MEDICAL IMAGING—VIEWPOINT

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Is ultrasound sufficient in detecting adenomyosis as pre-procedure work-up for uterine artery embolisation? An audit in the community setting

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Introduction

Adenomyosis is a benign uterine disease due to the presence of ectopic endometrium and stroma in the myometrium and associated myometrial hyperplasia and hypertrophy,[1] typically causing menorrhagia and dysmenorrhea. Although adenomyosis is found in 40–70% of hysterectomy specimens[2] and in 80–90% of women with endometriosis,[3] the diagnosis is far less often diagnosed clinically.[3] A previous prevalence study using transvaginal ultrasound (TVUS) has reported adenomyosis in up to 20.9% of women presenting to general gynaecology clinics.[4] One previous meta-analysis has shown magnetic resonance imaging (MRI) is 5% more sensitive than TVUS (77% vs. 72%) in diagnosing adenomyosis.[5] A more recent meta-analysis showed contradictory results with TVUS being more sensitive than MRI (81% vs. 71%).[6]

However, it is the clinical impression that in our real-world practice, a high percentage of TVUS missed the diagnosis or mis-interpreted adenomyosis as leiomyoma. This could lead to inappropriate choice of uterine artery embolisation (UAE) particle size and embolisation endpoint resulting in suboptimal outcome.[7] Missing adenomyosis might also lead to inappropriate use of endometrial ablation to treat adenomyosis. Without recognising the presence of adenomyosis, women might not be forewarned of their reduced fertility potential and potential pregnancy related complications.[8] Therefore, it is important to document the sensitivity of TVUS and highlight its limitations in diagnosing adenomyosis.

The purpose of this audit is to review the sensitivity of ultrasound to detect adenomyosis, in real-world practice at the community level, against MRI for severely symptomatic patients undergoing uterine artery embolisation (UAE).

Methods

The study cohort consists of women who had undergone UAE for symptomatic adenomyosis. Between January 2017 and March 2022, 270 women underwent uterine artery embolisation (UAE) as an alternative to hysterectomies, having exhausted all other conservative management options. They were referred to our joint clinic (gynaecology and interventional radiology) with severe menstrual issues (menorrhagia and/or dysmenorrhea) and were diagnosed with adenomyosis.

The diagnosis of adenomyosis was based on MRI findings interpreted by an interventional radiologist with a special interest in adenomyosis. MRI diagnosis of

Table 1. Pre-UAE MRI findings in 169 women underwent UAE for adenomyosis

MRI adenomyosis diagnosis type	No of patients (n = 169)
Diffuse	124 (73.4%)
Focal	30 (17.8%)
Mixed	14 (8.3%)
Cystic	1 (0.6%)
Presence of fibroid(s)	**No of patients (n = 169)**
Pure adenomyosis (no fibroids)	113 (66.9%)
Fibroid(s) present	56 (33.1%)

adenomyosis was based on previously published criteria: junctional zone thickness of ≥12 mm or >40% of myometrial thickness, or the presence of T2 hyperintense cysts/foci/fissuring. The type of adenomyosis (diffuse, focal, mixed or cystic) and coexistence with fibroids were noted. Pre-UAE MRI findings are summarised in Table 1.

Medical records were reviewed, searching for previous pelvic ultrasound reports. If these were not found, further attempts were made to retrieve the ultrasound reports by contacting patients, referrers or imaging service providers. TVUS reports that were within 12 months of the MRI were available from 169 women.

TVUS reports were reviewed by the research team. Only patients with TVUS reports within 12 months of the MRI study were included in the audit. Ultrasound diagnosis was deemed positive for adenomyosis if the following terms were used in the report: 'diagnostic of, consistent with, suggestive of, suspicious of'. The ultrasound diagnosis was deemed negative for adenomyosis if the term adenomyosis was not mentioned or if a focal lesion was misinterpreted as fibroids.

The sensitivity of TVUS in detecting adenomyosis was hand calculated using MRI as the gold standard.

