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Cerebral toxoplasmosis and hiv infection: experience of the infectious diseases department of the military hospital of rabat

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ABSTRACT

Cerebral toxoplasmosis is a frequent opportunistic infection and a not uncommon manifestation of the acquired immunodeficiency syndrome (AIDS) related to the Human Immunodeficiency Virus (HIV).
This is a retrospective study over a 6-year period (June 2016 to December 2022), including HIV-infected patients with a diagnosis of cerebral toxoplasmosis in the Infectious Diseases Department of the Military Hospital of Rabat (13 patients).
The prevalence of cerebral toxoplasmosis was estimated at 3.59% among the department's HIV cohort. Clinical manifestations on admission were dominated by motor deficit (54% of cases). Disturbed consciousness was reported in 23% of cases. Medullary toxoplasmosis was associated in three patients (23%).
The CD4 count on admission was <100/mm3 in 90% of cases. PCR for the detection of *Toxoplasma gondii* was not performed in any patient in our study due to unavailability.
Brain MRI was performed on 9 patients, and showed multiple lesions in 69% of cases, with lesions appearing hypointense on T1-weighted images and hyperintense on T2-weighted and FLAIR images in 77% of cases. The characteristic radiological descriptions of “eccentric target sign” and “concentric target sign” were found simultaneously in one patient only (7.7% of cases).
Brain biopsy was performed in 3 patients, with diffuse granulomatous process without caseous necrosis in one sample, necro-inflammatory tissue changes with vaguely epithelioid cells in another, and a single positive result for *Toxoplasma gondii*.
The preferred therapeutic regimens being unavailable in Morocco, orally administred Cotimoxazole was the initial treatment in 12 patients. Short-term outcome was favorable in 77% of cases. One year mortality was estimated at 30.7%.
Improvement rates under cotrimoxazole were very close to the percentages reported in the literature under first-line therapeutic lines. This leads us to consider cotrimoxazole to be therapeutically non-inferior but further investigations are necessary. Nevertheless, we emphasize the irrevocable place of the injectable form of this drug.

KEYWORDS

Cerebral toxoplasmosis , HIV , Cotrimoxazole

MAIN ARTICLE

INTRODUCTION:

Cerebral toxoplasmosis is the most common opportunistic infection of the central nervous system in people living with HIV (PLWHIV). It is an AIDS-defining (acquired immunodeficiency syndrome) condition, and its clinical severity and prognosis depend greatly on early diagnosis and treatment.
The diagnosis of cerebral toxoplasmosis in immunocompromised individuals relies primarily on clinical, radiological, and evolutionary findings. Diagnostic certainty is provided by histopathological data; however, the benefit-risk balance does not always favor brain biopsy. Serology plays a secondary role in the diagnosis of toxoplasmosis in immunocompromised individuals.

The objectives of this study, conducted at the Virology and Infectious and Tropical Diseases Center (CVMIT) at the Military Teaching Hospital Mohammed V (HMIMV), are to:
To analyze the clinical, biological, and radiological aspects of cerebral toxoplasmosis at the Infectious Diseases Center of the Rabat Military Hospital.
To evaluate the contribution of advances in imaging to the diagnosis of cerebral toxoplasmosis.
To establish the role of orally administered cotrimoxazole in the therapeutic arsenal for cerebral toxoplasmosis to compare its equivalence to the therapeutic options preceding it in recommended treatment protocols.

MATERIALS & METHODS:

1. STUDY TYPE:

This was a retrospective descriptive study of medical records of PLWHIV hospitalized in the CVMIT for cerebral toxoplasmosis and meeting the inclusion criteria. Data was collected on an operational form then entered to Jamovi data analysis software.

2. STUDY DURATION:

This study spanned a 6-year period from June 2016 to December 2022.

3. INCLUSION CRITERIA:

Adult patients hospitalized in the CVMIT during study period with complete medical records, confirmed HIV infection (N=362) and a diagnosis of probable or biologically confirmed central nervous system toxoplasmosis were included in this study.

RESULTS:

1. EPIDEMIOLOGICAL DATA:

Among a total of 362 patients hospitalized for HIV infection at our center during the study period and adhering to the inclusion criteria, 13 had central nervous system toxoplasmosis, corresponding to a prevalence of 3.59%. The mean age was 44 years (± 12). Males were predominant in our study, with a sexe ratio of 5,5 M/F.

2. CLINICAL FINDINGS:

a. MODE OF ONSET:

The average time to clinical manifestations being 16 days, an acute onset in less than 24 hours was observed in 3 patients, the longest delay being two months in 1 patient.
Central nervous system toxoplasmosis was the revealing factor of the retroviral infection in 11 out of the 13 studied patients (85%).

b. CLINICAL SYMPTOMS:

Clinical manifestations upon admission, summarized in
, were dominated by motor deficits (54% of cases) : notably hemiplegia (3 patients) associated in 33% of cases with facial paralysis, paraplegia (2 patients), and monoplegia (2 patients). Motor deficits were associated with sensory disturbances in 57% of cases. Aphasia was observed in 15% of cases (2 patients). Altered consciousness was present in 23% of cases, with intubation indicated in one-third of these. Generalized seizures were reported in

one patient (7.7% of cases), and partial motor seizures in 15% of cases. Intracranial hypertension was present in 7.7% of cases. Headaches were reported in 15% of cases, cerebellar syndrome in 7.7% of cases, and memory impairment in 7.7% of cases. Meningeal syndrome and psychiatric manifestations (stiff neck, photophobia) were not reported. An infectious syndrome, including fever, was found in 5 patients (38%), and a wasting syndrome in 85% of cases (11 patients).

c. LOCALIZATION OF TOXOPLASMOSIS:

Cerebral localization of toxoplasmosis was the most frequent, with 9 patients affected (69%). Spinal cord toxoplasmosis was observed in 3 patients (23%), and ophthalmological abnormalities consistent with toxoplasma retinitis were noted in 3 patients.

d. ASSOCIATED OPPORTUNISTIC INFECTIONS:

CMV infection in 6 patients of cases (46%), oral and/or esophageal candidiasis in 4 patients (30%), anti-tuberculosis treatment was started in 46% of patients in the context of clinically diagnosed or biologically confirmed tuberculosis.

3. BIOLOGICAL DATA:

a. TOXOPLASMIC SEROLOGY:

Toxoplasma serology was consistent with prior exposure (IgM-IgG+) in 8 patients (61.4%), and negative (IgM-IgG-) in 1 patient (7.7%). Serological testing was not performed in 4 patients (30.7%).

b. CD4 COUNT:

The CD4 count on admission was < 50 /µl in 8 patients (61.4%), between 50 and 100 in 2 patients (15.38%), and between 100 and 200 in 1 patient (7.7%).

c. VIRAL LOAD:

Viral load was measured on admission in 12 patients with an average load of 5.14 log.copies/ml (138.038 copies/ml).

d. CEREBROSPINAL FLUID ANALYSIS:

Lumbar puncture was performed in 9 patients (69%), with a normal sample in 7 patients (53.84%) and a lymphocytic meningitis in 2 cases (15%).

4. RADIOLOGICAL DATA:

a. BRAIN CT-SCAN:

Brain CT scans were performed in 9 patients. The most frequently observed lesions were hypodensities with perilesional edema. The latter constituted most of the CT scan findings in one patient (**Error! Reference source not found.Error! Reference source not found.**).

Posterior reversible encephalopathy syndrome (PRES) was diagnosed in one patient (**Error! Reference source not found.**). The CT scan was normal in one cas (

Figure *3*).

b. MAGNETIC RESONANCE IMAGING:

MRI was performed on all 13 patients; findings are summarized in Table 2. It revealed multiple lesions in 9 patients (69%). The lesions were located both above and below the tentorial margin in 8 patients (61.5%), and solely above the tentorial margin in 5 cases (38.5%).

The lesions were hypointense on T1-weighted images and hyperintense on T2-weighted images and hyper-FLAIR in 10 cases (77%). The signal was iso-intense on T1-weighted images in 1 patient (7.7%), hypointense on T2-weighted images in 1 case (7.7%), and intermediate on T2-weighted images in 1 patient (7.7%).

Eccentric and concentric target signs were observed simultaneously in only one patient (7.7%). Diffusion-weighted imaging was studied in 5 patients, and diffusion restriction was reported in 8 MRIs (60%).

A peripheral target-like enhancement was reported in all patients in the study (100%), perilesional edema in 69% of cases and signs of mass effect in 31% of cases.

5. BRAIN BIOPSY:

Brain biopsies were performed in 3 patients:

- One open biopsy following a trial of anti-toxoplasma treatment without improvement,
- One excisional biopsy of an epileptogenic process of unknown nature,
- One stereotactic biopsy of a suspicious brain lesion.

Parasitological examination was performed on 2 of the 3 samples, with only one result positive for *Toxoplasma gondii*.

Histopathological examination was also performed on 2 of the 3 samples, and the results consisted of:

- One diffuse granulomatous process without causing caseous necrosis
- One necrotizing inflammatory changes with vaguely epithelioid cells.

6. TREATMENT:

a. ETIOLOGIC TREATMENT:

Cotrimoxazole was the initial treatment for 12 patients (92.3%). Pyrimethamine-sulfadiazine was started immediately in one patient due to availability.

Two patients experienced allergic skin and/or hematological reactions to cotrimoxazole, prompting a switch to pyrimethamine-sulfadiazine. This therapeutic change was insufficient in one patient, who ultimately required pyrimethamine-clindamycin.

b. SYMPTOMATIC TREATMENT:

Folinic acid supplementation was administered to all 13 patients.

