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Endometriosis: Does the menstrual cycle affect magnetic resonance (MR) imaging evaluation?

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ABSTRACT

Purpose: To determine if the menstrual cycle affects MR interpretation in patients with pelvic endometriosis.

Materials and methods: Thirty-one patients with either laparoscopically proven endometriosis, or a high clinical suspicion of deep infiltrative endometriosis, were prospectively recruited from May 2008 to October 2009 and January to June 2012. Two pelvic MR scans were performed for pre-operative planning; during menses and the other mid-cycle. Two experienced radiologists independently assessed image quality and disease extent. Both were blinded to patient identity, previous imaging and menstrual status. Interobserver agreement was assessed using the Kappa (k) test. Descriptive statistics were prepared using chi-squared (or Fishers' exact) tests and Mann–Whitney (rank sum) tests to assess for significant differences between menstrual and non-menstrual imaging.

Results: Interobserver agreement for image quality was moderate for T2 weighted imaging ($k = 0.475$, p-value <0.001) and substantial for T1 fat saturated imaging ($k = 0.733$, p-value < 0.001), with no significant difference in image quality between menstrual and non-menstrual scans (all p-values > 0.255). Readers demonstrated at least moderate interobserver agreement for certainty level of endometriosis at site-specific locations, with median k 0.599 (IQR 0.488–0.807). No significant difference in disease extent was observed between menstruating and non-menstruating scans (all p-values > 0.05).

Conclusion: Findings suggest no significant differences in image quality, disease extent or disease severity between menstruating and non-menstruating MR; thus, timing of pelvic MR for assessment of endometriosis need not be influenced by the menstrual cycle.

1. Introduction

Endometriosis is one of the most common diseases in women of childbearing age, with an estimated prevalence between 5 and 15% [1,2]. Although first described by Thomas Cullen in 1908, the term "endometriosis" was not officially coined until 1927 by John A. Sampson [3]. It is defined as the presence of endometrial tissue outside the uterine cavity [2]. Symptoms are variable depending on the site of involvement, ranging from no symptoms to severe pelvic pain and other symptomatology including dyspareunia, dyschezia, dysmenorrhoea and urinary manifestations. Additionally, endometriosis has an important association with infertility, with up to 50% of women with endometriosis experiencing fertility issues [2].

Pelvic MR is increasingly utilised in the pre-operative assessment of endometriosis. A recent meta-analysis demonstrated that pelvic MR has high sensitivity and specificity in predicting the diagnosis of deep infiltrating endometriosis (DIE) [4]. MR provides an excellent overview of disease extent and is highly accurate in the assessment of DIE [5–10], particularly for those lesions deep to adhesions.

Clinical assessment of endometriosis is optimally performed during menstruation, as it is thought that disease is more active and implants are more likely to be large and tender at this time [2,11]. However, the optimal timing for pelvic MR in the assessment of

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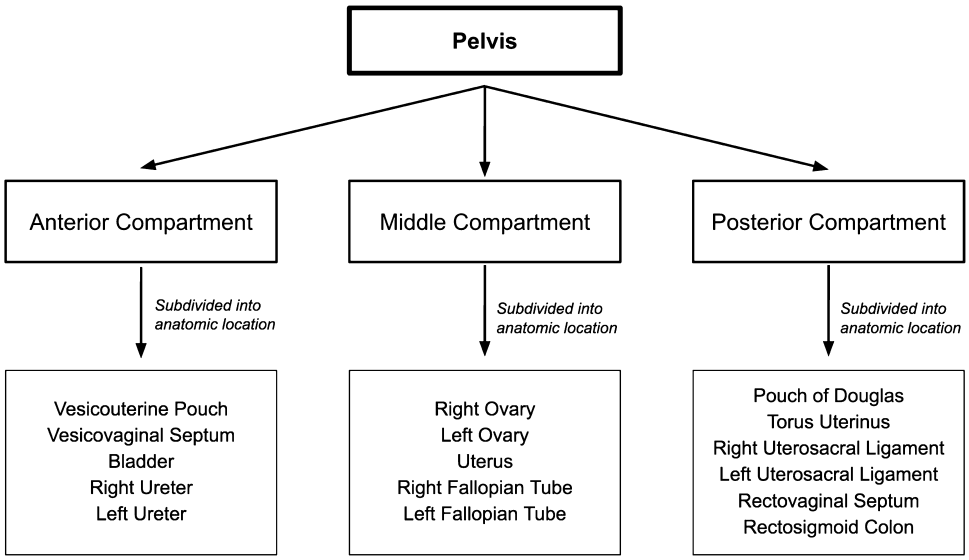

