

# Acute Obstructive Hydrocephalus Caused by *Pseudomonas aeruginosa* Ventriculitis after Transsphenoidal Surgery: Case Report

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Received 13 October 2014; revised 13 November 2014; accepted 12 December 2014

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## Abstract

*Pseudomonas aeruginosa* (*P. aeruginosa*) frequently causes various infections, some of which are serious and require prompt medical detection and appropriate antibiotic selection. Although *P. aeruginosa* commonly exists within the nasal cavity, meningitis or ventriculitis following transsphenoidal surgery to relieve *P. aeruginosa* has been reported only occasionally. However, as the endoscopic transnasal approach is more widely utilized for the suprasellar lesions, nosocomial *P. aeruginosa* infection associated with cerebrospinal fluid (CSF) leakage becomes more common in patients with panhypopituitarism who undergo transsphenoidal surgery. We report a case of a 36-year-old man with an intrasellar craniopharyngioma presenting with an acute obstructive hydrocephalus caused by *P. aeruginosa* ventriculitis following transsphenoidal surgery. Treatment with optimal antibiotics was initiated immediately after *P. aeruginosa* was recognized as the pathogen, and was continued for 3 months. After removal of the infected fascia and fat graft used for the closure of CSF leakage and sellar floor reconstruction, endoscopic third ventriculostomy was successfully performed to treat the obstructive hydrocephalus induced by the occlusion of the fourth ventricle outlet, resulting in a positive outcome. Although the obstructive hydrocephalus caused by *P. aeruginosa* is extremely rare, prompt detection and appropriate treatment should be required once *P. aeruginosa* ventriculitis happens.

## Keywords

Obstructive Hydrocephalus, Ventriculitis, *Pseudomonas aeruginosa*, Transsphenoidal Surgery

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## 1. Introduction

Acute bacterial meningitis or ventriculitis after the transsphenoidal (TS) surgery infrequently leads to a potentially fatal situation of intraoperative cerebrospinal fluid (CSF) leakage [1] [2]. Although *Pseudomonas aeruginosa* (*P. aeruginosa*), one of the gram-negative rods, is common in the nasal cavity, it rarely causes postoperative intracranial infections. However, development of a *P. aeruginosa* infection in the central nervous system (CNS) can lead to serious meningitis or ventriculitis [3]. Therefore, the treatment of *P. aeruginosa* infection requires prompt medical evaluation and appropriate antibiotic selection [4].

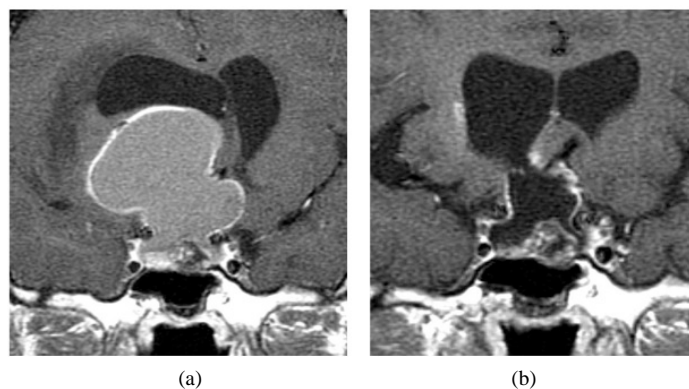
CSF leakage associated with the spread of endoscopic procedures has caused an increase in the risk of postoperative meningitis and ventriculitis, if the skull base construction could not be performed successfully. Hydrocephalus, of either the communicating or the obstructive type, is occasionally found in patients with meningitis or ventriculitis [5] [6]. We present here a very rare case of obstructive hydrocephalus caused by *P. aeruginosa* infection following TS surgery.

## 2. Case Report

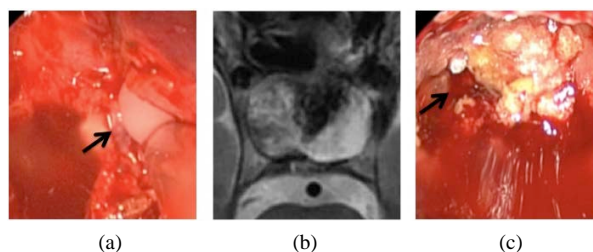
A 36-year-old man presented with disturbances of consciousness due to panhypopituitarism was transferred to our hospital. He had no obvious past medical history. Hormone replacement was immediately initiated with hydrocortisone and thyroxin. Magnetic resonance imaging (MRI) showed a huge cystic tumor extending from the intra-sellar region into the frontal lobe (**Figure 1(a)**). Although most of the tumor was removed via trans-ventricular approach, the residual intrasellar portion and a direct passage from the intrasellar region to the right lateral ventricle were detected on postoperative MRI (**Figure 1(b)**).

