Interrater Agreement Using the VASARI Lexicon for Glioblastoma Characterisation with Raters of Varied Experience

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Disclosure

The authors have no financial disclosures or conflicts of interest with the presented material in this E-poster.
Introduction

**Glioblastoma** is the most common malignant brain tumor in adults, with only 15 months median survival.\(^1\)

Tumor MRI features can correlate with outcomes, with **tumour enhancement** and **necrosis** key indicators of poor prognosis.\(^2-4\)

The Visually AccessAble Rembrandt Images (VASARI) lexicon, an established set of 24 imaging features, aids standardisation of glioma MR reporting.\(^5\)

Previous work has relied on **expert rater agreement**, typically the same research dataset (TCGA\(^2-3\))

**Study Aim:** Through the use of a regional cohort of glioblastoma cases, we anticipated that agreement of some significant VASARI features could be reproducibly achieved with non-expert raters

Figure 1. Satellite lesions in right temporal glioblastoma
Methods

Proven glioblastomas presenting serially through a regional neuro-oncology center from 2012-2015 were included. Raters were blinded to molecular diagnosis and clinical outcomes.

Index MRIs (across seven hospitals / radiology departments) were included if FLAIR, diffusion, pre- and post-contrast T1w sequences (ideally volumetric) were available.

A novice / non-expert rater (clinical medical student) was familiarised with PACS and the VASARI lexicon, by use of a training set of cases. MRIs were then assessed using all 24 VASARI imaging features, including bi-dimensional lengths.

These MR studies were independently rated by a neuroradiology fellow and an expert neuro-oncology neuroradiologist (10 years’ experience) using VASARI criteria as well.

Interrater agreement was assessed using intraclass correlation coefficients (ICC).
Results: Rater agreement

116 MRI studies were included.

Excellent agreement (ICC>0.8) was recorded by all raters for a number of structural tumor features including:

- location (VASARI feature 1, ICC=0.90)
- side (F2, ICC=0.92)
- size (F29, ICC=0.92; F30, ICC=0.91)
- enhancing tumor crossing midline (F23, ICC=0.86)

Figure 2. Enhancing tumor involving corpus callosum and crossing midline
Results: Rater agreement

**Good agreement** was recorded for other structural and some imaging features:

- eloquent cortex involvement (especially motor and visual centres; F3, ICC=0.71)
- corpus callosum invasion (F21, ICC=0.69)
- proportion of enhancing tumor (F5, ICC=0.66)
- proportion of edema (F14, ICC=0.71)
- multifocal (F9, ICC=0.70) or satellite lesions (F24, ICC=0.75)
- ependymal invasion (F19, ICC=0.79)

*Poster #39365*
Results: Interpretational features

While not significant across all raters, some features had higher agreement between the neuroradiologists* including:
- necrosis
- hemorrhage
- diffusion abnormalities
- deep white matter invasion

* one way ANOVA inter-item correlation p=0.001

Figures 4a / 4b (above). ADC and DWI sequences demonstrating central restricted diffusion in right frontal glioblastoma

Figure 5 (right). T2W sequence with peripheral focus of hemorrhage in right frontal glioblastoma
Discussion

Many VASARI features, particularly gross **structural** features, can be reliably assessed by novice readers (with **limited training**) on real-world data.

Some complex, **interpretational** features (e.g. diffusion characteristics, hemorrhage) appear reliant on more neuroimaging expertise.

Analysis with **matched molecular and outcomes** data is planned to identify whether VASARI features in clinical cohorts provide useful diagnostic or prognostic biomarkers, as reported for TCGA / TCIA data.

Non-expert raters can reproduce standardised visual features, which could facilitate imaging biomarker research and pragmatic clinical applications, including **large scale reference** groups for machine learning and radiomics.
Summary

Structural VASARI features can be reliably assessed by non-expert raters.

Complex image interpretation still requires neuroradiology experience.

Some of these non-expert features may have diagnostic and prognostic correlations, permitting large scale and efficient comparisons for future machine learning and radiomic glioblastoma studies.
References


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