Corticosteroids were used in 46% of cases (6 patients).

Antiepileptic drugs were used in 8 patients of cases (61.5%), either for therapeutic purposes (3 patients who experienced seizures) or preventively in the presence of potentially epileptogenic lesions.

c. ANTIRETROVIRAL THERAPY:

Antiretroviral therapy (ART) was initiated within 2 to 3 weeks in patients with newly diagnosed cerebral toxoplasmosis. Treatment consisted of TDF-FTC-EFV (tenofovir disoproxil fumarate, emtricitabine and efavirenz) in 7 patients, DTG-3TC-TDF (dolutegravir, lamivudine and tenofovir disoproxil fumarate) in 4 patients (with or without another 50mg of dolutegravir when combined with antituberculosis drugs), and AZT-3TC-EFV (zidovudine, lamivudine and efavirenz) in 1 patient. ART was not initiated in one patient who died before the end of the first 2 weeks.

d. PROPHYLACTIC TREATMENT:

Secondary prophylaxis was started in 10 patients using cotrimoxazole, pyrimethamine or pyrimethamine-clindamycin.

e. KINESITHERAPY:

Motor physiotherapy was prescribed for 5 patients in our series.

7. OUTCOMES:

a. SHORT-TERM OUTCOMES:

- Favorable outcome in 77% of cases, assessed based on clinical and radiological criteria. These included neurological improvement, improvement in general condition, a reduction in the size of radiological toxoplasmic lesions, perilesional edema, and mass effect.
- Reported adverse effects of therapy were allergic reactions to treatment in 23% of cases, and hematologic toxicity in 15.38% of cases.
- Negative outcomes included persistence or worsening of initial clinical manifestations in 23% of cases, including status epilepticus (one case 7.7%).

- One case of immune reconstitution syndrome with ophthalmological manifestations was reported (increased hyalitis).

b. MEDIUM-TERM OUTCOMES:

- Favorable outcome in 53.8% of cases.
- Sequelae in 23% of cases.
- We recorded 3 deaths (23%): 1 from cerebral herniation, 1 from chronic diarrhea with electrolyte imbalances, and 1 from respiratory distress and bowel obstruction.

c. LONG-TERM OUTCOMES:

- stable in 50% of cases, favorable in 30% of cases, resulting in sequelae in one case (7.7%), and one death (7.7%), following aspiration pneumonia.

DISCUSSION:

1. EPIDEMIOLOGY:

a. PREVALENCE:

Toxoplasmosis seroprevalence in people living with HIV (PLWHIV) varies significantly by geographic location but can be high, with some studies showing seroprevalence rates as high as 54.5% as demonstrated by Manuel et al in Mozambique [1]. The risk of symptomatic disease, particularly toxoplasmic encephalitis, is higher in PLWHIV who are not on antiretroviral therapy (ART) and have a low CD4 count, often below 200 cells/µL.

The prevalence of central nervous system toxoplasmosis in our center is estimated at 3.59% (13 out of 362). A large-scale, recent study in the Asia-Pacific region found that 2.8% of PLWH were diagnosed with toxoplasmosis [2]. A comparable study was conducted in Morocco in 2016 by Lahoucine et al. and described a prevalence of 4.5% [3].

In this study, toxoplasmosis was the first indicator of retroviral infection in more than half of cases (85%). Supporting this, in an Iranian study Javvi et al. reported that in 57.89% of cerebral toxoplasmosis patients, the disease was the initial sign of HIV infection [4]. This is consistent with results from a Brazilian case series where cerebral toxoplasmosis was the first manifestation of HIV infection in 48.21% of patients [5].

b. DEMOGRAPHICS:

In our study, cerebral toxoplasmosis in PLWHIV was predominantly diagnosed in middle-aged men, corresponding with the demographic distribution described in different studies. The mean age at diagnosis was 44 years in our study, versus 37 years in a study conducted by Martin-Iguacel et al. [6], and 38 years in Lahoucine et al.'s cohort [3].

The sex ratio shows a male predominance (84.6%), consistent with data from the literature: 57.89% males as described by Javvi et al. [4], and 76.1% in the series of Martin-Iguacel et al. [6].

2. CLINICAL PRESENTATION:

The clinical manifestations observed in our study have been described elsewhere, but with varying proportions in numerous series. We compared these clinical aspects to those reported in other studies, and the comparisons have been summarized in Table 3.

3. RADIOLOGY:

Imaging plays a crucial role in the diagnosis of cerebral toxoplasmosis. However, the relative rarity of highly specific signs for cerebral toxoplasmosis and the multitude of differential diagnoses, explained by the immunosuppression of these patients, contribute to the difficulty of definitively confirming this diagnosis in cases of brain abscesses.

Therefore, functional and nuclear imaging are encouraged in inconclusive cases, particularly in the most challenging differential diagnosis: primary central nervous system lymphoma [9].

a. BRAIN CT SCAN:

CT scanning proved less effective than MRI in diagnosing cerebral toxoplasmosis, with a normal result contradicted by MRI in one patient. Brain MRI is a more sensitive tool for diagnosing cerebral toxoplasmosis lesions [10, 11, 12]; however, brain CT scans are more widely available as an initial imaging modality, especially in settings where HIV infection is most frequent.

b. BRAIN MRI:

The inferiority of CT scanning led to the systematic use of MRI in all our patients, both initially and two weeks after treatment, given that a decrease in size and/or a hemorrhagic remodeling seen around the third week of treatment is an argument in favor of diagnostic. Hemorrhagic changes (best visualized on gradient echo or T2* sequences) generally appear during treatment, but may be present from the outset, particularly in hematology patients [13,14].

In this study, MRI revealed multiple lesions in 69% of cases, with the most frequent location of lesions being at the gray-white matter junction and in the basal ganglia. The typical MRI

findings in patients with cerebral toxoplasmosis are multiple ring-enhancing lesions in basal ganglia (48%), frontal lobe (37%), and parietal lobe (37%) with surrounding edema [10, 15]. Typical MRI lesions are an eccentric target sign on post-contrast T1-weighted sequences (which has 95% specificity and less than 30% sensitivity) [13] and a concentric target sign on T2-weighted imaging [14]. Peripheral target-like enhancement was observed in all patients in our study. Eccentric target signs and concentric target signs were found simultaneously in only one patient (7.7% of cases).

Most initial lesions reported in our study were hypointense on T1-weighted images, hyperintense on T2-weighted images and hyper-FLAIR, which was consistent with data for a study by Brightbill et al. among 27 patients, where three distinct imaging patterns on T2-weighted MRI sequences were described depending on the timing it was performed: 10 of them performed on average 3 days after starting treatment had mainly T2-hyperintense lesions, another 10 were realized on average 61 days after treatment and had T2-isointense lesions, and 7 had mixed lesions on an average of 6 days of treatment.

4. BIOLOGY:

a. CEREBROSPINAL FLUID:

Lumbar puncture was performed in 9 patients (69%), with a normal sample in 7 patients (53.84%) and lymphocytic meningitis in 2 cases (15%).

HIV-related cerebral toxoplasmosis usually has little or no meningeal involvement. For this reason, basic CSF characteristics are usually not relevant and only subtle abnormalities such as cell count and protein values normal or mildly elevated are described [10, 16, 17]. Interestingly, eosinophils can be occasionally found in the CSF of patients with cerebral toxoplasmosis [10, 18], and only one case of eosinophilic meningitis has been reported [10, 19].

b. CD4 COUNT:

We reported a CD4 count on admission <50 in 72% of cases, between 50 and 100 in 18%, and >100 in 90%, which is consistent with the literature establishing a significantly higher risk of cerebral toxoplasmosis when the CD4 count is below 100. [6]

c. BRAIN BIOPSY:

A brain biopsy was performed in 3 of our 13 patients, with Toxoplasma gondii isolated in only one patient, and histology suggestive of an inflammatory process in 2 patients.

Only brain biopsy can definitively diagnose the condition; however, this procedure is not feasible when lesions are situated deep within the brain tissue. The outcomes of brain biopsy are usually better in centers with higher technical expertise. Barriers to use of biopsy include

clinical condition of the patients, topography of the lesion, its invasiveness, elevated costs, and structural requirements [10, 12, 20]. Consequently, central nervous system toxoplasmosis is most often diagnosed through imaging techniques [21].

d. SUMMARY:

The biological diagnosis of toxoplasmosis was not widely used in our study. This can be explained by:

- The limited contribution of toxoplasmosis serology in the diagnosis of toxoplasmosis in immunocompromised individuals. Most of these cases are due to reactivation rather than primary infection, as established in literature and supported in our study by the serological profiles dominated by prior contact with the parasite.
- Isolation of Toxoplasma gondii has impeccable diagnostic value; however, it is a rare result (7.7% in our study) because on the one hand, brain biopsy is not readily indicated due to several factors, including the invasive nature of the procedure and the preferential deep location of toxoplasmic abscesses, and on the other hand brain biopsy is generally performed after a trial of anti-toxoplasma treatment without improvement, thus suggesting that the probability of negative results increases.
- PCR was not performed on any patient in our study due to unavailability in our structure. However, it represents a valuable diagnostic tool. As a reminder, regarding CSF: its sensitivity varies between 11% and 100% (~50%-60%), specificity 96-100%, with a positive predictive value of 100%, and a negative predictive value of 71-92% [10, 22–34]. PCR in peripheral blood is also useful, especially in situations where lumbar puncture is contraindicated. However, the DNA concentration of Toxoplasma gondii is very low in the blood of patients with cerebral toxoplasmosis, and this feature appears to affect the sensitivity of the test [10, 35].

