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A consensus opinion from the International Deep Endometriosis Analysis (IDEA) group: addendum about sonographic evaluation of the parametrium

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A consensus opinion from the International Deep Endometriosis Analysis (IDEA) group: addendum about sonographic evaluation of the parametrium

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Abstract

Preoperative sonographic staging in patients with suspected parametrial endometriosis is essential to plan the surgical intervention and to anticipate the need for a multidisciplinary approach, and hence optimize surgical outcome. The results of a recent metanalysis suggest that defining more accurately the ultrasonographic criteria of parametrial involvement in endometriosis is needed. The aim of this addendum to the IDEA-consensus is to highlight the sonographic characteristics of the parametrium and identify ultrasound techniques to diagnose deep endometriosis in this area.

INTRODUCTION

Endometriosis is a chronic benign gynecological disease affecting 10% of women of reproductive age. It is a multifocal and multiorgan pathology that may involve the reproductive tract (ovary, tubes, uterus) and various structures in the pelvis (bladder, uterosacral ligaments, ureters, rectum, rectosigmoid, rectovaginal septum, vagina). Noninvasive diagnostic techniques that may help describe and/or stage this complex condition are essential prior to medical or surgical treatment. For this reason, the IDEA (International Deep Endometriosis Analysis group) published a consensus opinion to describe the sonographic features of different phenotypes of endometriosis[1]. However, the IDEA consensus did not describe the ultrasonographic features of deep endometriosis (DE) of the parametrium (anterior, posterior, lateral) or lateral compartment.

Amongst patients undergoing surgical treatment for endometriosis, 14.5% to 57% of the cases are estimated to have lateral parametrial deep endometriosis[2]. This localization of endometriosis is often associated with the more severe disease with possible involvement of the ureter or the nerve fibers of the lower hypogastric plexus and possibly somatic nerves such as the sacral roots[3]. Surgical removal of parametrial endometriosis is complex and requires adequate surgical knowledge of the pelvic nerve structures, which run through the presacral and pararectal space[4]. Laparoscopic nerve-sparing techniques aim to preserve nerve fibers of the inferior hypogastric nerve, and the pelvic splanchnic nerves, thus reducing postsurgical dysfunction of organs such as the bladder, rectum and vagina/vulva [5-7]. Preoperative sonographic staging in patients with suspected parametrial endometriosis is essential to plan the surgical intervention and to anticipate the need for a multidisciplinary approach, and hence optimize surgical outcome. The results of a recent metanalysis suggest that defining more accurately the ultrasonographic criteria of parametrial involvement in endometriosis is needed[2] . The aim of this addendum to the IDEA-consensus

is to highlight the sonographic characteristics of the parametrium and identify ultrasound techniques to diagnose deep endometriosis in this area.

ANATOMY

For both endometriosis sonographers and surgeons, understanding the retroperitoneal pelvic space anatomy is mandatory [6-9]. Agreement for a concordant anatomical description between sonographers and surgeons is therefore essential. Aiming for a standardized classification for “mapping” endometriosis to facilitate interdisciplinary communication, non-invasive and invasive methods have recently been proposed based on the surgical staging models of the #Enzian classification[10] and the AAGL Classification[11-12].

The parametrium is the fibrous, connective, and fatty tissue surrounding partially the uterus, containing blood vessels, nerves, and lymphatic vessels[13]. From the historical perspective, according to the International Anatomic nomenclature, the *parametrium* consists of the tissue that overlies the cranial part of the ureter and extends from the corpus uterine to the medial aspect of internal iliac vessels. The parametrium includes the superficial uterine pedicle (uterine artery and superficial uterine vein), related connective tissue, and lymphatic channels[14]. In 2022 Querleu *et al.* suggested a new adjective to replace the term ‘parametrial’ by introducing the term ‘para-uterine’ to describe those tissues standing laterally to the uterine corpus within the mobile tract of the broad ligament[14-15]. The para-cervix, instead, depicts the fibrous and fatty tissue that lies beneath the parametrium, cranially delimited by the ureter and caudally confined by the levator ani muscle and the presacral fascia[13-14]. The International Anatomical Nomenclature includes the paracolpos or paracolpium within the para-cervix[16], the upper part of this structure contains important functional nerves and vessels. Many paramount structures run through the para-cervix including the vesical and vaginal arteries, the deep uterine vein, the splanchnic nerves, the distal tract of the hypogastric nerve, and the inferior hypogastric plexus[15-16] (Fig.3)

The parametrium extends between the parietal and visceral pelvic fascia up to the lateral pelvic wall and is divided into *anterior, posterior, and lateral parametrium regions (Fig.1)* [17]. The anterior region is the anterior extension of the parametrium and defines the roof of the ureteral tunnel in its proximal section to the bladder inlet[17] (Fig.2). It includes the cervico-vesical branches of the uterine artery. The vesico-uterine, vesico-vaginal and lateral vesical ligaments are the medial, cranio-caudal and lateral limits of anterior parametrium, respectively, which connect the cervix to the bladder.

