Accuracy of MRI in predicting Extramural Vascular Invasion (EMVI) in patients with locally advanced rectal cancer

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BACKGROUND: MRI PROGNOSTIC FEATURES

Rectal cancer management is **complex** and is based on a wide **range of factors**.

- These factors include TNM staging, performance status, and prognostic features such as **circumferential resection margin (CRM)** and **extramural vascular invasion (EMVI).**

MRI-detected prognostic features can influence rectal cancer treatment decisions.

- **CRM involvement** and a **positive EMVI status** supports the use of **neoadjuvant therapy** prior to **surgical resection.**

Accurate detection of these features is therefore of critical importance.

- **NHS Grampian** achieved higher accuracy rates for the detection of CRM on MRI compared to the standards set by the MERCURY study group (2006).
- No **current standards** exist for **EMVI reporting rates**.

BACKGROUND: EMVI

- EMVI is defined as the invasion of the extramural veins beyond the muscularis propria (Figure 1).
- A positive EMVI on MRI is associated with an increased risk of **distant metastasis** and **poor survival**, thus supporting the need for neoadjuvant therapy.
- MRI-detected EMVI correlated well with histopathological EMVI, however histopathology remains the gold standard.

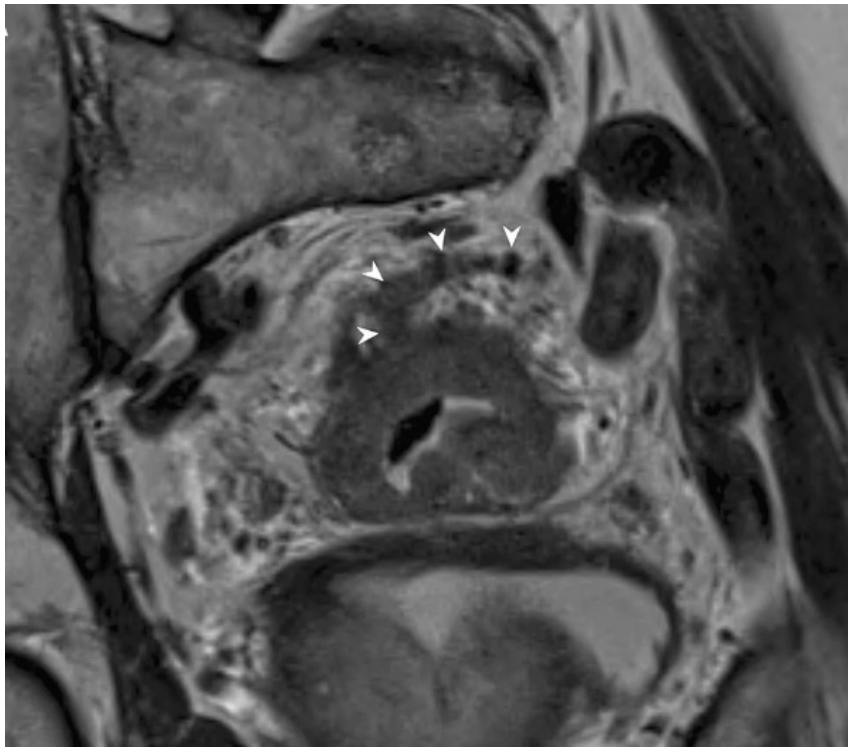
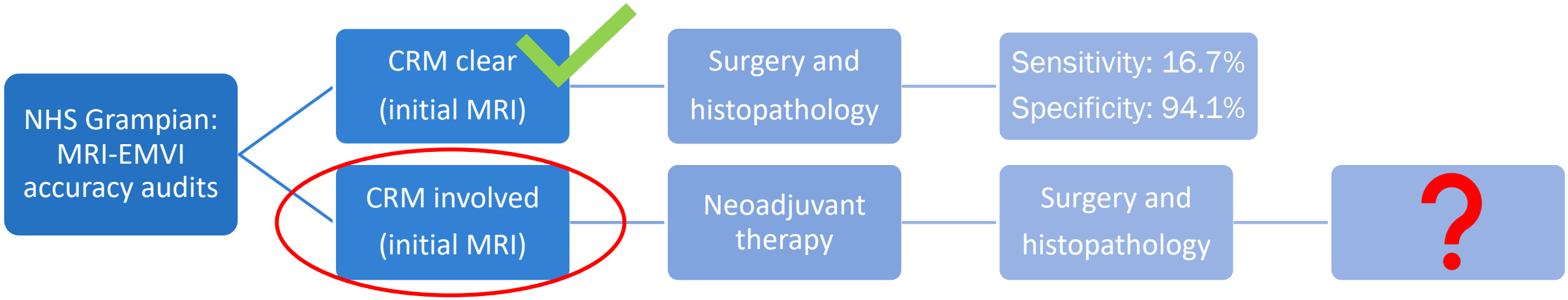


