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Cystic Radionecrosis: A Case Report and Literature Review

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ABSTRACT

Introduction: Cerebral radionecrosis is a rare but serious iatrogenic complication that occurs in patients who have undergone radiation therapy for various types of cancer, such as brain metastases or nasopharyngeal carcinoma. It can have significant consequences on the health and quality of life of affected individuals.
Case Report: We report the case of a 65-year-old man, previously treated and declared cured of nasopharyngeal cancer, who was admitted to the intensive care unit for the management of a super-refractory status epilepticus secondary to cerebral radionecrosis.
Discussion: Cerebral radionecrosis, most commonly localized in the temporal region, is becoming increasingly frequent among patients who have received radiotherapy for nasopharyngeal cancer. One of the main strategies to prevent this complication is to limit the radiation dose.
The clinical symptoms of cerebral radionecrosis vary, ranging from mild to severe. It may be discovered incidentally during imaging in an asymptomatic patient or present with neurological symptoms on clinical examination.
MRI is the preferred modality for diagnosing and monitoring this condition. However, distinguishing radionecrosis from a recurrence in the form of brain metastasis is often challenging.
Conclusion: Cerebral radionecrosis is a rare and serious complication. Brain imaging plays a major role in its diagnosis. In the absence of an effective treatment, prevention through improved dosimetric planning is essential.

KEYWORDS

Cystic radionecrosis, nasopharyngeal cancer, Radiotherapy.

MAIN ARTICLE

Introduction

The incidence of nasopharyngeal cancers is high in Morocco and in Maghreb countries. Radiotherapy is considered the primary treatment for these cancers [1].

However, this treatment is not without risks, and complications may arise due to damage to surrounding structures (radionecrosis, radiation-induced dementia, endocrinopathies, and radiation-induced tumors). Because of the proximity to the skull base, the radiation field inevitably includes the middle and lower regions of the temporal lobes of the brain.

Moreover, the radiation dose typically used—between 65 and 70 Gy—exceeds the tolerance of brain tissue [2].

The very first case of cerebral radionecrosis was described by Fischer and Holfelder in 1930 [1]. Since then, such lesions have been reported following irradiation of intracranial, epicranial, nasopharyngeal, and orbital tumors [3].

Through this clinical case, we examine the diagnostic, therapeutic, and prognostic aspects of this complication, along with a review of the existing literature.

Case report :

This is a 65-year-old male patient with a history of nasopharyngeal carcinoma treated with radiotherapy and chemotherapy for two years, ten years ago (the number of sessions was not specified by the family), and congenital mutism.

The onset of his illness dates back to the night before his admission, during sleep, with the occurrence of multiple generalized tonic-clonic seizures without recovery of consciousness between seizures, in an afebrile context. Upon admission to the emergency department, clinical examination revealed a patient with a Glasgow Coma Scale (GCS) score of 9 (Eyes: 2, Verbal: 2, Motor: 5), congenital mutism, equal and reactive pupils, a supple neck, unassessable gait and upright posture, muscle strength rated 5/5 in all four limbs, normal tone, present and symmetrical deep tendon reflexes, and preserved sensation.

Hemodynamically, the blood pressure was 130/70 mmHg, heart rate 90 bpm, no signs of right heart failure, peripheral pulses were present, no signs of hypoperfusion, no added heart sounds, a regular rhythm, and free carotid axes. Respiratorily, the patient was eupneic with a respiratory rate of 18 breaths/min, SpO2 at 98% on room air, no signs of respiratory distress, and some rhonchi heard on pulmonary auscultation. The patient was afebrile at 37.2°C, and capillary blood glucose was 1.76 g/L.

