgical repair, the CSF pressure with gradually rise, resulting in the leak's recurrence. It is not surprising that an association has been made between idiopathic CSF leaks and BIH, given the demographics of the populations.

Furthermore, the clinical manifestations and demographic profile of patients with empty sella syndrome are strikingly like those of BIH and nontraumatic CSF leaks. These findings have important clinical implications for the treatment of idiopathic CSF leaks as well as surgical failures following traumatic CSF leak repair.

For a better understanding of CSF leaks and the case in question, anatomical knowledge of the skull base is of great importance. The upper surface of the skull base has three depressions located at different levels, namely: the anterior, middle and posterior cranial fossae, which form the floor of the cranial cavity. The anterior fossa assumes the highest position on the floor and the posterior the lowest level.

The case reported is a spontaneous CSF fistula located in the clivus, connecting it to the rhino pharynx. The clivus is a smooth, sloping surface of the central portion of the base of the skull. It is located inferiorly to the sella turcica, superiorly to the foramen magnum, superomedial to the hypoglossal canal and medially to the opening of the internal acoustic meatus, at the level of the bulb pontine junction, anteriorly to the prepontine cisterna.

Its formation comes from the union of the sphenoid and occipital bones, which complete their junction in adulthood after the process of ossification of the sphenoooccipital synchondrosis cartilage. These bones are called basioccipital and basisphenoids and their super-posterior portion inside the skull is the clivus.

CSF leaks can have traumatic and non-traumatic etiology, the former representing most cases, amounting to around 80-90%. Those of non-traumatic origin can be congenital or spontaneous. Spontaneous CSF fistulas may or may not be associated with increased intracranial pressure (ICP) and may be associated with meningoencephalocele. Our case specifically showed a spontaneous CSF fistula, not being associated, therefore, with trauma, previous surgery and congenital conditions.

In cases associated with sustained ICP elevation, bone remodeling and bone thinning in the skull base regions can be observed. In cases where the ICP is normal, the fistulization process may be associated with physiological changes in the ICP with erosive potential. In addition, excessive
aeration of the paranasal sinuses and empty sella syndrome may also be related\textsuperscript{15,16}.

CSF fistulas drain cerebrospinal fluid to another cavity, as they communicate regions lined with meninges. Based on this, the symptoms can progress with unilateral rhinoliquorrhea (most common) or bilateral rhinoliquorrhea associated with headache, helping in the clinical diagnosis process. Dosing beta-2-transferrin and blood glucose levels in rhinorrhea fluid can also confirm it. The patient in the case described presented only severe, pulsating occipital headache without associated focal deficits\textsuperscript{16}.

The dosing of beta-2-transferrin is importante due to it being present in cerebrospinal fluid. It has a specificity and sensibility of over 94\%\textsuperscript{15}.

As for imaging exams, it is possible to utilize CT, magnetic resonance imaging (MRI) cisternography, CT cisternography (CTC) and radionuclide cisternography (RC).

CTs are regarded as the gold standard diagnostic imaging exams due to its high sensibility (between 88 to 93\%), where it is possible to analyze, through the coronal and sagittal planes, an anatomical alteration of the paranasal sinuses, including paranasal bones\textsuperscript{17}.

The MRI cisternography, when utilized with CT, presents a highly specific diagnosis since it has an affinity with soft tissues such as paranasal mucous membranes, outlining the contents that herniated trough the bone discontinuity\textsuperscript{18}.

CTC has rationale for patients with multiple fractures and bone defects, and those with suspected bone defect and clinically confirmed CSF leaks\textsuperscript{19,20}. Its positivity occurs with increasing contrast concentration (50\% or more increase in attenuation values in fluid or soft tissue adjacent to a post-contrast bone defect). This method has the disadvantage of having low sensitivity in patients who have inactive/intermittent leaks due to the non-leakage of high-viscosity contrast around the high-density bone\textsuperscript{21,22}.

And RC is a technique which consists of the continuous or intermittent infusion of a radioactive marker (indium 111 or technetium 99). Cottons are inserted, endoscopically, in the middle meatus and lamina cribosa region for CSF collection. After a few hours, the cottons are removed, and the average radioactivity is checked. This method’s advantage is the low volume necessity for collection, since the cottons remain for a long period in the nasal cavity, continuously collecting the CSF\textsuperscript{23}.

Currently, this method has been replaced by other more sensitive and less costly methods, as this method would be restricted to cases where the low volume of RLR would prevent the collection of CSF for measurement of beta 2 transferrin\textsuperscript{24}.

There are several ways to choose the treatment of patients with CSF leaks, their method of choice may be the use of more conservative methods, such as the use of laxatives, prophylactic antibiotics, relative rest with an elevated headboard, among others, being evaluated daily for 2 to 4 weeks\textsuperscript{18}. If there is a recurrence rate or in cases of traumatic fistulas, a surgical approach is chosen,
which is used to prevent complications in case of failure of conservative treatment, intermittent rhinoliquorrhea and in cases associated with tumors.

The intracranial approach has a success rate in the treatment of CL around 70-90% and 87-100% using the trans nasal endoscopy technique. The transptiterigo endoscopic Route is chosen as the treatment of choice, as it promotes better access and means of visualization.

Major technological and technical advances have been developed to transform trans nasal surgery into a minimally invasive process, such as high-definition cameras, more ergonomic and precise surgical instruments, as well as new hemostatic agents, making patient recovery and treatment more effective.

Many medical specialties are needed for an adequate recovery, such as otolaryngology, to diagnose and continue the patient’s treatment, especially in the postoperative period, avoiding deleterious complications such as the development of pneumocephalus, meningeal infections and sequelae.

CONCLUSION

The revised data discussed in this literature review and case report approach the diagnostic and therapeutic models related to cerebrospinal fluid fistulas, based on the most recent articles and books available. From the research undertaken, it is possible to conclude that, even though CSF fistulas are a rare form of neurological affliction, it has been widely reported all around the medical Community, with extensive and corresponding clinical presentations. These findings are of direct practical relevance and corroborates our intention of summarizing reliable information regarding this disease.

REFERENCES


