Empty sella syndrome (ESS) is a condition in which the sella turcica is partially or completely filled with CSF resulting in a displacement of the normal pituitary gland.

Objective: This study was done to evaluate the clinical features, surgical management and outcome in a consecutive 20 cases with ESS.

Methods: This retrospective study included 20 adult patients suffering from manifestations due to ESS. 12 patients (60%) had symptomatic primary ESS and the rest 8 patients (40%) had manifestations due to secondary ESS. The male to female ratio was 1–3 and their ages ranged from 20 till 56 years with mean age of 41 years. As regards the clinical presentation, manifestations of increase the intracranial pressure were found in 12 patients (60%), visual manifestations in 10 patients (50%), CSF rhinorrhea in 10 cases (50%), and endocrinological dysfunction in 7 patients (35%). All patients had preoperative plain X-ray, CT scan and MRI of the brain. Different surgical procedures were done according to the mode of presentation and the radiological findings. Mean post-operative follow-up period was 30 months, including both clinical and radiological examinations.

Results: After surgery 10 patients (50%) were asymptomatic, 6 patients (30%) improved, and 4 patients (20%) stabilized. (85.3%) of patients with preoperative complaint of headache respond well to surgery, (12 cases out of 14). While 60% of the patients with preoperative visual field defect improved. No patients with preoperative visual acuity (4 cases) have improved after surgery. Post-operative MRI studies after extradural transsphenoidal packing revealed that the sellar contents appeared satisfactory elevated with upward lifting of suprasellar structures in all cases.
Empty sella syndrome (ESS) is a condition in which the sella turcica is partially or completely filled with CSF resulting in a displacement of the normal pituitary gland.\(^1,^2\) Usually the sella is enlarged and the pituitary gland is compressed and reshaped.\(^3\) ESS is divided into primary and secondary types depending on the presence of previous surgery or irradiation to the pituitary gland.\(^4\) Primary empty sella can be due to an inherent weakness of the diaphragma sella and or to an increase in the intracranial pressure which promotes the herniation of arachnoid membrane into the pituitary fossa.\(^5,^6\) Although most individuals who have primary ESS are asymptomatic, a few present with clinical symptoms and signs related to the condition.\(^7,^8\) It is more common in middle-aged obese females, usually presents with headache, and only occasionally associated with endocrine or visual abnormalities.\(^9\) Surgical therapy is rarely required except for cases presented with CSF rhinorrhea or progressive visual loss.\(^10\)

Aim of the work was to study different diagnostic criteria of primary and secondary ESS and to evaluate the results of its surgical management. Also to compare these results with the results of the other authors reported in literature.

### 2. Methods

This retrospective study was carried out on 20 adult patients suffering from manifestations due to ESS. Twelve patients had symptomatic primary ESS and the rest 8 patients had manifestations due to secondary ESS. The study was done in Alexandria hospitals over a period of 8 years starting from March 2000 to March 2008. The male to female ratio was 1–3 and their ages ranged from 20 till 56 years with mean age of 41 years.

All the 12 cases with symptomatic primary ESS were middle aged obese females and were complaining of manifestation of increase the intracranial pressure. Also 10 of these 12 patients had visual field defect. Also endocrinological dysfunction was found in three cases. All the 8 cases with symptomatic secondary ESS had previous transphenoidal operations for pituitary adenoma followed by radiotherapy in only one of them. Five patients were males and the other three patients were females. All these patients had visual disturbances in the form of field defect alone or with decrease the visual acuity as occurred in 4 patients. Also associated endocrinological dysfunction was found in 4 patients.

Headache was the commonest symptom (70% of patients). As regards the clinical presentation, manifestations of increase the intracranial pressure were found in 12 patients (60%), visual manifestations in 10 patients (50%), CSF rhinorrhea in 10 cases (50%), and endocrinological dysfunction in 7 patients (35%) (five women present with oligoamenorrhea with galactorrhea, and two males present with hypothyroidism) (Table 1).

### 3. Results

Measurement of intrathecal CSF pressure was intermittently high in 7 out of 12 cases but not more than 23 cm in all measurement.

