



Late-Onset Intractable Cerebrospinal Fluid Leakage After Stereotactic Radiotherapy After Resection of Giant Nonfunctioning Pituitary Adenoma

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Key words

- Endoscopic endonasal surgery
- Late-onset cerebrospinal fluid leakage
- Nonfunctioning pituitary adenoma
- Stereotactic radiotherapy
- Transcranial approach

Abbreviations and Acronyms

CSF: Cerebrospinal fluid
SRT: Stereotactic radiotherapy
TSR: Transsphenoidal resection

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INTRODUCTION

Skull base cerebrospinal fluid (CSF) leakage after radiation therapy for a pituitary adenoma is a very rare complication. Although a leak may occur early after a transsphenoidal resection (TSR) procedure, late-onset leakage, even after resection of a large tumor, is quite uncommon, with a rate <1% in the 30- to 90-day window. Exceedingly rare cases of CSF leakage beyond the 6-month threshold after surgery have been reported.¹⁻⁶ We present here a case of late-onset intractable CSF leakage after performing stereotactic radiotherapy (SRT) after resection of a giant nonfunctioning pituitary adenoma.

CASE DESCRIPTION

A 54-year-old woman came to our department for convulsions and was admitted. Brain magnetic resonance imaging

■ **BACKGROUND:** Late-onset skull base cerebrospinal fluid (CSF) leakage after stereotactic radiotherapy (SRT) is a very rare complication.

■ **CASE DESCRIPTION:** A 54-year-old woman came to our department for convulsions and was admitted. Brain magnetic resonance imaging revealed a giant tumor in the skull base region, including the sphenoid sinus, pituitary fossa, right cavernous sinus, right middle fossa, and right basal ganglia. Mild left hemiparesis was noted. An ophthalmologic examination revealed left side homonymous hemianopsia. Using an endonasal endoscopic surgical approach, tumor removal was performed, with the residual tumor removed with a transcranial approach. Residual tumor tissue remained around the right cavernous sinus; therefore, SRT was performed 1 month after the second procedure, which resulted in good control of growth. Four years later, spontaneous CSF leakage occurred, for which endoscopic endonasal surgery was performed. One month later, CSF leakage recurred, and the same procedure was again used. A third episode of recurrent CSF leakage occurred 5 days later. A transcranial approach was finally used for repair, and the patient showed complete recovery.

■ **CONCLUSIONS:** Late-onset CSF leakage after SRT for a pituitary adenoma can be intractable, and several aggressive repair procedures may be needed, including a combination of endonasal and transcranial approaches.

revealed a giant tumor in the skull base region, including the sphenoid sinus, pituitary fossa, right cavernous sinus, right middle fossa, and right basal ganglia (Figures 1A–C). Mild left hemiparesis was also noted, and an ophthalmologic examination showed evidence of left side homonymous hemianopsia. There were no other comorbidities, such as diabetes mellitus or hypertension, and no history of smoking. Initially, the tumor in the midline section was removed by endonasal endoscopic surgery, then 1 month later a transcranial orbitozygomatic approach was used to remove the residual tumor in the lateral portion. Nevertheless, some residual tumor tissue remained in the right cavernous sinus (Figures 1D–F). The cavernous sinus tumor was difficult to remove with a direct surgery method; therefore, we decided to proceed to SRT before regrowth of the residual tumor

caused compression of the surrounding neurovascular structures. That was performed 1 month after the second procedure to control tumor growth (Figure 2). The total dose of radiation was 50 Gy with 25 fractionations, and the residual tumor was well controlled.