The sources of TVUS reports are grouped into general imaging providers or specialist women's health imaging providers. The sensitivity of the two groups were compared, and Fisher's exact test was applied to the data.

The study was approved by the local Human Research Ethics Committee.

Results

TVUS reports are summarised in Tables 2 and 3. TVUS identified adenomyosis diagnosed on MRI in 87 (51.5%) women (Tables 2,3) (Figs 1,2). TVUS sensitivity dropped to 35.7% when fibroids were present, compared with 59.3% when no fibroids were present (Fig. 3). TVUS sensitivities for focal and diffuse adenomyosis were 41.4% and 57.1% respectively. The ultrasound reports were from 43 specialist women's health imaging providers and 126 general imaging providers. Specialist women's health imaging providers performed better than general imaging providers (74.4% vs. 43.2%, $P < 0.001$).

Table 2. Real-world performance of TVUS in detecting adenomyosis using MRI as 'Gold' standard: overall

Ultrasound reports	Number of patients, n = 169
Did not mention adenomyosis	32 (18.9%)
Mistaken for fibroids	50 (29.6%)
Suspicious of adenomyosis	75 (44.4%)
Definitive for adenomyosis	12 (7.1%)
Total	169

Table 3. Real-world performance of TVUS in detecting adenomyosis using MRI as 'Gold' standard-difference between women's imaging facilities and general imaging facilities

Adenomyosis	Women's imaging	General imaging
Identified	32	55
Missed	11	71
% Identified	74.42%	43.65%
95% CI	59.76–85.07%	35.31–52.37%
P-value*	0.00068	

**P*-value derived by applying Fisher exact test.

Discussion

The result of this audit confirmed our clinical impression of the very poor performance of TVUS in detecting adenomyosis in real-world practice at the community setting. This contrasts with the previously published meta-analyses[5,6] suggesting similar and comparable diagnostic performances between TVUS and MRI. We postulate that research data were generated from academic centres with special interest in adenomyosis looking for the more subtle signs on TVUS. The meta-analyses were based on diagnostic performance studies with completely different patient populations and study designs better designed to estimate diagnostic performance but the studies included in the systematic reviews were also heterogeneous.[6]

It is well accepted that TVUS is more operator dependent than MRI. Lack of awareness and experience of the sonographer and sonologist/radiologist in community settings were likely to have contributed to the poor performance. This was also reflected in this study that specialist gynaecology ultrasound service providers performed better than general radiology service providers.

Newly published revised MUSA (Morphological Uterus Sonographic Assessment) features might help to improve TVUS performance.[9] However, the signs remain subtle and the improved performance of MUSA against MRI is yet to be confirmed (Figs 2,3).

When leiomyoma is present, TVUS performed much worse (Fig. 3). This was previously documented in a meta-analysis[5] and comparative studies.[10] The presence of fibroids can obscure the subtle sonographic features and distract the sonographer's attention. Focal adenomyosis/adenomyoma can be misinterpreted as leiomyoma.