Determination of the visual acuity was found to be counting fingers in two cases, and 6/60 in the other two cases. Field of vision defects was present in the form of constricted field in

### Table 1 Clinical features in 20 patients with empty sella syndrome.

<table>
<thead>
<tr>
<th>Clinical presentation</th>
<th>Cases</th>
<th>Type of ESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intracranial pressure</td>
<td>12</td>
<td>60 Primary</td>
</tr>
<tr>
<td>CSF rhinorrhea</td>
<td>10</td>
<td>50 Primary</td>
</tr>
<tr>
<td>Visual field defect</td>
<td>10</td>
<td>50 Primary and secondary</td>
</tr>
<tr>
<td>Endocrinological dysfunction</td>
<td>7</td>
<td>35 Primary and secondary</td>
</tr>
<tr>
<td>Visual acuity</td>
<td>4</td>
<td>20 secondary</td>
</tr>
</tbody>
</table>

Most patients had multiple symptoms.
<table>
<thead>
<tr>
<th>No</th>
<th>Age in year</th>
<th>Sex</th>
<th>Clinical presentation</th>
<th>Radiological and MRI findings</th>
<th>Operative procedures</th>
<th>Outcome and follow up period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
<td>F</td>
<td>+ +</td>
<td>MRI and CT with intrathecal contrast → the site of fistula can not be found</td>
<td>Subfrontal craniotomy with intradural repair of the anterior cranial fossa with fascia → failed thecoperitoneal shunt → successful</td>
<td>Asymptomatic 42 months</td>
</tr>
<tr>
<td>2</td>
<td>31</td>
<td>F</td>
<td>+ +</td>
<td>MRI and CT with intrathecal contrast → transsellar fistulous tract</td>
<td>Transsphenoidal packing of the sella using fat and fascia with fibrin glue + floor reconstruction</td>
<td>Asymptomatic 42 months</td>
</tr>
<tr>
<td>3</td>
<td>29</td>
<td>F</td>
<td>+ +</td>
<td>MRI and CT with intrathecal contrast → the site of fistula can not be found</td>
<td>Transsphenoidal packing of the sella using fat and fascia with fibrin glue + floor reconstruction</td>
<td>Asymptomatic 40 months</td>
</tr>
<tr>
<td>4</td>
<td>34</td>
<td>F</td>
<td>+ +</td>
<td>MRI and CT with intrathecal contrast → transsellar fistulous tract</td>
<td>Subfrontal craniotomy with intradural repair of the anterior cranial fossa with fascia → failed thecoperitoneal shunt → successful</td>
<td>Asymptomatic 34 months</td>
</tr>
<tr>
<td>5</td>
<td>44</td>
<td>F</td>
<td>+ +</td>
<td>MRI and CT with intrathecal contrast → transsellar fistulous tract</td>
<td>Transsphenoidal packing of the sella using fat and muscle + reconstruction of the sellar floor</td>
<td>Asymptomatic 60 months</td>
</tr>
<tr>
<td>6</td>
<td>41</td>
<td>F</td>
<td>+ +</td>
<td>MRI and CT with intrathecal contrast → transsellar fistulous tract</td>
<td>Transsphenoidal packing of the sella using fat + reconstruction of the sellar floor</td>
<td>Asymptomatic 40 months</td>
</tr>
<tr>
<td>7</td>
<td>36</td>
<td>F</td>
<td>+ +</td>
<td>MRI and CT with intrathecal contrast → the site of fistula</td>
<td>Subfrontal craniotomy with intradural repair of the anterior cranial fossa with fascia → failed thecoperitoneal shunt → successful</td>
<td>Asymptomatic 20 months</td>
</tr>
<tr>
<td>8</td>
<td>38</td>
<td>F</td>
<td>+ +</td>
<td>MRI and CT with intrathecal contrast → transsellar fistulous tract</td>
<td>Transsphenoidal packing of the sella using fat and muscle + reconstruction of the sellar floor</td>
<td>Asymptomatic 48 months</td>
</tr>
<tr>
<td>9</td>
<td>48</td>
<td>F</td>
<td>+ +</td>
<td>MRI and CT with intrathecal contrast → transsellar fistulous tract</td>
<td>Transsphenoidal packing of the sella using fat + reconstruction of the sellar floor</td>
<td>Asymptomatic 14 months</td>
</tr>
<tr>
<td>10</td>
<td>45</td>
<td>F</td>
<td>+ +</td>
<td>MRI and CT with intrathecal contrast → the site of fistula through cribriform plate</td>