Figure 1. Histologically positive EMVI depicted in a high-resolution T2-weighted MRI image (white arrowheads). Adapted from Ali et al (2019).

AIMS

In NHS Grampian, we previously performed an audit to evaluate the accuracy of MRI in detecting EMVI in patients with a **clear CRM**. In this current audit, we aimed to:

1. Assess the accuracy of EMVI detection on MRI in patients with an involved CRM, using **histopathology as reference standard.**
2. Identify challenges in assessing the EMVI status on MRI post-downstaging treatment.



METHODOLOGY: AUDIT STANDARD

Data from previous studies

No current standards exist for MRI EMVI reporting rates.

Following a literature review, we identified the most recent **meta-analysis** (Kim et al., 2019).

This meta-analysis showed that MRI had a pooled **sensitivity** of **61%** and **specificity** of **87%** for detecting EMVI.

Assessing local practice

Indicator: MRI detection of EMVI

Population: patients with **involved CRM** on the initial staging scan, subsequently treated with neoadjuvant therapy.

Comparator: MRI-EMVI status post-downstaging compared to final histopathology.

Target: 61% sensitivity and 87% specificity

METHODOLOGY: APPROACH

1. Patients who underwent rectal resections for colorectal cancer between **September 2018 to August 2021** were identified.

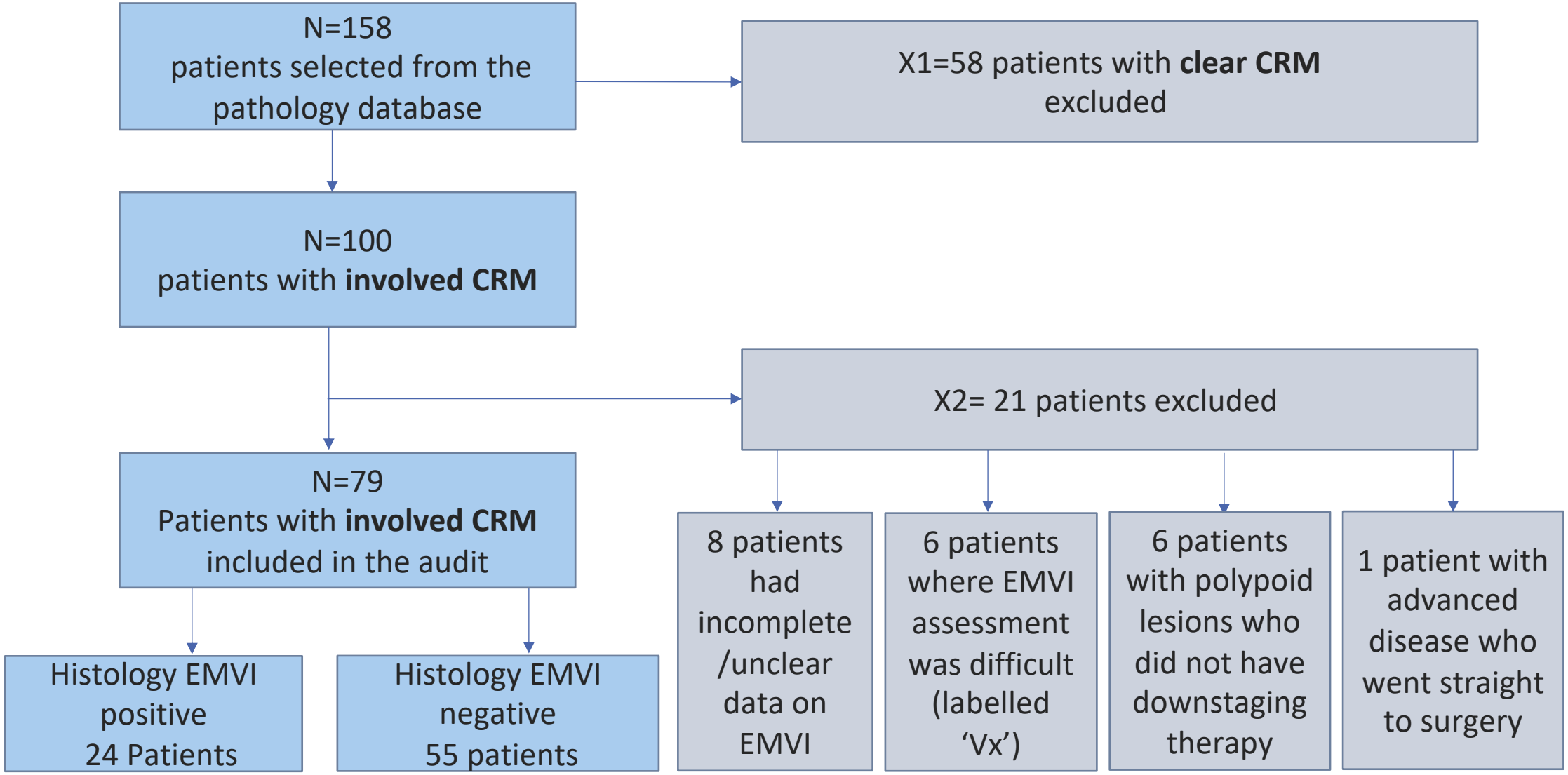
2. Patients with an involved CRM on the initial staging MRI were selected.

3. We excluded cases with incomplete EMVI data and patients who did not have neoadjuvant therapy prior to surgical resection.

4. The EMVI status on histopathology and MRI was recorded. The EMVI status on the scan performed **after neoadjuvant therapy** was compared with the **histopathology result**.

