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Case of Cerebrospinal Fluid Leakage Nine Years after Pituitary Gamma Knife Surgery for Poststroke Thalamic Pain Syndrome

Natsumi TESHIMA,[1,2] Kazuhito MATSUZAKI,[2] Noriya ENOMOTO,[2] Masaaki KORAI,[2] Yoshitaka KURASHIKI,[3] Mami HANAOKA,[2] Hitoshi NIKI,[4] and Koichi SATOH[2]

[1]*Department of Neurosurgery, Tokushima University Hospital, Tokushima, Tokushima, Japan*
[2]*Department of Neurosurgery, Tokushima Red Cross Hospital, Komatsushima, Tokushima, Japan*
[3]*Department of Neurosurgery, Tokushima Prefectural Miyoshi Hospital, Miyoshi, Tokushima, Japan*
[4]*Department of Neurology, Tokushima Red Cross Hospital, Komatsushima, Tokushima, Japan*

Abstract

Pituitary gamma knife surgery (GKS) is a treatment option for poststroke thalamic pain syndrome. Complications such as hypopituitarism, transient enuresis, and transient hyponatremia have been reported. However, cerebrospinal fluid (CSF) leakage has not yet been reported as a complication of pituitary GKS for poststroke thalamic pain syndrome. Herein, we report a case of delayed CSF rhinorrhea that developed 9 years after GKS for poststroke thalamic pain syndrome. A 64-year-old man presented to our hospital with bacterial meningitis and CSF rhinorrhea. Pituitary GKS for poststroke thalamic pain had been performed 9 years prior to his admission to our hospital. Computed tomography revealed pneumocephalus, fluid in the sphenoid and maxillary sinuses, and a partial bony defect of the sella turcica floor with communication between the paranasal and intracranial spaces. The CSF rhinorrhea resolved with bed rest and a lumbar CSF drain but recurred several days later. The patient underwent direct endoscopic surgical repair of the skull base. The sellar floor was covered with an autologous fascia graft harvested from the rectus sheath, and the sphenoid sinus was packed with abdominal fat grafts. The patient recovered, and the CSF rhinorrhea has not recurred for 2 years. Long-term follow-up is necessary after pituitary GKS, considering the complication of delayed CSF leakage.

Keywords: gamma knife surgery, delayed cerebrospinal fluid leak, thalamic pain syndrome

Introduction

Currently, gamma knife surgery (GKS) of the pituitary gland has mainly been performed for pituitary tumors. The complication of delayed cerebrospinal fluid (CSF) leakage has been reported to occur after GKS following transsphenoidal surgery (TSS) or the administration of dopamine agonists.[1,2] However, among patients who underwent pituitary GKS alone, delayed CSF leakage was rare, with only one reported case.[3]

In recent years, pituitary GKS has also been employed to efficiently reduce the pain associated with poststroke thalamic pain syndrome,[4] a condition characterized by intractable pain and an impaired quality of life. Although complications such as anterior pituitary hypofunction, transient diabetes insipidus, and transient hyponatremia have been reported following pituitary GKS for poststroke thalamic pain syndrome,[4] delayed CSF leakage has not yet been reported as a complication of this procedure. Here we report a case of CSF leakage that occurred 9 years after GKS of the pituitary gland for poststroke thalamic pain syndrome.

Case Report

A 64-year-old man presented to our hospital with bacterial meningitis and CSF rhinorrhea. His medical history revealed that at 53 years of age, he had a left-sided thalamic