5. TREATMENT AND OUTCOME:

a. FAVORABLE OUTCOME:

Short-term outcome was favorable in 77% of cases; assessment was based on the clinical improvement (regression of neurological signs and the improvement in general condition) and radiological progress (reduction in the size of toxoplasmic abscesses, hemorrhagic remodeling of lesions, reduction of perilesional edema and mass effect). This cure rate is close to that of the standard treatment (80-90%) [36].

In a Danish population-based cohort 61.2% of the patients experienced an improvement of their neurological symptoms and 18.4% experienced a complete resolution of their deficits four months after cerebral toxoplasmosis. In the same study, most patients had regression of cerebral lesions at control neuroimaging; however, rescanning was not systematically performed during follow-up [6].

A comparable Moroccan study revealed clinical improvement with regression of symptoms and physical signs in 66% of cases [3].

b. MORTALITY:

We reported an overall mortality 30.7% within one year of diagnosis. Mortality was directly related to cerebral toxoplasmosis in 2 patients (50% of deaths). In the Danish cohort forty-two patients (58.3%) diagnosed with cerebral toxoplasmosis died during the study period of whom 30 (71%) died within the first year and 21 (50%) within the first 90 days after the cerebral toxoplasmosis diagnosis [6].

c. THERAPEUTIC IMPLICATIONS:

The correlation between the percentage of favorable outcomes in our study and those reported in the literature leads us to conclude that cotrimoxazole can be considered an effective and therapeutically equivalent to the gold standard, as it was the antiparasitic treatment for 10 of the 13 patients in our study. However, non-inferiority trials should be conducted to ensure solid proof. Trimethoprim-sulfamethoxazole (TMP-SMX) usually appears as alternative in the American, British and European guidelines, but other recommendations include TMP-SMX in the first-line therapies [10, 37–39]. In clinical practice, however, TMP-SMX is infrequently used when first line treatments are available. In contrast, TMP-SMX is the first choice in Africa and in other low- and middle-income countries, particularly where pyrimethamine-based regimens are not available or where there is experience with TMP-SMX [10].

However, it is essential to note that the entire therapeutic arsenal available for the treatment of cerebral toxoplasmosis in Morocco is only available in oral form. The advantage of the injectable form is undeniable: the considerable number of tablets taken daily, the frequency of severe neurological complications compromising swallowing function and/or requiring orotracheal intubation.

STUDY LIMITS:

- The study included 13 of the 17 patients with a probable or confirmed diagnosis of cerebral toxoplasmosis; the 4 missing records are considered lost.

- The clinical assessment of neurological and general signs was subjective and not based on standardized evaluation scores.
- Toxoplasma serology was not performed in all patients.
- Some samples from the brain biopsies were not subjected to parasitological and/or histopathological examination.
- Ophthalmological examination was not systematic.
- The behavior of lesions in the different sequences was not always described in the brain/spinal cord MRI reports.

CONCLUSION:

Cerebral toxoplasmosis is the most common infection of the central nervous system in HIV-infected patients. It develops during a state of profound immunosuppression and manifests clinically with various neurological signs in the form of focal neurological syndromes. The severity of these syndromes depends on the size and location of the lesions, the associated mass effect, and the delay in treatment, hence the urgent need for diagnosis.

Cerebral toxoplasmosis presents major diagnostic challenges due to the multitude of differential diagnoses for a cerebral expansive process in an immunocompromised patient, the scarcity of highly specific signs, the limited contribution of laboratory tests, and the inaccessibility of brain lesions to direct non-invasive diagnosis.

Cerebral imaging, particularly MRI, is an essential diagnostic tool because of its ability to accurately characterize lesions and, above all, to track the evolution of images after the introduction of antiparasitic treatment. This evolution is correlated with clinical improvement, allowing for a retrospective diagnosis, which is crucial for confirming cerebral toxoplasmosis.

Advances in functional imaging are promising and are increasingly competing with brain biopsy, the gold standard for diagnosing cerebral toxoplasmosis.

Cotrimoxazole, considered a third-line treatment in cerebral toxoplasmosis guidelines and often perceived as a drug for low-resource settings, has demonstrated efficacy and tolerability comparable to first-line therapies. However, the availability of an injectable form would make it an even more attractive treatment option in our context.

FIGURES:

Figure 1: *Axial section of a brain CT scan without contrast injection showing a right frontoparietal hypodense lesion surrounded by perilesional edema in a glove-finger pattern.*

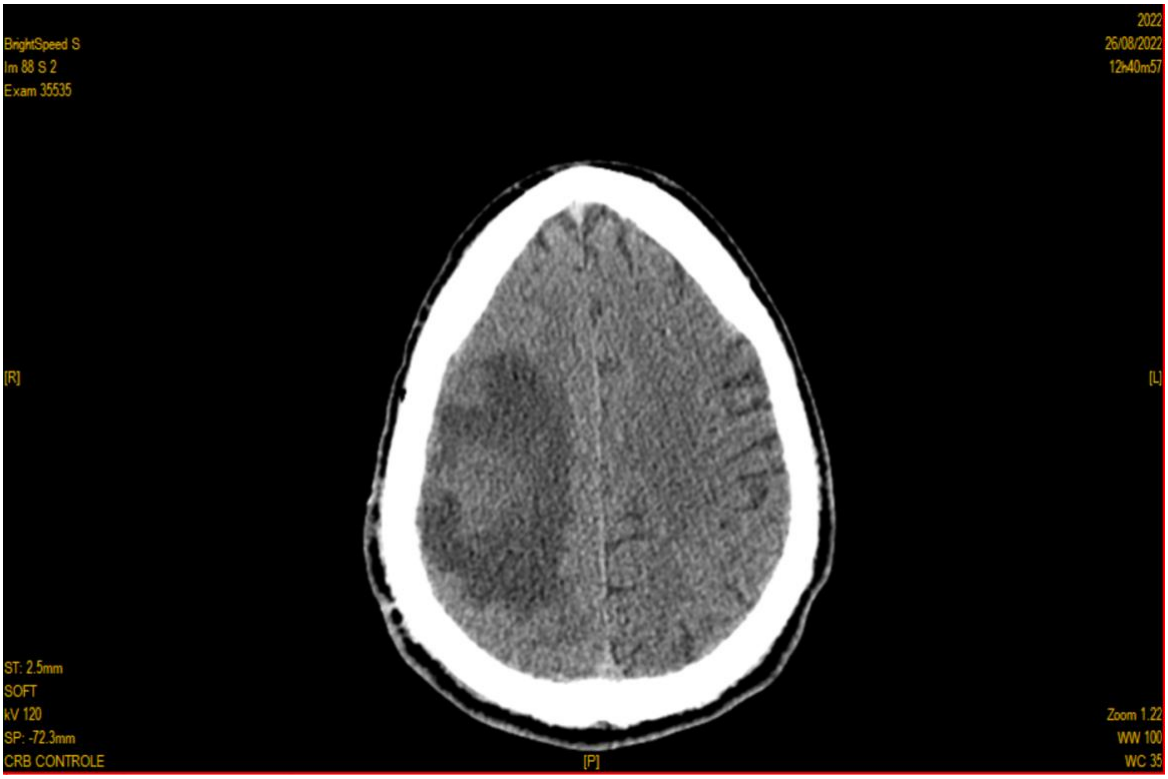
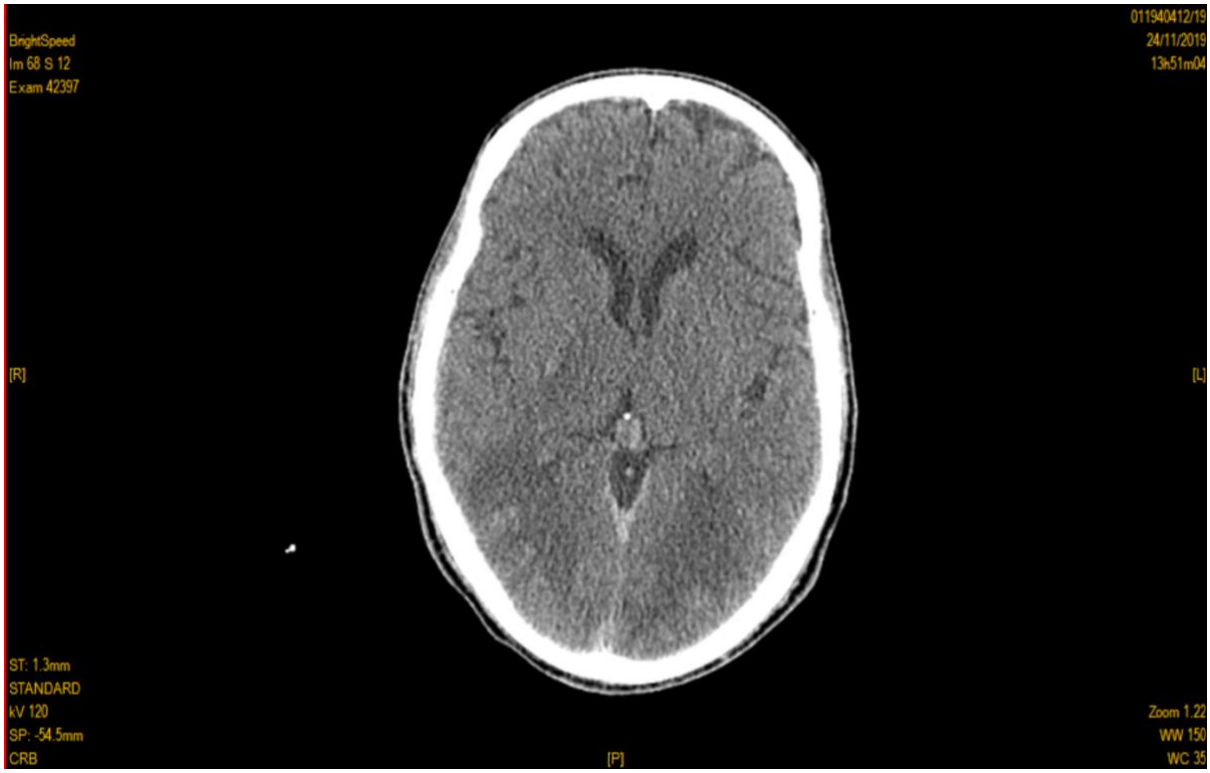