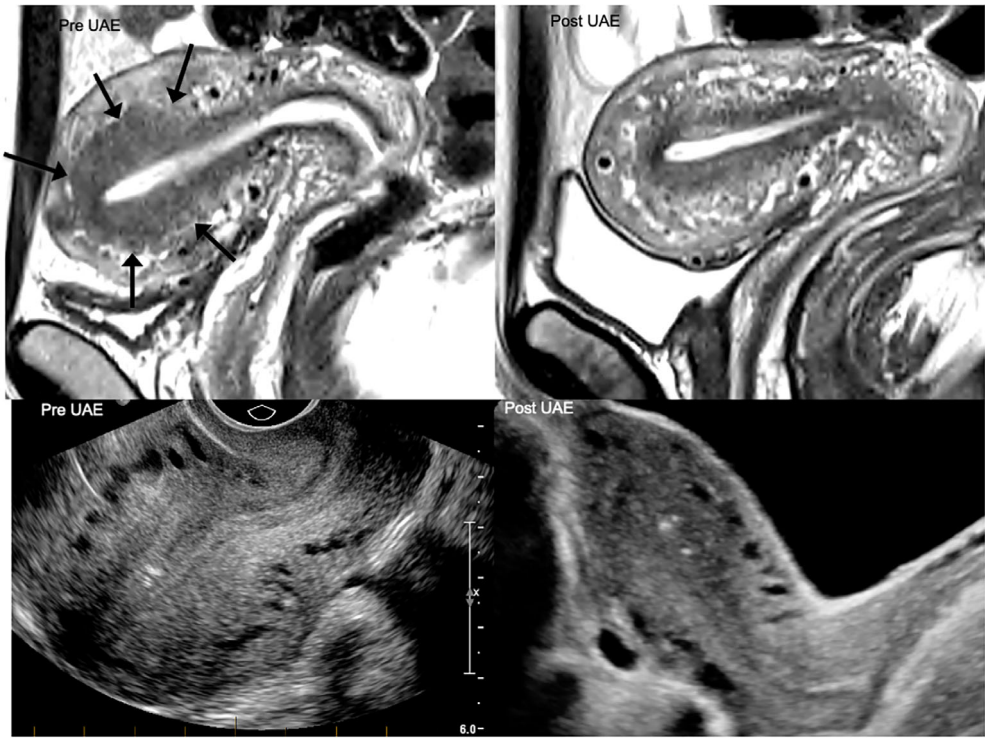

Fig. 1. Diffuse adenomyosis missed by TVUS. A 40-year-old woman para 3 presented with severe heavy menstrual bleeding and dysmenorrhea, failing Mirena IUD but would try to avoid hysterectomy. UAE was performed achieving satisfactory clinical outcomes. Initial TVUS (bottom left) reported 'a bulky uterus', yet Pre-UAE MRI clearly demonstrated thickening of the junctional zone (black arrows) which normalised after UAE (top right). Note the prominent arcuate veins, as this patient also had pelvic congestion syndrome that were subsequently treated successfully with ovarian vein embolisation.

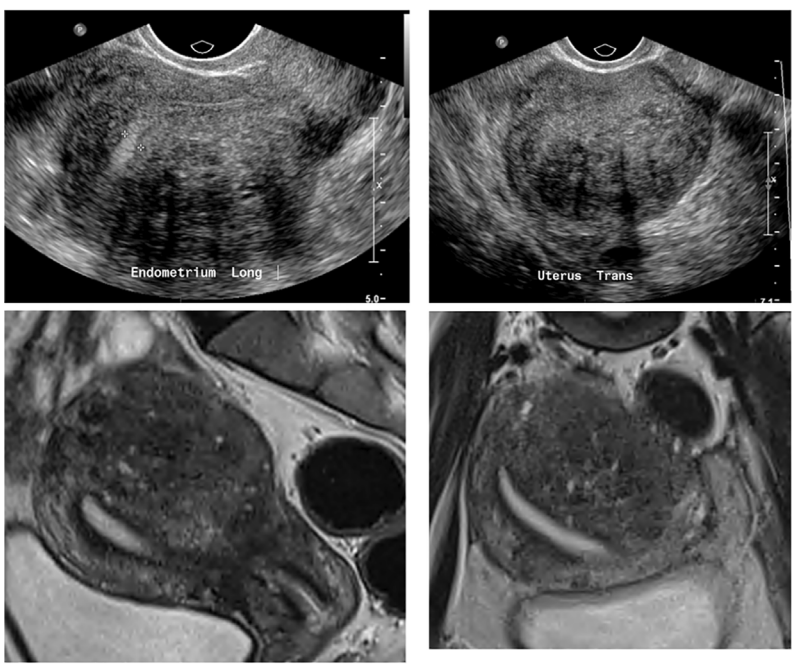

Fig. 2. Focal adenomyosis mis-interpreted as fibroid. A 43-year-old woman para 2 with heavy menstrual bleeding and dysmenorrhea referred for UAE. Initial ultrasound reported a posterior wall fibroid, although Venetian artefacts and microcysts were present, indicating focal adenomyosis. MRI clearly demonstrated the multiple T2 hyperintense foci representing ectopic endometrial tissue in a poorly defined posterior wall T2 hyperintense lesion causing postural wall thickening.