<td>Subfrontal craniotomy with intradural repair of the anterior cranial fossa with fascia → failed thecoperitoneal shunt → successful</td>
<td>Asymptomatic 18 months</td>
</tr>
<tr>
<td>11</td>
<td>47</td>
<td>F</td>
<td>+ +</td>
<td>MRI → intrasellar CSF collection with posterior displacement flattening of pituitary gland</td>
<td>Transsphenoidal packing of the sella using fat and fascia + reconstruction of the sellar floor</td>
<td>Improved 24 months</td>
</tr>
<tr>
<td>12</td>
<td>41</td>
<td>F</td>
<td>+ +</td>
<td>MRI → intrasellar CSF collection with posterior displacement flattening of pituitary gland</td>
<td>Transsphenoidal packing of the sella using fat + reconstruction of the sellar floor</td>
<td>Improved 14 months</td>
</tr>
<tr>
<td>No</td>
<td>Age in year</td>
<td>Sex</td>
<td>Clinical presentation</td>
<td>Radiological and MRI findings</td>
<td>Operative procedures</td>
<td>Outcome and follow up period</td>
</tr>
<tr>
<td>----</td>
<td>-------------</td>
<td>-----</td>
<td>-----------------------</td>
<td>-----------------------------</td>
<td>----------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>1</td>
<td>51</td>
<td>M</td>
<td>+</td>
<td>MRI → intrasellar CSF collection with posterior displacement flattening of pituitary gland eccentric position of the stalk</td>
<td>Transsphenoidal packing of the sella using fat + reconstruction of the sellar floor</td>
<td>Stabilized 50 months</td>
</tr>
<tr>
<td>2</td>
<td>31</td>
<td>M</td>
<td>+</td>
<td>MRI → intrasellar CSF collection with posterior displacement flattening of pituitary gland eccentric position of the stalk</td>
<td>Transsphenoidal packing of the sella using fat + reconstruction of the sellar floor</td>
<td>Improved 12 months</td>
</tr>
<tr>
<td>3</td>
<td>51</td>
<td>M</td>
<td>+</td>
<td>MRI → intrasellar CSF collection with posterior displacement flattening of pituitary gland eccentric position of the stalk</td>
<td>Transsphenoidal packing of the sella using fat + reconstruction of the sellar floor</td>
<td>Stabilized 20 months</td>
</tr>
<tr>
<td>4</td>
<td>44</td>
<td>F</td>
<td>+</td>
<td>MRI → intrasellar CSF collection with posterior displacement flattening of pituitary gland eccentric position of the stalk</td>
<td>Transsphenoidal packing of the sella using fat + reconstruction of the sellar floor</td>
<td>Improved 20 months</td>
</tr>
<tr>
<td>5</td>
<td>36</td>
<td>F</td>
<td>+</td>
<td>MRI → intrasellar CSF collection with posterior displacement flattening of pituitary gland eccentric position of the stalk</td>
<td>Transsphenoidal packing of the sella using fat + reconstruction of the sellar floor</td>
<td>Stabilized 39 months</td>
</tr>
<tr>
<td>6</td>
<td>38</td>
<td>M</td>
<td>+</td>
<td>MRI → intrasellar CSF collection with posterior displacement flattening of pituitary gland</td>
<td>Transsphenoidal packing of the sella using fat + reconstruction of the sellar floor</td>
<td>Stabilized 31 months</td>
</tr>
<tr>
<td>7</td>
<td>57</td>
<td>M</td>
<td>+</td>
<td>MRI → intrasellar CSF collection with posterior displacement flattening of pituitary gland, eccentric position of the stalk</td>
<td>Transsphenoidal packing of the sella using fat + reconstruction of the sellar floor</td>
<td>Improved 14 months</td>
</tr>
<tr>
<td>8</td>
<td>50</td>
<td>F</td>
<td>+</td>
<td>MRI → intrasellar CSF collection with posterior displacement flattening of pituitary gland</td>
<td>Transsphenoidal packing of the sella using fat + reconstruction of the sellar floor + radiotherapy</td>
<td>Improved 18 months</td>
</tr>
</tbody>
</table>
6 cases, binasal hemianopia in 2 cases and multiple scotomas in two cases.

