Surgical management of cerebrospinal fluid rhinorrhea factors affecting success

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Introduction Cerebrospinal fluid (CSF) rhinorrhea was defined firstly by Willis in 1676 owing to breakdown of the layers of the meninges, the bone of the skull, the periosteum, and the nasal mucosa. Multiple causes can induce CSF rhinorrhea. These causes may be traumatic (accidental or iatrogenic after endoscopic sinus surgery) or spontaneous. The most common symptom is unilateral rhinorrhea which may be increased by stooping or performing valsalva maneuver. Other manifestations like irritability caused by pneumocephalus can also occur.

Aim The management of cerebrospinal fluid (CSF) rhinorrhea is challenging. Many factors affect its success and can prevent recurrence or failure. This study aims to investigate the outcome of surgical management for CSF rhinorrhea and the factors associated with it.

Patients and methods A total of 30 patients were admitted for surgery for nasal CSF fistula. Patients with rhinorrhea with more than 2 weeks of conservative treatment, some patients who underwent open surgery, and others who underwent endoscopic surgery were included in our study. The follow-up was continued for 6–18 months after surgery. Many factors were studied to recognize the causes of recurrence and failure such as intracranial hypertension, site of defect, etiology of leak, size of graft, using of fibrin glue, packing of defect, and type of graft.

Results Among the included patients, 22 (73.3%) had a history of increased intracranial tension (ICT). The defect was in the cribriform plate in 10 (33.3%) patients, ethmoidal in five (16.7%) patients, sphenoidal in five (16.7%) patients, and in the frontal sinus in two (6.7%) patients. The success of surgery was observed in 20 patients, whereas failure occurred in seven patients, and recurrence occurred in three patients. The most important two factors affecting the outcome are the increased ICT (P=0.006) and the size of graft (P=0.003).

Conclusion For successful surgical management of CSF rhinorrhea, increased ICT must be treated thoroughly preoperatively and postoperatively. Furthermore, the size of graft must be large in relation to the size of defect.

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Introduction

Cerebrospinal fluid (CSF) rhinorrhea was defined firstly by Willis in 1676 owing to breakdown of the layers of the meninges, the bone of the skull, the periosteum, and the nasal mucosa [1]. Multiple causes can induce CSF rhinorrhea. These causes may be traumatic (accidental or iatrogenic after endoscopic sinus surgery) or spontaneous [2]. The most common symptom is unilateral rhinorrhea which may be increased by stooping or performing valsalva maneuver [3]. Other manifestations like irritability caused by pneumocephalus can also occur [3].

CSF leak can cause meningeal or intracranial infection [4]. The mortality associated with meningitis following CSF rhinorrhea is variable, and the mortality rate ranges from 1 to 20%. The onset and time of meningitis as a consequence of CSF rhinorrhea might be expected to vary according to the etiology and the severity of the injury [5,6].

This study aimed to investigate the surgical management of CSF rhinorrhea to restore the normal barriers and prevent the intracranial infection and meningitis. Moreover, this study aimed to investigate the factors associated with the success or failure of such management.

Patients and methods

Study design and set

A prospective case series study was conducted to recruit patients who came to Alzhraa University Hospital, Faculty of Medicine for Girls, Al-Azhar University, between July 2017 and October 2018 experiencing CSF rhinorrhea. IRB approval was gained from the ethical committees of the Faculty of Medicine for Girls at Al-Azhar University. At the time of enrollment, a written informed consent was obtained from all cases in consideration with the declaration of Helsinki.

Data collection and operative data

Preoperative clinical assessment was conducted for all patients. This clinical assessment includes the patients history with more focus on the duration of leak, its mode of onset, possible etiology of rhinorrhea, and history suggestive of meningitis or not. Furthermore, robust nasal examination was conducted. In addition, radiological imaging, including high-resolution computed tomography (CT) scan of the brain and skull base thin cuts with reconstruction, and CT cisternography were conducted. In patients who were planned for endoscopic approach, high-resolution CT scan of the nose and paranasal sinuses thin cuts with reconstruction were performed. Moreover, MRI of the brain with contrast was performed for all patients to investigate the presence of associated meningocele or not.

All patients were subjected firstly to conservative treatment for 2–3 weeks in the form of bed rest in a semisetting position, avoidance of straining, coughing and sneezing, restriction of fluids, subarachnoid catheter, prophylactic broad-spectrum antibiotic especially for patients with posttraumatic fistula, and acetazolamide 250 mg tablet two tab three times per day. After failure of conservative treatment, surgical repair was done either open through intracranial approach or endoscopic transnasal approach. The type of surgical approach depended on the site of defect, associated intracranial trauma, and the severity and number of the defects.