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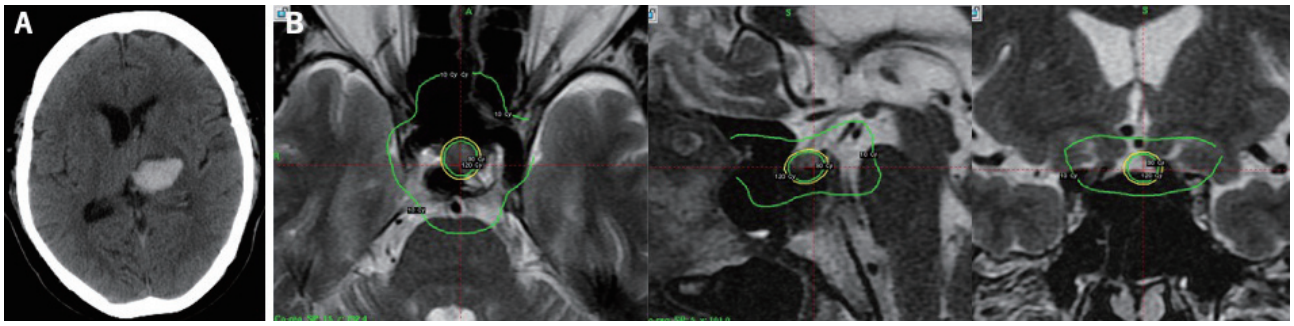

Fig. 1 (A) Head computed tomography image obtained 11 years prior to admission at our hospital (age 53 years) shows left thalamic hemorrhage. (B) T2-weighted magnetic resonance images in axial, sagittal, and coronal sections indicating dose planning of gamma knife surgery.
The yellow circle indicates the 50% isodose center.

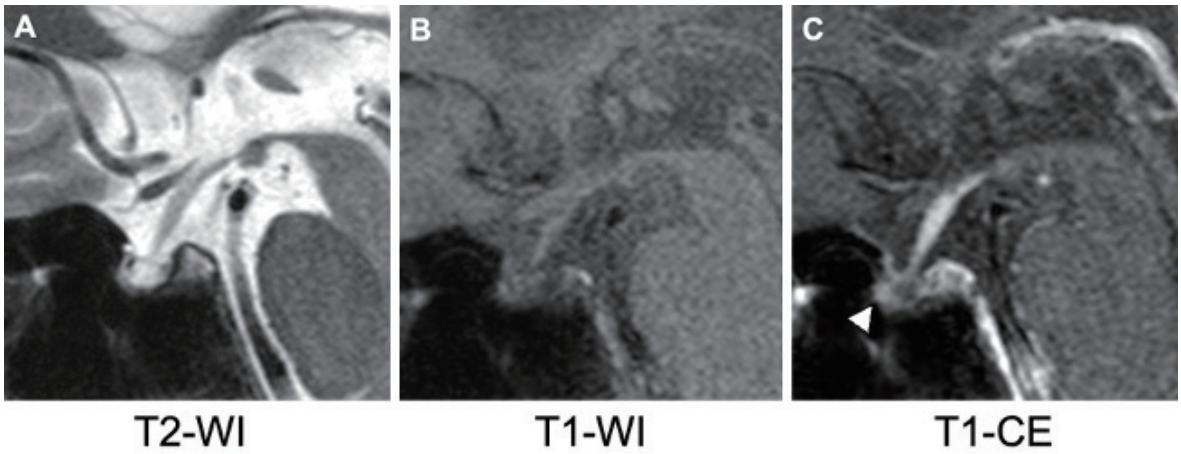

Fig. 2 Magnetic resonance images at 56 years of age show atrophy of the pituitary gland and accumulation of cerebrospinal fluid in the sella turcica. (A) T2-weighted image. (B) T1-weighted image. (C) T1-weighted image with gadolinium enhancement. The arrow indicates pituitary gland atrophy.

hemorrhage (Fig. 1A) and intractable pain in the left upper and lower limbs. Pituitary GKS for thalamic pain was performed with a maximum dose of 180 Gy at another hospital at 55 years of age (Fig. 1B). The pituitary gland was completely covered using the 50% isodose line corresponding to a 90-Gy irradiation dose. Following the pituitary GKS, the patient's pain was relieved; however, panhypopituitarism developed at 56 years of age, requiring hormone replacement. Magnetic resonance imaging performed to examine the cause of the panhypopituitarism revealed remarkable atrophy of the pituitary gland (Fig. 2).