The posterior region is the posterior extension of the parametrium and it is made up of the recto-vaginal ligaments, the recto-vaginal septum, the lateral rectal ligaments and it is delimited by the peritoneal folds defined as uterosacral ligaments. The posterior parametrium runs medially to the pelvic path of the ureters, and it contains the uterosacral ligaments, the retroperitoneal structures extending posteriorly from the cervix to the sacrum including deep pelvic vessels and the sacral nerve roots S1-S4. The posterior parametrium includes the connective fibers that extend from the postero-lateral wall of the pelvis and converge at the level of the postero-lateral portions of the cervix in correspondence to the upper and middle vagina. The posterior parametrium also contains, caudally and medially, the rectovaginal fascia and recto-vaginal ligaments, caudally and laterally the lateral rectal ligaments extending from the lateral pelvic wall to the postero-lateral aspect of the rectum[13-14] (Fig.2).

The lateral parametrium refers to the para-cervix (from the cervix to lateral pelvic wall) and it is the anatomical region that is visualized in the pelvic retroperitoneum at the surgical dissection of the para-rectal and para-vesical spaces[15,17].(Fig.2;Fig.3). It contains the main blood and lymphatic vessels of the uterine cervix.

158 SONOGRAPHIC EVALUATION OF PARAMETRIUM: CONSENSUS METHODOLOGY

159 We propose a standardized ultrasonographic approach to describe the anterior, posterior
160 and lateral parametrium and the parametrial endometriotic infiltration based on the above
161 mentioned anatomical landmarks. In this consensus, when performing ultrasound
162 assessment of this anatomical area, we do suggest using the terms “parametrium” and
163 “`paracolpos” instead of “para-cervix” or “para-uterine”.

164

165 1. EVALUATION OF THE ANTERIOR PARAMETRIUM

166 First, the ultrasound probe is placed on the anterior vaginal fornix in a midsagittal plane to
167 visualize the uterine cervix, bladder and urethra. Then, the probe is swept laterally until the
168 distal pelvic ureteral tract is visualized. For the right ureter the probe is rotated slightly
169 clockwise, for the left ureter, slightly anti-clockwise. The ureter is recognized as a tubular
170 hypoechoic structure. It can be followed from each lateral corner of the bladder trigone, from
171 which it crosses the bladder wall tangentially towards the lateral pelvic wall. Peristaltic
172 movements may be seen. During the passage of urine, the lumen of the ureter becomes
173 visible as a transient anechoic structure and its wall becomes clearly visible and measurable.
174 The distal extra-vesical segment of the ureter is delineated by hyperechoic lines: medially,
175 the vesicouterine (cranially) and vesicovaginal (caudally) ligaments, and laterally the lateral
176 vesical ligaments. Using color Doppler mode, it is possible to identify the superior vesical
177 artery inside the lateral vesical ligaments. Hereby it is possible to identify the vesico-uterine,
178 vesico-vaginal and lateral vesical ligaments.

179

180 A negative anterior sliding sign, where the bowel loops do not slide over the anterior aspect
181 of the uterus, indicates the presence of adhesions or fibrosis in the anterior compartment
182 and is an indirect sign of possible presence of anterior parametrial endometriosis[18].

183

Anterior parametrial endometriosis is suspected if infiltrating, hypoechoic nodules are identified in the distal ureter wall or in the structures that we have described as anterior parametrial limits. The ultrasound image of endometriotic nodules can be regular or irregular, homogeneous or heterogeneous.

The measurements of deep endometriosis nodules should be recorded in three orthogonal planes (this applies also for lesions in the lateral and posterior parametrium).

During ultrasonographic study, it is important to identify intrinsic or extrinsic deep endometriosis ureteral involvement.

Ureteral dilatation and/or hydronephrosis should also be recorded.

2. EVALUATION OF THE LATERAL PARAMETRIUM

First, the probe is placed in the posterior vaginal fornix, visualizing the uterine midsagittal plane and then laterally swept towards the pelvic sidewall until the iliac vessels are visualized. The ureter and the uterine artery are isolated in the longitudinal section (Fig.4; Fig 5). Then, starting from the midsagittal plane, the transverse section at a 90° rotation of the probe is obtained to study the lateral extension of the parametrium from the uterus to iliac vessels. Subsequently, the sonographer moves the probe cranially from the external cervical os towards the plane crossing the salpinx and the ovarian fossa to analyze the lateral parametrium's cranial and caudal parts[18,27].

Lateral parametrial endometriosis is suspected if there is a regular or irregular shape (star shaped) hypoechoic nodule. It may or may not infiltrate the ipsilateral ureter. The internal appearance can be homogeneous or heterogeneous, usually not vascularized and with or without hyperechoic buds related to embedded endometrial foci. These lesions are localized at the level of the attachment of the parametrium to the cervix at the uterine arterial bifurcation and medially limited by the cervical vascular plexus[21,22] (Fig. 6). Well-defined parametrial nodules are more commonly located cranially to the uterine artery (Fig. 7) while

fan-shaped lesions with retraction of the surrounding tissues, are more frequently found in a caudal location (para-cervix). In the latter case, ovarian mobility is often reduced[27]. Lateral parametrium endometriosis can be classified depending on the level of infiltration: no infiltration, partial infiltration (with < 50% of nodule within USL thickness), and significant infiltration (with ≥ 50% of nodule within USL thickness)[26]. Evaluation of the ureters should always be performed (see reference 1). The kidneys should be assessed for hydronephrosis[26].