Preoperative and intraoperative factors were studied to investigate its association with the outcome of surgery (failure, recurrence, and success). Preoperative factors that were assessed were age, etiology of the fistula, increased intracranial tension (ICT), site of defect, and number of defects. Intraoperative factors that were assessed were graft material used for repair (fascia lata, adhesive dura, or middle turbinate), packing of defect or not, usage of fibrin glue, and size of the graft (small, coapted, or large, i.e. its size 5–7 mm larger than diameter of the defect).

Postoperative follow-up

All patients were subjected immediately postoperatively to broad-spectrum antibiotics, restriction of fluids, and bed rest. Furthermore, some patients were subjected to insertion of subarachnoid catheter if there was profuse amount of CSF leakage preoperatively owing to the multiple defects. Follow-up period was 6–18 months. Patients were followed up clinically and educated to come back if they experienced recurrence of the preoperative symptoms. Radiological examinations were repeated in cases of recurrences or failure. The included imaging was high-resolution CT scan of the brain, skull base thin cuts with reconstruction, high-resolution CT scan of the nose, paranasal thin cuts with reconstruction, CT cisternography, and MRI brain with contrast.

Statistical analysis

Normally distributed data were elucidated in the form of mean and SD and the particular groups were compared using Student t test. On the contrary, nonparametric variables were expressed as median and range, and the difference between those groups was estimated using Mann–Whitney U test. Moreover, categorical variables were elucidated as number and percentage, and compared using Fisher exact test and χ^2 test. Significance was established when P value less than 0.05. Analyses were performed using SPSS, version 23 software (IBM SPSS Statistics; IBM Corp, Armonk, New York, USA).

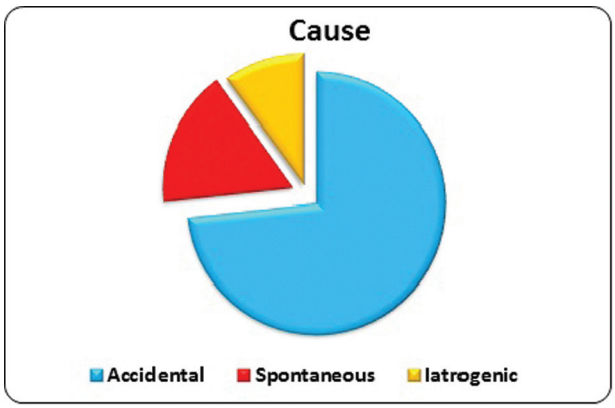
Results

A total of 30 patients with CSF rhinorrhea were included in the study. Among them, 17 (56.7%) patients were males and 13 (43.3%) patients were females. The mean age of studied patients was 37.77 ±12.52 years, whereas the average follow-up duration was 11.2 months (range, 6–18 months).

Regarding the etiology, 22 (73.3%) patients experienced accidental etiology that was caused by motor vehicle accident, five (16.7%) patients experienced spontaneous etiology, and three (10%) patients had iatrogenic etiology after transnasal endoscopic hypophysectomy (Fig. 1).

Regarding the preoperative history of increased ICT, 22 (73.3%) patients were negative and eight (26.7%)

Figure 1



Description of etiology in the studied patients.

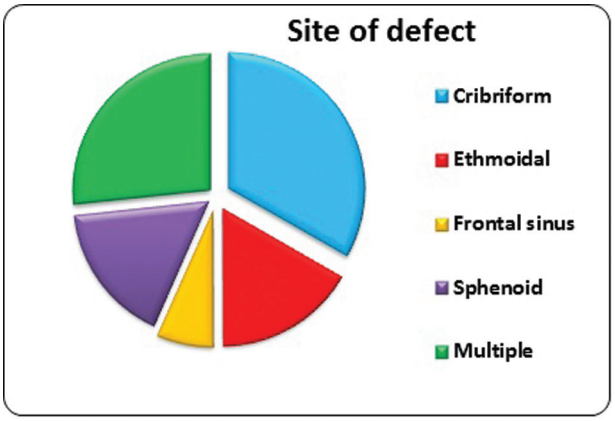
patients were positive. Off these eight patients, five patients were associated with accidental etiology, and three patients were associated with spontaneous etiology. Among the five patients with accidental etiology, the causes of ICT were recurrent attacks of fever (neck rigidity with negative CSF culture) in three patients (meningitis), and there was pneumocephalus with (positive imaging finding of slightly dilated ventricles) in two patients. All the three patients who had spontaneous etiology were reported to have pseudotumor cerebri.

