

# The use of Contrast Clearance Analysis Software to differentiate Brain Tumors from Radionecrosis: A Revolution?

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## Purpose

To evaluate the experience of the first center in Brazil, and second in South America, using Contrast Clearance Analysis Software (Brainlab) to differentiate tumor recurrence from radionecrosis in the management of benign and malignant brain lesions after radiation treatments.

## Materials and Methods

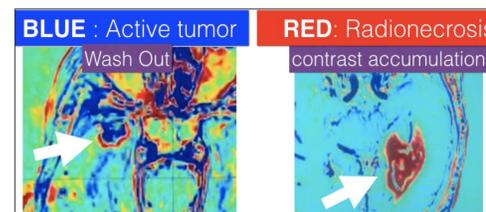
We analyzed benign and malignant brain lesions (tumors and Arteriovenous malformations) images with Contrast Clearance Analysis (CCA) Software from April 2021 to July 2023 in a Radiation Oncology Center in Brazil. Data from 91 patients and 274 CCA images at our institution were studied. All images were obtained with 3T MRI (Verio, Siemens), and a T1 contrast enhanced volumetric sequence (MPRAGE) was acquired at 5 min and 60 to 105 min. The images were transferred to CCA software. A fusion between the 2 MPRAGE sequences was made and a CCA colored map was calculated. The lesion studied was evaluated according to the color on the map: blue (active tumor) or red (radionecrosis) (**Figure 1**). The results of CCA software were compared to conventional MRI sequences (diffusion, perfusion and spectroscopy) and in five cases a biopsy was performed.

## Results

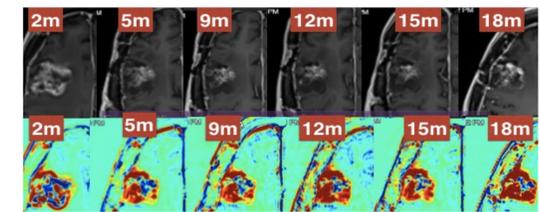
Median age was 46.2 years (Range: 4-75) and mean follow up was 28.1 months (Range: 2-53). Patient diagnosis were malignant tumor (81 patients), benign lesions (9) (**Figure 5 and 6**) and brainstem tumor without biopsy (1). 47,25% patients were treated with single dose radiosurgery, 37,36% with hypofractionation and 15,38% with conventional Radiotherapy. At follow up, 33,3% of patients developed new symptoms and Control MRI with conventional sequences demonstrated disease progression, however, at CCA software was radionecrosis (**Figure 2 and 3**). 100% had complete symptoms relief after treatment (steroids and vitamin E), and 2 lesions practically disappeared (**Figure 4**). All biopsied cases were compatible to the CCA software.

## Conclusion

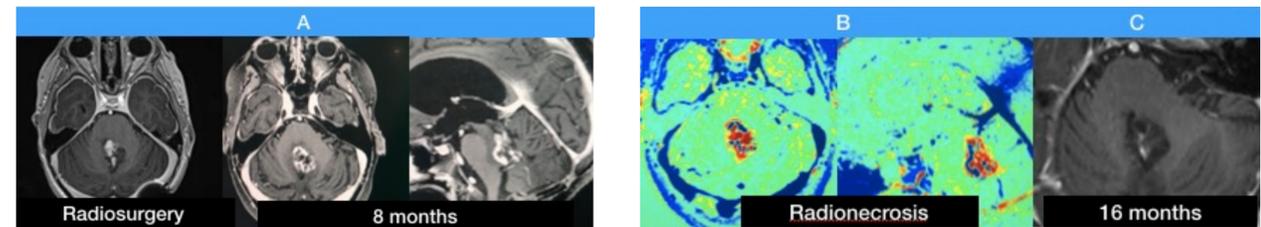
The CCA software is a new technological approach providing efficient distinction between tumor/radionecrosis. The methodology provides high resolution and easy to interpret images with high accuracy. The present study is the first to describe the CCA software contribution among benign tumors and AVMs.



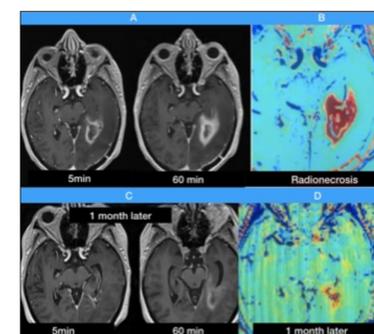
**Figure 1:** Differences in active tumor (blue) and radionecrosis (red) at Contrast Clearance Analysis



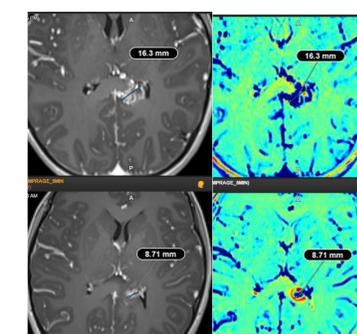
**Figure 3.** Follow up of a glioblastoma patient, treated with Stupp Protocol. At 18 months, MRI showed lesion, but CCA software showed more radionecrosis.



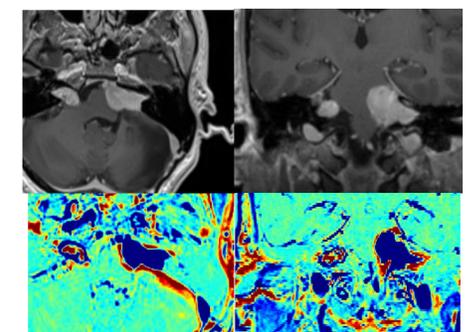
**Figure 2:** 4 year boy with pilocytic astrocytoma that recurred after surgery. **A-** Patient was treated with Radiosurgery. After 8 months, lesion grew and the MRI showed tumoral progression. **B-** Imaging obtained with CCA software - axial and sagittal view (Red at the lesion is considered radionecrosis). **C-** After steroids therapy, patient was asymptomatic and MRI after 16 months showed significant lesion reduction, confirming radionecrosis.



**Figure 4:** High Grade Glioma treated with surgery and Stupp protocol. After 4 months, a distant lesion was observed, with conventional MRI showing recurrence. **A-** MRI with volumetric T1 contrast enhanced acquisition at 5 min ad 60 to 105min **B-** CCA showing radionecrosis. **C-** After steroids therapy, patient was asymptomatic and MRI after 1 month showed complete response to therapy. **D-** CCA after 1 month.



**Figure 5.** 8 years old patient with a corpus callosum AVM treated with 23Gy single dose radiosurgery. Control MRI after 6 months show reduction of blue area and partial obliteration at CCA software.



**Figure 6.** Patient with 41 years old and type 2 neurofibromatosis. Patient treated left acoustic schwannoma with 5 fractions of 5Gy 4 years ago, and there is no radionecrosis. Patient treated right acoustic schwannoma 2 years ago and CCA software showed internal radionecrosis.