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Review Article

**SONOGRAPHIC ASSESSMENT OF CERVICAL CARCINOMA
IN FEMALE PRESENTING WITH ABNORMAL UTERINE
BLEEDING: A SYSTEMATIC REVIEW**

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INTRODUCTION:**Literature Review**

Sr. No.	Publication Year	Author Name	Title	Variables	Material & Methods	Results
1	2011	Ozgur Akbayir	Preoperative assessment of myometrial and cervical invasion in endometrial carcinoma by transvaginal ultrasound	Endometrial cancer Transvaginal ultrasound Myometrial invasion Cervical invasion	The data of 298 consecutive patients operated between January 2002–December 2010 with a diagnosis of endometrial cancer were evaluated retrospectively.	TVS can be considered as a feasible, economical and simple imaging modality with a high diagnostic accuracy for the prediction of cervical involvement.
2	2011	Juan Luis Alcázar	Three-dimensional ultrasound for assessing women with gynecological cancer.	Three-dimensional ultrasound Endometrium Ovary Cervix Cancer	Systematic review on previous studies	Three-dimensional ultrasound offers unique ways for assessing Women with gynecologic cancer. Current evidence shows that it is reproducible. It might be useful in some clinical circumstances. But in case of cervical cancer, there is little evidence to support its routine use in clinical practice.
3	2018	Wei Zheng	Contrast-enhanced ultrasonography vs MRI for evaluation of local invasion by cervical cancer	contrast-enhanced ultrasound MRI Cervical cancer remains	From June 2013 to September 2016, 108 patients with biopsy-confirmed cervical cancer were enrolled in this study and their clinical data retrospectively reviewed.	CEUS shows good concordance with MRI for evaluating local invasion of cervical cancer [parametrial, pelvic wall, uterine corpse, bladder and rectal], and potential for assessing tumour size. In addition, ultrasound is more convenient and less expensive than MRI. Thus, CEUS as well as convention ultra- sound may be suitable alternatives for staging cervical cancer and guiding brachytherapy.

4	2013	Jung Mi Byun	Three-Dimensional Transvaginal Ultrasonography for Locally Advanced Cervical Cancer	Cervical cancer, Three-dimensional transvaginal ultrasound MRI	Prospective study performed on 24 patients and compared preoperative clinical, magnetic resonance imaging [MRI], and ultrasonography findings with the histological results from surgery.	Preoperative 3D-TVUS may prove to be an excellent method for the evaluation of locally advanced cervical cancer. Transvaginal ultrasound also has advantages over MRI for the assessment of tumor volume and Doppler velocimetry and is a low-cost alternative. However, TVUS cannot identify nodal or distant metastasis
5	2016	Fiachra Moloney	Comparison of MRI and High-Resolution Transvaginal Sonography for the Local Staging of Cervical Cancer	cervical cancer staging MRI transvaginal ultrasonography	This was a prospective, operator-blinded, interdisciplinary study conducted at a university teaching hospital and regional cancer center for gynecologic cancer.	In conclusion, high-resolution TVS is a cost-efficient staging tool with a diagnostic accuracy rate comparable to that of MRI. The use of TVS may thus permit rapid and confident triage of patients into operative and nonoperative management groups in a gynecologic outpatient setting.
6	2010	E. Epstein	Sonographic characteristics of squamous cell cancer and adenocarcinoma of the uterine cervix	Adenocarcinoma cervical cancer Doppler ultrasound squamous cell cancer transvaginal sonography transvaginal ultrasound	cross sectional study	Study shows that the appearance of AC and SCC might be different when examined using ultrasound. Cervical tumors are quite often difficult to detect using grayscale ultrasound. They suggest that color Doppler should routinely be used in the assessment of cervical tumors. They believe that it is important to understand the sonographic features of different types of cervical tumors. This knowledge can help in the detection and assessment of tumors, in particular, of isoechoic AC and small-size tumors
7	2007	Carla A. Testa	Imaging techniques for the evaluation of cervical cancer	cervical cancer staging ultrasound magnetic resonance imaging computed tomography	Secondary data pf previous searches and published articles	Ultrasound has gained increased attention in the assessment of cervical cancer. Ultrasound is faster, cheaper, and more widely available than other imaging techniques, and requires no preparation of the patient. Transrectal and transvaginal ultrasound give detailed images of the cervical tumour, because