Emergency management included stabilization and administration of intramuscular midazolam at a dose of 0.15 mg/kg, followed by a loading dose of phenobarbital at 15 mg/kg over 30

minutes, without recovery of consciousness. An electroencephalogram (EEG) showed normal background activity with features suggestive of a focal status epilepticus in the left fronto-temporal region (Figure 3). A diagnosis of refractory status epilepticus was made, and the patient was admitted to intensive care. He was intubated and ventilated following rapid sequence induction and sedated with fentanyl at 3 µg/kg/h and propofol at 2 mg/kg/h.

A brain CT scan showed two bilateral temporal cysts (Figure 1). Metabolic workup was normal. Brain MRI revealed bilateral temporal sequelae lesions suggestive of post-radiation radionecrosis (Figure 2). The patient was sedated (Midazolam + Fentanyl) and received antiepileptic treatment (Gardenal), with plans to stop sedation after 48 hours for neurological evaluation.

The clinical course was marked by the absence of awakening, even after adequate levels of antiepileptics. An EEG was performed to investigate ongoing seizure activity. It showed depressed background activity and a persistent focus of slow waves in the bilateral fronto-temporal region, more pronounced on the right (Figure 4). A decision was made to re-sedate the patient and change the antiepileptic regimen (Depakine + Urbanyl).

The patient developed hemodynamic instability in the form of hypotension, probably of central origin, and was placed on vasopressors (norepinephrine). He responded poorly to treatment and eventually passed away a few days later.

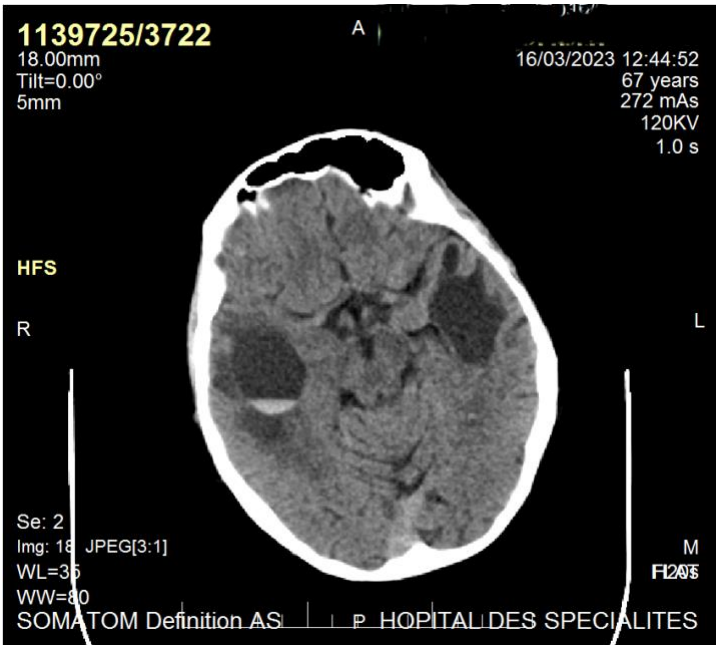


Figure 1 : Scanner cérébral en coupe axiale présente deux kystes temporaux bilatéraux bien limités, de contours réguliers à droite et lobulés à gauche, à contenu liquidien hétérogène renfermant à droite un niveau hématique déclive, mesurant : A droite : 44x26x35 mm et à gauche : 52x26x29 mm.

