# Radiotherapy-Related Frontal Lobe Encephalocele Following Transnasal Endoscopic Resection of a Esthesioneuroblastoma: A Case Study and Literature Review

Mariana Agudelo-Arrieta, MD[1,2]; Nayeh Arana-Isaac, MS[2]; Alfredo Herrera, MD[3], Oscar Hernando Feo-Lee, MD[1,2]

[1]Neurosurgery Department, Pontificia Universidad Javeriana - Hospital Universitario San Ignacio, Bogotá, Colombia. [2]Neurosurgery Research Group, Pontificia Universidad Javeriana, Bogotá, Colombia. [3]Otorhinolaryngology Department, Pontificia Universidad Javeriana - Hospital Universitario San Ignacio, Bogotá, Colombia.

## Introduction

Esthesioneuroblastoma (ENB) is a rare sinonasal tumor (2%–6%) often diagnosed at advanced stages (Kadish stage C). Treatment typically involves surgical resection, with endoscopic techniques preferred for minimally invasive management and craniofacial resection reserved for intracranial involvement. Adjuvant radiotherapy, particularly intensity-modulated radiotherapy (IMRT), improves survival in high-grade or advanced cases, while chemotherapy is used selectively in advanced disease.

Complications include cerebrospinal fluid (CSF) leaks, encephalocele, and temporal lobe necrosis, often linked to radiotherapy or extensive surgical interventions. These risks underscore the need for multidisciplinary management and long-term monitoring to optimize patient outcomes.

## Methods and Materials

We conducted a retrospective case report of a rare radiotherapy-related complication in a patient with esthesioneuroblastoma, analyzing medical records, imaging, and follow-up data. A literature review (PubMed, Scopus, Web of Science, Embase) identified studies on radiotherapy-related skull base complications in sinonasal tumors. Data on demographics, tumor staging, treatments, and complications were analyzed to understand mechanisms and emphasize early detection and management.

## Case report

We present the case of a **37-year-old male** with **Kadish stage C esthesioneuroblastoma** involving the right nasal fossa, bilateral frontal sinuses, and ethmoid cells. Imaging revealed **intracranial extension** to the **cribriform plate** and **right olfactory bulb**, without leptomeningeal dissemination or nodal metastasis. The patient underwent **endoscopic transcribriform resection**, supported by an **extended nasoseptal flap**. Pathology confirmed **Hyams grade II ENB**, with an **R1 resection.**

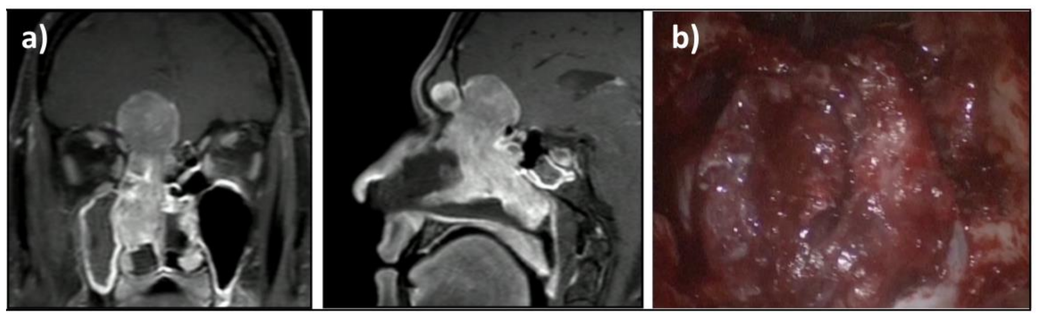


**Figure 1. a)** Pre-operative MRI. **b)** Intra-operative view.

**Adjuvant IMRT** (6000 cGy in 30 fractions) was administered. Initial follow-ups showed no complications or recurrence. However, at **11 months**, the patient developed a **CSF leak** and **bacterial meningitis** due to a **RT-induced frontal encephalocele**. Surgical repair included a **dural patch**, **fibrin sealant**, and **fascia lata graft**. A **recurrent defect** required a second repair using a **pericranial flap**. Antibiotic therapy resolved the infection, and no organisms were cultured from CSF or blood.

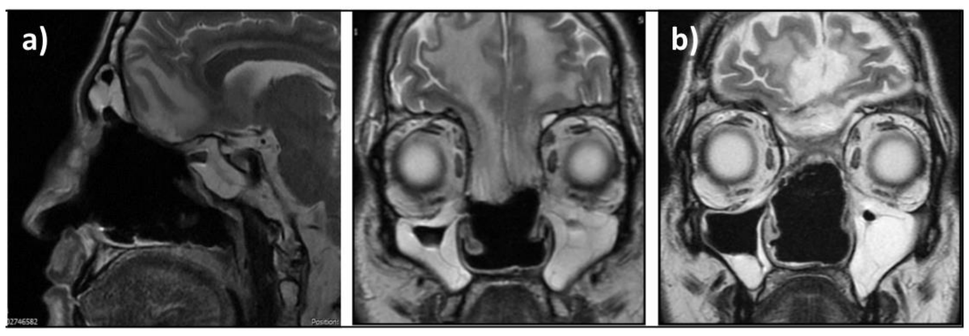


**Figure 2. a)** RT induced frontal encephalocele. **b)** Post-operative repair MRI.

At **4 years post-treatment**, the patient remains **asymptomatic** with **no tumor recurrence**, highlighting the importance of multidisciplinary management and long-term follow-up in such cases.