Figure 2: *Brain CT scan showing bilateral symmetrical temporo-occipital hypodensities suggestive of a reversible posterior encephalopathy (PRES).*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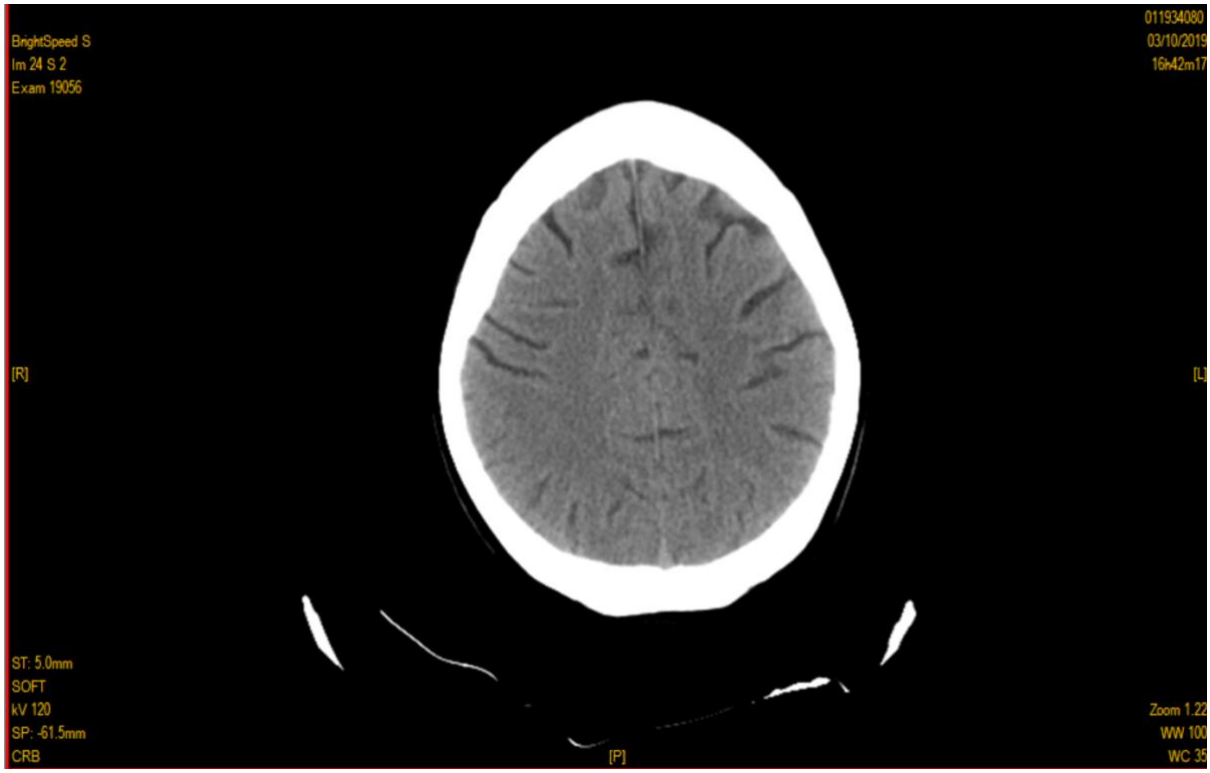
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Figure 3: *Normal brain CT scan found in one of study patients*

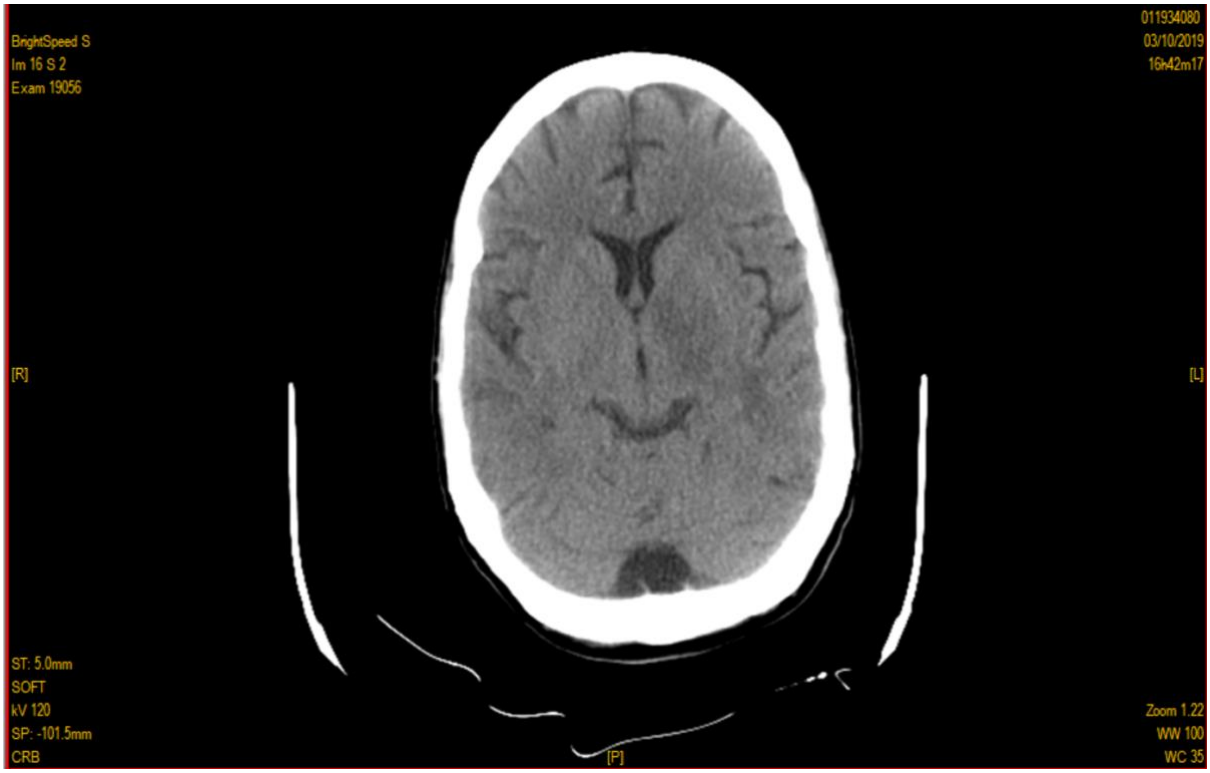


Figure 4: *Axial section of a brain MRI showing a hypointense right thalamic toxoplasmic abscess with target-like enhancement*