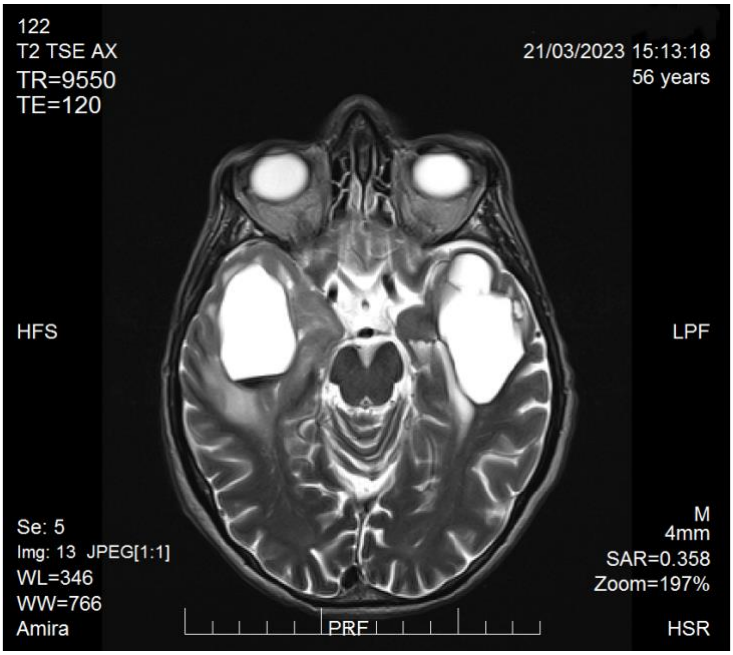
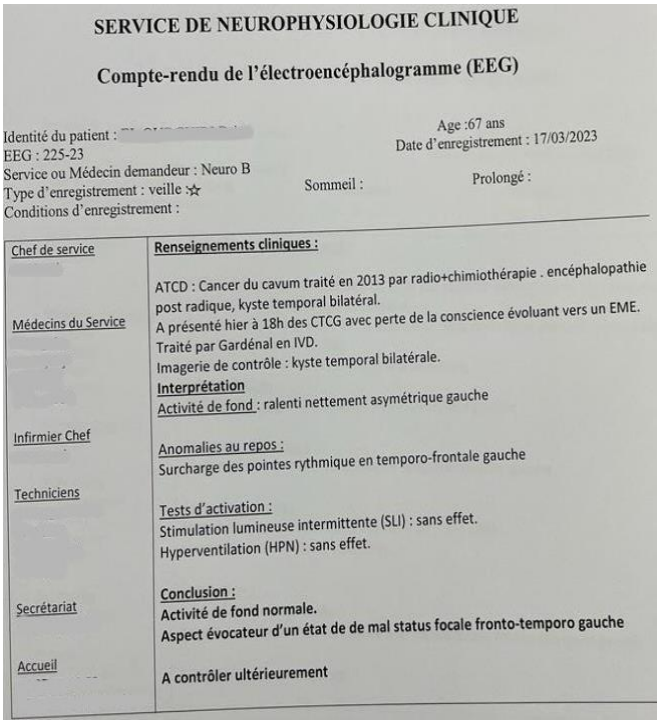


Figure 2 : IRM cérébrale coupe axiale montre Lésions kystiques sous-corticales temporales bilatérales, bien limitées, ovalaires de contours lobulés, se présentant en hypersignal T2 renfermant un sédiment déclive en hyposignal T2 réalisant un niveau liquide-liquide à droite, avec remaniements hémorragiques pariétaux générant un artefact de susceptibilité magnétique de façon bilatérale.



SERVICE DE NEUROPHYSIOLOGIE CLINIQUE

Compte-rendu de l'électroencéphalogramme (EEG)

Identité du patient :
EEG : 225-23
Age :67 ans
Date d'enregistrement : 17/03/2023
Service ou Médecin demandeur : Neuro B
Type d'enregistrement : veille ☆
Sommeil :
Prolongé :
Conditions d'enregistrement :

Chef de service

Médecins du Service

Infirmier Chef

Techniciens

Secrétariat

Accueil

Renseignements cliniques :

ATCD : Cancer du cavum traité en 2013 par radio+chimiothérapie . encéphalopathie post radique, kyste temporal bilatéral.
A présenté hier à 18h des CTCG avec perte de la conscience évoluant vers un EME.
Traité par Gardénal en IVD.
Imagerie de contrôle : kyste temporal bilatérale.