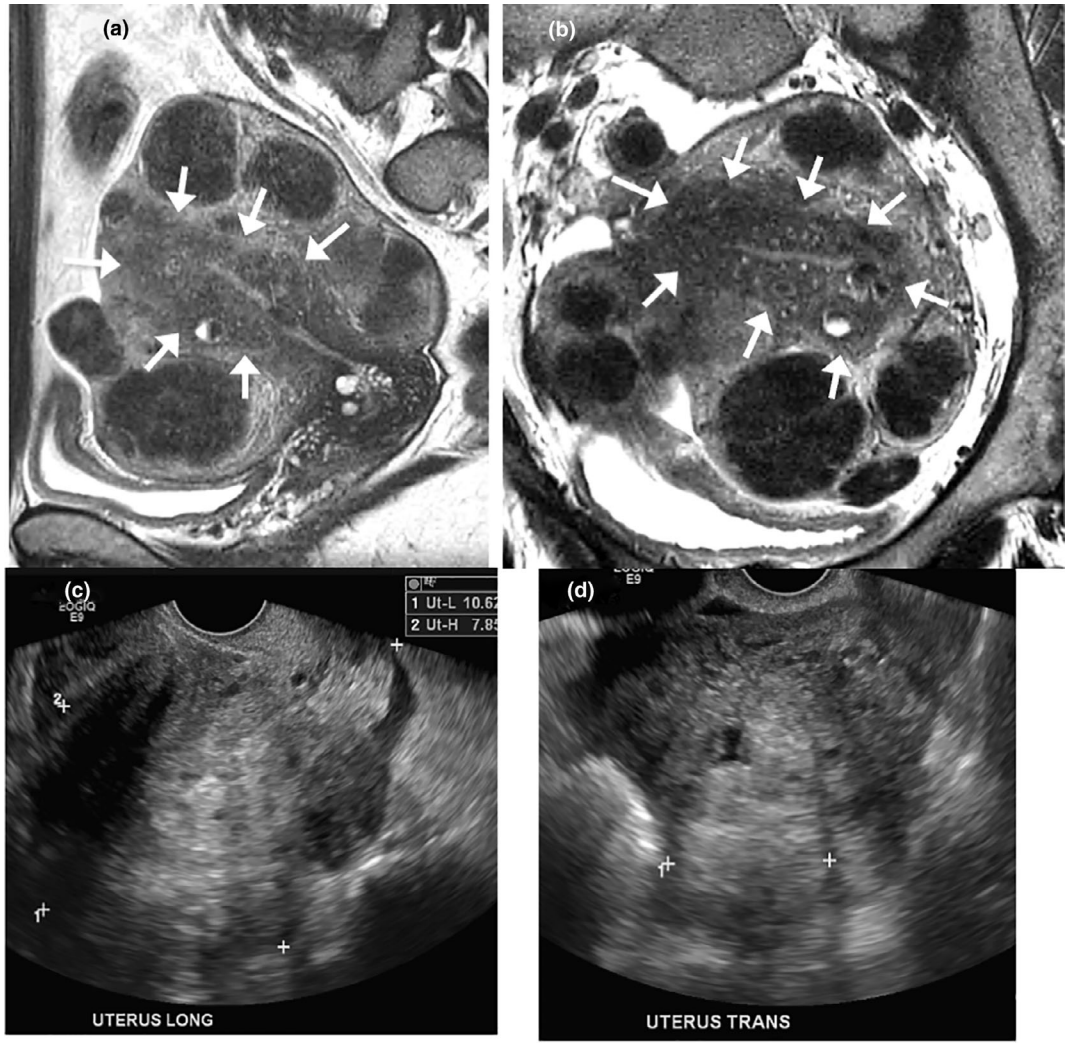

Fig. 3. Missed adenomyosis among multiple fibroids. A 39-year-old para 0 with history of multiple surgeries for uterine fibroids, ongoing heavy menstrual bleeding, referred for fibroid embolisation. On MRI (a and b), the irregular thickening of junctional zone (white arrows) with numerous tiny T2 hyperintense spots and cystic lesion with fluid–fluid level can be easily visualised to establish the diagnosis of adenomyosis, among the multiple fibroids which are further out in the myometrium. TVUS a few days prior to the MRI (c) and on several previous occasions reported multiple fibroids only. The subendometrial cystic lesion was not recognised as adenomyotic lesion (d).

