Diagnosing adenomyosis using transvaginal ultrasound in current practice: a scoping review and service evaluation.

Abstract

Background

A departmental audit identified a case of adenomyosis which had not been reported, highlighting the need to assess if the current service provision is adequate in identifying patients with (possible) adenomyosis and how improvements in this part of the service could be made.

Aim

To assess if sonographers are effectively identifying and reporting adenomyosis on transvaginal ultrasound.

Methodology

A scoping review and retrospective service evaluation was undertaken which included (n=79) adult female premenopausal patients with symptoms of adenomyosis who had undergone a transvaginal ultrasound scan during the first quarter of 2023. Patients were identified using the CRIS statistic module according to pre-defined inclusion and exclusion criteria. All data was anonymised and collated to include the patient age, referral information (symptoms), scan report and sonographer. The scan report and archived images were evaluated using the sonographic signs identified by the Morphological Uterus Sonographic Assessment (MUSA) group (Harmsen *et al*., 2022), then compared to the original report.

Results

21.5% (n=17) of patients had signs of adenomyosis on image review, but only 23.5% (n=4) of these were reported as such. The majority (n=8) of unidentified cases were reported as having a 'heterogeneous myometrium'. Inter-rater agreement ranged from 50-100%.

Conclusion

Most ultrasonic diagnoses of adenomyosis were not identified in our service which is likely due to a lack of internationally agreed criteria for ultrasound diagnosis of adenomyosis preventing adequate reporting.

Key words: TV US, uterus, abnormal uterine bleeding, ectopic endometrial glands, service improvement.

Introduction

Adenomyosis is a common, benign gynaecological condition defined by the presence of ectopic endometrial glands within the myometrium[1]. Diagnosis can be difficult due to varying and often non-specific symptoms; however, women often present with pain, abnormal uterine bleeding, and issues with fertility[2]. Disease prevalence can range wildly from 5 to 70% based on histological confirmation, however on imaging alone is around 20-30%[3]. Adenomyosis is typically thought to affect older women of reproductive age, with key risk factors being number of prior pregnancies, previous uterine surgery, and advancing reproductive age, however, thanks to advances in radiological techniques, younger women are increasingly being diagnosed with the condition[3]. Diagnosis, previously reliant on histopathology after hysterectomy, is now made using non-invasive imaging such as transvaginal pelvic ultrasound and pelvic magnetic resonance imaging (MRI)[3], and management is frequently based solely on those findings[4]. Despite this, there are no internationally recognised guidelines which have been fully implemented within U.K. practice at the time of writing clearly defined ultrasound criteria for diagnosing adenomyosis.

A departmental audit on non-obstetric ultrasound examinations highlighted a clear case of adenomyosis where the report did not describe any sonographic signs of this or offer adenomyosis as a diagnosis or differential diagnosis; appearances were described as 'fibrotic change'. Historically, non-specific heterogeneous myometrial appearances with lack of clearly defined focal areas have been incorrectly reported in this way to describe the presence of fibroids[5]. The aim of this service evaluation, therefore, is to assess if sonographers across the service are effectively identifying and reporting adenomyosis on transvaginal ultrasound.

A scoping review was conducted which found many studies on the sensitivity and specificity of ultrasound in the diagnosis of adenomyosis, however there is little research and no published audit or service evaluations regarding the identification and reporting of adenomyosis, with a lack of universally agreed guidelines and numerous sonographic signs of adenomyosis being well documented.

Method

This is a retrospective observational service evaluation assessing scan images and reports on adult female patients who underwent transvaginal ultrasound for possible symptoms of adenomyosis in the ultrasound department of one site of a district general hospital over a period of three months in 2023.

The basis of the image interpretation is taken from the MUSA group[6] findings and their sonographic signs (see image 1) as they are the most up-to-date version of their work, and the literature base widely acknowledges their previous findings. Reports were reviewed to ascertain the description of any relevant imaging characteristics and the presence of a diagnosis or differential diagnosis (where indicated) as per The Royal College of Radiologists (RCR)[7].