Endocrinological tests showed hyperprolactinemia in five women with DI in two of them, and hypothyroidism in the third case.

Plain X-ray showed enlarged sella turcica in 18 cases. CT scan with intrathecal contrast showed transsellar fistulous tract in 6 cases, CSF leak through cribiform plate in two cases and failed to identify the exact site of leak in two cases.

Preoperative MRI showed flattened pituitary gland against sellar floor and stretched pituitary stalk in all cases (Fig. 1), while postoperative MRI studies after transsphenoidal extradural packing revealed that the sellar contents appeared satisfactory elevated both on sagittal and coronal planes with

![Figure 1](image1.png)

**Figure 1** Preoperative sagittal and coronal T1-weighted MRI in patient with primary ESS showing the pituitary gland is flattened against the sellar floor, and the stretched pituitary stalk.

![Figure 2](image2.png)

**Figure 2** A & B: Preoperative sagittal and coronal T1-weighted MRI in patient with primary ESS showing downward traction of chiasm and the pituitary gland is flattened against the sellar floor, and the stretched pituitary stalk. C & D: Postoperative sagittal and coronal MRI of the same patient 6 months after extradural transphenoidal packing of the sella with muscle & fat showing that the chiasm and pituitary stalk are in normal position.
upward lifting of suprasellar structures in all the 16 cases (Figs. 2–4).

Patients with preoperative complaint of headache respond well to surgery, with complete resolution in 85.3% of cases (12 cases out of 14). On contrast only 60% of the patients with preoperative visual field defect improved (6 cases out of 10). No patients with preoperative visual acuity (4 cases) have improved after surgery.

Outcome of cases: At the last follow-up examination period after surgery, 10 patients (50%) were asymptomatic, 6 patients (30%) improved, and 4 patients (20%) stabilized. No patient in the improved group developed new deficits or had progression of an existing preoperative deficit. The differences between the age of the patients among the various outcome groups were not significant ($p > 0.05$). The differences in the main clinical presentation before surgery among the various outcome groups were statistically significant ($p < 0.05$) (Table 4).

Postoperative morbidity and mortality: There was no postoperative mortality, and surgery did not provoke any permanent neurological aggravation of any of the cases. Three patients had severe postoperative headache, lasting from three to seven days after surgery. One patient had temporary postoperative decrease of his visual acuity lasting for two days then improved on cortisone therapy.

4. Discussion

The term ESS describes a distinct radiological and anatomical entity in which the subarachnoid space extends significantly through an incompetent diaphragma sella into the sella turcica. The diaphragma sella almost completely covers the pituitary body with only a small central opening for the passage of the infundibulum. Even though the term empty sella is the one most commonly used to refer to this clinical condition, it is well known that the term is incorrect, because in these cases the sella is not empty, but rather completely filled by the pituitary gland, with its stalk, the arachnoid, the CSF and occasionally, the optic system and the third ventricle. That is why some authors prefer to use the term intrasellar arachnoidocele because it expresses in a simple and clear way the findings in this entity.

The condition is more common and benign in adults, with a female predominance, but its occurrence in children has been reported.

It has been found in association with several conditions, such as obesity, hypertension, and migraine. A number of hypotheses have been offered to explain the cause of primary ESS such as pituitary infarction, pituitary apoplexy, and rupture of an intrasellar cyst. Although one or more of these conditions may play role in the development of ESS, a reasonable explanation is that the condition arises in a patient who has either a transient or constant elevation in intracranial pressure and who has incompetent diaphragma sella that allows the subarachnoid space to be forced into the sella by the hydrostatic pressure and pulsatile movement of CSF. Recently, shrinkage of the pituitary gland by antipituitary antibodies was advocated as another possible cause of primary ESS. Secondary ESS is generally associated with a previous surgery, radiotherapy, or medical treatment for tumors of the sellar region.
In a review study by Bjerre, an empty sella (ES) of normal size was considered as a normal variant, whereas an enlarged ES is associated with pituitary disease or other clinical disorders. Enlarged sella was found in 90% of the cases in this study. Many theories explain enlargement of the sella. CSF pulsations against the parasellar structures can cause remodeling of the bony sellar floor. The bony erosion, especially if augmented by increased intracranial pressure, can cause communication of the intrasellar subarachnoid space with the sphenoid sinus. CSF rhinorrhea may be also attributed to benign intracranial hypertension, which is frequently associated with ESS. CSF pressure elevation has been recorded in 65% of patients with CSF rhinorrhea. The site of the leak is usually into the sphenoid sinus but may be through the cribiform plate and can be distinguished after the injection of the intrathecal contrast. In this study, the 10 cases presented with CSF rhinorrhea the intrathecal CSF pressure was intermittently high in 7 of them (70%). Also the site of the CSF leak was through the sellar floor in 6 cases, through cribiform plate in two cases and cannot be identified in the two cases.