Upon presentation to our hospital, the patient reported a 2-month history of rhinorrhea and headache. He was diagnosed with sinusitis and treated with antibacterial drugs. Although his symptoms improved briefly, they gradually returned. Computed tomography of the head at the time of this visit showed pneumocephalus, fluid accumulation in the sphenoid sinus, and a partial bone defect in the floor of the sella turcica (Fig. 3). CSF examination showed a leukocyte count of 1062/μL (lymphocyte, 474/μL; neutrophil, 588/μL); protein, 98 mg/dL; glucose, 24 mg/dL; and chloride, 124 mEq/L. CSF culture was negative. Therefore, the patient was diagnosed with post-gamma knife CSF rhinorrhea and bacterial meningitis. The CSF rhinorrhea resolved following further use of antibacterial drugs, bed rest, and the placement of a lumbar CSF drain for 11 days, but it recurred a few days later. On day 22 after admission, the patient underwent direct endoscopic surgical repair of the skull base. During the procedure, it was noticed that the sphenoid sinus was filled with fluid, and there was a 4-mm bone defect in the anterior wall of the sellar floor and a defect in the dura mater from which CSF was continuously leaking. The surrounding mucosa was necrotic. Furthermore, the mucosa of the sellar floor was deficient, and the bony surface was exposed. Thus, the leakage site was sealed with polyglycolic acid felt (Durawave, Medical U&A, Inc., Osaka, Japan) and fibrin glue, which remarkably reduced the CSF leakage. Moreover, the necrotic mucosa was removed, the sellar floor was covered with an autologous fascia graft harvested from the

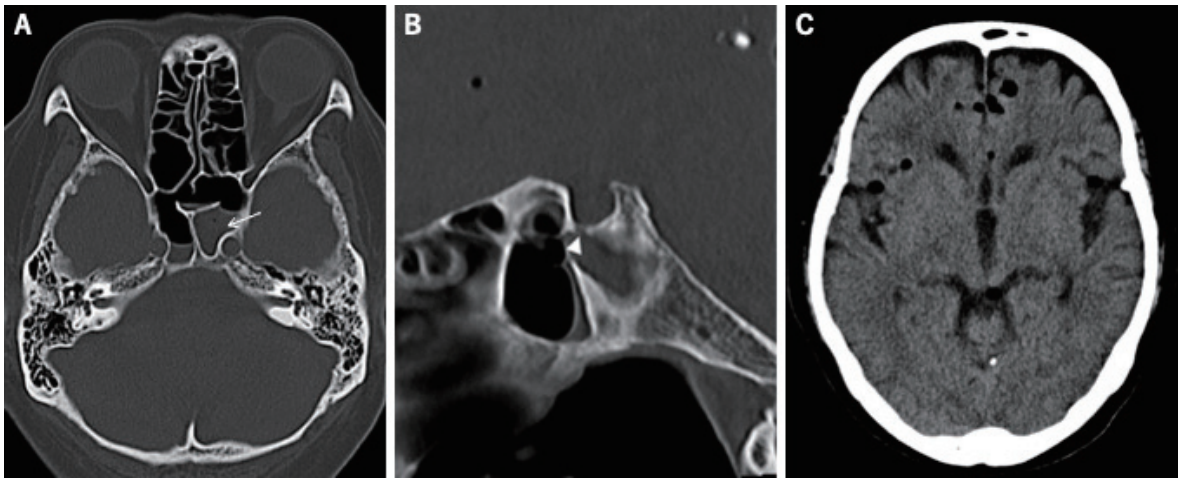

Fig. 3 Head computed tomography images acquired on admission to our hospital (age 64 years) demonstrate fluid in the sphenoid sinus (A), a bony defect in the sellar floor (B, arrowhead), and pneumocephalus (C).