				positron emission tomography Improvements		the probe is positioned close to the tumour, which means that high-frequency ultrasound can be used.
8	2013	M.P. Schmid	Feasibility of transrectal ultrasonography for assessment of cervical cancer	Cervical cancer · Radiotherapy · Image-guided adaptive brachytherapy · Magnetic resonance imaging · Transrectal ultrasonography	It is retrospective study.	In this retrospective study, the feasibility of Transrectal ultrasonography [TRUS] for the assessment of local target extension in cervical cancer patients undergoing radio-chemotherapy and image-guided adaptive brachytherapy [IGABT] could be demonstrated in a heterogeneous patient cohort. Comparison of target width and thickness showed a high correlation between TRUS and MRI, indicating the potential use of TRUS for target definition in IGABT. Based on these first promising results
9	2012	P. BELITSOS	Three-dimensional power Doppler ultrasound for the study of cervical cancer and precancerous lesions	cervical cancer; cervical intraepithelial neoplasia; three-dimensional power Doppler [3D-PDU]	It was prospective observational study	In conclusion, their study assessed women with both precancerous lesions and cervical cancer and found significant differences in all 3D-PDU indices studied [VI, FI and VFI].
10	2012	Kallie Appleton,	Role of Ultrasound in the Assessment of Postmenopausal Bleeding	Postmenopausal bleeding Endometrial carcinoma, cervical carcinoma	case-based discussion of the most common differential diagnoses of postmenopausal bleeding	Color and pulsed Doppler ultrasound improves diagnostic accuracy because the endometrial and cervical carcinoma, and myometrial malignancy shows abnormal blood flow pattern due to tumor neovascularization. Contrast agents are another possibility for enhancing ultrasound examination by increasing the detection rate of small vessels.

11	2016	Smarandita Cotarcea	The Importance of Ultrasound Monitoring of the Normal and Lesional Cervical Ectropion Treatment	Ectropion, Ultrasound, Colposcopy, Cervical volume	A prospective study conducted in patients diagnosed and treated for congenital ectropion to investigate the importance of various ultrasound prognosis features, in order to create an effective algorithm for treatment monitoring	They conclude that ultrasound monitoring of ectropion treatment do not provide reliable prognosis data regarding the evolution of cervical lesion.
12	2014	Alca'zar Juan Luis	The Role of Ultrasound in the Assessment of Uterine Cervical Cancer	Ultrasound Cervical cancer Staging	current knowledge about the use of ultrasound for assessing uterine cervical cancer will be reviewed and discussed	In conclusion, current evidence suggests that ultrasound may be a useful technique for assessing local extent of disease in cervical cancer, even with higher accuracy than MRI. This technique is limited for assessing lymph nodes. The assessment of tumor vascularization by Doppler ultrasound is controversial. Most reports suggest that it could be useful for monitoring and predicting response to therapy.
13	2015	Daniela Fischerova	Ultrasound in Gynecological Cancer: Is It Time for Re-evaluation of Its Uses?	Ultrasound . Cervical cancer . Endometrial cancer . Ovarian cancer . FIGO staging .	Systemic Review study from last 5 years literature	Ultrasound is a reliable imaging modality, which is commonly available, non-invasive, inexpensive, and free of risk for the patient. Results of numerous studies published within the last 5 years, including international multicenter trials, showed that the ultrasound is an accurate procedure in diagnostics and clinical staging of pelvic gynecological malignancies.
14	2011	A. GAURILCIKAS	Early-stage cervical cancer: agreement between ultrasound and histopathological findings with regard to tumor size and extent of local disease	cervical cancer; cervical stroma invasion; parametrial invasion; pathology; transvaginal ultrasonography	observational study	Their results showed that transvaginal ultrasound examination can provide reliable information on all three factors [tumor size, location of stromal invasion and depth of stromal invasion] which are important in selecting the extent of surgery while clinical examination has limitations in revealing these parameters accurately.