Bjerre discounted that theory of being the cause of chiasomatic cistern herniation into the sella because as many patients with an enlarged empty sella have normal intracranial pressure. In addition, patients with hydrocephalus rarely have an enlarged ES. The theory receiving his support is that an enlarged ES reflects a stage in the spontaneous course of some pituitary adenomas. The bony enlargement is a result of the growing adenoma, whereas spontaneous necrosis may allow

### Table 4
Outcome in 20 cases with EES versus main clinical presentation and age of patients.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Cases</th>
<th>Main clinical presentation</th>
<th>Average age in years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>(%)</td>
<td></td>
</tr>
<tr>
<td>Asymptomatic</td>
<td>10</td>
<td>50</td>
<td>CSF rhinorrhea</td>
</tr>
<tr>
<td>Improved</td>
<td>6</td>
<td>30</td>
<td>Visual field defect</td>
</tr>
<tr>
<td>Stabilized</td>
<td>4</td>
<td>20</td>
<td>visual field defect</td>
</tr>
<tr>
<td>Aggravated</td>
<td>0</td>
<td>0</td>
<td>visual acuity</td>
</tr>
</tbody>
</table>

![Figure 4](image.png)

**Figure 4** A & B: Preoperative sagittal and coronal T1-weighted MRI in patient with secondary ESS showing downward traction of chiasm, and the stretched pituitary stalk. C & D: Postoperative sagittal and coronal MRI of the same patient 8 months after extradural transsphenoidal packing of the sella with fat showing that the chiasm and pituitary stalk are in normal position.
herniation of the subarachnoid space after absorption of the necrotic material. This theory explains the enlargement of the sella, the presence of pituitary hypersecretions, chiasmal lesions, spontaneous CSF rhinorrhea, and possibly even pseu-
dotumor cerebi. Necrosis of a pituitary adenoma also explains
the lack of further sellar enlargement once an enlarged ES has
been diagnosed. The onset of pituitary necrosis with hemor-
rhage can have no symptoms or variable symptoms such as
classic pituitary apoplexy or a minor attack.

The pathogenesis of the visual changes is attributed to hernia-
tion of the suprasellar cisterns into the sellar space. This
causes downward displacement of the optic nerves, optic
chiasm and exposes the optic structures to a more intense
CSF pulsation, which results in a force directed toward the sellar
floor that does not exist under normal conditions.21,22

The MRI is most effective tool for diagnosis of the empty sella
that appeared large and filled with CSF extending down-
ward from the suprasellar cistern. The pituitary gland is flat-
tened along the floor of the sella turcica, usually in the
posteroinferior portion. The pituitary stalk can be seen to trans-
verse this CSF space from the median eminence of the hypo-
thalmus down to the flattened pituitary gland. This is an im-
portant feature to ascertain, because it excludes the possibil-
ity that the sella turcica is occupied by a space occupying
cyst.1,2,23 Cysts and other space occupying lesions deviate the
stalk away from its normal course.2,3

Considering the high risk of CSF rhinorrhea and infection,
the technique of intradural packaging was replaced by the extra-
dural technique that had been widely accepted and put into use as
the current treatment modality. The extradural packing of the
sella was performed with minimal trauma, and avoid the risk of overpacking, because the intradural and suprasellar
structures were not directly manipulated as they were protected
by the dural and arachnoidal planes, also their upward displace-
ment was self limited by the insertion of the dura mater of the
sellar floor on the medial wall of the cavernous sinus.24