Regarding the location of the defect, the defect was in cribriform plate in 10 (33.3%) patients, ethmoidal in five (16.7%) patients, sphenoidal in five (16.7%) patients, and in the frontal sinus in two (6.7%) patients. The remaining eight (26.7%) patients had multiple defects, and all were associated with accidental etiology (Fig. 2).

Operative data

Regarding the operative data, the graft material used was fascia lata in 11 (36.7%) patients, adhesive dura in five (16.7%) patients, middle turbinate in 10 (33.3%) patients, and multiple graft types were used in four (13.3) patients. Furthermore, packing was done in 26 (86.7%) patients, and fibrin glue was used in 14 (46.7%) patients. The graft size was large in 26 (86.7%) patients and small in four (13.3%) patients. Regarding the procedure, nine (30%) patients were operated intracranially, and 21 (70%) patients were operated endoscopically.

Figure 2



Description of defect site in the studied patients.

Outcome and associated factors

Regarding the outcome, failure was considered when recurrence of symptoms occurred in a period less than 6 months of surgery; however, recurrence was considered when rhinorrhea recurred in more than 6 months after surgery. The operation was successful in 20 (66.7%) patients, whereas failure occurred in seven (23.3%) patients, and recurrence occurred in three (10%) patients.

The association between outcome and different variables is summarized in Table 1. There was a significant inverse relation between presence of meningitis or increased ICT and the outcome (P=0.006). On the contrary, the graft size was directly associated with the positive outcome of the operation (P=0.003) (Table 1).

Case presentation

Case 1: a 27-year-old male patient presented with right-sided CSF rhinorrhea of 18-month duration. The cause of the leak was head trauma that preceded the onset of symptoms by 6 months. The operation was done transcranially by bifrontal approach. There were multiple defects at left frontal sinus and right-sided cribriform plate. The repair was conducted by both adhesive dura and fascia lata. Furthermore, fibrin glue was used. The surgery was performed through intradural approach and the surgery was successful (Figs 3–5).

Case 2

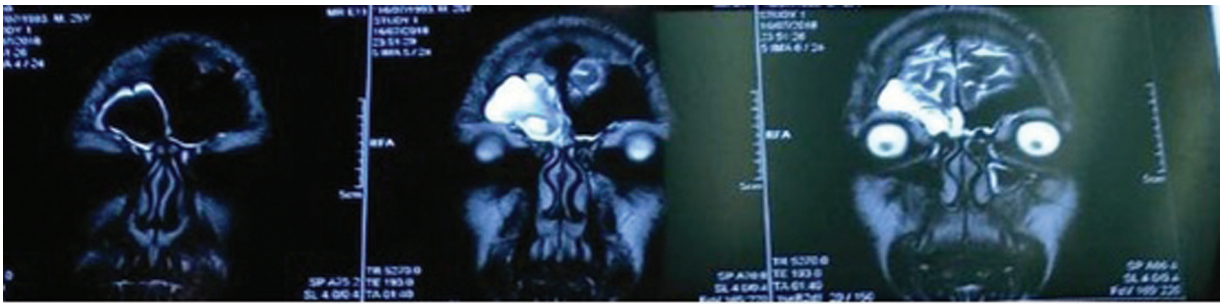
A 37-year-old female patient presented with a history of head trauma that resulted in fracture base of the anterior cranial fossa 1 year ago. After 2 months from the trauma, the patient presented with right-sided CSF rhinorrhea which subsided conservatively. After 8 months, the rhinorrhea recurred and continued for 4

Table 1 Variables associated with the outcome of operation

Variables	Success (N=20) [n (%)]	Fail (N=7) [n (%)]	Recurrence (N=3) [n (%)]	P value
Meningitis, signs of increased ICT				
Negative	18 (90)	2 (28.6)	2 (66.7)	0.006
Positive	2 (10)	5 (71.4)	1 (33.3)	
Graft size				
Small	0 (0)	2 (28.6)	2 (66.7)	0.003
Large	20 (100)	5 (71.4)	1 (33.3)	