Image 1: Schematic of MUSA sonographic signs of adenomyosis
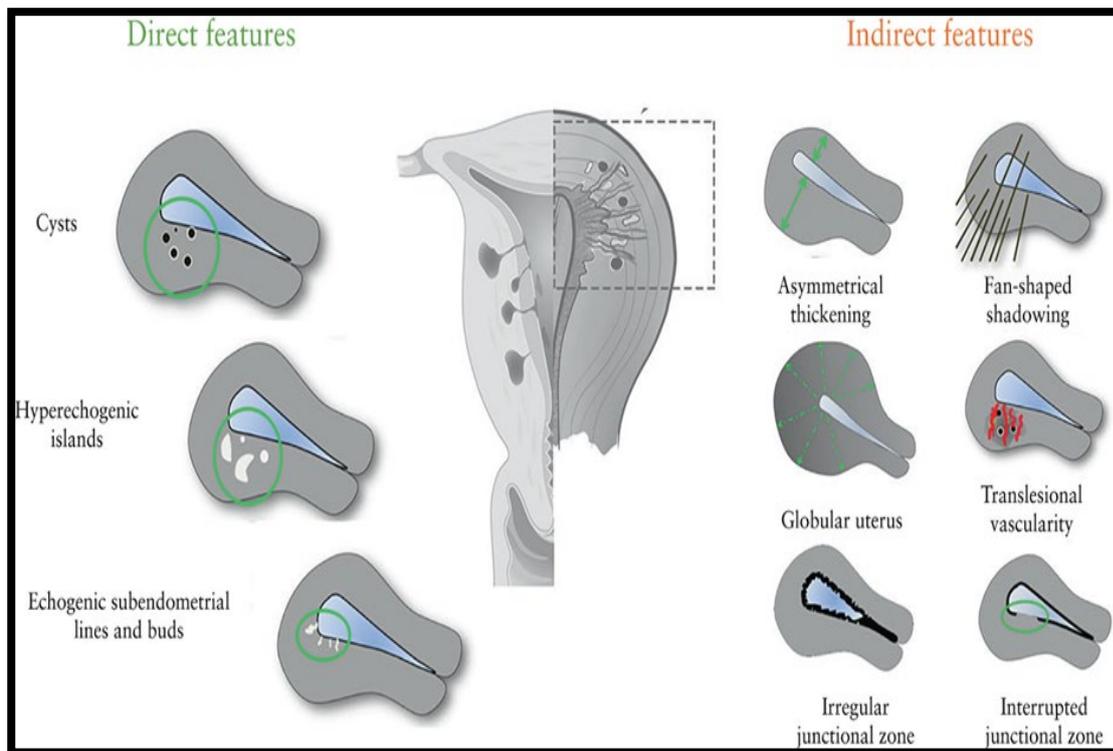
("Schematic representation of direct and indirect Morphological Uterus Sonographic Assessment (MUSA) features of uterine adenomyosis (not endometriosis), according to modified Delphi procedure" by Harmsen M, Van Den Bosch T, De Leeuw R, Dueholm M, Exacoustos C, Valentin L, Hehenkamp W, Groenman F, De Bruyn C, Rasmussen C, Lazzeri L, Jokubkiene L, Jurkovic D, Naftalin J, Tellum T, Bourne T, Timmerman D and Huirne J, available at https://obgyn.onlinelibrary.wiley.com/doi/10.1002/uog.24786, licensed under CC BY-NC-ND 4.0. https://creativecommons.org/licenses/by-nd/4.0/deed.en)

Ethics

This service evaluation was approved and registered with the Trust's research department (project number: 23-308). The Health Research Authority decision tool considered this study as non-research therefore formal ethical approval was not required as no patient identifiable data were collected.

Data abstraction tools

A pre-designed electronic data collection form comprising of three sections: extracted data, scan report evaluation, and researcher image evaluation was used. This form had been piloted on a sub-selection of the patients found and revised for more practical purposes to facilitate data inputting using the Microsoft Excel® spreadsheet list function.

Sample

Due to the methodological approach of this evaluation, non-random convenience sampling was used for ease and time constraints[8].

Patients were identified using the CRIS® (Computerised Radiology Information System) statistic module by searching for pre-defined inclusion criteria of which patients were then manually excluded for several reasons as this could not be done electronically. Pre-defined inclusion criteria included scan referrals for pelvic pain, abnormal uterine bleeding and fertility issues.