3. EVALUATION OF THE POSTERIOR PARAMETRIUM

The ultrasonographic evaluation of the posterior parametrium can be performed in transverse and midsagittal planes moving the probe cranially and caudally[18,26] .

First, the probe is placed in midsagittal plane in the posterior vaginal fornix visualizing the posterior vaginal fornix and the uterine cervical canal from internal to external cervical ostia. Rotating the probe 90º, and moving the probe cranially and caudally, the uterosacral ligaments are identified as well as the recto-vaginal ligaments. Uterosacral- and rectovaginal ligaments appear as linear hyperechoic structures starting from the posterior cervical- and vaginal border respectively. By moving the probe laterally and angling it at 45°, these ligaments (uterosacral ligaments or recto-vaginal ligaments) can be identified for their entire lateral extension[18, 26].

The transverse section at 90° rotation of the probe is obtained to evaluate the lateral extension of the posterior parametrium from the uterus to iliac vessels. Subsequently, the sonographer moves the probe cranially from posterior vaginal fornix towards the internal cervical ostium to analyze the posterior parametrium's cranial and caudal parts.

Lateral rectal ligaments are localized posteriorly to the lateral caudal portion of the parametrium and can be identified with ultrasound as lateral extensions of the vagino-rectal ligaments to pelvic wall.

Recently Szabò et al[28] described a standardized method to study normal pelvic sacral nerve roots of the posterior parametrium. During the study of posterior paremetrium in the transverse section, it is possible to identify in the most lateral part of the pelvic wall the obturator internus muscle, a hypoechoic thin band lateral to utero sacral ligaments. Lateral to the obturator muscle the body of the ischium is seen as a continuous bright white band. Pushing the probe medially and superior to the obturator muscle, the branches of anterior division of internal iliac vessels are recognized in a tranverse and oblique section. In addition, using Color Doppler, the sonographer can differentiate internal iliac vessels from the ureter on pelvic wall. The piriformis muscle, a hypoechoic structure, and the anterior surface of the sacrum, a hyperchoic line, are located deeper to the internal iliac vessels. At this level, the sacral roots of sacral plexus are recognized in the longitudinal section as hypoechoic bands with echogenic septae ("bundle of straw" appearance). In transverse section, the same structure has a "honeycomb" appearance[28] .

Posterior parametrial deep endometriosis is suspected if the posterior sliding sign is negative (the anterior rectum glides freely across the posterior aspect of the cervix, posterior vaginal wall, for an anteverted uterus, or uterine fundus for a retroverted uterus).

Posterior parametrial endometriosis is suspected if infiltrating, regular or irregular, homogeneous or heterogeneous hypoechoic nodes are identified in the retro-cervical part or in the structures (uterosacral ligaments, vagino-rectal ligaments, posterior vaginal fornix) that we have described as posterior parametrial limits.

Posterior parametrial deep endometriosis could be associated with pelvic nerve involvement[18]. Therefore, pelvic nerve involvement with endometriosis should be sought in the posterior parametrium.

CONCLUSION

In summary, ultrasound assessment of the parametrium should be performed in women with suspected pelvic endometriosis in order to detect the involvement of this structure. Herein, we describe how this assessment should be performed and how abnormal findings should be described. We hope that this consensus could help the researchers to obtain more reproducible results in the evaluation of diagnostic accuracy of ultrasonography in this compartment but also help the clinician in the daily practice.

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Legends of figures:

Fig.1 Schematic drawing of female pelvic structures with identification of parametrial areas (anterior, posterior and lateral parametrium) in a transversal pelvic section.

Fig.2 Schematic drawing of female pelvic parametrial ligaments in transversal pelvic section. Abbreviations: A1:common iliac artery; A2: internal iliac artery; A3:external iliac artery; A4: uterine artery; C: cardinal ligament; P: lateral pelvic bone; Sy: symphysis; Sa: Sacrum; U: ureter; USL: uterosacral ligament; VUL: vesico-uterine ligament

Fig.3 Schematic drawing of female pelvic structures with identification of lateral parametrial area in a coronal section. Abbreviations: A1: common iliac artery; A2: internal iliac artery; A3:external iliac artery; A4: uterine artery; B: bladder; C: cardinal ligament; P: lateral pelvic bone; S: sacral nerve roots; U: ureter; V: vagina

Fig.4 Ultrasound longitudinal visualization of normal lateral parametrium. Figures show lateral parametrial vessels using color Doppler. Figure A is marked image of figure B. Internal iliac vessels are in red; uterine vessels are in purple. Abbreviations: I, Internal iliac vessels; UV, Uterine vessels; U:uterus