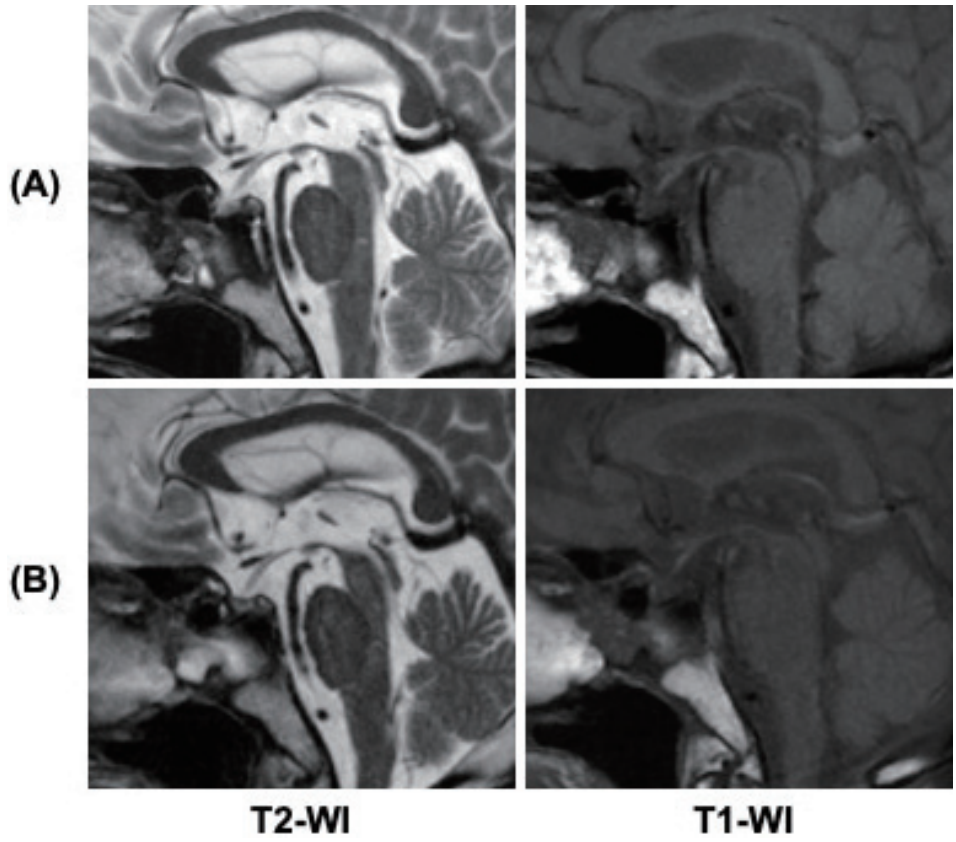

Fig. 4 Magnetic resonance images show no fluid in the sphenoid sinus. (A) 1 month after endoscopic surgery. (B) 23 months after endoscopic surgery.

rectus sheath, and the sphenoid sinus was packed with abdominal fat grafts. Lumbar CSF drainage was also performed after the operation. The CSF leakage gradually decreased and eventually completely resolved. The spinal drain was removed on postoperative day 9. The patient had a good postoperative course without complications, and serial magnetic resonance images obtained 1 and 23 months after the operation revealed no accumulation of fluid in the sphenoid sinus (Fig. 4). The CSF rhinorrhea has not recurred during 27 months of follow-up.

Discussion

Surgical hypophysectomy is effective for the management of intractable pain, such as that in cancer. Pituitary GKS is another safe, effective, and minimally invasive treatment option for cancer pain, with significant pain relief demonstrated in at least 50% of cases.[5] Given its pain relief benefits, pituitary GKS is used to treat poststroke thalamic pain syndrome. One study showed that thalamic pain was reduced in 71% of patients within 48 h of pituitary GKS.[4] In that study, complications such as hypopituitarism, transient enuresis, and transient hyponatremia were reported in 33%, 8%, and 4% of cases, respectively.[4] To our knowledge, delayed CSF leakage has not been reported as a complication of pituitary GKS for intractable pain. Therefore, although pituitary dysfunction is the most common complication, CSF leakage seems to be extremely rare.