The search was limited to two specific scan rooms as they both had the newest and same equipment to limit imaging variability: GE Logic E10 with an IC5-9-D transvaginal ultrasound probe (GE Healthcare).

An age restriction of 18-55 years was placed on the search to help exclude post-menopausal patients and to limit any who may be on hormone replacement therapy (HRT) or have had a hysterectomy (not always documented in clinical history or on scan reports) as junctional zone appearances are impacted by age[9].

Patients scanned for retained products of conception, miscarriage, pregnancy, pelvic masses and haematomas were excluded as these can cause the same symptoms as adenomyosis[10,11,12] therefore it is important to distinguish between them and those patients with (possible) adenomyosis[13]. Patients who were postmenopausal and/or on HRT or had had a hysterectomy were also excluded.

All examinations were performed by sonographers due to radiologists not performing this type of scan at this site. Sonographer post-qualification scanning experience ranged from 4 months to over 30 years. No restriction was placed on sonographer experience or expertise, as this does not reflect current day to day practice. Only symptomatic patients were included for this service evaluation, to assess for the presence of adenomyosis from clinical presentation[14].

The search identified 126 patients, and each patient was then assessed by a single researcher to exclude any using pre-defined exclusion criteria. Upon reviewing the data other non-relevant scan indications were found and added to the exclusion criteria to include scan for coil position, as this implies that the patients are asymptomatic and the presence of adenomyosis is not in question as well as coild potentially having an impact on uterine assessment[10], along with follow up for large cysts, multiple large fibroids and hydrosalpinx as these can also have symptoms consistent with adenomyosis[10,11,15].

Flow chart to demonstrate exclusion process

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┌─────────────────────────────────────┐
│ Search identified (n=126) patients   │
│ following pre-defined search criteria │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│ Did any meet pre-defined exclusion   │
│              criteria?               │
└─────────────────────────────────────┘
         │                    │
         ▼                    ▼
┌──────────────────┐   ┌──────────────────┐
│ Yes:             │   │ No:              │
│ HRT (n=9)        │   │ (n=93)           │
│ Haematoma (n=3)  │   └──────────────────┘
│ RPOC (n=6)       │
│ Miscarriage (n=1)│
│ Pelvic mass (n=2)│
│ Pregnant (n=3)   │
│ Hysterectomy (n=3)│
│ Post-menopausal (n=6)│
└──────────────────┘
         │
         ▼
┌─────────────────────────────────────┐
│ Did any meet post-defined exclusion criteria? │
└─────────────────────────────────────┘
         │                    │
         ▼                    ▼
┌──────────────────┐   ┌──────────────────┐
│ Yes:             │   │ No:              │
│ Coil position (n=1)│  │ (n=79)           │
│ Large cysts (n=5))│  └──────────────────┘
│ Multiple fibroids (n=6)│
│ Hydrosalpinx (n=2)│
└──────────────────┘
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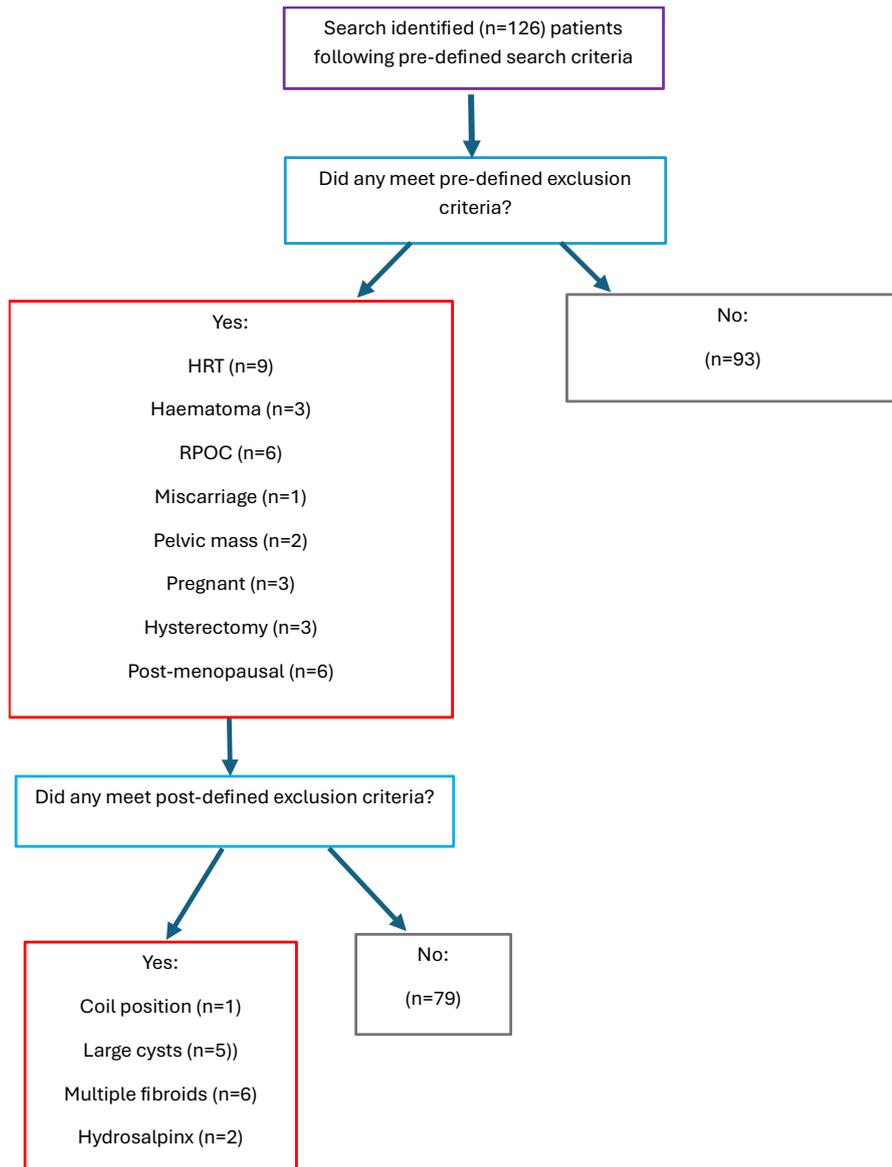
Data abstraction