Four years after STR, the patient came to us with headache and rhinorrhea. Head computed tomography scan results showed pneumocephalus, suggesting spontaneous CSF leakage (Figure 3). For repair, an endoscopic endonasal surgical procedure was performed using abdominal fat tissue to close the leakage point, which resulted in prompt recovery from rhinorrhea. However, 1 month later, a recurrent CSF leak from the parasellar region was noted (Figure 4), and a second endoscopic endonasal procedure was performed. Five days later, CSF leakage again recurred from the right middle fossa to right infratemporal fossa, and head computed

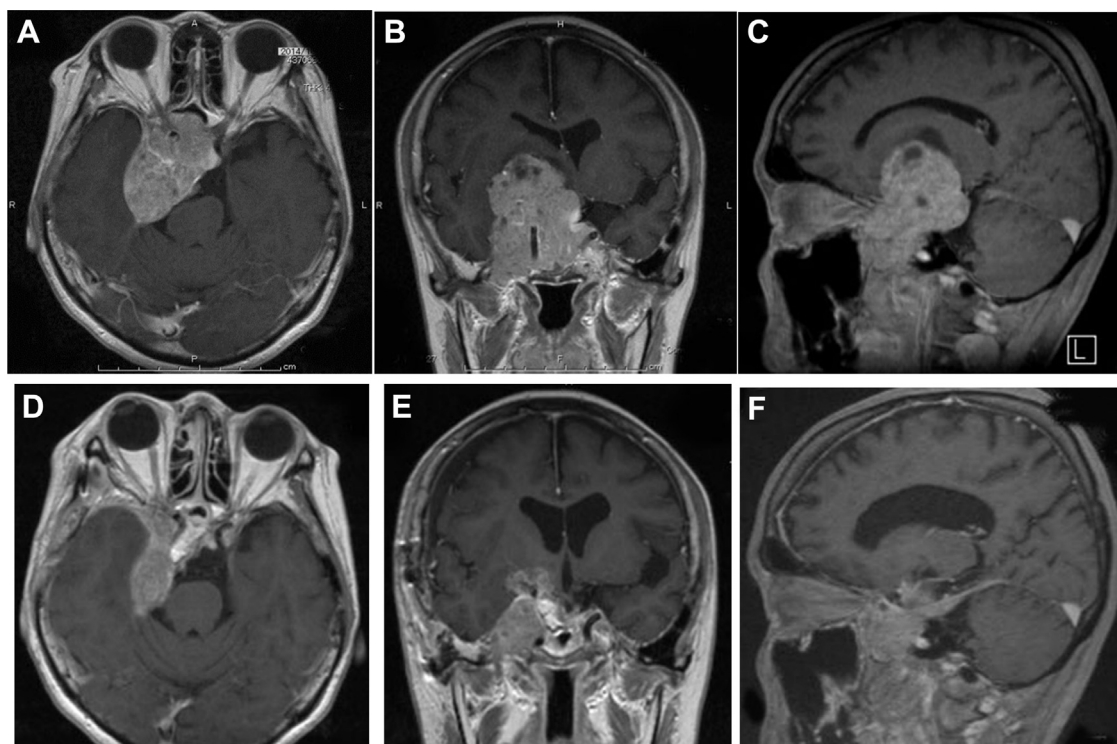


Figure 1. (A–C) Results of brain magnetic resonance imaging with gadolinium on admission and (D–F) after endoscopic

endonasal and transcranial surgery. After these procedures, residual tumor tissue remained in the right cavernous sinus.

tomography scan findings showed severe pneumocephalus (Figure 5). We considered that repair using an endonasal approach would be difficult and chose a transcranial approach for the recurrent CSF leakage because of the wide working space, which was performed under a microscope with a right frontotemporal

craniotomy. The leak point was in the tumor itself (Figure 6A) and sutured with 4-0 NUROLON (Suture Express, Overland Park, Kansas, USA) (Figure 6B), and then covered using right thigh fascia with microscopic visualization (Figure 6C). Lumbar drainage was applied for 7 days. Thereafter, the patient

demonstrated full recovery from the late-onset intractable CSF leakage (Figure 7).

DISCUSSION

Late-onset CSF leakage is an exceedingly rare complication after neurosurgical intervention for a pituitary pathology.