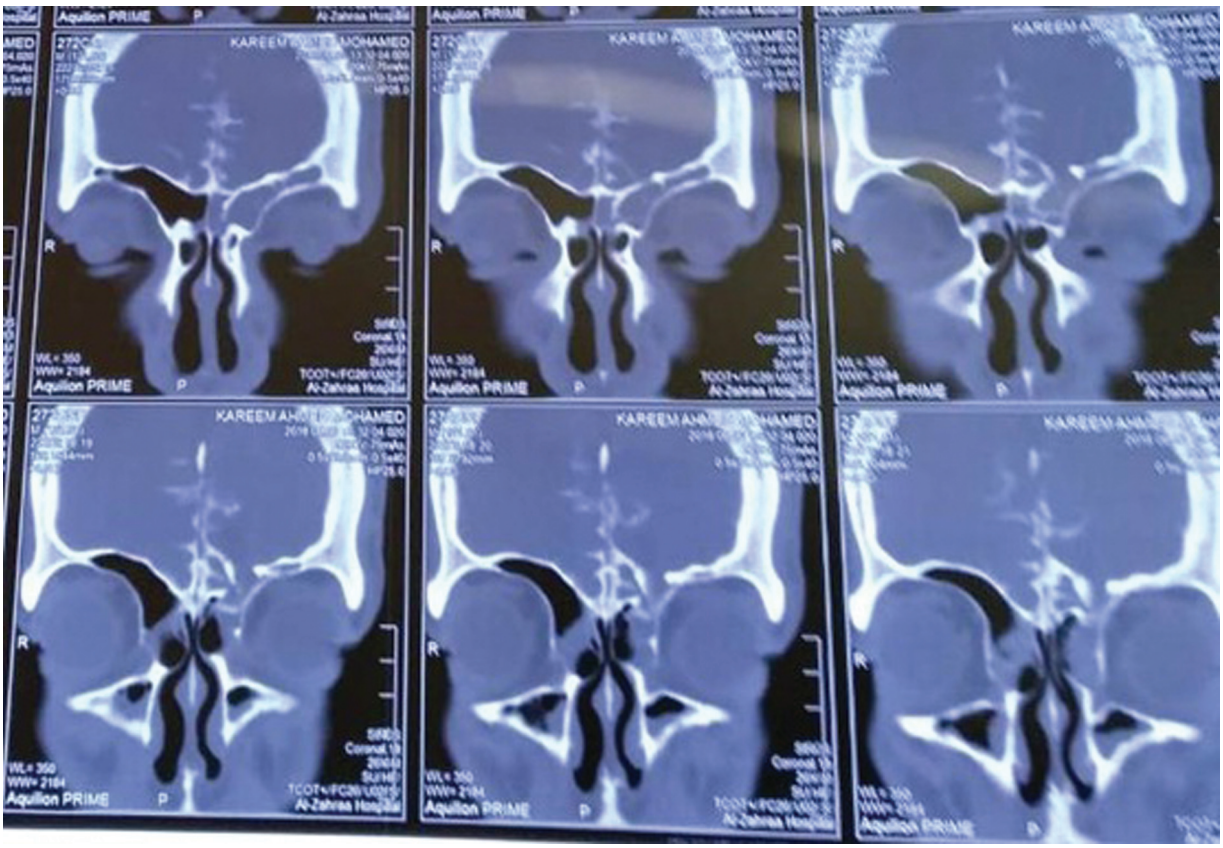
ICT, intracranial tension.

Figure 3



The preoperative MRI brain T2-weighted imaging showing right frontal basal meningocele.

Figure 4



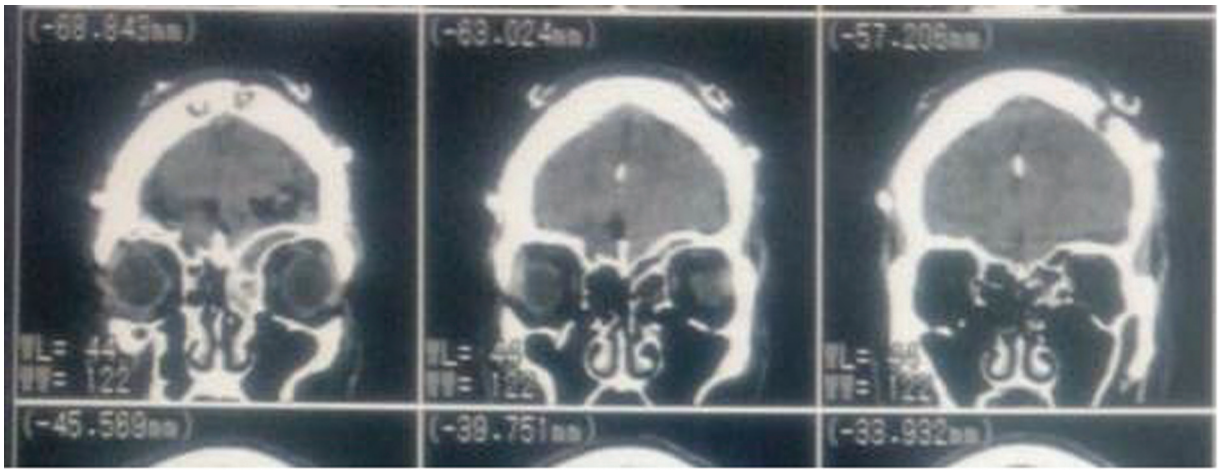
The preoperative computed tomography cisternography illustrating the defect in left frontal sinus.