						<p>Their results, together with those of other recent studies that have shown ultrasound examination to have a diagnostic performance similar to that of MRI for determining the size and local extent of cervical cancer suggest that ultrasound could be the first-line imaging technique for pretreatment evaluation of early cervical cancer. The relatively low cost of ultrasound examination and its widespread availability support this notion.</p>
15	2014	H. LIANG	Transvaginal three-dimensional color power Doppler ultrasound and cervical MVD measurement in the detection of cervical intraepithelial neoplasia	Color Doppler, Microvessel density, Cervical cancer, Cervical intraepithelial neoplasia	Randomized control trial study	<p>3D-CPA can be used to assess blood flow in the cervix. It is particularly useful for the early diagnosis of cervical cancer and CIN and for the postoperative follow-up of CIN. patients with cervical cancer using surgery or other treatment, whether the three-dimensional power Doppler ultrasound can be applied to the patient's follow-up.</p>
16	2012	MING C. TSAI	Office Diagnosis and Management of Abnormal Uterine Bleeding	abnormal uterine bleeding, conservative treatment, office diagnosis and management, menstrual disorder, minimally invasive procedure, heavy menstrual bleeding	Descriptive study	<p>Diagnosis and management of AUB still poses challenges to most gynecologists in their office practice. Available evidences suggest that a significant portion of patients with AUB can be diagnosed and managed in the office with currently available uterine-sparing treatment. TVS is an inexpensive, noninvasive, convenient way to indirectly visualize the endometrial cavity. Therefore, it is recommended as a first-line diagnostic instrument for assessing uterine pathology in reproductive age women presenting with AUB. The argument for using imaging study is based on the fact that organic pathology that may not be</p>

						obvious on physical examination may be the underlying cause of uterine bleeding. Ultrasonographic assessment is often an extension of the physical examination and can provide additional information affecting management decision
17	2019	Yael Goldberg	The added benefit of transvaginal sonography in the clinical staging of cervical carcinoma	cervical cancer, clinical staging, Doppler, positron emission tomography transvaginal sonography	A retrospective study of consecutive women diagnosed with cervical cancer. Inclusion criteria were histology of cervical cancer and the availability of three modalities—a thorough physical examination, a high-detail TVS, and positron emission tomography [PET] with 18F-FDG and computed tomography [18F-FDG PET/CT].	The combination of high-detail TVS, directed to predict tumor dimensions and local spread, performed by a trained operator, combined with 18F-FDG PET/CT and physical examination, can assist in selecting optimal treatment for cervical cancer patients, thus avoiding unnecessary operations.
18	2017	XIAOLAN LV	Correlation analysis between the parameters of contrast-enhanced ultrasonography in evaluating cervical cancer metastasis and expression of E-cadherin	Types of tissue Metastasis Pathological staging	Double-blind clinical experimental study	In conclusion, quantitative analysis of the results of contrast-enhanced ultrasonography can play a certain role in the determination of cervical cancer metastasis. The combined use of contrast-enhanced ultrasonography and E-cadherin expression can significantly improve the diagnosis and treatment of cervical cancer.
19	2018	Kolbrún	APILOT STUDYON DIAGNOSTIC PERFORMANCE OF CONTRAST-ENHANCED ULTRASONOGRAPHY FOR DETECTION OF EARLYCERVICALCANCER	Cervical carcinoma, Contrast-enhanced ultrasonography, [CEUS] Diagnostic accuracy, Filling pattern	Prospective cohort study	In conclusion, the CEUS parameters differ significantly between tumors and healthy cervical tissue.

20	2020	Dr. Meena Jain	TAS/TVS versus histopathological diagnosis in abnormal uterine bleeding: A comparative study	Abnormal uterine bleeding [AUB], adenomyosis, endometrial polyp, myoma, non-gravid	Randomized Control Trial Study	Transabdominal or transvaginal ultrasound is low cost primary modality for screening and should include as a first line screening method. Though the investigation and management of AUB among the non-gravid women was confusing, histopathological diagnosis proved to be the gold standard.
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SYSTEMATIC REVIEWS:

A retrospective study was performed on 298 patients operated between January 2002–December 2010 regarding Preoperative assessment of myometrial and cervical invasion in endometrial carcinoma through transvaginal ultrasound by Ozgur Akbayir in 2010. They concluded that TVS can be considered as a feasible, economical and simple imaging modality with a high diagnostic accuracy for the prediction of cervical involvement.[1]