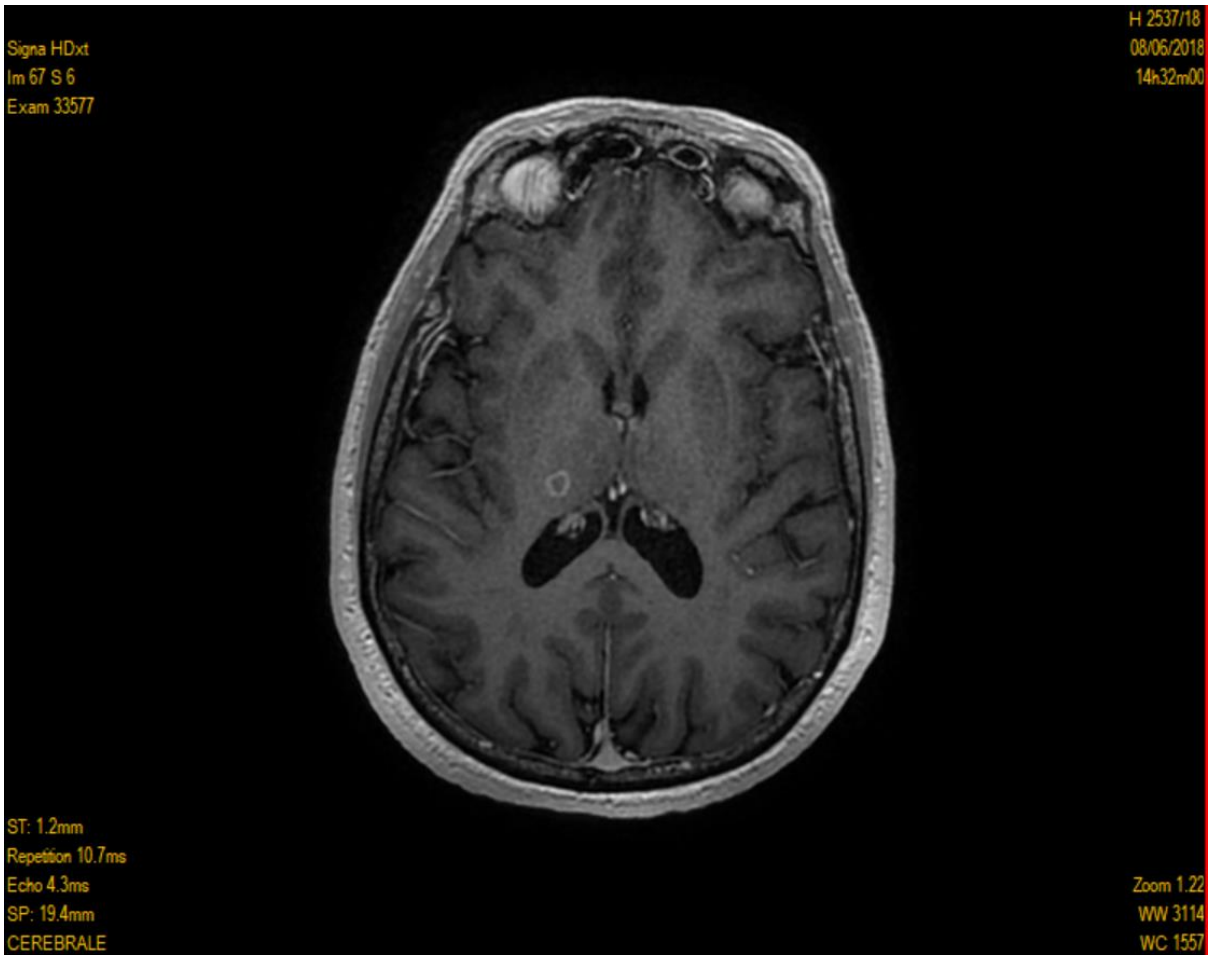


Figure 5: *Axial sections of cerebral MRI in injected T1 sequence showing toxoplasmic abscesses: hypointense T1 lesions with target-like enhancement, at the level of typical locations: grey matter-white matter junctions and central grey nuclei.*

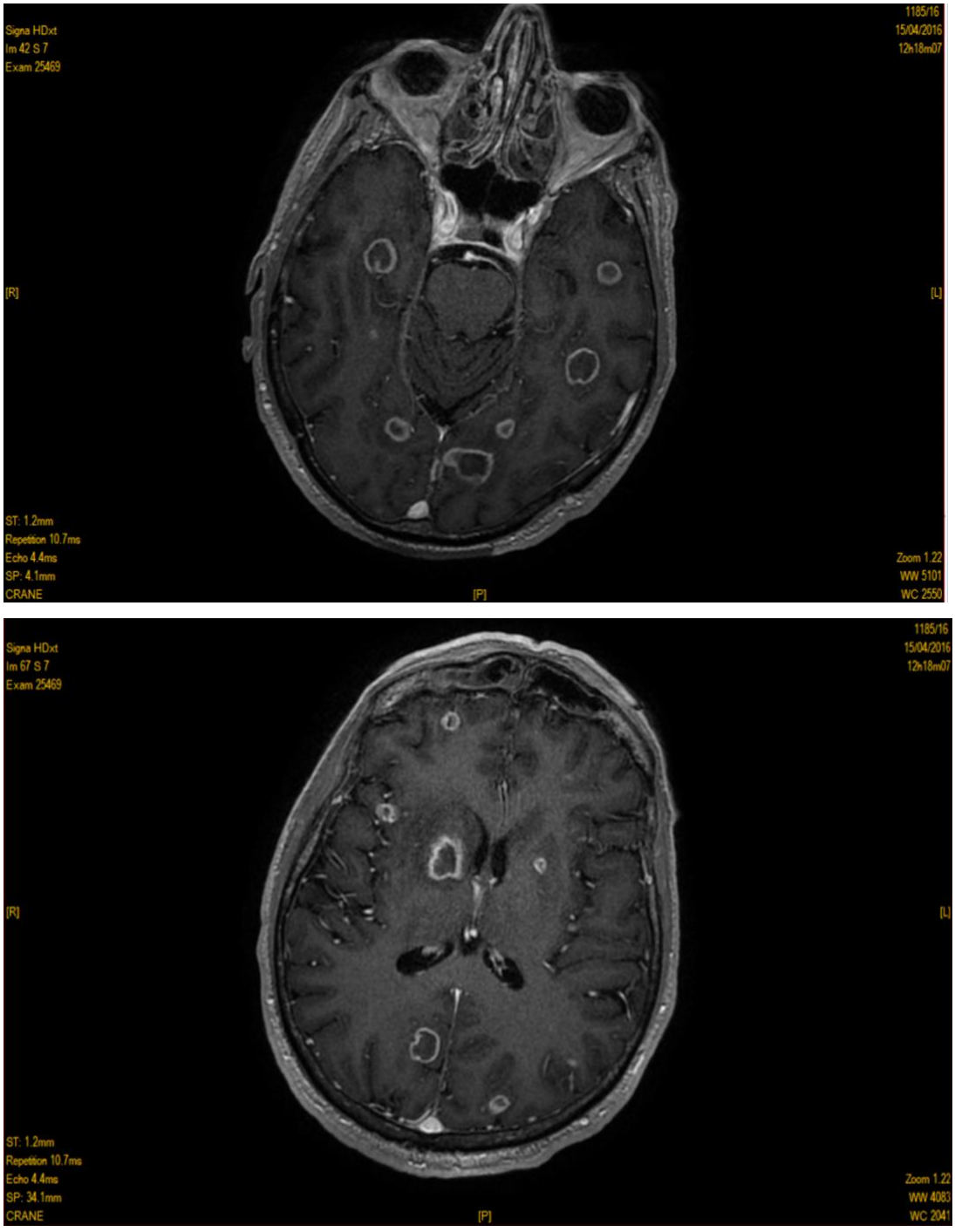


Figure 6: *Toxoplasmic abscesses in the right basal ganglia are hyperintense on FLAIR sequence.*

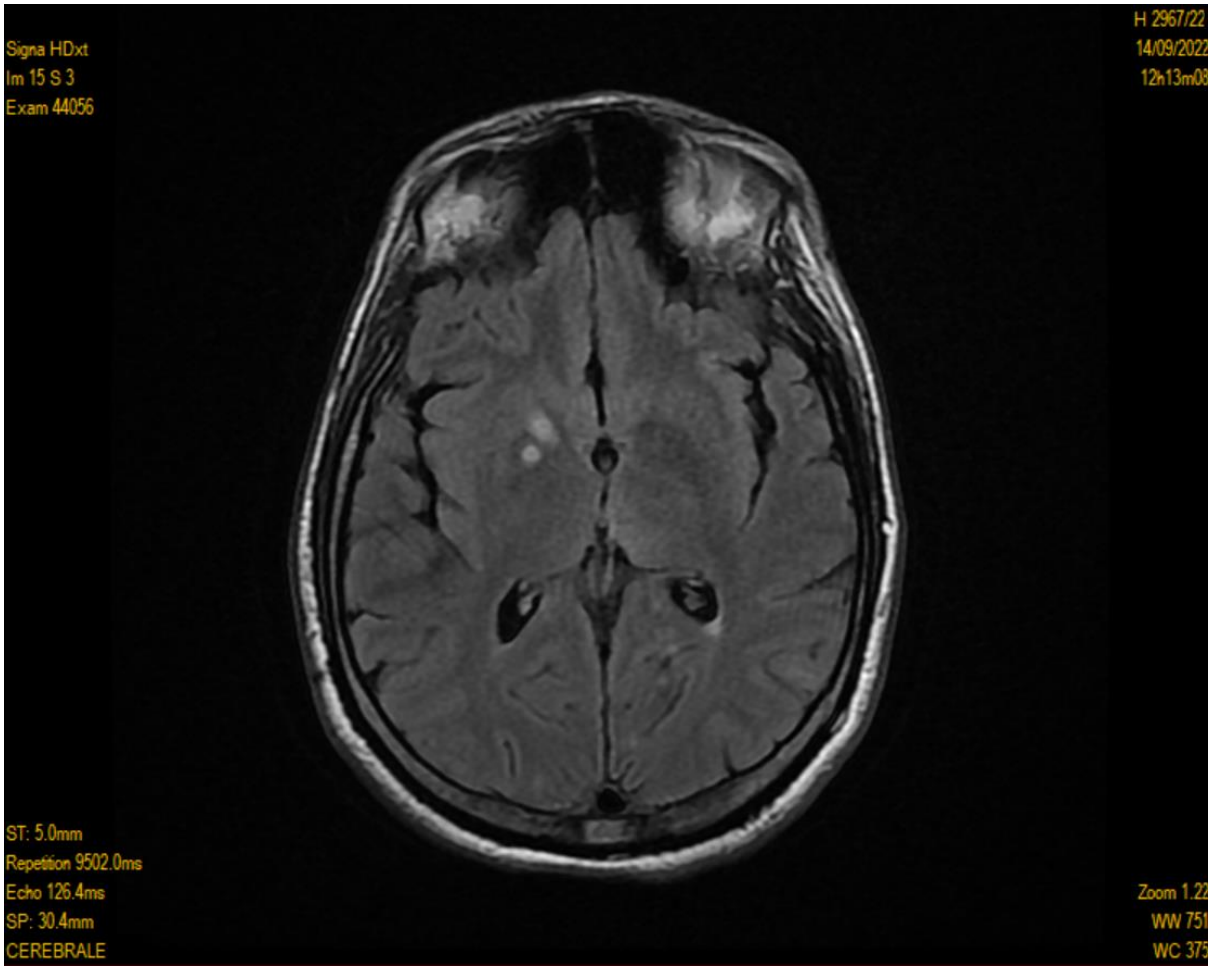
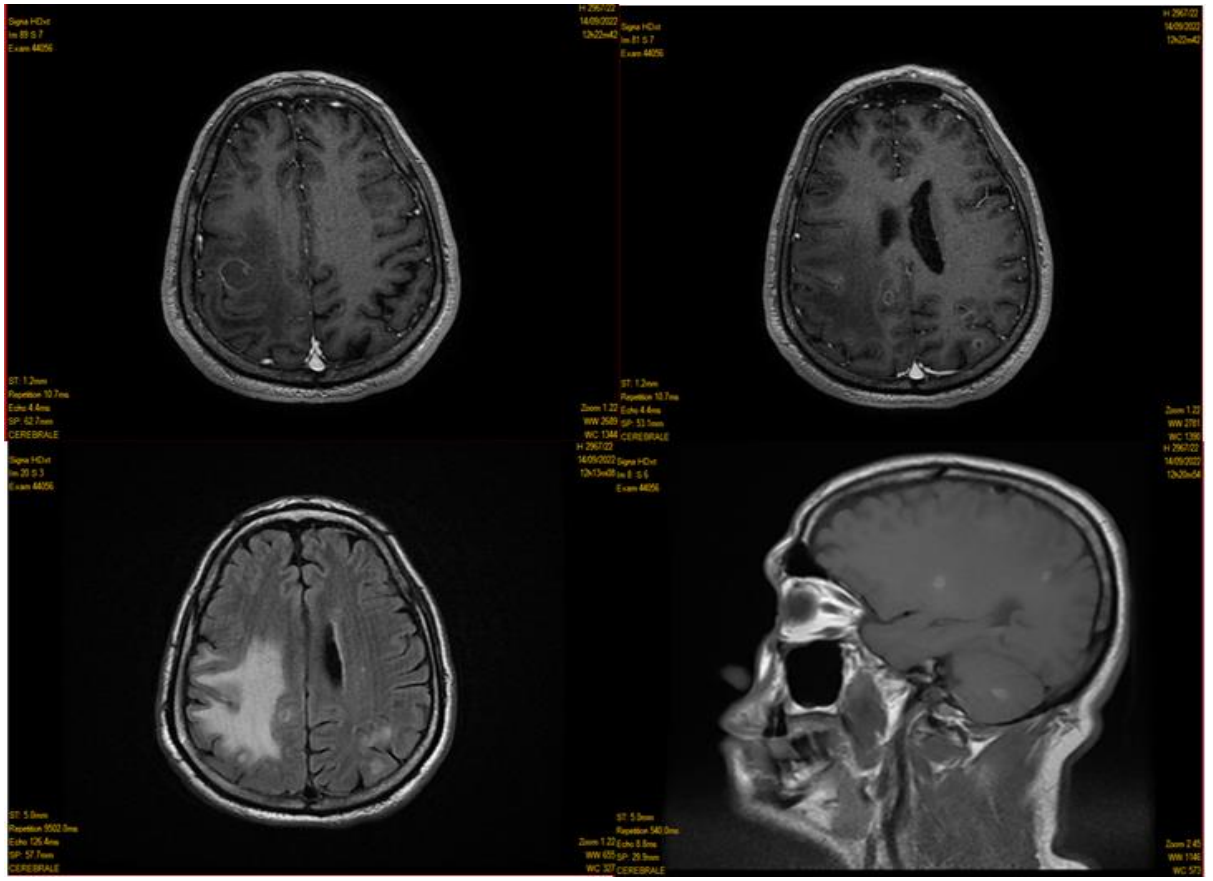