TS surgery for the residual intra-sellar lesion was planned. During the endoscopic endonasal TS surgery, a small amount of pus was found adjacent to the sella turcica at the sphenoid sinus, which was found on pre-operative MRI retrospectively (**Figure 2(a)** and **Figure 2(b)**). After aspiration and saline irrigation of the pus, the calcified intrasellar lesion was entirely removed, allowing CSF leakage from right lateral ventricle (**Figure 2(c)**). Sellar floor plasty was successfully performed by placing the fat graft in the sella, the fascia in the subdural space and the nasal pedicled mucosal flap over the sella floor. Cefazolin was administered according to the first line of postoperative antibiotics protocol determined by hospital infection control team in our hospital.

The patient suffered from high-grade fever and headache immediately after the operation. The number of white blood cells in CSF was elevated to 5300/ $\mu$ L, and sugar was decreased to 5 mg/dL, indicating severe bacterial meningitis. The antibiotic was changed from cefazolin to ceftriaxone without achieving remarkable improvement. Then, culture of the pus in the sphenoid sinus demonstrated to be negative, possibly because the sample was picked up after the saline irrigation. *P. aeruginosa* was detected on the CSF culture as the responsible pathogen and found to be sensitive to meropenem, which did not resolve the CSF findings in two weeks. Although *P. aeruginosa* also was sensitive to ceftazidime and relieved the infectious activity initially, the meningitis relapsed.



**Figure 1.** (a) A coronal section from magnetic resonance imaging (MRI) revealed a huge cystic tumor extending from the intrasellar region into the frontal lobe; (b) The intrasellar solid portion of the tumor remained and a direct passage between the intrasellar region and the right lateral ventricle was demonstrated in a coronal section from the postoperative MRI.



**Figure 2.** (a) An intraoperative endoscopic view revealed that small sinusitis was present at the sphenoid sinus adjacent to the sella turcica (arrow); (b) An axial MRI section revealed sinusitis adjacent to the sella floor in the sphenoid sinus, which was recognized retrospectively; (c) Endoscopic observation detected CSF outflow from the lateral ventricle into the tumor cavity (arrow).

Shortly, he developed consciousness disturbance and a computed tomography (CT) scan showed remarkable whole ventriculomegaly (**Figure 3(a)**). External ventricular drainage was then placed, after which he recovered immediately. Because this pathophysiology was diagnosed as ventriculitis due to *P. aeruginosa*, removal of the infected fascia and fat graft in the sellar turcica and sellar floor reconstruction were performed. After these procedures, high-grade fever and headache could be controlled.

The intra-ventricular administration of a contrast agent clearly revealed an occlusion of the fourth ventricle outlet, suggesting this was the cause of obstructive hydrocephalus (**Figure 3(b)**). Endoscopic third ventriculostomy (ETV) was successfully performed. Endoscopic intraoperative views showed many pigmented spots on the ventricular wall, suggesting remnant of ventriculitis (**Figure 3(c)**). Ceftazidime could be ceased a week after ETV. The patient could discharge from hospital. He has been free from ventriculitis for four years, and hormone replacement has been maintained with hydrocortisone and thyroxin all the time.

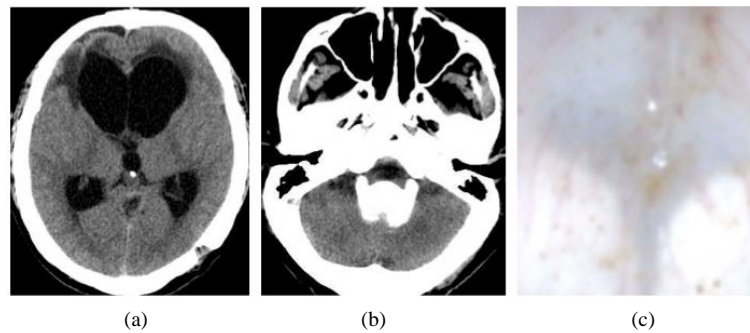
### 3. Discussion

Meningitis and ventriculitis are major complications following TS surgery [7] [8], and the rates of their incidence are reported to be 0.3% - 3.3% [9]-[11]. There are some evidences that the use of prophylactic antibiotics may increase the incidence of infection with gram-negative organism among patients with CSF leaks [2]. The gram-negative bacilli were reported to be isolated from 80% of patients with hospital-acquired meningitis and most of them were received prophylactic antibiotics [12]. The hospitalization and the prophylactic use of antibiotics alter host flora and allow for meningitis with opportunistic gram-negative rods in patients with CSF leaks [2]. *P. aeruginosa* is a causative pathogen with low incidence among postoperative meningitis following TS surgeries, early detection of *P. aeruginosa* meningitis is mandatory for successful treatment [1] [2]. We believed that one successful method for early detection of *P. aeruginosa* is to perform a culture of the nasal cavity prior to irrigation with saline during TS surgery.