The data output from the CRIS statistic module was generated into an Microsoft Excel® spreadsheet and then data was abstracted from this independently by the author. Aggregated data was anonymised by assigning each patient and sonographer a number preventing any re-identification. For the first component on the form, extracted data, the following clinical elements were collected:

1. Patient age

2. Referral information

3. Referral location

4.   Ultrasound report

5.   Performing sonographer

The sonographer who performed and reported the examination was included to evaluate inter-rater agreement and to identify possible knowledge gaps.

The second component, scan report evaluation, looks at whether the scan report free text offers adenomyosis as a diagnosis or not (yes/no), and if any of the sonographic signs identified by the MUSA group[6] or through the literature review (e.g. heterogeneous, question-mark sign) were documented (yes/no) and which ones.

For the final component, researcher image evaluation, scans were then reviewed on the Patient Archiving and Communication System (PACS) to assess for any sonographic signs as identified by the MUSA group[6]. As Ultrasound is considered a dynamic study this was an element to consider in the overall evaluation, therefore the whole examination was assessed to optimise analysis. Findings were then compared to the scan report to determine whether there was any correlation or not (yes/no) and if adenomyosis was offered as a diagnosis accordingly (yes/no). Overall image quality was not assessed due to time constraints and there being no obvious need from the audit findings.

Data management

Data collection concerned computerised medical records only and was stored on the Trust's network, which is both safe and secure. All local information governance policies were adhered to and collected in accordance with European General Data Protection Regulations 2018.

Data

An explanatory type of mixed methods approach was used for comprehensive evaluation of the findings and due the nature of the study[8]. No incomplete records were found within the secondary data eliminating any issues with completeness and accuracy and therefore any potential bias which may arise from this.

Data analysis

Quantitative data obtained in this service evaluation is demonstrated using both bar and pie charts as it is numerical (age) and categorical (age range, yes/no) in nature[16]. Qualitative data was coded and condensed into themes and categories[16].

