



Zero-shot Learning with RAG to Characterize Brain Radiation Necrosis from Aggregate Clinical Text

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Background/Problem Being Solved

Radiation Therapy (RT) is often used to treat brain metastases (BM); however, Radiation necrosis (RN) is a side effect of radiotherapy in which surrounding healthy brain tissue becomes inflamed in around 5-25% of metastatic intracranial lesions. RN is difficult to diagnose and manage because it is often indistinguishable from tumor progression on imaging and has variable symptomatic rates. Treating physicians must manage patients with RN with limited, disorganized data. Here, we sought to use LLMs to aggregate all relevant Electronic Health Record (EHR) data to characterize radiation necrosis in over 1000 patients with BM treated with radiotherapy.

Intervention(s)

We conducted SQL queries to identify all BM patients who underwent RT at our institution from 3/1/2013 to 10/22/2023. All Imaging reports, pathology reports, clinical notes, medications, problem lists, and operative notes were extracted into data frames and collated for each patient. We prompted Meta's Llama 3.3 70B parameter model to identify which patients developed RN, their clinical progression, treatment history, and response to RN interventions on a large scale. We used zero-shot learning with Retrieval-Augmented Generation (RAG).

Barriers/Challenges

Although Llama3.3 is state-of-the-art at the time of this abstract writing, the overall window length is still limited to 128K tokens (~96,000 words).

Outcome

The LLM correctly identified the patient's first occurrence of RN on imaging, medication administration, BM treatments, and the overall clinical response to RN. We are now validating these results through expert chart review.

Conclusion/Statement of Impact/Lessons Learned

The aggregation and summarization of patient data using clinical informatics with LLM integration effectively elucidates treatment history and outcomes tailored to each patient uniquely. By identifying a large cohort of patients, we are now characterizing risk factors for radiation necrosis that have been difficult to ascertain with tedious manual review alone.

Figure(s)



Figure 1. Data curation and prompt for LLM prompt.



Figure 2. Decision tree of questions prompted for LLM analysis using zero-shot RAG learning.

Keywords

Applications; Artificial Intelligence/Machine Learning