A systematic review of 46 studies on Three-dimensional ultrasound for assessing women with gynecological cancer was performed after doing Medline search by Juan Luis Alcázar. Out of these 46 studies, six were focused on cervical carcinoma. They concluded by this study that Three-dimensional ultrasound is a new imaging technique that offers unique ways for assessing Women with gynecologic cancer. Current evidence shows that it is reproducible. It might be useful in some clinical circumstances. Further studies are needed to establish its role in clinical practice in gynecologic oncology. [2]

In 2018, Wei Zheng reviewed clinical data of 108 confirmed cases of cervical carcinoma retrospectively and compared Contrast-enhanced ultrasonography vs MRI for evaluation of local invasion by cervical cancer. They concluded that CEUS shows good concordance with MRI for evaluating local invasion of cervical cancer [parametrial, pelvic wall, uterine corpse, bladder and rectal], and potential for assessing tumour size. In addition, ultrasound is more convenient and less expensive than MRI. Thus, CEUS as well as convention ultrasound may be suitable alternatives for staging cervical cancer and guiding brachytherapy. [3]

In 2013, a study was performed by Jung Mi Byun on Three-Dimensional Transvaginal Ultrasonography for Locally Advanced Cervical Cancer. They compared the preoperative clinical, magnetic resonance imaging [MRI], and ultrasonography findings with the histological results from surgery. They found that with respect to cancer staging, accuracy was 62.5% with clinical examination, 40.9% with MRI, and 66.7% with TVUS. Magnetic resonance imaging demonstrated both low specificity [64.3%] and accuracy [68.2%] for nodal involvement. For the detection of parametrial invasion: sensitivity was 25% with clinical examination, 75% with MRI, and 75% with TVUS; specificity was 55.6% with MRI and 90% with TVUS; accuracy was 59% with MRI and 87.5% with TVUS. Preoperative 3D-TVUS may prove to be an excellent method for the evaluation of locally

advanced cervical cancer. Transvaginal ultrasound also has advantages over MRI for the assessment of tumor volume and Doppler velocimetry and is a low-cost alternative. However, TVUS cannot identify nodal or distant metastasis. [4].

A study was performed by Fiachra Moloney on the comparison of MRI and High-Resolution Transvaginal Sonography for the Local Staging of Cervical Cancer in 2016. They resulted that Both MRI and TVS had a sensitivity of 80%, a specificity of 50%, and a diagnostic accuracy of 63.6% for the detection of stromal invasion in early-stage disease. For the detection of parametrial invasion, they found sensitivity rates of 40% for MRI and 86% for TVS; specificity rates of 78.8% for MRI and 20% for TVS; and diagnostic accuracy rates of 89% for MRI and 78.7% for TVS. A matched-sample analysis revealed that there was no statistically significant difference between MRI and TVS in the assessment of stromal or parametrial invasion. So, it can be concluded from results that high-resolution TVS is a cost-efficient staging tool with a diagnostic accuracy rate comparable to that of MRI. The use of TVS may thus permit rapid and confident triage of patients into operative and nonoperative management groups in a gynecologic outpatient setting. [5]

E. Epstein in 2010 performed a study to describe sonographic characteristics of squamous cell cancer [SCC] and adenocarcinoma [AC] of the cervix using transvaginal ultrasound. Study shows that the appearance of AC and SCC might be different when examined using ultrasound. Cervical tumors are quite often difficult to detect using grayscale ultrasound. They suggest that color doppler should routinely be used in the assessment of cervical tumors. They believe that it is important to understand the sonographic features of different types of cervical tumors. This knowledge can help in the detection and assessment of tumors, in particular, of isoechoic ac and small-size tumors. [6]

In 2014, Carla A. Testa evaluated previous published research and concluded that in the past 2 decades, ultrasound has gained increased attention in the assessment of cervical cancer. Ultrasound is faster, cheaper, and more widely available than other imaging techniques, and requires no preparation of the patient. Transrectal and transvaginal ultrasound give detailed images of the cervical tumour, because the probe is positioned close to the tumour, which means that high-frequency ultrasound can be used. Recent studies have shown high accuracy of ultrasound in detecting tumour presence, and in assessing diameters, stromal

involvement, and parametrial infiltration. Unfortunately, the low number of women with vaginal spread, septa infiltration, and lymph-node metastasis included in the published studies on ultrasound examination of cervical carcinoma, does not allow any conclusion to be drawn about the ability of ultrasound to correctly identify women with vaginal spread, septal infiltration, and lymph-node metastasis. [7]