Delayed CSF leakage has been reported as an infrequent complication of various radiotherapy, including stereotactic radiosurgery for the skull base or parasellar tumors.[1-3,6-8] In many of these cases, TSS is carried out before radiotherapy. Yamada et al. reported a case of delayed CSF leakage after CyberKnife radiation for skull base osteosarcoma and mentioned tumor invasion to the dura mater as a risk factor for radiation-induced CSF leakage.[7] The skull base bone erosion is also reported to be related to postirradiation CSF leakage.[8] Reduction in tumor volume by radiotherapy may cause a connection between the paranasal cavities and CSF space in cases of tumors with dural invasion or bone destruction. Stereotactic radiosurgery, especially GKS, is an established treatment option for intrasellar or parasellar tumors, including pituitary adenomas, craniopharyngiomas, and meningiomas.[9-11] In many cases, TSS or dopamine agonist therapy was performed prior to GKS.[1,2] Only one case of delayed CSF leakage after GKS alone for a growth hormone-secreting adenoma has been reported in detail.[3] In this case, CSF leakage occurred 11 years after the patient was treated with radiosurgery alone, and it is suggested that the cause of the CSF leakage was a secondary empty sella following tumor shrinkage by GKS.[3] In addition, Ogawa et al.[2] stated that radiation damage to the mucous membrane is associated with the development of delayed CSF leakage.

In our case, magnetic resonance images acquired before the onset of CSF leakage showed atrophy of the pituitary gland and fluid accumulation in the sella turcica, which may have been caused by GKS, and this image finding appears similar to an empty sella. In addition, necrosis of the mucous membrane around the fistula was observed during the endoscopic repair. Necrosis of the mucosa of the sphenoid sinus and defects in the sellar floor and dura mater were also identified. Because the pituitary gland was completely covered using the 50% isodose line, the structures around the sellar floor were near to the line. Hence, GKS may have caused an empty sella and necrosis of the skull base structures, resulting in delayed CSF leakage in our case.

Although the risk of CSF leakage may be reduced by reducing the radiation dose to the sellar floor or inferior part of the pituitary gland, there are concerns regarding the impact of the reduced dose on therapeutic efficacy. A promising method to prevent CSF leakage is not available. CSF accumulation in the sella turcica associated with atrophy of the pituitary gland or tumor shrinkage following radiotherapy may predict delayed CSF leakage. Preexisting atrophy of the pituitary gland before radiotherapy might also predict delayed CSF leakage. In such a case, close clinical and radiological follow-up examinations are required over a prolonged period.

Specific treatments for radiation-induced delayed CSF leakage have not yet been established. In several reported cases, patients were treated conservatively with spinal drainage, but leakage recurred in all patients, and direct repair surgery was eventually performed.[2,3] Repairs can be performed with various free grafts, including muscle, fascia, and fatty tissue grafts,[2,3] or with vascularized pedicled flaps, such as a nasoseptal flap.[1,2,9] Although it was unclear whether the tissue in our patient would be viable, he was treated with a free graft consisting mainly of autologous tissue and had a good postoperative course.

If the pituitary gland is included in the radiotherapy irradiation area during GKS, CSF leakage may occur in the delayed phase, even in the absence of TSS. Therefore, long-term follow-up is necessary following pituitary GKS, including that for poststroke thalamic pain syndrome, considering the potential complication of delayed CSF leakage.

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Informed Consent

The patient consented to us using his data in a case report.

Conflicts of Interest Disclosure

The authors declare that they have no conflict of interest.

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Corresponding author: Kazuhito Matsuzaki, MD PhD
Department of Neurosurgery, Tokushima Red Cross Hospital, 103 Irinoguchi, Komatsushima-cho, Komatsushima, Tokushima 773-8502, Japan.
e-mail: mkazuhito@outlook.com