5. The cases with discrepancies between MRI and histopathology were reviewed.

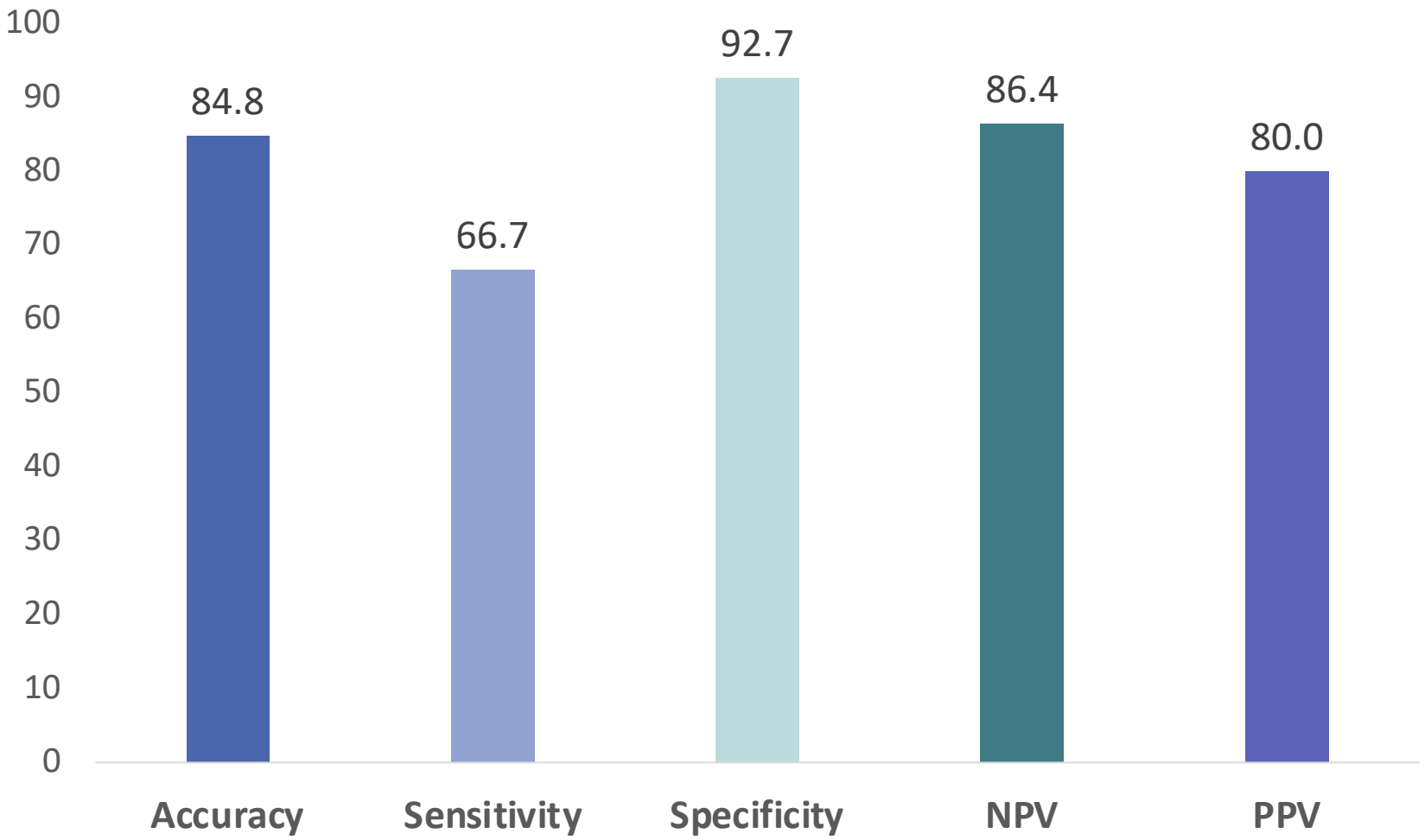
METHODOLOGY: PATIENT SELECTION



RESULTS: EMVI DETECTION CONTINGENCY TABLE

MRI \ Histology	Positive (Pathology)	Negative (Pathology)	
Positive (MRI)	16 (True Positive)	4 (False Positive)	20 MRI EMVI positive
Negative (MRI)	8 (False Negative)	51 (True negative)	59 MRI EMVI negative
	24 pathology EMVI positive	55 pathology EMVI negative	TOTAL=79

RESULTS: MRI PERFORMANCE PARAMETERS FOR EMVI DETECTION (%)



NPV: negative predictive value

PPV: Positive predictive value

RESULTS: MRI EMVI POSITIVITY RATE BEFORE AND AFTER NEOADJUVANT THERAPY

	Initial MRI (pre-neoadjuvant therapy)	**Pre-surgical MRI (post-neoadjuvant therapy)**
Patients with positive EMVI	60	20
Patients with negative EMVI	19	59
EMVI + rate	**75.9%**	**25.3%**

DISCUSSION: OVERALL RESULTS

MRI achieved a good diagnostic performance in detecting EMVI in patients with an involved CRM.

- **Specificity and sensitivity** exceeded the **target** compared to the meta-analysis by Kim et al. (92.7% > 87%; 66.7% > 61%)
- **Accuracy, negative predictive value** and **positive predictive value exceeded 80%.**
- **12 discrepancies overall,** including 8 false negative cases and 4 false positive cases.

The EMVI positivity rate was higher on the initial staging MRI compared to the scan performed after neoadjuvant therapy. This indicates effective response to treatment.