## Results

**Literature Review Findings:**

- 72 articles initially identified; 7 included after screening.
- Seven cases of radiotherapy-related encephaloceles in skull base/sinonasal tumors were analyzed.
- Patients: Average age 49.6 years (18–80), male-to-female ratio 3.5:1.
- Tumors included ethmoid adenocarcinoma, olfactory neuroblastoma, and other skull base malignancies.

**Radiotherapy & Reconstruction:**

- Multimodal treatments (surgery + IMRT, 24–72 Gy) were common.
- Reconstruction techniques, including nasoseptal flaps, were critical in minimizing complications.

**Complications & Risk Factors:**

- Encephaloceles developed months to years post-radiotherapy, with symptoms like CSF rhinorrhea, headaches, and seizures.
- Key risk factors: radionecrosis, inadequate duraplasty, and increased intracranial pressure.

**Management & Outcomes:**

- Surgical repair using autologous grafts and vascularized flaps (e.g., fascia lata, nasoseptal flaps) was effective.
- Favorable outcomes achieved with timely intervention and adherence to postoperative care.
- Long-term monitoring essential due to the risk of delayed complications.

**Case Study Correlation:**

- Consistent with literature, delayed CSF leakage and meningitis occurred post-radiotherapy.
- Secondary intervention with a pericranial flap achieved symptom resolution and long-term success (4+ years follow-up).

**Table 1.** Literature review about radiotherapy-related encephalocele and skull base tumors.

| Author/ Year | Patient | Tumor type | Radiotherapy | Complications | Management | Outcome |
|---|---|---|---|---|---|---|
| **Oker et al., 2014** | 50 (mean 62.5y, 76%M) | Ethmoid malignancies | 3D-CRT (80%), 2D (12%), IMRT (8%) | Radionecrosis (16%), encephalocele (1%), seizures (4%) | Surgery, steroids, AEDs | No recurrence specified |
| **Lalwani et al., 1993** | 21M | ALL | EBT (24Gy + 18Gy) | Bilateral temporal encephaloceles | Multilayer repair | Successful repair |
| **Battaglia et al., 2015** | 64M | ENB | PRT (dose not specified) | Frontal encephalocele, meningitis, flap necrosis | Endonasal repair with fascia lata | Successful repair, ongoing monitoring |
| **Akins et al., 2022** | 60 patients | Various SB tumors | Not specified | Encephaloceles, CSF leaks, osteoradionecrosis, infections | Multidisciplinary approach, surgical repair | Mostly successful repairs |
| **Carta et al., 2011** | 16 (mean 59y) | Ethmoid adeno-carcinoma, ENB | Conformal RT (64Gy) | Encephaloceles (6.25%), radionecrosis (6.25%), seizures (6.25%) | Surgical repair | 83% 5-year DFS, 2 recurrences |
| **Wise et al., 2009** | 89 (mean 47.8y) | SB neoplasms | Prior RT (6%) | CSF leaks (92%), encephaloceles, meningitis (9%) | Endoscopic multilayer repair | 93% success rate |
| **El Mjabber et al., 2024** | 47M | SFT | VMAT (54Gy) | Encephalocele rupture, CSF leak | Conservative management | No recurrence post-RT |
| **Current case study** | 37M | ENB (Kadish C) | IMRT (60Gy) | CSF leak, frontal encephalocele, meningitis, flap necrosis | Multilayer repair, secondary pericranial flap | Asymptomatic at 4 years, no recurrence |

## Conclusions

Frontal lobe encephalocele is a rare complication of radiotherapy for sinonasal tumors, highlighting the need for long-term monitoring due to risks of delayed skull base defects and CSF leaks. Early recognition and multidisciplinary management are crucial. This case emphasizes integrating awareness of radiotherapy-related risks into follow-up protocols and the need for further research to improve prevention and care.

## Contact

Mariana Agudelo-Arrieta
Pontificia Universidad Javeriana, Bogotá DC, Colombia
Carrera 7 # 40 – 62
mariana.agudelo@javeriana.edu.co
+57 (601) 5946161 Ext 2301

## References

1. Winn HR. Youmans & Winn Neurological Surgery. Eighth Edition. Vol. 1. Philadelphia, PA 19103-2899: Elsevier; 2022.
2. Thompson L.D.R.: Olfactory neuroblastoma. Head Neck Pathol 2009; 3: pp. 252-259.
3. Mozaffari K, Pradhan A, Yang I, Patel K, Vivas AC. Metastatic esthesioneuroblastoma recurrence after 19 years of remission: A systematic review with case illustration. Journal of the Neurological Sciences. 2022 Sep 1;442:120406–6.
4. Berger MH, Lehrich BM, Yasaka TM, Fong BM, Hsu FPK, Kuan EC. Characteristics and overall survival in pediatric versus adult esthesioneuroblastoma: A population-based study. International Journal of Pediatric Otorhinolaryngology. 2021 Mar 28;144:110696–6.
5. Oskouian RJ, Jane JA, Dumont AS, Sheehan JM, Laurent JJ, Levine PA. Esthesioneuroblastoma: clinical presentation, radiological, and pathological features, treatment, review of the literature, and the University of Virginia experience. Neurosurgical Focus. 2002 May 1;12(5):1–9.

Access QR code for: complete references list and complete table.