Figure 5. Ultrasound transverse visualization of normal lateral parametrium. Figures show lateral parametrium anatomical landmarks using color Doppler. Figure A is marked image of figure B. Internal iliac vessels are in red; uterine vessels are in purple; pelvic ureter is in yellow. Abbreviations: I internal iliac vessels; UV, uterine vessels; U, pelvic ureter

Figure 6. Ultrasound transverse visualization of lateral para-cervical endometriosis. Figures show lateral caudal parametrial endometriosis nodule infiltrating ipsilateral ureter and rectal nodule of endometriosis. Figure A is marked image of figure B. Ureter stented is in yellow, fan shaped lesion of paracervix is in black, rectal nodule of endometriosis is in blue. Abbreviations: PE lateral parametrial endometriosis; RE, rectal nodule of endometriosis

Figure 7. Ultrasound longitudinal visualization of lateral parametrial endometriosis. Figures show lateral cranial parametrial endometriosis nodule infiltrating ipsilateral ureter and lateral parametrial vessels using color Doppler. Figure A is marked image of figure B. Ureter is in yellow, lateral parametrial nodule of endometriosis is in black,internal iliac vessels are in red, uterine vessels are in blue. Abbreviations : PE lateral parametrial endometriosis ; I internal iliac vessels; UV, uterine vessels; U, pelvic ureter stented

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A consensus opinion from the International Deep Endometriosis Analysis (IDEA) group: addendum about sonographic evaluation of the parametrium

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Abstract

Preoperative sonographic staging in patients with suspected parametrial endometriosis is essential to plan the surgical intervention and to anticipate the need for a multidisciplinary approach, and hence optimize surgical outcome. The results of a recent metanalysis suggest that defining more accurately the ultrasonographic criteria of parametrial involvement in endometriosis is needed. The aim of this addendum to the IDEA-consensus is to highlight the sonographic characteristics of the parametrium and identify ultrasound techniques to diagnose deep endometriosis in this area.

INTRODUCTION

Endometriosis is a chronic benign gynecological disease affecting 10% of women of reproductive age. It is a multifocal and multiorgan pathology that may involve the reproductive tract (ovary, tubes, uterus) and various structures in the pelvis (bladder, uterosacral ligaments, ureters, rectum, rectosigmoid, rectovaginal septum, vagina). Noninvasive diagnostic techniques that may help describe and/or stage this complex condition are essential prior to medical or surgical treatment. For this reason, the IDEA (International Deep Endometriosis Analysis group) published a consensus opinion to describe the sonographic features of different phenotypes of endometriosis[1]. However, the IDEA consensus did not describe the ultrasonographic features of deep endometriosis (DE) of the parametrium (anterior, posterior, lateral) or lateral compartment.

Amongst patients undergoing surgical treatment for endometriosis, 14.5% to 57% of the cases are estimated to have lateral parametrial deep endometriosis[2]. This localization of endometriosis is often associated with the more severe disease with possible involvement of the ureter or the nerve fibers of the lower hypogastric plexus and possibly somatic nerves such as the sacral roots[3]. Surgical removal of parametrial endometriosis is complex and requires adequate surgical knowledge of the pelvic nerve structures, which run through the presacral and pararectal space[4]. Laparoscopic nerve-sparing techniques aim to preserve nerve fibers of the inferior hypogastric nerve, and the pelvic splanchnic nerves, thus reducing postsurgical dysfunction of organs such as the bladder, rectum and vagina/vulva [5-7]. Preoperative sonographic staging in patients with suspected parametrial endometriosis is essential to plan the surgical intervention and to anticipate the need for a multidisciplinary approach, and hence optimize surgical outcome. The results of a recent metanalysis suggest that defining more accurately the ultrasonographic criteria of parametrial involvement in endometriosis is needed[2] . The aim of this addendum to the IDEA-consensus

is to highlight the sonographic characteristics of the parametrium and identify ultrasound techniques to diagnose deep endometriosis in this area.

ANATOMY

For both endometriosis sonographers and surgeons, understanding the retroperitoneal pelvic space anatomy is mandatory [6-9]. Agreement for a concordant anatomical description between sonographers and surgeons is therefore essential. Aiming for a standardized classification for "mapping" endometriosis to facilitate interdisciplinary communication, non-invasive and invasive methods have recently been proposed based on the surgical staging models of the #Enzian classification[10] and the AAGL Classification[11-12].