Coding

For the purposes of data analysis, symptoms identified from the referral information were categorised into pain, bleeding, or fertility issues, or any combination of the three, as free text options are harder to assimilate[16].

Sonographic signs and any combination thereof within the scan report evaluation and researcher evaluation were individually categorised, along with pertinent comments documented verbatim[16].

Statistical analysis

Descriptive statistical analysis was performed to summarise and describe results using graphs and tables[17]. Basic analysis was conducted using Microsoft Excel® Data Analysis function to glean the most from the information[17].

Inter-rater agreement

Percentage agreement was used to assess for inter-rater agreement as deemed adequate for the nature of the study and small sample size[18]. Statistical analysis was attempted however calculation of Cohen's K was only possible with three sonographers due to some results being constants primarily on the sonographer's part and therefore deemed inadequate for valid interpretation of results[18].

Pilot Study

This study was not piloted due to time constraints and the issue with re-using data in such a small sample.

Results

A total of 79 patients were included in this study, along with 12 sonographers. The patient age ranged from 19 years to 55 years, the mean age being 35.4 years (see image 2). Adenomyosis was identified upon review in almost all age ranges, with a high proportion being 40-44 years of age. Pain was the most commonly reported symptom given within the clinical information. All patients were referred from within the Trust. No referral specifically posed the clinical question of '? Adenomyosis.'

Image 2: Bar chart demonstrating patient age with findings of adenomyosis on scan review.

[insert image 2]

Sonographers

Identification and reporting of adenomyosis.

17 (21.5%) of patients were identified as having signs of adenomyosis on review of the ultrasound images. Of those 17, only 4 (23.5%) were formally reported as such (see image 3).

Image 3: Proportion of patients identified as having signs of adenomyosis on scan review in relation to those reported as having signs of adenomyosis.

[insert image 3]

There is a marked difference in the number of total scans performed by the sonographers, with sonographer 6 having scanned the most patients (20) and sonographer 7 the fewest (1). Agreement between the original reports by each sonographer and the retrospective image review showed agreement rates ranging from 50-100% (see image 4).

Image 4: Overall agreement between scan reports and the evaluation.

[insert image 4]

There were 4 cases of adenomyosis reported on the original scans. Of these, 2 were scanned by sonographer number 5, 1 by sonographer 6, and 1 by sonographer 2. Out of the 13 cases identified as having adenomyosis on scan review but not on the report, scans were performed by 8 of the 12 sonographers.

The 4 patients reported as having adenomyosis were all experiencing pain, yet those with the disease only identified upon scan review presented with pain (6), bleeding and pain (5), and bleeding (2).

Inter-rater agreement

Percentage agreement varied across all sonographers and does not appear related to the number of scans performed. Sonographers 6 and 5 performed the most scans yet had only 80 and 85% agreement, respectively. By contrast, sonographers 1, 12 and 7 did the fewest scans, and had agreements of 67, 50 and 100%, respectively.

Discussion

Most cases of adenomyosis were not identified. Known limitations to this were reduced by using good quality equipment and removing the possible impact of large fibroids. Despite being new ultrasound machines, they lacked 3D functionality,

however the lack of use of 3D imaging reflects general practice and therefore gives a truer reflection on the state of the service.

Guidelines

Guidelines for professional ultrasound practice[19] in place at the time of the service evaluation describes several sonographic signs of adenomyosis and explicitly states that adenomyosis has been misdiagnosed as 'early fibroid change'.

The National Institute for Health and Care Excellence guidance[20] is the only other formal document discussing the role of ultrasound in the investigation of women with suspected adenomyosis and supports the use of transvaginal ultrasound but only when certain criteria are met. There are also no references to how this is diagnosed on ultrasound.

Findings

Patients

In this study, patient specific findings such as prevalence of disease (21.5%) and the higher proportion of 40–44-year-olds identified as having adenomyosis on review, reflects current literature[21,22].

All scan requests were made from within the Trust, suggesting some level of prior Gynaecological review or referral. The lack of any specific clinical questions regarding adenomyosis within the clinical information may be a significant contributor to the low accuracy of adenomyosis reporting seen[23]. Additional evidence for this negatively affecting sonographic diagnoses is that the higher detection rate on review, suggesting that the author, when reviewing the images, was 'primed' to be looking for features of the pathology. This stresses the need for referrers to state potential diagnoses in the clinical information, and for sonographers to be vigilant to ultrasound signs in keeping with adenomyosis, irrespective of whether the diagnosis is suggested by the referrer.