Several materials have been suggested for filling the sellar
space and reconstruction the sellar floor. They include bioab-
sorbable materials, muscle, fat, dural substitutes, cartilage,
bone fragments, ceramic substances, titanium plates, and oth-
ers.24,25 As recorded by many authors in this study the fat was
preferable to muscle because it results in less necrosis or scar
retraction over time, so loss of initial volume was not excessive.
This allowed for a more proportionate amount of initial pack-
ning material.3,24

In cases with secondary (ESS) adequate bone for recon-
struction of the sellar floor may not be available, in such cases
a bone graft from iliac crest, titanium plates, ceramic sub-
stances or acrylic material may be used.24,29

Transcranial operations were done formerly in secondary
cases for the release of adhesions and elevating the herniated
optic chiasm (chiasmapexy). Outcome has generally been dis-
appointing in these operations, as the visual failure commonly worsened.30,31 Mortara and Norell32 suggested opening of the
lamina terminalis to direct CSF pulsation away from the optic
chiasm. Recently, filling of the sellar cavity by the way of treat-
ment. The procedure consists of inserting inside the sella an
amount of fat sufficient to push the optic structure into their
normal suprasellar position.3,4,24 Extradural transphenoidal
chiasmapexy was indicated when the optic chiasm herniates in-
side the sella and the herniation causes progressive visual
abnormalities. Other techniques of chiasmapexy that involves
insertion of an extradural inflatable balloon or silastic coil into
the sellar space were proved successful. These techniques allow
the sellar space to be monitored by intraoperative fluoroscopic
means after the balloon is inflated with contrast material.30–34
These techniques were criticized by some authors32,35,36 who noted that basal dura was continuous with the medial wall of
the cavernous sinus, with no clear dissection plan between them; therefore dura could not be elevated su2ciently for the placement of the balloon into the sellar cavity and bleeding from the cavernous sinuses could occur.

In this study, the indication for surgery was based on the
presence of neurological deficit (visual field or acuity) or CSF
rhinorrhea, prophylactic surgery was not done to any one of
the cases. In this study, extradural transphenoidal packing of
the sellas with fat alone or with fat, muscle and fascia were done
in 16 of 20 cases with no permanent postoperative neurologi-
cal complications. Postoperative improvement of headache oc-
urred in 85.3% of cases (12 cases out of 14), and of the visual
field deficit in 60% of the patients (6 cases out of 10). No pa-
ients with preoperative visual acuity (4 cases) have improved
after surgery. CSF rhinorrhea was not resolved by the first oper-
ation in 4 out of 10 cases. In this series good results were ob-
tained in 16 cases (80%) after a mean follow up period of
30 months. Nearly the same results were marked by Gallardo et al.37 who reported the results of treatment in 76 successive
cases with ESS (73 primary and 3 secondary). Transphenoidal
packing of the sellas was done in 56 of their cases with 7.1%
postoperative complications. They reported postoperative
improvement of headache in 71% and of visual disturbances
in 46% of their cases. Also CSF rhinorrhea was not resolved
by the first operation in 6 out of 13 cases. In 20 patients without
surgery, headache improved in 64.4% of patients.

5. Conclusion
Surgical indications for correction of symptomatic ESS remain
controversy and rare. Visual disturbances and CSF rhinorrhea
are the main indications for surgery. When surgery is indi-
cated, the type of surgery depends on clinical presentation and
radiological findings. The surgical outcome of cases with
ESS is favorable, as most patients report improvement or sta-
bilization of their symptoms.

References

2. Braatvedt GD, Corral RJ. The empty sella syndrome: much do
3. McGrail KM, Zervas NT. The empty sella syndrome. In:
Youmans JR, editor. Neurological surgery, vol. 121. Philadel-
1975;25:1137–43.
5. Sander EC, Peter Jr WC. Empty sella syndrome. In: Wilkins R,
6. Tindal GT, Assietti R. Empty sella syndrome. In: Tindall GT,
Collins WF, editors. The practice of neurosurgery. New York:
7. Olson DR, Guiot G, Dereme P. The symptomatic empty sella:
predvention and correction via the transsphenoidal approach. J
Review of empty sella syndrome and its surgical management