The parametrium is the fibrous, connective, and fatty tissue surrounding partially the uterus, containing blood vessels, nerves, and lymphatic vessels[13]. From the historical perspective, according to the International Anatomic nomenclature, the *parametrium* consists of the tissue that overlies the cranial part of the ureter and extends from the corpus uterine to the medial aspect of internal iliac vessels. The parametrium includes the superficial uterine pedicle (uterine artery and superficial uterine vein), related connective tissue, and lymphatic channels[14]. In 2022 Querleu *et al.* suggested a new adjective to replace the term 'parametrial' by introducing the term 'para-uterine' to describe those tissues standing laterally to the uterine corpus within the mobile tract of the broad ligament[14-15]. The para-cervix, instead, depicts the fibrous and fatty tissue that lies beneath the parametrium, cranially delimited by the ureter and caudally confined by the levator ani muscle and the presacral fascia[13-14]. The International Anatomical Nomenclature includes the paracolpos or paracolpium within the para-cervix[16], the upper part of this structure contains important functional nerves and vessels. Many paramount structures run through the para-cervix including the vesical and vaginal arteries, the deep uterine vein, the splanchnic nerves, the distal tract of the hypogastric nerve, and the inferior hypogastric plexus[15-16] (Fig.3)

The parametrium extends between the parietal and visceral pelvic fascia up to the lateral pelvic wall and is divided into *anterior, posterior, and lateral parametrium regions (Fig.1)* [17]. The anterior region is the anterior extension of the parametrium and defines the roof of the ureteral tunnel in its proximal section to the bladder inlet[17] (Fig.2). It includes the cervico-vesical branches of the uterine artery. The vesico-uterine, vesico-vaginal and lateral vesical ligaments are the medial, cranio-caudal and lateral limits of anterior parametrium, respectively, which connect the cervix to the bladder.

The posterior region is the posterior extension of the parametrium and it is made up of the recto-vaginal ligaments, the recto-vaginal septum, the lateral rectal ligaments and it is delimited by the peritoneal folds defined as uterosacral ligaments. The posterior parametrium runs medially to the pelvic path of the ureters, and it contains the uterosacral ligaments, the retroperitoneal structures extending posteriorly from the cervix to the sacrum including deep pelvic vessels and the sacral nerve roots S1-S4. The posterior parametrium includes the connective fibers that extend from the postero-lateral wall of the pelvis and converge at the level of the postero-lateral portions of the cervix in correspondence to the upper and middle vagina. The posterior parametrium also contains, caudally and medially, the rectovaginal fascia and recto-vaginal ligaments, caudally and laterally the lateral rectal ligaments extending from the lateral pelvic wall to the postero-lateral aspect of the rectum[13-14] (Fig.2).

The lateral parametrium refers to the para-cervix (from the cervix to lateral pelvic wall) and it is the anatomical region that is visualized in the pelvic retroperitoneum at the surgical dissection of the para-rectal and para-vesical spaces[15,17].(Fig.2;Fig.3). It contains the main blood and lymphatic vessels of the uterine cervix.

SONOGRAPHIC EVALUATION OF PARAMETRIUM: CONSENSUS METHODOLOGY

We propose a standardized ultrasonographic approach to describe the anterior, posterior and lateral parametrium and the parametrial endometriotic infiltration based on the above mentioned anatomical landmarks. **In this consensus, when performing ultrasound assessment of this anatomical area, we do suggest using the terms "parametrium" and "`paracolpos" instead of "para-cervix" or "para-uterine**".

1. EVALUATION OF THE ANTERIOR PARAMETRIUM

First, the ultrasound probe is placed on the anterior vaginal fornix in a midsagittal plane to visualize the uterine cervix, bladder and urethra. Then, the probe is swept laterally until the distal pelvic ureteral tract is visualized. For the right ureter the probe is rotated slightly clockwise, for the left ureter, slightly anti-clockwise. The ureter is recognized as a tubular hypoechoic structure. It can be followed from each lateral corner of the bladder trigone, from which it crosses the bladder wall tangentially towards the lateral pelvic wall. Peristaltic movements may be seen. During the passage of urine, the lumen of the ureter becomes visible as a transient anechoic structure and its wall becomes clearly visible and measurable. The distal extra-vesical segment of the ureter is delineated by hyperechoic lines: medially, the vesicouterine (cranially) and vesicovaginal (caudally) ligaments, and laterally the lateral vesical ligaments. Using color Doppler mode, it is possible to identify the superior vesical artery inside the lateral vesical ligaments. Hereby it is possible to identify the vesico-uterine, vesico-vaginal and lateral vesical ligaments.

A negative anterior sliding sign, where the bowel loops do not slide over the anterior aspect of the uterus, indicates the presence of adhesions or fibrosis in the anterior compartment and is an indirect sign of possible presence of anterior parametrial endometriosis[18].

Anterior parametrial endometriosis is suspected if infiltrating, hypoechoic nodules are identified in the distal ureter wall or in the structures that we have described as anterior parametrial limits. The ultrasound image of endometriotic nodules can be regular or irregular, homogeneous or heterogeneous.

The measurements of deep endometriosis nodules should be recorded in three orthogonal planes (this applies also for lesions in the lateral and posterior parametrium).

During ultrasonographic study, it is important to identify intrinsic or extrinsic deep endometriosis ureteral involvement.

Ureteral dilatation and/or hydronephrosis should also be recorded.