Figure 7: *Right parietal perilesional edema and multiple toxoplasmic abscesses*



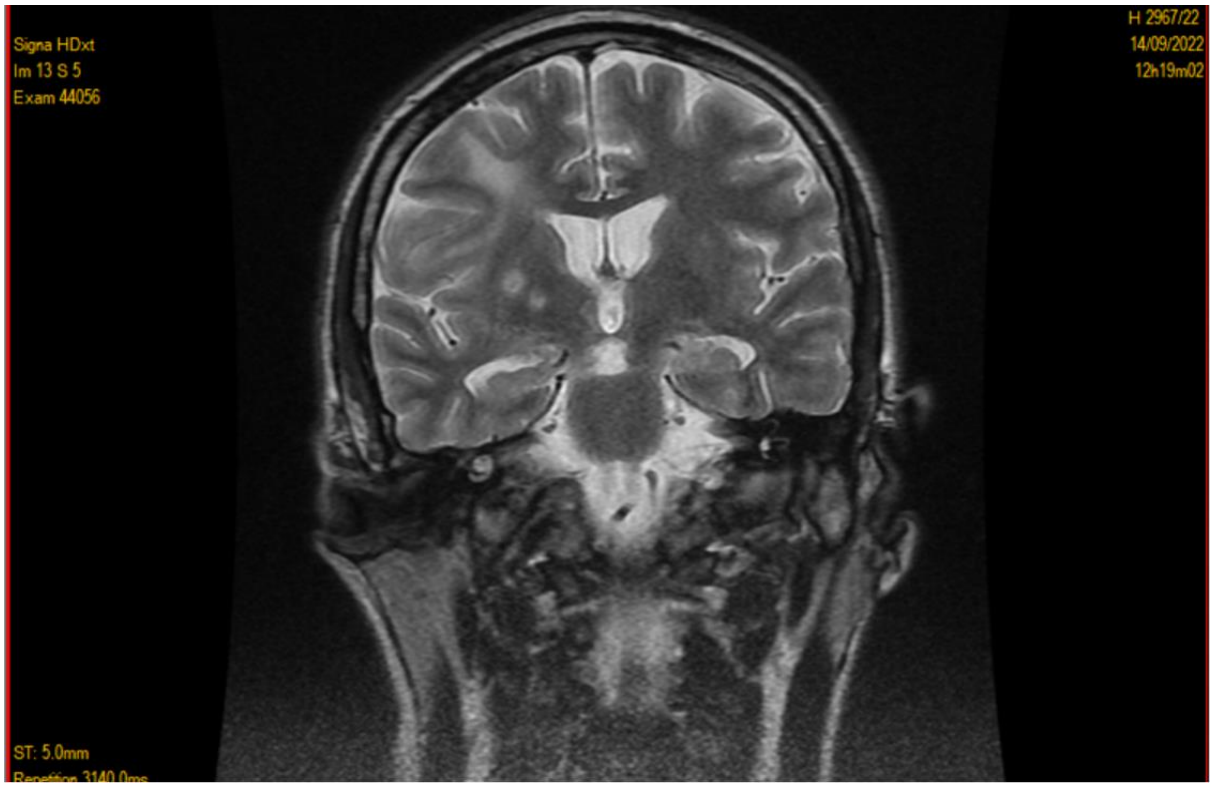


Figure 8: *Multiple supratentorial and infratentorial cerebral lesions, hypointense on T1-weighted images and hyperintense on T2-weighted images, surrounded by large areas of perilesional edema with mass effect: obliteration of cortical sulci, collapse of the third ventricle, moderate dilation of the lateral ventricles, and signs of trans-ependymal resorption. These lesions are hypointense on diffusion-weighted imaging (no ADC restriction).*