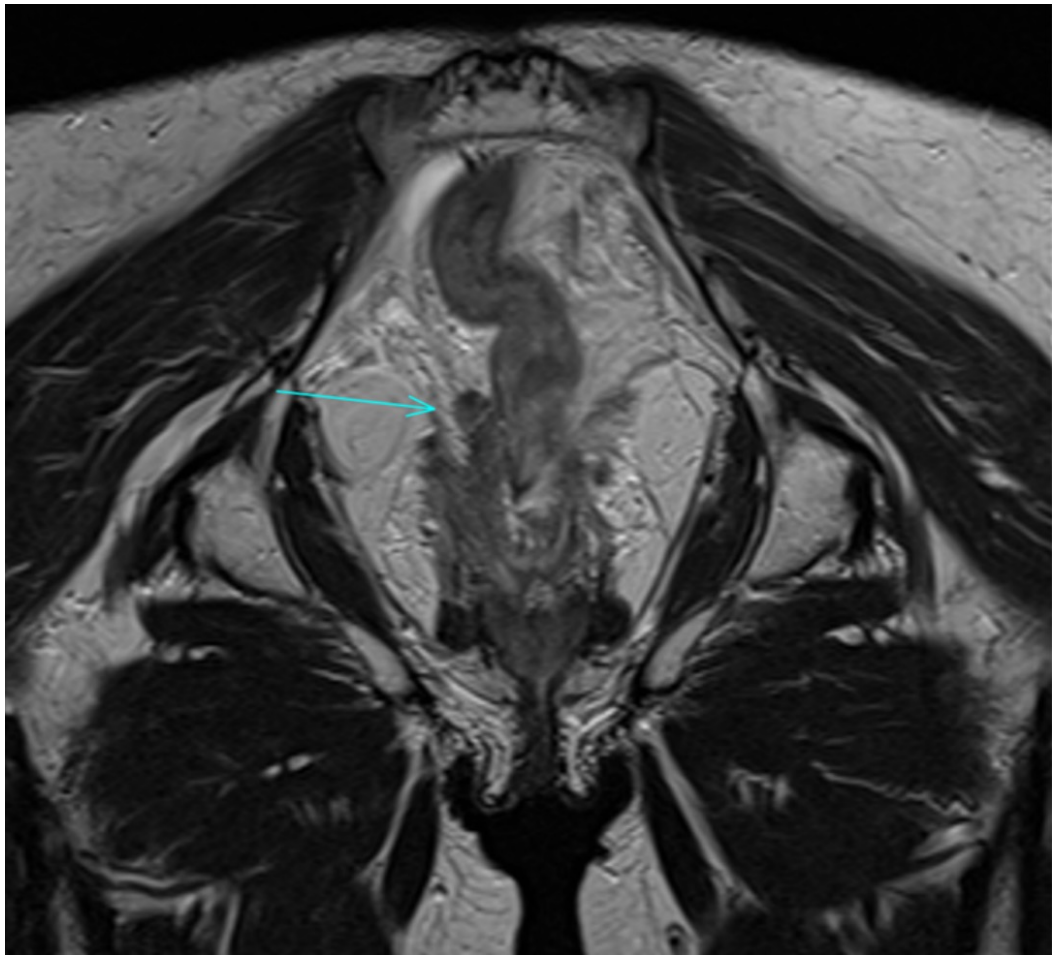
DISCUSSION: Discrepancies & challenges in identifying EMVI on post-treatment MRI

One of the challenges in the interpretation of MRI-EMVI was **difficulty in differentiating EMVI from post-neoadjuvant therapy fibrosis.**

In case 1 and 2, the initial MRI images showed positive EMVI.

Following neoadjuvant therapy, MRI demonstrated fibrotic changes, however EMVI was positive on histopathology.

DISCUSSION: discrepancies & challenges in identifying EMVI on post-treatment MRI



The above case highlights the challenge in **differentiating EMVI from nodular-shaped tumour deposits** (EMVI misinterpreted as tumour deposits or malignant lymph node).

DISCUSSION: RECOMMENDATIONS

Action plan	Organise an educational session highlighting challenging cases with corresponding learning points.
	Present findings at Colorectal and Pathology CMEs.
	Re-audit in 2-3 years.