2. EVALUATION OF THE LATERAL PARAMETRIUM

First, the probe is placed in the posterior vaginal fornix, visualizing the uterine midsagittal plane and then laterally swept towards the pelvic sidewall until the iliac vessels are visualized. The ureter and the uterine artery are isolated in the longitudinal section (Fig.4; Fig 5). Then, starting from the midsagittal plane, the transverse section at a 90° rotation of the probe is obtained to study the lateral extension of the parametrium from the uterus to iliac vessels. Subsequently, the sonographer moves the probe cranially from the external cervical os towards the plane crossing the salpinx and the ovarian fossa to analyze the lateral parametrium's cranial and caudal parts[18,27].

Lateral parametrial endometriosis is suspected if there is a regular or irregular shape (star shaped) hypoechoic nodule. It may or may not infiltrate the ipsilateral ureter. The internal appearance can be homogeneous or heterogeneous, usually not vascularized and with or without hyperechoic buds related to embedded endometrial foci. These lesions are localized at the level of the attachment of the parametrium to the cervix at the uterine arterial bifurcation and medially limited by the cervical vascular plexus[21,22] (Fig. 6). Well-defined parametrial nodules are more commonly located cranially to the uterine artery (Fig. 7) while

fan-shaped lesions with retraction of the surrounding tissues, are more frequently found in a caudal location (para-cervix). In the latter case, ovarian mobility is often reduced[27]. Lateral parametrium endometriosis can be classified depending on the level of infiltration: no infiltration, partial infiltration (with < 50% of nodule within USL thickness), and significant infiltration (with ≥ 50% of nodule within USL thickness)[26]. Evaluation of the ureters should always be performed (see reference 1). The kidneys should be assessed for hydronephrosis[26].

3. EVALUATION OF THE POSTERIOR PARAMETRIUM

The ultrasonographic evaluation of the posterior parametrium can be performed in transverse and midsagittal planes moving the probe cranially and caudally[18,26] .

First, the probe is placed in midsagittal plane in the posterior vaginal fornix visualizing the posterior vaginal fornix and the uterine cervical canal from internal to external cervical ostia. Rotating the probe 90º, and moving the probe cranially and caudally, the uterosacral ligaments are identified as well as the recto-vaginal ligaments. Uterosacral- and rectovaginal ligaments appear as linear hyperechoic structures starting from the posterior cervical- and vaginal border respectively. By moving the probe laterally and angling it at 45°, these ligaments (uterosacral ligaments or recto-vaginal ligaments) can be identified for their entire lateral extension[18, 26].

The transverse section at 90° rotation of the probe is obtained to evaluate the lateral extension of the posterior parametrium from the uterus to iliac vessels. Subsequently, the sonographer moves the probe cranially from posterior vaginal fornix towards the internal cervical ostium to analyze the posterior parametrium's cranial and caudal parts.

Lateral rectal ligaments are localized posteriorly to the lateral caudal portion of the parametrium and can be identified with ultrasound as lateral extensions of the vagino-rectal ligaments to pelvic wall.

Recently Szabò et al[28] described a standardized method to study normal pelvic sacral nerve roots of the posterior parametrium. During the study of posterior paremetrium in the transverse section, it is possible to identify in the most lateral part of the pelvic wall the obturator internus muscle, a hypoechoic thin band lateral to utero sacral ligaments. Lateral to the obturator muscle the body of the ischium is seen as a continuous bright white band. Pushing the probe medially and superior to the obturator muscle, the branches of anterior division of internal iliac vessels are recognized in a tranverse and oblique section. In addition, using Color Doppler, the sonographer can differentiate internal iliac vessels from the ureter on pelvic wall. The piriformis muscle, a hypoechoic structure, and the anterior surface of the sacrum, a hyperchoic line, are located deeper to the internal iliac vessels. At this level, the sacral roots of sacral plexus are recognized in the longitudinal section as hypoechoic bands with echogenic septae ("bundle of straw" appearance). In transverse section, the same structure has a "honeycomb" appearance[28] .

Posterior parametrial deep endometriosis is suspected if the posterior sliding sign is negative (the anterior rectum glides freely across the posterior aspect of the cervix, posterior vaginal wall, for an anteverted uterus, or uterine fundus for a retroverted uterus).

Posterior parametrial endometriosis is suspected if infiltrating, regular or irregular, homogeneous or heterogeneous hypoechoic nodes are identified in the retro-cervical part or in the structures (uterosacral ligaments, vagino-rectal ligaments, posterior vaginal fornix) that we have described as posterior parametrial limits.

Posterior parametrial deep endometriosis could be associated with pelvic nerve involvement[18]. Therefore, pelvic nerve involvement with endometriosis should be sought in the posterior parametrium.

CONCLUSION

In summary, ultrasound assessment of the parametrium should be performed in women with suspected pelvic endometriosis in order to detect the involvement of this structure. Herein, we describe how this assessment should be performed and how abnormal findings should be described. We hope that this consensus could help the researchers to obtain more reproducible results in the evaluation of diagnostic accuracy of ultrasonography in this compartment but also help the clinician in the daily practice.

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Legends of figures:

Fig.1 Schematic drawing of female pelvic structures with identification of parametrial areas (anterior, posterior and lateral parametrium) in a transversal pelvic section.