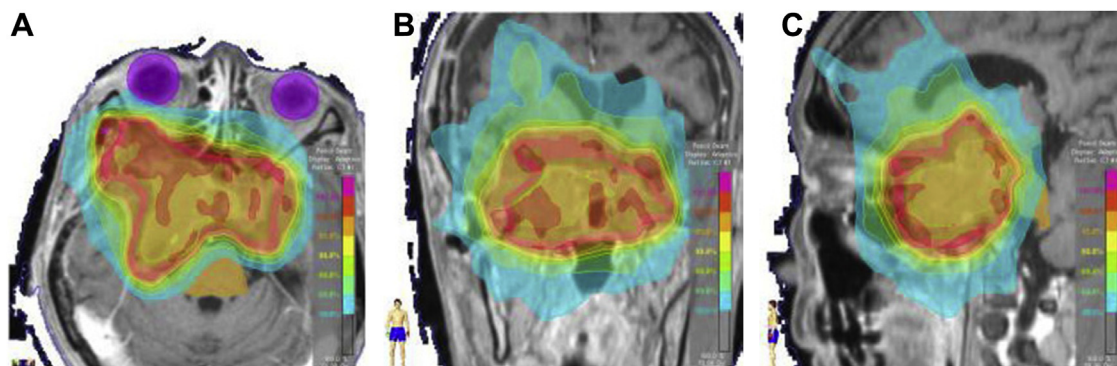


Figure 2. Stereotactic radiotherapy for residual tumor. Dose distribution is shown: (A) axial section, (B) coronal section, and (C) sagittal section.

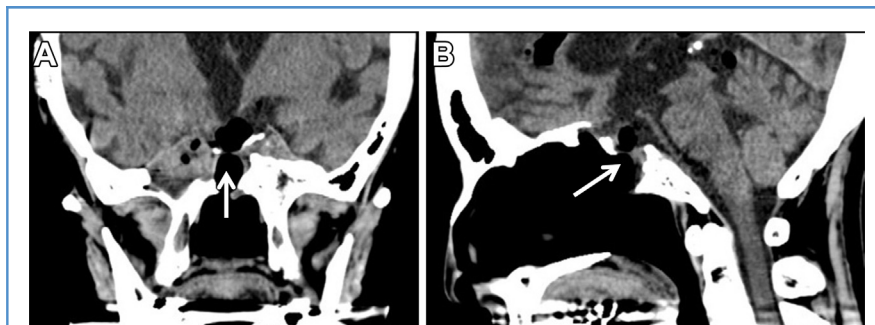


Figure 3. Head computed tomography scan findings on readmission. Four years later after stereotactic radiotherapy, cerebrospinal fluid leakage spontaneously occurred. *White arrows* indicate leak point: (A) coronal section and (B) sagittal section.

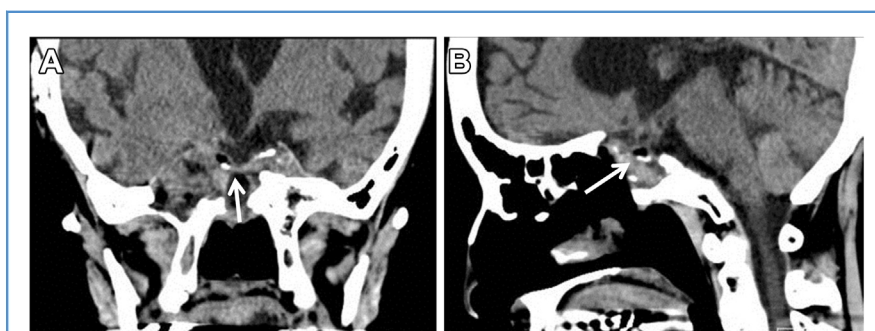


Figure 4. Head computed tomography scan findings 1 month after performing repair of cerebrospinal fluid (CSF) leak using an endonasal endoscopic approach. CSF leakage recurred from the parasellar region. *White arrows* indicate leak point: (A) coronal section and (B) sagittal section.