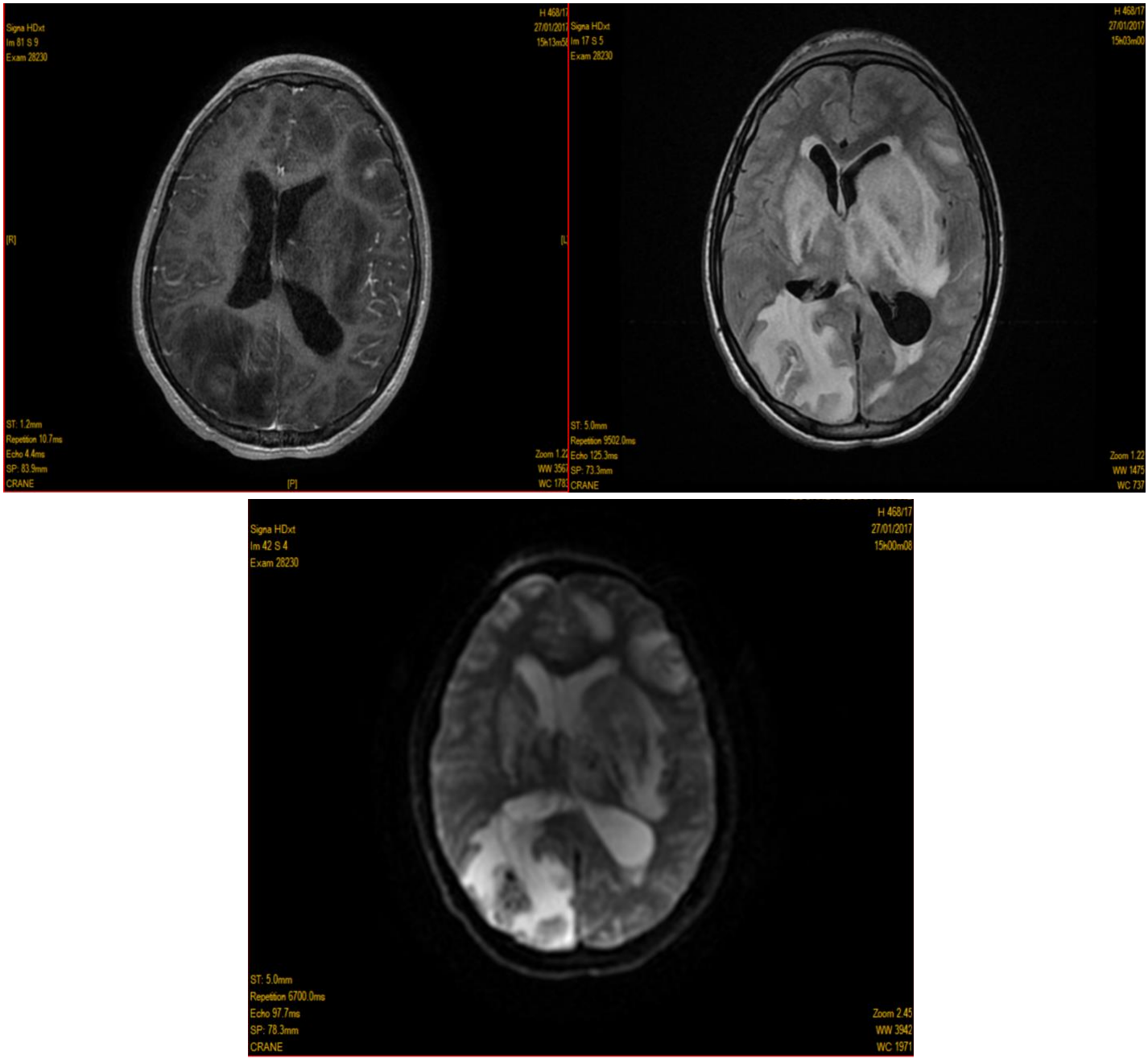


Figure 9: *Brain MRIs showing toxoplasmic lesions with restricted diffusion.*

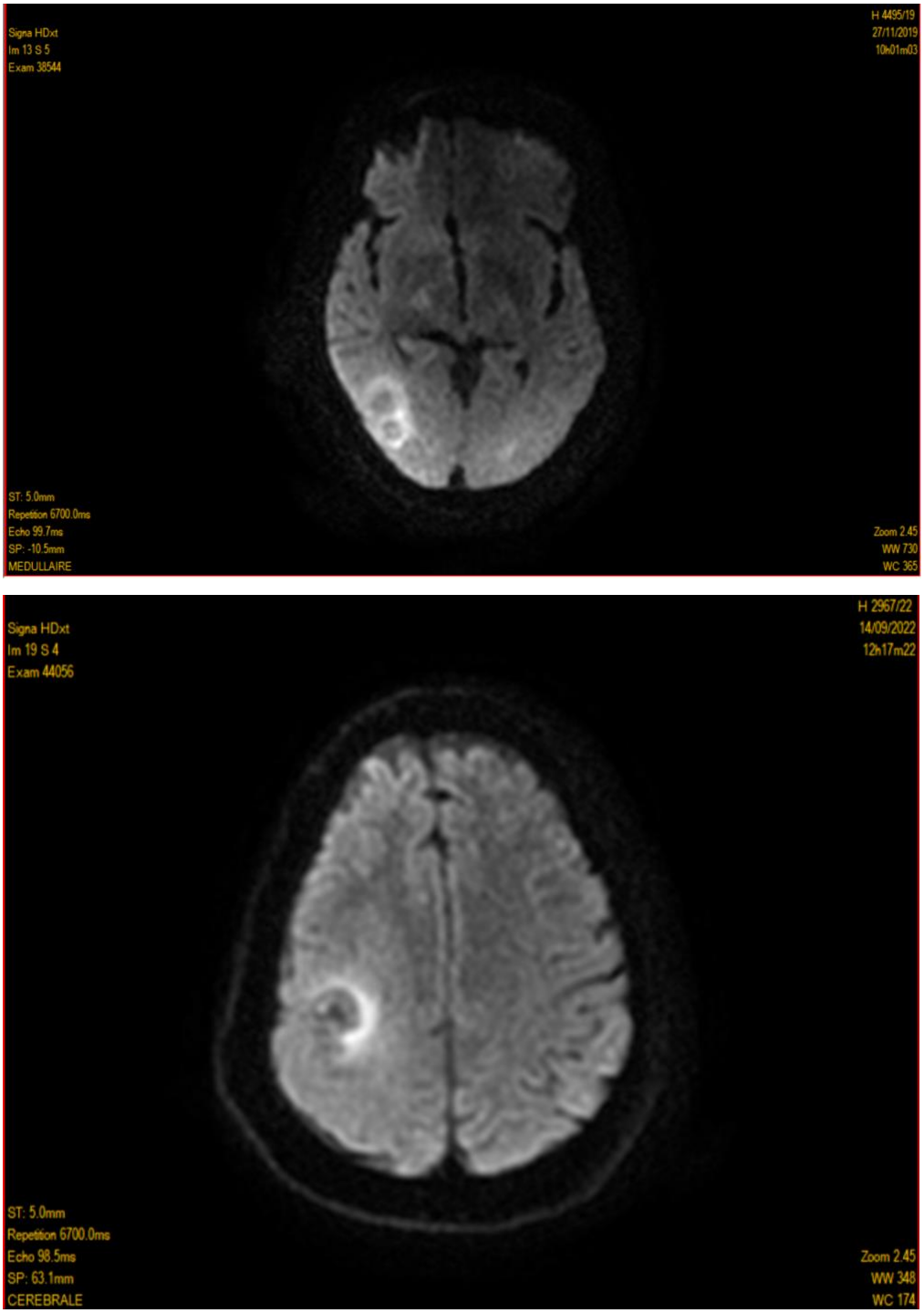


Figure 10: *Multiple supratentorial cerebral lesions with heterogeneous T1 iso-signal and peripheral enhancement, some of which contain a peripherally enhanced mural nodule producing the Eccentric Target Sign, surrounded by perilesional edema in a glove-finger pattern.*

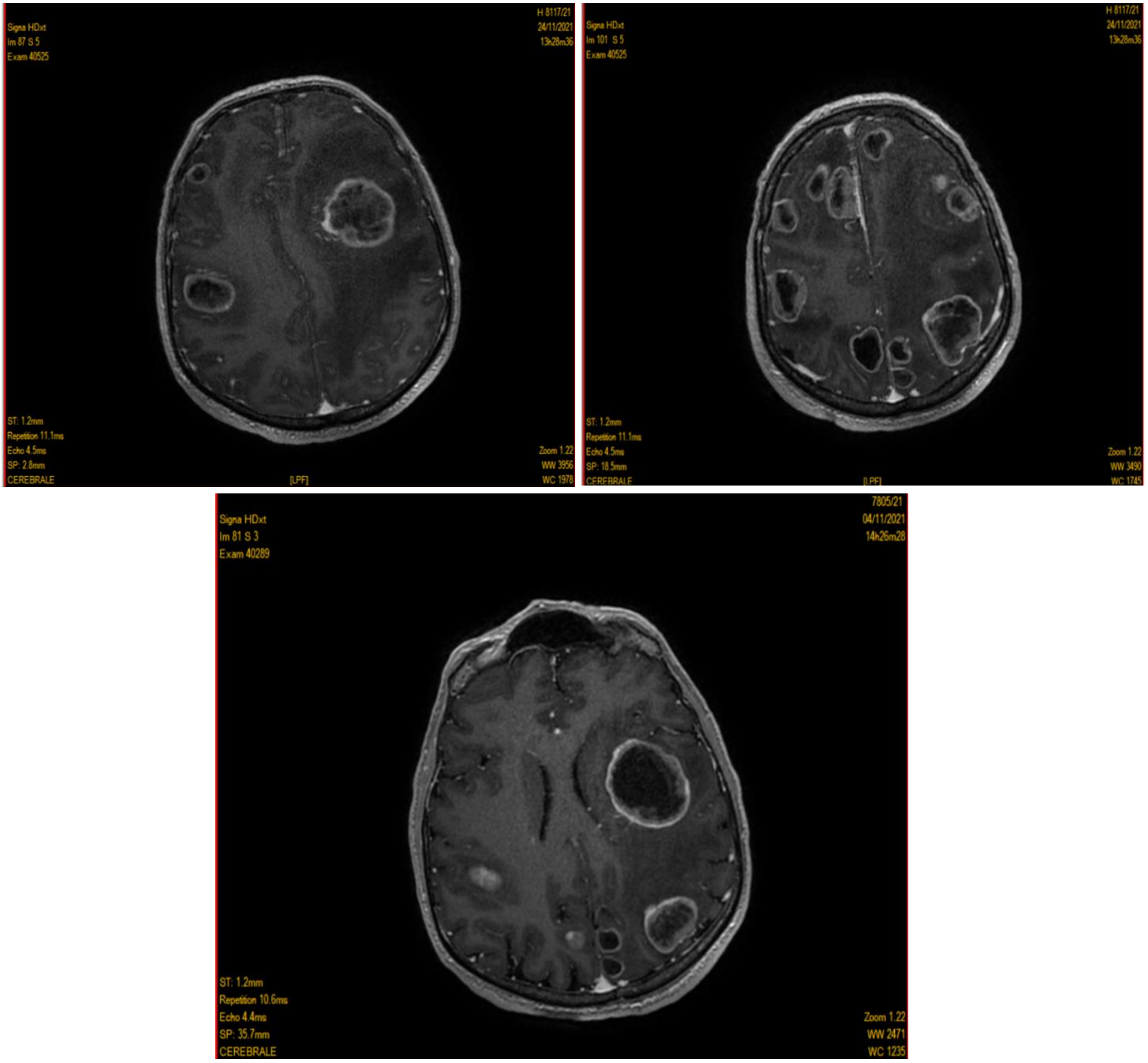


Figure 11: *Multiple supratentorial brain lesions, some of which show an alternation of hyper and hypo T2 rings producing the Concentric Target Sign.*