Interprétation

Activité de fond : ralenti nettement asymétrique gauche

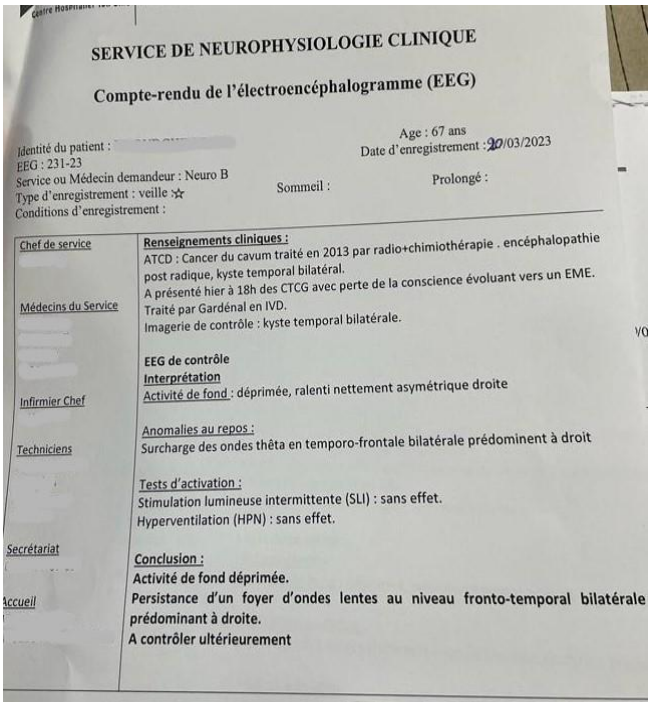
Anomalies au repos :
Surcharge des pointes rythmique en temporo-frontale gauche

Tests d'activation :
Stimulation lumineuse intermittente (SLI) : sans effet.
Hyperventilation (HPN) : sans effet.

Conclusion :
Activité de fond normale.
Aspect évocateur d'un état de de mal status focale fronto-temporo gauche

A contrôler ultérieurement

Figure 3 : Compte rendu de l'électroencéphalogramme réalisé avant intubation du patient.



SERVICE DE NEUROPHYSIOLOGIE CLINIQUE

Compte-rendu de l'électroencéphalogramme (EEG)

Identité du patient :
EEG : 231-23
Age : 67 ans
Date d'enregistrement : 20/03/2023
Service ou Médecin demandeur : Neuro B
Type d'enregistrement : veille ☆
Sommeil :
Prolongé :
Conditions d'enregistrement :

Chef de service

Médecins du Service

Infirmier Chef

Techniciens

Secrétariat

Accueil

Renseignements cliniques :

ATCD : Cancer du cavum traité en 2013 par radio+chimiothérapie . encéphalopathie post radique, kyste temporal bilatéral.
A présenté hier à 18h des CTCG avec perte de la conscience évoluant vers un EME.
Traité par Gardénal en IVD.
Imagerie de contrôle : kyste temporal bilatérale.

EEG de contrôle

Interprétation

Activité de fond : déprimée, ralenti nettement asymétrique droite

Anomalies au repos :
Surcharge des ondes thêta en temporo-frontale bilatérale prédominent à droit

Tests d'activation :
Stimulation lumineuse intermittente (SLI) : sans effet.
Hyperventilation (HPN) : sans effet.

Conclusion :
Activité de fond déprimée.
Persistance d'un foyer d'ondes lentes au niveau fronto-temporal bilatérale prédominant à droite.
A contrôler ultérieurement

Figure 4 : Compte rendu de l'électroencéphalogramme réalisé après l'intubation et la sédation du patient.

Discussion :

The incidence of cerebral radionecrosis varies considerably, ranging from 0.95% to 14% according to different studies, with a slight male predominance [4]. Several factors play a role in its development, including the total radiation dose, duration of irradiation, and especially the dose administered per fraction [5]. Hypofractionated radiotherapy appears to play a major role in the onset of this complication [5]. In two studies by Lee et al., the first involving 1,008 patients and the second 1,032 patients treated with radiation therapy for nasopharyngeal carcinoma, it was estimated that conventional fractionation carried a 5% risk of necrosis at ten years. Jen et al. suggested that the brain is more sensitive to the accelerated hyperfractionated schedule, leading to a higher incidence of temporal necrosis.