In 2013, M.P. Schmid performed a retrospective study. In this retrospective study, the feasibility of Transrectal ultrasonography [TRUS] for the assessment of local target extension in cervical cancer patients undergoing radio-chemotherapy and image-guided adaptive brachytherapy [IGABT] could be demonstrated in a heterogeneous patient cohort. Comparison of target width and thickness showed a high correlation between TRUS and MRI, indicating the potential use of TRUS for target definition in IGABT. Based on these first promising results.[8]

In 2012, P. Belitsos performed a study to evaluate the blood flow characteristics of the cervix in normal women and in women with cervical precancerous lesions or cervical cancer using three Dimensional Power Doppler. He found statistically significant differences in all 3D-PDU indices among all groups of women studied. It appears that as the pathological process progresses from the normal cervix to the premalignant and malignant status, the vasculature of the cervix changes in parallel to support this. This change can be quantitatively assessed using 3D-PDU angiography. The differences in vascularization index [VI], flow index [FI] and vascularization flow index [VFI] were significant [$P < 0.001$] for the transition from normal cervix to precancerous lesions and to cancer. VI, FI and VFI were significantly higher in patients with cancer than in normal controls. [9]

In 2012, Kallie Appleton done a case-based discussion of the most common differential diagnoses of postmenopausal bleeding. They concluded that Color and pulsed Doppler ultrasound improves diagnostic accuracy because the endometrial and cervical carcinoma, and myometrial malignancy shows abnormal blood flow pattern due to tumor neovascularization. Contrast agents are another possibility for enhancing ultrasound examination by increasing the detection rate of small vessels. [10]

In 2016, Smarandita Cotarcea performed a prospective study conducted in patients diagnosed and treated for congenital ectropion to investigate the importance of various ultrasound prognosis features, in order to

create an effective algorithm for treatment monitoring. Evaluation of pulsed Doppler velocimetric indices of uterine arteries flows showed absolute variations but the vast majority were minor, up to 25% from the initial findings. They could not identify a constant positive or negative trend, in any of the uterine arteries, during the menstrual cycle, and also the indices varied widely as amplitude. Note that these indexes have suffered the most significant changes in the periovulatory phase at the left uterine artery towards lower values, but later in the day 21, in the end of treatment, the respective indices were increased compared to previous values. Moreover, this trend has not been followed by the measurements in the contralateral uterine artery. Since changes were inconstant and minor, they conclude that uterine vasculature was not influenced by the treatment or remission of the cervical ectropion.[11]

Alca'zar Juan Luis [2014] reviewed and discussed the current knowledge about the use of ultrasound for assessing uterine cervical cancer. He concluded that current evidence suggests that ultrasound may be a useful technique for assessing local extent of disease in cervical cancer, even with higher accuracy than MRI. This technique is limited for assessing lymph nodes. The assessment of tumor vascularization by Doppler ultrasound is controversial. Most reports suggest that it could be useful for monitoring and predicting response to therapy.[12]

In 2015, Daniela Fischerova performed Systemic Review study from last 5 years literature on role of Ultrasound in Gynecological Cancer. They concluded that Ultrasound is a reliable imaging modality, which is commonly available, non-invasive, inexpensive, and free of risk for the patient. Results of numerous studies published within the last 5 years, including international multicenter trials, showed that the ultrasound is an accurate procedure in diagnostics and clinical staging of pelvic gynecological malignancies. [13]

In 2011, GAURILCIKAS conducted an observational study to determine the agreement between ultrasound and histological examination of the cervix in patients with early stage cervical cancer with regard to tumor size and local extent of the disease. He concluded that that transvaginal ultrasound examination can provide reliable information on all three factors [tumor size, location of stromal invasion and depth of stromal invasion] which are important in selecting the extent of surgery while clinical examination has limitations in revealing these parameters accurately. their results,

together with those of other recent studies that have shown ultrasound examination to have a diagnostic performance similar to that of MRI for determining the size and local extent of cervical cancer, suggest that ultrasound could be the first-line imaging technique for pretreatment evaluation of early cervical cancer. The relatively low cost of ultrasound examination and its widespread availability support this notion. [14]

LIANG in 2014 performed a study to explore the potential correlation between three-dimensional color power Doppler ultrasound [3D-CPA] parameters and high-grade cervical lesions and early cervical cancer micro vessel density [MVD] and investigate the role of transvaginal three-dimensional power Doppler ultrasonography in the detection of cervical intraepithelial neoplasia.