Effective Diagnosis

Interpretation of the findings is compounded by the lack of officially agreed criteria on the ultrasonic diagnosis of adenomyosis, however current U.K. ultrasonic professional guidance does refer to a good proportion of the signs reported by the MUSA group[6].

Knowing that subendometrial lines and buds is highly specific for adenomyosis and that it has also been found to be the most reliable ultrasonic sign, the Society of Radiographers (SOR) and British Medical Ultrasound Society (BMUS) guidance[19,24]

does not include it as a diagnostic criterion for adenomyosis, and also does not note the need to specify why the appearance is heterogeneous. SoR/BMUS guidance[19] also explicitly states that describing uterine appearances as early fibrotic change has led to misdiagnosis of adenomyosis, which can be demonstrated in this service evaluation. Missed diagnoses were not attributable to one or two individuals, showing a generalised knowledge gap, likely due to the lack of accepted diagnostic guidelines.

Guidance[19] in place at the time of the service evaluation uses a reference from 2011, which could be argued is out of date, especially with the increasing amount of current literature available on the topic.

Identification and reporting of adenomyosis.

Sonographic signs

The four reported cases of adenomyosis from the original reports were made by just three sonographers: 6, 5 and 2. For one of these patients, adenomyosis was offered as a diagnosis but none of the signs given by the MUSA group[6] as seen in image 1 were identified. In this case the myometrium was described as 'heterogeneous', with the suggestion of 'adenomyosis or fibrotic change' despite the lack of fibroids seen (scanned by sonographer 2).

One other interesting case is where the sonographer (sonographer no.6) identified ultrasonic signs yet did not state a diagnosis/possible diagnosis of adenomyosis. Knowing that the sonographer is aware of the condition and has reported it (as seen within the results), the author asks why the diagnosis was not made in this instance. The difference with their other patient in which adenomyosis was reported, is that two sonographic signs were seen compared to just one, suggesting a greater confidence in the possible diagnosis with the more features seen. This is further supported by the fact that the single sign identified was 'globular uterus', an indirect sonographic sign. There is no consensus on the minimum number of signs seen to make a diagnosis, or the relative importance of direct versus indirect signs, yet it is generally considered that the more signs there are the stronger the diagnosis. Despite this, one could still argue identifying any number of signs should prompt a possible diagnosis to be offered.

Depending upon the interpretation of the RCR guidance[7], the describing of the signs could be a way of offering, indirectly, a diagnosis of adenomyosis. To add to this, from the authors personal experience and knowledge, providing a diagnosis/differential diagnosis is not as common a practice in sonographer report writing despite current guidance. Some historical teaching advising not to make comments like this but to just describe what is seen, so this could also explain why adenomyosis was not explicitly stated. If we take this patient into account, it could be

deemed that five out of 17 (29.4%) of cases of adenomyosis were identified, making at best, 70.6% not having been identified.

On review, the reports which failed to describe or diagnose adenomyosis, most features seen which were not described are indirect signs which should be easier to identify[6]. Moreover, looking at figure 12, the signs which were correctly identified on the original reports are all indirect signs of the disease, suggesting that, at least for those individuals, sonographers have sufficient skill and awareness to identify the signs. It is therefore unclear the discrepancy between cases where them specific signs were identified compared to those where non-specific or incorrect terminologies were reported.

For the twelve patients where there was no reference to adenomyosis or its signs, 8 (75%) were described as having a 'heterogeneous myometrium'. The scoping review acknowledges the prevalent use of the term 'heterogeneous', including the SoR/BMUS[19,24] guidelines which offer it as a descriptor. However, it is not recognised as a sonographic sign according to the MUSA group[25,26,6]. Conversely, a heterogeneous uterus was seen in 4 (7%) of the patients where there was no evidence at all of adenomyosis either on examination or review, reflecting the literature which indicates that it is a non-specific sign. This is supported by Krentel et al.,[27] who state that this appearance may lead the operator to the wrong diagnosis due to its lack of specificity. When seen, a heterogeneous myometrium should prompt assessment for other true sonographic signs identified by the MUSA group[6].