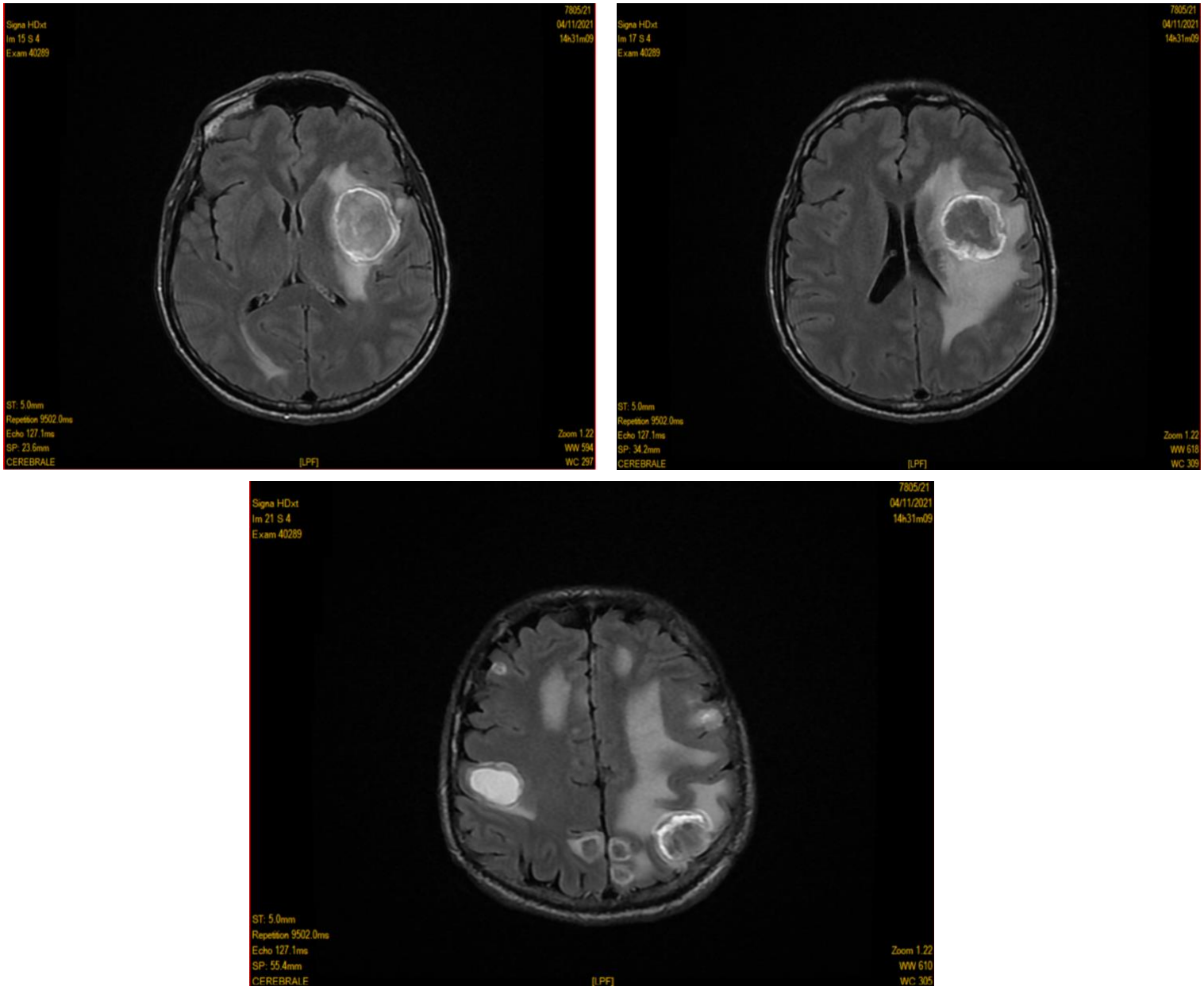


Figure 12: *Lesions identified on a brain MRI concurrent with a normal CT scan (*

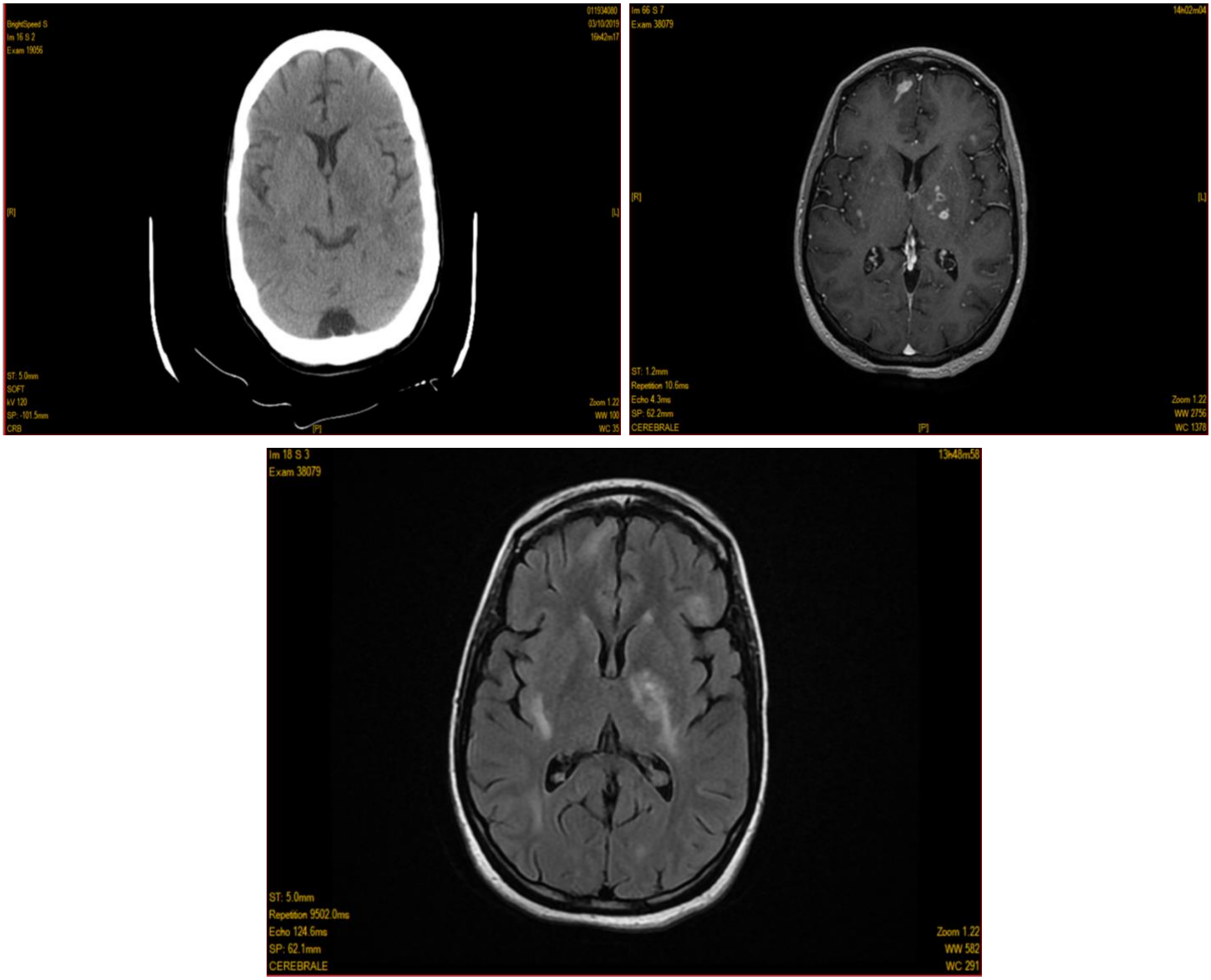


Figure 3)

TABLES :

Table 1: *Clinical symptoms.*

Symptoms	Patients (*n*)	Percentage (%)
Motor deficit	7	54
Hemiplegia	3	23
Paraplegia	2	15.38
Monoplegia	2	15.38
Facial paralysis	1	7.7
Paresthesia	4	30.7
Aphasia	2	15.38

Altered consciousness	3	23
Epilepsy	3	23
Headaches	2	15.38
Intracranial hypertension	1	7.7
Cerebellar syndrome	1	7.7
Memory impairment	1	7.7
Infectious syndrome	5	38
Wasting syndrome	11	85

Table 2: *Magnetic resonance imaging findings.*

MRI description	Patients (*n*)	Percentage (%)
Number of lesions		
Multiple lesions	9	69
Single lesion	4	31
Location of lesions		
Supra- & infra-tentorial	8	61.5
Supra-tentorial	5	38.5
Signal intensity		
Hypo-T1 & Hyper-T2	10	77
Iso-T1	1	7.7
Hypo-T2	1	7.7
Intermediate T2	1	7.7
Eccentric Target Sign + Concentric Target Sign	1	7.7
Diffusion restriction	3	23
Enhancement		
Peripheral target-like	13	100
Perilesional edema	9	69
Signs of mass effect	4	31

Table 3: *Clinical characteristics at initial presentation of central nervous system toxoplasmosis diagnosis in PLWHIV reported in different studies.*

Symptoms	Lahoucine *et al.* [3] (Morocco) (%)	Goïta *et al.* [7] (Mali) (%)	Van Deuzen *et al.* [8] (Netherlands) (%)	Our study (%)
Motor deficit	80.95	73.07	29	54
Paresthesia			N/A	30.7
Aphasia	N/A	19.23	22	15.38
Altered consciousness	38.09	30.80	19	23
Epilepsy	38.09	57.69	18	23
Meningeal syndrome	4.76	15.40	N/A	0

Psychiatric symptoms	9.5	3.84	N/A	0
Headaches	N/A	65.38	56	15.38
Intracranial hypertension	42.85	69.2	N/A	7.7
Cerebellar syndrome	4.76	N/A	N/A	7.7
Infectious syndrome	28.57	N/A	29	38

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