Fig.2 Schematic drawing of female pelvic parametrial ligaments in transversal pelvic section. Abbreviations: A1:common iliac artery; A2: internal iliac artery; A3:external iliac artery; A4: uterine artery; C: cardinal ligament; P: lateral pelvic bone; Sy: symphysis; Sa: Sacrum; U: ureter; USL: uterosacral ligament; VUL: vesico-uterine ligament

Fig.3 Schematic drawing of female pelvic structures with identification of lateral parametrial area in a coronal section. Abbreviations: A1: common iliac artery; A2: internal iliac artery; A3:external iliac artery; A4: uterine artery; B: bladder; C: cardinal ligament; P: lateral pelvic bone; S: sacral nerve roots; U: ureter; V: vagina

Fig.4 Ultrasound longitudinal visualization of normal lateral parametrium. Figures show lateral parametrial vessels using color Doppler. Figure A is marked image of figure B. Internal iliac vessels are in red; uterine vessels are in purple. Abbreviations: I, Internal iliac vessels; UV, Uterine vessels; U:uterus

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Addendum to the consensus opinion from the International Deep Endometriosis Analysis (IDEA) group: sonographic evaluation of the parametrium

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ABSTRACT

Preoperative sonographic staging in patients with suspected parametrial endometriosis is essential to plan the surgical intervention and to anticipate the need for a multidisciplinary approach, and hence optimize surgical outcome. The results of a recent metanalysis suggest that defining more accurately the ultrasonographic criteria of parametrial involvement in endometriosis is needed. The aim of this addendum to the IDEA-consensus is to highlight the sonographic characteristics of the parametrium and identify ultrasound techniques to diagnose deep endometriosis in this area.

INTRODUCTION

Endometriosis is a chronic benign gynecological disease affecting 10% of women of reproductive age. It is a multifocal and multiorgan pathology that may involve the reproductive tract (ovary, tubes, uterus) and various structures in the pelvis (bladder, uterosacral ligaments, ureters, rectum, rectosigmoid, rectovaginal septum, vagina). Noninvasive diagnostic techniques that may help describe and/or stage this complex condition are essential prior to medical or surgical treatment. For this reason, the IDEA (International Deep Endometriosis Analysis group) published a consensus opinion to describe the sonographic features of different phenotypes of endometriosis[1]. However, the IDEA consensus did not describe the ultrasonographic features of deep endometriosis (DE) of the parametrium (anterior, posterior, lateral) or lateral compartment.

Amongst patients undergoing surgical treatment for endometriosis, 14.5% to 57% of the cases are estimated to have lateral parametrial deep endometriosis[2]. This localization of endometriosis is often associated with the more severe disease with possible involvement of the ureter or the nerve fibers of the lower hypogastric plexus and possibly somatic nerves such as the sacral roots[3]. Surgical removal of parametrial endometriosis is complex and requires adequate surgical knowledge of the pelvic nerve structures, which run through the presacral and pararectal space[4]. Laparoscopic nerve-sparing techniques aim to preserve nerve fibers of the inferior hypogastric nerve, and the pelvic splanchnic nerves, thus reducing postsurgical dysfunction of organs such as the bladder, rectum and vagina/vulva [5-7]. Preoperative sonographic staging in patients with suspected parametrial endometriosis is essential to plan the surgical intervention and to anticipate the need for a multidisciplinary approach, and hence optimize surgical outcome. The results of a recent metanalysis suggest that defining more accurately the ultrasonographic criteria of parametrial involvement in endometriosis is needed[2] . The aim of this addendum to the IDEA-consensus is to highlight the sonographic characteristics of the parametrium and identify ultrasound techniques to diagnose deep endometriosis in this area.

ANATOMY

For both endometriosis sonographers and surgeons, understanding the retroperitoneal pelvic space anatomy is mandatory [6-9]. Agreement for a concordant anatomical description between sonographers and surgeons is therefore essential. Aiming for a standardized classification for "mapping" endometriosis to facilitate interdisciplinary communication, non-invasive and invasive methods have recently been proposed based on the surgical staging models of the #Enzian classification[10] and the AAGL Classification[11-12] .

The parametrium is the fibrous, connective, and fatty tissue surrounding partially the uterus, containing blood vessels, nerves, and lymphatic vessels[13]. From the historical perspective, according to the International Anatomic nomenclature, the *parametrium* consists of the tissue that overlies the cranial part of the ureter and extends from the corpus uterine to the medial aspect of internal iliac vessels. The parametrium includes the superficial uterine pedicle (uterine artery and superficial uterine vein), related connective tissue, and lymphatic channels[14]. In 2022 Querleu *et al.* suggested a new adjective to replace the term 'parametrial' by introducing the term 'para-uterine' to describe those tissues standing laterally to the uterine corpus within the mobile tract of the broad ligament[14-15]. The para-cervix, instead, depicts the fibrous and fatty tissue that lies beneath the parametrium, cranially delimited by the ureter and caudally confined by the levator ani muscle and the presacral fascia[13-14]. The International Anatomical Nomenclature includes the paracolpos or paracolpium within the para-cervix[16] , the upper part of this structure contains important functional nerves and vessels. Many paramount structures run through the para-cervix including the vesical and vaginal arteries, the deep uterine vein, the splanchnic nerves, the distal tract of the hypogastric nerve, and the inferior hypogastric plexus[15-16] (Fig.3)