Totally 90 subjects were randomly divided into three groups: the control group [n = 30, including patients with chronic cervicitis], the high-grade cervical intraepithelial neoplasia [CIN] group [n = 30, mainly CIN II-III], and the early cervical cancer group [stage Ia-IIa] [n = 30]. All patients received preoperative 3D-CPA, and the cervical blood flow was graded. The cervical and intra-mass parameters including vascularization index [VI], flow index [FI], and vascularization-flow index [VFI] were measured. The MVD of the tumors was calculated. The difference of each parameter was compared among these three groups, and the correlations between the ultrasound vascular parameters and MVD were analyzed. They concluded that Compared with the other two groups, the early cervical cancer group had significantly higher VI, FI, and VFI parameters [p < 0.01]. 3D-CPA can be used to assess blood flow in the cervix. It is particularly useful for the early diagnosis of cervical cancer and CIN and for the postoperative follow-up of CIN. patients with cervical cancer using surgery or other treatment, whether the three-dimensional power Doppler ultrasound can be applied to the patient's follow-up. [15]

MING C. TSAI in 2012 a study on Office Diagnosis and Management of Abnormal Uterine Bleeding Diagnosis and management of AUB still poses challenges to most gynecologists in their office practice. Available evidences suggest that a significant portion of patients with AUB can be diagnosed and managed in the office with currently available uterine-sparing treatment. TVS is an inexpensive, noninvasive, convenient way to indirectly visualize the endometrial cavity. Therefore, it is recommended as a first-line diagnostic instrument

for assessing uterine pathology in reproductive age women presenting with AUB. The argument for using imaging study is based on the fact that organic pathology that may not be obvious on physical examination may be the underlying cause of uterine bleeding. Ultrasonographic assessment is often an extension of the physical examination and can provide additional information affecting management decision. [16]

Yael Goldberg in 2019 performed a retrospective study showing benefit of transvaginal sonography in the clinical staging of cervical carcinoma. They concluded that the dedicated TVS correctly ruled out parametrial involvement in women who were operated at an early stage of cervical cancer. For 77% of the patients who were treated by chemoradiation, findings were congruent with this treatment selection according to more than one modality. TVS is readily available in less-than-ideal health services and therefore should be used more widely. Moreover, recently released FIGO guidelines specify TVS as a recommended modality for staging of cervical cancer. The combination of physical examination, dedicated high-detail TVS and 18F-FDG PET/CT appears effective for triage in patients with cervical cancer.[17]

XIAOLAN LV in 2017, analysed correlation between the parameters of contrast-enhanced ultrasonography in evaluating cervical cancer metastasis and expression of E-cadherin. In conclusion, quantitative analysis of the results of contrast-enhanced ultrasonography can play a certain role in the determination of cervical cancer metastasis. The combined use of contrast-enhanced ultrasonography and E-cadherin expression can significantly improve the diagnosis and treatment of cervical cancer.[18]

In 2018, Kolbrún performed a Cohort study on diagnostic performance of contrast-enhanced ultrasonography for detection of early cervical cancer and concluded that they found a strong correlation between a focal filling pattern and a residual tumor at histology as well as a substantial difference over time in contrast enhancement between tumors and healthy tissue. These results require further clinical validation in a larger prospective series, preferably with a more homogenous disease stage to determine whether CEUS is superior or complimentary to conventional US, to compare the accuracy of CEUS with MRI and to suggest cut-off values for differentiating normal from tumorous tissue. They believe that CEUS may become a valuable diagnostic tool to identify those

women with early stage cervical cancer who are suitable candidates for fertility- sparing surgery.[19]

Dr. Meena Jain in 2020 performed a comparative study to evaluate the efficacy of Trans Abdominal Sonography/Trans Vaginal Sonography and histopathological findings in AUB patients. Conclusion was Transabdominal or transvaginal ultrasound is low-cost primary modality for screening and should include as a first line screening method. Though the investigation and management of AUB among the non-gravid women was confusing, histopathological diagnosis proved to be the gold standard.

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