The distinction between adenomyoma and leiomyoma on MRI is much easier[11] (Fig. 2).

Mis-interpreting adenomyoma as leiomyoma, or missing co-existing adenomyosis when planning for UAE could be detrimental. Studies have suggested a different technical protocol using smaller size particles with a harder endpoint might achieve a better UAE outcome for adenomyosis.[7] UAE for adenomyosis with leiomyoma tends to have better results than pure adenomyosis.[12] While there is plenty of evidence to suggest possible pregnancy following UAE for leiomyoma,[13] there is to date very scanty literature to document successful pregnancies after UAE for adenomyosis. Adenomyosis has a negative impact on fertility and pregnancy outcome. Missing adenomyosis can result in women going through IVF cycles without knowing the potential negative impact and suffering repeated pregnancy losses without knowing the reasons.[8]

Mis-interpreting adenomyosis as leiomyoma might lead to futile attempts to resect the lesion completely. Unlike leiomyoma, adenomyosis is an infiltrative disease without clear boundary and therefore cannot be enucleated like a leiomyoma.[14]

Missing adenomyosis can result in inappropriate selection of endometrial ablation as treatment for women with menorrhagia, resulting in more pain and ineffective reduction of menstrual flow.[15]

There are several shortfalls and limitations from this study. We did not aim to study the true sensitivities and

specificities of the imaging modalities that require pathological proofs. The sensitivity of TVUS was calculated assuming MRI as the gold standard rather than pathology. The specificity of TVUS could not be evaluated as we did not have normal cases in our cohort.

Nevertheless, this audit did highlight the inadequacy of TVUS in the community setting, in detecting adenomyosis in a cohort of severely symptomatic patients seeking an alternative to hysterectomy. Sadly, MRI for the diagnosis of adenomyosis is not currently funded by Medicare, unless it is for investigation of infertility.

Without access to MRI to accurately diagnose adenomyosis, women might continue to suffer from severe heavy menstrual bleeding and debilitating dysmenorrhea without a proper diagnosis. Women might not need to be subjected to invasive yet inappropriate laparoscopy or hysteroscopy, if MRI is more widely available for the investigation of painful heavy bleeding from adenomyosis. Adenomyosis has its pathology within the uterine wall and is usually undetectable by these invasive surgical procedures. Missing adenomyosis might result in women being treated with endometrial ablation resulting in more pain, or be put through cycles of expensive IVF without being aware of the reduced success rate.[16]

Early diagnosis of adenomyosis has a huge impact on many facets of management of this common but underrecognised condition said to affect 10% of the women population.[2-4] Radiologists can play a pivotal role by advocating for access to MRI to improve the diagnosis and management of adenomyosis within the women's health medical community.

In conclusions, TVUS in the community setting performed poorly in detecting the presence of adenomyosis in severely symptomatic women, especially when fibroids were present, and therefore might lead to incorrect selection of UAE protocol and suboptimal UAE outcome. MRI should be part of pre-UAE assessment, especially when adenomyosis is suspected clinically. Access to MRI could be pivotal in the appropriate management of many facets of adenomyosis.

Funding information

There was no external funding source.

Data availability statement

The research data are available for review if required.

Ethical approval

The study was approved by the local ethics committee: Adventist HealthCare Limited Human Research Ethics Sub-committee (HREC) on 28 November 2022. AHCL Reference ID: 2022-027.

Informed consent

All patients have consented for their data to be used for clinical research and audit.

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