Fig. 1. Division of the pelvis for MR assessment. The pelvis was divided into three compartments, which were further subdivided into specific anatomic locations as described in the flow chart.

endometriosis is uncertain. No studies to date have addressed the effect of the menstrual cycle on MR interpretation in the setting of known endometriosis. The literature presents conflicting recommendations with regard to the optimal timing of MR, with no studies to support the recommendations suggested. Some authors report that MR is best performed early in the menstrual cycle in order to detect small haemorrhagic foci [10], others report mid-cycle scanning as optimal to ensure maximal T1 hyperintensity of endometriotic blood [12], whilst others perform imaging independent of the menstrual cycle [6,13].

The purpose of our study was to determine if MR interpretation of endometriosis is affected by the menstrual cycle and whether recommendations regarding the optimal timing of MR assessment can therefore be suggested.

2. Materials and method

2.1. Study group

Ethics approval was obtained from the two institutions of practice and in accordance with National Health and Medical Research Council (NHMRC) guidelines. Thirty-one patients (median age 32 years; range 22–45 years) were recruited from May 2008 to October 2009, with a second recruitment phase from January to June 2012, with a pause in recruitment from 2010 to 2011 due to a lack of study funding. Inclusion criteria were adult patients with a laparoscopically proven diagnosis of endometriosis or high clinical suspicion of DIE of the posterior pelvic compartment with possible rectosigmoid bowel involvement. Clinical suspicion of DIE was based on patient symptoms and/or abnormal pelvic examination findings. Laparoscopically proven endometriosis was diagnosed in 27/31 patients (87.1%), with 4/31 patients (12.9%) having a high clinical suspicion of disease. Exclusion criteria included contraindications to MR imaging, medical treatment for menstrual suppression or amenorrhea for any other reason. All patients met the inclusion criteria and provided informed consent. All patients underwent two pelvic MRs, one performed at day 1–3 of the menstrual cycle, and the other mid cycle. The median time interval between the studies was 17 days with an interquartile range (IQR) of 14–56 days.

2.2. MR technique

All MR images were acquired at 1.5 T (Siemens Avanto, Germany) using a standardised protocol. Patients were positioned supine with a phased-array surface coil. All patients received 20 mg of intravenous hyoscine butylbromide (Buscopan) just prior to imaging, to minimise bowel peristalsis.

High-resolution 3D T2 weighted images (T2WI) were obtained in the coronal plane (repetition time [TR] 1500 ms/echo time [TE] 131 ms; field of view [FOV], 400 mm; section thickness, 1 mm; matrix 384 × 384) with 3 mm thick three plane reformats in the axial, coronal and sagittal planes; axial T1-weighted imaging (T1WI) (TR 546 ms/TE 9.3 ms; FOV 320 mm; section thickness, 7 mm; intersection gap, 1 mm; matrix 224 × 320) and three-plane T1 fat saturated imaging (T1FS) (TR 724 ms/TE 9.6 ms; FOV 220 mm; section thickness, 4 mm; intersection gap, 0.4 mm; matrix 269 × 384). Intravenous contrast [2,14] and rectal contrast [7,8,15] were not administered in accordance with previous literature.

2.3. Image analysis

Two radiologists (SE, NY) experienced in pelvic MR imaging, with a sub-specialty interest in endometriosis, independently analysed the images in random order to avoid sequential reading. The readers were blinded to patient clinical information, menstrual status and previous imaging.

A scoring sheet (link: http://goo.gl/forms/OqScz57tfd) was devised to record each reader's assessment of image quality and certainty level of endometriosis at multiple sites within the pelvis, with additional information recorded at specific sites. For assessment, the pelvis was divided into three anatomic compartments: middle, posterior and anterior compartments as described by previous authors [13,16], with each compartment further subdivided into specific anatomic sites (Fig 1).

Both readers independently recorded overall (T2 and T1FS imaging) and site-specific image quality using a two-level categorical variable with a rating of non-diagnostic (classified as artifact that results in imaging that is not clinically useful or of borderline clinical utility) or diagnostic (classified as either no artifacts or minor artifacts that do not adversely affect clinical use). A reason for non-diagnostic image quality was recorded.