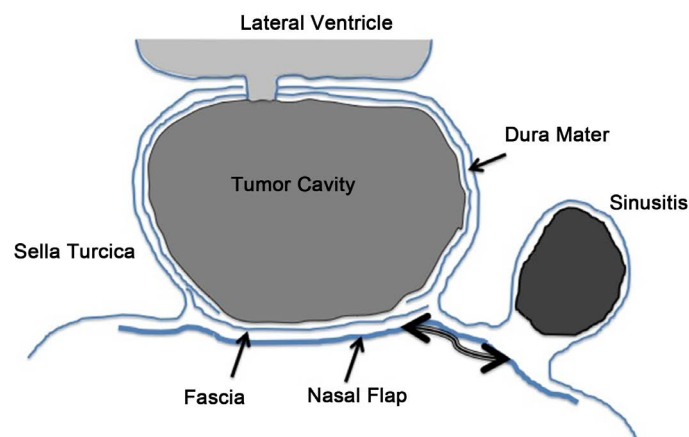
In our case, progressive consciousness disturbance, prompt recovery from consciousness disturbance with external ventricular drainage, and remarkable whole ventriculomegaly indicated occlusion of the foramen of Luschka and Magendie. In patients with complications of ventriculitis and intracranial hypertension, the presence of obstructive hydrocephalus should be strongly suspected. Once a diagnosis of the fourth ventricle outlet occlusion is made, ETV is the first choice of the treatment to ensure a good outcome [13] [14].

Several possible mechanisms have been postulated for hydrocephalus associated with bacterial ventriculitis, such as the blockage of the CSF flow owing to leptomeningeal inflammation or obliteration of the subarachnoid space and the foramen of Luschka and Magendie due to the presence of meningeal exudates [5] [6]. In cases of obstructive hydrocephalus, CSF flow is blocked at the third or fourth ventricle. The fulminant course of *P. aeruginosa* ventriculitis may present as acute obstructive hydrocephalus [3].

Sharma reported factors predicting the development of postoperative hydrocephalus following TS surgery. These factors included age, intraoperative and postoperative CSF leakage, CSF infection, and duration of hospital stay [15]. In our patient, intraoperative CSF leakage was encountered but postoperative CSF leakage could not be found, suggesting that the residual sphenoid sinusitis near the sellar floor directly connected to the tumor cavity and right lateral ventricle (**Figure 4**). Because our sellar floor plasty—placement of the fascia in the subdural space—may allow CSF to travel between the tumor cavity and the residual sinusitis, epidural autologous bone and/or fascia placement should be added to prevent postoperative *P. aeruginosa* infection.



**Figure 3.** (a) Computed tomography (CT) of the head showed remarkable whole ventriculomegaly; (b) Intra-ventricular administration of a contrast agent revealed occlusion of the outlet of the fourth ventricle; (c) Intraoperative endoscopic view showed many pigmented spots throughout the ventricle wall.



**Figure 4.** Scheme of the suspected pathogenesis around the sella. Sinusitis adjacent to the sella floor communicates with the tumor cavity at the sella via a passage under the nasal flap that covers the sella floor. The curved line with arrow at both ends indicates direct communication between the tumor cavity and the sinusitis.

#### 4. Conclusion

Meningitis is one of the major complications following TS surgery, and its rate of occurrence is increased if cerebrospinal fluid leakage develops postoperatively. If the *Pseudomonas aeruginosa* infection occurs in a compromised host, such as in patients with panhypopituitarism, a potential diagnosis of progressive obstructive hydrocephalus should be considered based on the clinical status and neuroradiological evaluation, and prompt surgical intervention should be applied to prevent neurological deterioration.

#### Conflict of Interest

The authors declare that they have no conflict of interest.

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## List of Abbreviations

CNS: central nervous system

CSF: cerebrospinal fluid

CT: computed tomography

ETV: endoscopic third ventriculostomy

MRI: magnetic resonance imaging

*P. aeruginosa*: *Pseudomonas aeruginosa*

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