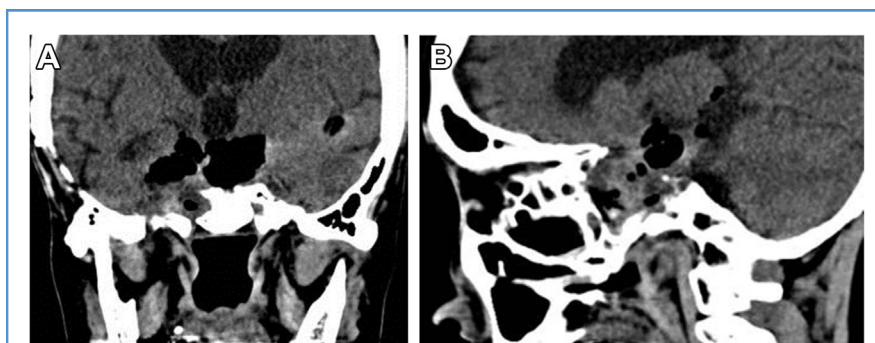


Figure 5. Head computed tomography (CT) scan findings 5 days after performing repair of cerebrospinal fluid leakage with a repeated endonasal endoscopic approach. Leakage occurred from the right middle fossa to right infratemporal fossa, and head CT scan revealed severe pneumocephalus: (A) coronal section and (B) sagittal section.

Late-onset CSF leakage after TSR is relatively rare and nearly always occurs in the early postoperative period, with cases

beyond the 6-month threshold scarcely encountered. Although several reports of late-onset CSF leakage after SRT in patients

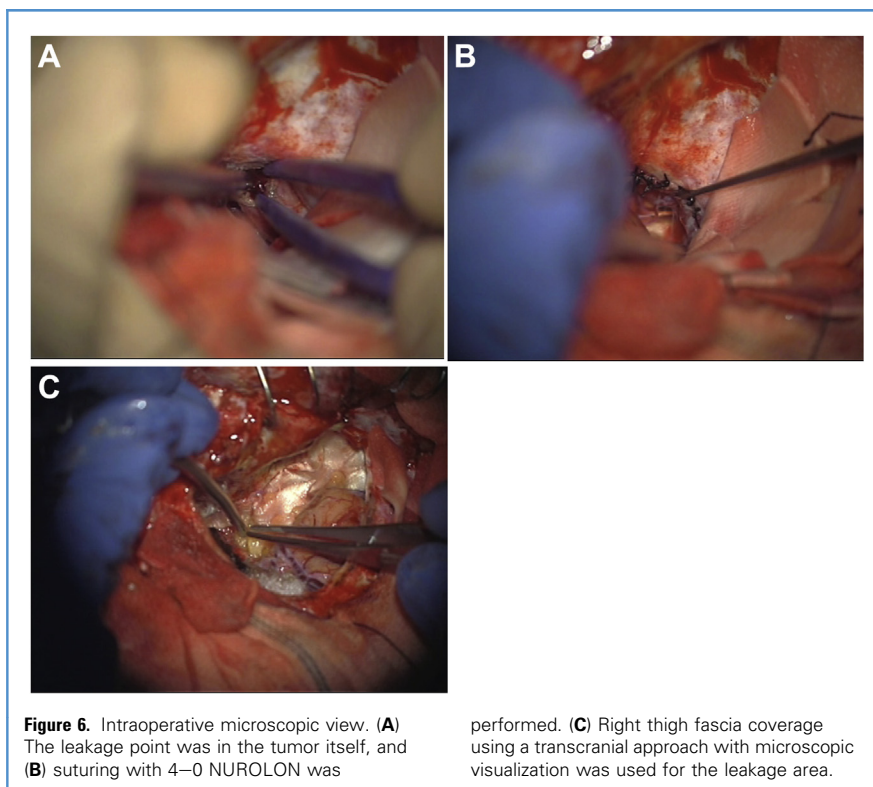
with functioning pituitary adenomas have been presented, the present is the first report of leak development that occurred >4 years after TSR and SRT in a patient with a nonfunctioning pituitary adenoma.