Other contributing factors to the risk of cerebral radionecrosis include age (with higher susceptibility in children and the elderly), the presence of cardiovascular risk factors such as hypertension or diabetes, the volume of brain parenchyma exposed to radiation, the underlying pathology, and the radiotherapy technique used [6]. In contrast, combining radiotherapy with brachytherapy and sequential chemotherapy seems to have less impact on the occurrence of radionecrosis [7,8].

In our case, the patient was a 65-year-old man with no history of hypertension or diabetes, who had undergone radiotherapy and chemotherapy (with unknown duration and dose).

Brain lesions usually appear between 1 and 3 years post-treatment [9]. However, nearly 90% of lesions become symptomatic within 5 years after irradiation [9], reflecting the brain's capacity to adapt to chronic alterations.

It typically presents as a nonspecific expansive process, with symptoms occurring in the following order of frequency: seizures or inaugural status epilepticus (50%), signs of increased intracranial pressure (ICP), progressive focal neurological deficits, language disorders, cognitive impairments, and behavioral disturbances.

A study by Cheung et al. [10,11], investigating the severity of cognitive disorders secondary to cerebral radionecrosis in 50 patients treated with radiation for nasopharyngeal carcinoma, showed a significant correlation between the volume of radionecrosis and the degree of cognitive impairment, as well as a relationship between lesion location and symptom type. Temporal lobe involvement, the most frequent, is associated with language, memory, and behavioral disorders [2,5].

In our case, the patient developed bilateral temporal brain lesions that became apparent 10 years later through epileptic seizures, consistent with literature findings indicating seizures as the most common symptom.

Brain MRI is the imaging modality of choice for diagnosis. The lesion typically appears as hypointense on T1 and hyperintense on T2, with heterogeneous contrast enhancement. Wand et al. identified specific radiological characteristics of post-radiation lesions. All detected lesions involved white matter, with 82% showing contrast enhancement and 12% presenting as post-radiation cysts. Despite its sensitivity, MRI lacks specificity—particularly in distinguishing radionecrosis from tumor recurrence.

To aid this differentiation, dynamic perfusion studies of the brain parenchyma can be performed using Positron Emission Tomography (PET) or Single Photon Emission Computed Tomography (SPECT).

In our case, imaging revealed bilateral temporal, well-defined, ovoid lesions showing isointensity on T1, hyperintensity on T2, T2 FATSAT, and FLAIR sequences, hyperintensity on diffusion-weighted imaging, hemosiderin deposits as T2 hypointense signals, and peripheral enhancement after contrast administration—indicative of cystic radionecrosis.

Treatment typically relies on four main strategies to mitigate the effects of radiotherapy-induced necrosis: hyperbaric oxygen therapy (HBOT), anticoagulants and antiplatelet agents, surgery, and corticosteroids. However, the efficacy of these treatments varies widely and is generally supported by moderate levels of evidence. Recent studies suggest that bevacizumab, an anti-VEGF monoclonal antibody, holds significant promise in treating central nervous system radionecrosis.

In our case, HBOT was not attempted due to the patient's intubated and sedated state resulting from super-refractory status epilepticus. The use of corticosteroid boluses combined with anticoagulant therapy helped stabilize only the radiological lesions, with no clinical improvement (seizure activity persisted on EEG). It is also worth noting that bevacizumab could not be administered due to its unavailability.

Conclusion

Radiotherapy is a highly effective treatment for central nervous system tumors and skull base tumors. However, cerebral radionecrosis is a rare and serious complication in these patients due to the diagnostic and therapeutic challenges it presents. Brain imaging (CT, and especially MRI) plays a major role in diagnosis. In the absence of an effective treatment, prevention through improved dosimetric planning is essential.

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