months. The CSF cisternography revealed CSF fistula and cribriform plate defect at the right side. The operation was performed endoscopically with middle turbinate graft. This procedure failed on the second day of operation. The patient experienced left-sided CSF rhinorrhea. Subsequently, a second repair was performed using a large-sized fascia lata, which revealed successful results (Figs 6 and 7).

Discussion

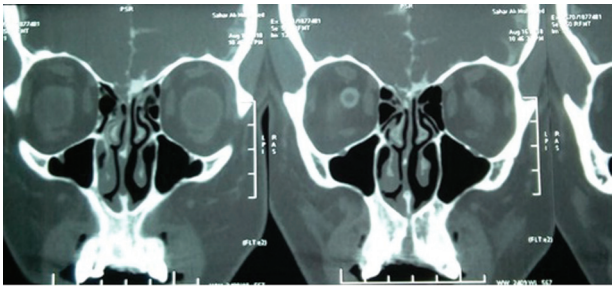
In this study, 30 patients with CSF rhinorrhea were surgically treated, of whom 20 patients had successful management, seven failed, and three had history of recurrence. Our statistical analysis showed that preoperative increase of ICT was associated with the negative outcome of the surgical management. These results coincide with a previous study done by Kumari Mishra *et al.* [7] which found that comorbid conditions such as chronic cough may contribute to raised ICT and failure of the repair. Some authors hypothesized that patients with increased CSF pressure are at increased risk of persistent or recurrent CSF leak at the reconstruction site or elsewhere along the skull base [8,9]. On the contrary, our statistical analysis showed that the type of the graft is not necessary for achieving a

Figure 5



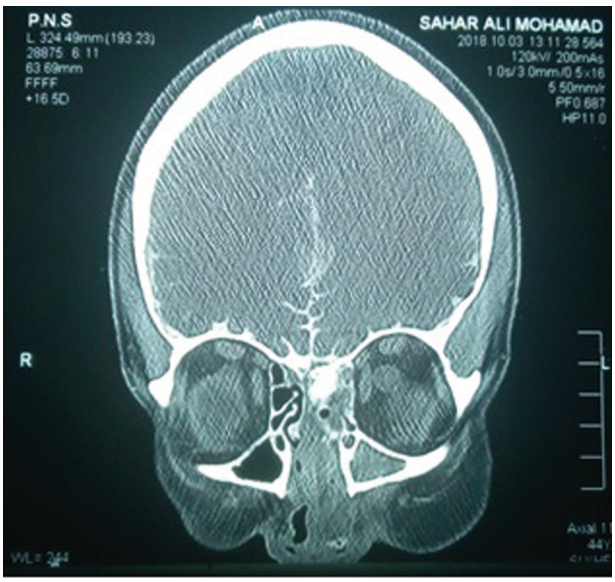
Postoperative computed tomography brain of case 1 showing repair of frontal sinus.

Figure 6



The preoperative computed tomography cisternography illustrating the defect at right side of cribriform plate.

Figure 7



Third day postoperative computed tomography cisternography after failure of first repair showing leak of contrast at left side cribriform plate.

successful outcome, and this report agrees with previous reports [10,11].The second factor in the study that significantly affects the outcome is the size of graft. The graft should be larger than the diameter of the defect by ~5 mm all around, as the ongoing scar tissue would increase the size of the defects. These results were in coordination with the previous results that were performed by Martín-Martín *et al*. [11] and Paolo *et al*. [12].

Conclusion

The accurate localization of site and size of the defect that can be done through clinical examination and radiological imaging is essential for accurate estimation of the size of the graft. A history of increased ICT should be suspected and excluded in cases with CSF rhinorrhea. If the increased ICT is present, strict preoperative and postoperative control is recommended. The follow-up is important for all positive cases to ensure successful outcome.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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