The overall rate of CSF leakage after TSR for a pituitary pathology is considered to be approximately 3.9%, with reported findings ranging from 0.5% to 15%.^{1,7,8} Rare case reports have documented delayed leakage, including Kudo et al.,³ who noted one at 7 months after TSR for a growth hormone–secreting adenoma, and the report by Ogawa and Tominaga² of a case that occurred 10 years after combined TSR and gamma knife radiosurgery for a prolactinoma. Perry et al.⁹ also presented 2 cases with delayed CSF leakage after gamma knife radiosurgery, one with and the other without preceding TSR for a functioning pituitary adenoma. All patients in these reported cases were affected by a functioning pituitary adenoma, whereas the present case is the first case of late-onset CSF leakage after surgery and SRT for a nonfunctioning pituitary adenoma.

Treatment recommendations for CSF leakage are well established and generally consist of an operative repair procedure for surgical candidates, particularly in those who have previously undergone TSR.^{1,10–12} Many reported cases required operative repair, and moving directly to a surgical repair procedure without attempting a nonoperative modality remains justified.¹³ In the present case as well, a direct operative repair was performed 3 separate times without nonoperative management.

The fundamental principles of an open reconstruction procedure in any region include preference for vascularized tissue, such as the pericranial scalp flap, to promote more efficient wound healing.^{14–16} Ideally, in the present case, we should have mobilized a pedicle flap, such as the temporalis fascia or frontal galea, to cover the skull base after resection of the tumor, or repaired CSF leakage after surgery and performed irradiation. However, we only used free avascular fascia to cover the defect because of failure to obtain an adequate pedicle flap length.

The patient was affected by a giant pituitary adenoma invading the right cavernous sinus and right middle fossa.



Even after 2-stage surgery with trans-sphenoidal and transcranial approaches, the residual tumor remained in the right cavernous sinus and right middle fossa. The reason why late-onset CSF leakage 4 years after SRT occurred in the present case may be because of tumor shrinkage, which is thought to result in uncovering of bony defects formed by late tumor regression. To prevent late-onset CSF leakage, skull base reconstruction should be considered during surgery for tumor

removal if radiation therapy is introduced at a later time.

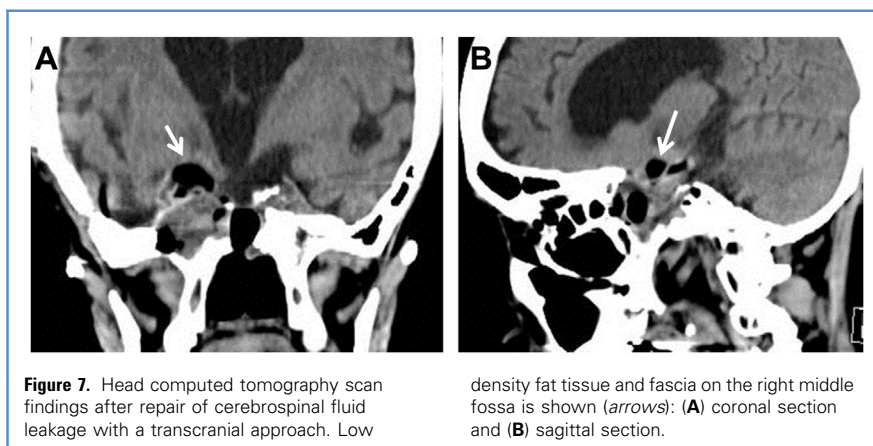
CONCLUSIONS

Late-onset CSF leakage after SRT for a giant nonfunctioning pituitary adenoma can be intractable with several additional aggressive repair procedures possibly required, including a combination of endonasal and transcranial approaches. Should SRT be considered after tumor

removal surgery, tight skull base reconstruction may be advisable during tumor removal surgery to prevent a future late-onset CSF leak after SRT.

DECLARATION OF COMPETING INTEREST

The authors declare that the article content was composed in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



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