Four of the 12 (25%) reported fibroid(s) (either less than 5cm or nor more than 3 present) which are known to limit identification of ultrasonic signs of adenomyosis[27]. In two of the cases, the myometrium was described as heterogeneous, one of which demonstrated asymmetrical thickening upon review, and in the other two cases, fibroids alone were reported in relation to the myometrium which both demonstrated fan-shaped shadowing, so the fibroids could also explain these[28]. A further patient was described as having possible "early fibroidal changes".

Two (17%) patients had an intrauterine contraceptive device (IUCD) present. The presence of such devices is known to limit assessment of the endometrium[10] however these patients were included in the study as they presented with possible signs of adenomyosis and the presence of the coil does not mean that they may not have the condition. Out of these two patients, one was found to have an irregular junctional zone on review, therefore an identifiable sign was still able to be seen yet was overlooked on the original report.

Focusing on the eight sonographers involved in the scans where adenomyosis was seen on review but not reported or signs identified, three (37.5%) of these we know are aware of the condition and its appearance as they have reported it on other patients. This suggests that there may be other factors to consider.

For the other nine, the suggestion is that they are either not aware of the sonographic signs, or that they are but either did not know how to report them or just did not report them.

Images 5. Examples of sonographic signs on scan

a) Uterus which appears globular in shape with an irregular and interrupted junctional zone

b) Uterus with asymmetrical thickening

Inter-rater Agreement

Looking at the agreement between the sonographers and reviewer, there was marked variability across the sonographers.

In this service evaluation, percentage agreement can be relied upon to determine inter-rater reliability as it is assumed the sonographers were not guessing the presence of adenomyosis or not[18]. The minimum acceptable percentage agreement clinically is 80% with percentage agreement across all scans included within the evaluation good at 82.9%[18]. Where adenomyosis was offered as a diagnosis and seen on review, percentage agreement is low and unacceptable at 23.5%[18]. This would increase to 82.4% if the patients where adenomyosis was described and not diagnosed, those with a 'heterogeneous myometrium' and 'early fibroidal change' were included, highlighting the negative impact of the use of these non-specific and out-dated terminologies, presenting a clear target for intervention which could quickly affect large improvements in the efficacy of the service.

Limitations of ultrasound

Ultrasound is known to be limited by patient habitus[29]. Out of the twelve patients where adenomyosis was either not reported or signs documented, only 2 (17%) examinations were documented as being limited by habitus, suggesting that this was not a limiting factor in the results.

Strengths, limitations, and biases

The strengths of this study include: its structured and rigorous processes making it easy to replicate; reduction in imaging bias; and the inclusion of sonographers with varying experience which reflects current practice. Another key strength is that this is the only apparent study assessing how adenomyosis is diagnosed and reported upon within ultrasound.

There are many limitations to this service evaluation, mainly the small sample (especially as this has limited statistical analysis). Other limitations include

retrospective review; selection bias; reviewing of static images; data collection and analysis by one individual; lack of standard of refence for adenomyosis diagnosis; and that findings are not generalisable due to nature of study.

Conclusion

Ultrasound has a high specificity and moderate sensitivity in the detection of adenomyosis[3], so the implication is that it is the sonographer awareness/ability/expertise in identifying and reporting appearances is the key factor in the results of this evaluation.

The service is ineffective at identifying signs of adenomyosis or reporting this as a (potential) diagnosis when seen on transvaginal ultrasound. Main issues appear to stem around the correct terminology to use in relation to sonographic signs as seen with the use of 'heterogeneous myometrium' and 'fibrotic change' as well as the need to explicitly provide a diagnosis or potential diagnosis within the report.

As adenomyosis is typically diagnosed based on ultrasound findings alone, and the with the lack of official consensus on how this is done, it is important for referrers to state a clinical suspicion of adenomyosis, and for sonographers to recognise any signs and to document accordingly. As the MUSA group[6] findings are predominant in the literature and current, it is recommended that they be incorporated into current guidelines and practices.

Word count:3816

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