Post-treatment Glioma Imaging

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Disclosures

- None
Objectives

- Post treatment imaging – When? How?
- Imaging patterns:
  - Tumor progression
  - Pseudoprogession
  - Pseudoresponse
- Possible to differentiate?
Introduction

- GBM is the **MC primary** malignant type of brain neoplasm

- Best imaging tool – **MRI with gad**

- Current standard of care is **surgery** followed by **RT** and concomitant and adjuvant **TMZ chemotherapy** (2005) - increases overall survival
Introduction

- Surgery and RT affect brain imaging appearances

- With newer treatments – TMZ, Bevacizumab, etc – newer patterns recognized on imaging

- Macdonald criteria – tumor progression > 25 % in 2D size of the contrast enhancing lesion

- Newer RANO criteria – accounts for non-enhancing component
Post surgery FU

Recurrence
First FU - 20 day post surgery
Enhancement ..

- Is it tumor residual?
- Is it tumor re-growing?

OR

- Is it something else happening?
Imaging - salient points

- Contrast enhancement reflects **status of BBB**

- Surrounding non-enhancing T2 hyperintensity is **not all edema**!

- Contrast **enhancement** in post treatment tumors is **rather non-specific** and can be due to many reasons – not only tumor progression!
Increased contrast enhancement
Non-tumoral processes

- Treatment related inflammation
- Post-surgical changes
- Ischemia
- Subacute radiation effects
- Radiation necrosis

- Microischemic lesions after surgery / RT can cause BBB disruption – can enhance for weeks to months after
Of infarctions and enhancements
Radiation injury

- **Acute** = during and immediate

- **Sub-acute / Early delayed** = up to 12 weeks after RT ends
  - Vasodilation / BBB injury / edema

- **Late delayed** = within few months to years
  - Blood vessel damage – ischemia – necrosis
  - Increased capillary permeability - edema
When to image?

- First scan post ttm will be baseline for future comparisons

- Within **first 48 hours** (at the most 72 hours) – the ttm effect enhancements have not set in and is good for residual tumor assessment
First follow up scan – new baseline

- Ideally within 48 hours, not more than 72
- Looking for:
  - Surgery bordering changes – ‘expected’ surgical changes or more? - ischemia, hemorrhage,
  - Any other adverse findings – distant effects – ischemia, hemorrhage
  - Residual tumor
How to image?

- CT – post – quick check for adverse findings – hemorr, infarction

- MRI
  - DWI
  - GRE/MPGR/SWI
  - Pre and post T1 images – 3D / 2D
  - T2
  - FLAIR
Case 1 pre-surgery
Case 1: post-surgery baseline
Case 1: post-surgery baseline
Case 1: post-surgery baseline
Case 1:

Checking DWI beyond stroke is important
Case 2: GBM, Surgery in Jan 2018, TMZ + RT

March 2018  |  June 2018  |  Aug 2018

Pseudoprogression
Pseudo-progression

- **Subacute** ttm-related reaction +/- clinical deterioration
- First few weeks - 6 month / 60 % within 3 months
- Increase in CE lesion size shortly after completion of RT – stabilizes and decreases over time without further ttm
- Mimics tumor progression

- Pronounced local tissue reaction + inflammatory component, edema, increased vessel permeability – enhancement
- Represents active ‘inflammatory’ reaction against tumor!
- Pts with methyl-MGMT-prom show more pseudo-progression
Pseudo-progression

Clinical dilemma is:
- Continue same?
- Change to second line ttm?

Attempts to differentiate are important!
Differentiation techniques -

- **Diffusion** – a) DWI  b) DTI
- **MR Spectroscopy** – low NAA, high cho, lipid-lactate
- **Perfusion** – DSC surrogate marker for neoangiogenesis
  - PsP – decrease in rCBV vs Tumor – increase in rCBV
- **Permeability** DSC – still being evaluated
- **PET** sensitivity / specificity also remains low

- **Follow up** still remains the most practical / Bx may be needed!
GBM, resected → recurrent

Bevacizumab

Cediranib

Aug

Sep

No real overall survival benefits!
Pseudo-response!

- Anti-angiogenic agents
- Produce a rapid decrease in enhancement by restoring BBB
- **Imaging improvement is fast – CAUTION!**
- With or without clinical improvement
- High response rate / 6-month progression free survival

- Tumor finds a way to expand without angiogenesis – vessel co-option
Recurrent tumor

Treated with antiangiogens
Of Diffusion and Perfusion

- Restricted diffusion reflects cellularity and may show infiltrative tumor tissue in the edema

- Increased blood volume seen in tumor as versus edema
Summary: Glioma post treatment MRI

- Careful interpretation – enhancements can be tricky!
- Awareness of:
  - Pseudo-progression and pseudo-response imaging signs
  - Pseudo-progression vs progression techniques available
  - Limitations of techniques
- Follow up is the best answer yet
Case 3: GBM, Surgery - apr 10, 2018

April 10

April 13

August 03

Pseudoprogession or tumor growth?

Follow-up imaging
Delayed radiation injury

- Few months to several years after radiation
- Necrosis triggered by ischemia secondary to blood vessel damage and increased permeability - edema