The parametrium extends between the parietal and visceral pelvic fascia up to the lateral pelvic wall and is divided into *anterior, posterior, and lateral parametrium regions (Fig.1)* [17]. The anterior region is the anterior extension of the parametrium and defines the roof of the ureteral tunnel in its proximal section to the bladder inlet[17] (Fig.2). It includes the cervico-vesical branches of the uterine artery. The vesico-uterine, vesico-vaginal and lateral vesical ligaments are the medial, cranio-caudal and lateral limits of anterior parametrium, respectively, which connect the cervix to the bladder.

The posterior region is the posterior extension of the parametrium and it is made up of the recto-vaginal ligaments, the recto-vaginal septum, the lateral rectal ligaments and it is delimited by the peritoneal folds defined as uterosacral ligaments. The posterior parametrium runs medially to the pelvic path of the ureters, and it contains the uterosacral ligaments, the

retroperitoneal structures extending posteriorly from the cervix to the sacrum including deep pelvic vessels and the sacral nerve roots S1-S4. The posterior parametrium includes the connective fibers that extend from the postero-lateral wall of the pelvis and converge at the level of the postero-lateral portions of the cervix in correspondence to the upper and middle vagina. The posterior parametrium also contains, caudally and medially, the rectovaginal fascia and recto-vaginal ligaments, caudally and laterally the lateral rectal ligaments extending from the lateral pelvic wall to the postero-lateral aspect of the rectum[13-14] (Fig.2).

The lateral parametrium refers to the para-cervix (from the cervix to lateral pelvic wall) and it is the anatomical region that is visualized in the pelvic retroperitoneum at the surgical dissection of the para-rectal and para-vesical spaces[15,17].(Fig.2;Fig.3). It contains the main blood and lymphatic vessels of the uterine cervix.

SONOGRAPHIC EVALUATION OF PARAMETRIUM: CONSENSUS METHODOLOGY

We propose a standardized ultrasonographic approach to describe the anterior, posterior and lateral parametrium and the parametrial endometriotic infiltration based on the above mentioned anatomical landmarks. In this consensus, when performing ultrasound assessment of this anatomical area, we do suggest using the terms “parametrium” and “`paracolpos” instead of “para-cervix” or “para-uterine”.

1. Evaluation of the anterior parametrium

First, the ultrasound probe is placed on the anterior vaginal fornix in a midsagittal plane to visualize the uterine cervix, bladder and urethra. Then, the probe is swept laterally until the distal pelvic ureteral tract is visualized. For the right ureter the probe is rotated slightly clockwise, for the left ureter, slightly anti-clockwise. The ureter is recognized as a tubular hypoechoic structure. It can be followed from each lateral corner of the bladder trigone, from which it crosses the bladder wall tangentially towards the lateral pelvic wall. Peristaltic movements may be seen. During the passage of urine, the lumen of the ureter becomes visible as a transient anechoic structure and its wall becomes clearly visible and measurable. The distal extra-vesical segment of the ureter is delineated by hyperechoic lines: medially, the vesicouterine (cranially) and vesicovaginal (caudally) ligaments, and laterally the lateral vesical ligaments. Using color Doppler mode, it is possible to identify the superior vesical artery inside the lateral vesical ligaments. Hereby it is possible to identify the vesico-uterine, vesico-vaginal and lateral vesical ligaments.

A negative anterior sliding sign, where the bowel loops do not slide over the anterior aspect of the uterus, indicates the presence of adhesions or fibrosis in the anterior compartment and is an indirect sign of possible presence of anterior parametrial endometriosis[18].

Anterior parametrial endometriosis is suspected if infiltrating, hypoechoic nodules are identified in the distal ureter wall or in the structures that we have described as anterior parametrial limits. The ultrasound image of endometriotic nodules can be regular or irregular, homogeneous or heterogeneous.

The measurements of deep endometriosis nodules should be recorded in three orthogonal planes (this applies also for lesions in the lateral and posterior parametrium).

During ultrasonographic study, it is important to identify intrinsic or extrinsic deep endometriosis ureteral involvement.

Ureteral dilatation and/or hydronephrosis should also be recorded.

2. Evaluation of the lateral parametrium

First, the probe is placed in the posterior vaginal fornix, visualizing the uterine midsagittal plane and then laterally swept towards the pelvic sidewall until the iliac vessels are visualized. The ureter and the uterine artery are isolated in the longitudinal section (Fig.4; Fig 5). Then, starting from the midsagittal plane, the transverse section at a 90° rotation of the probe is obtained to study the lateral extension of the parametrium from the uterus to iliac vessels. Subsequently, the sonographer moves the probe cranially from the external cervical os towards the plane crossing the salpinx and the ovarian fossa to analyze the lateral parametrium's cranial and caudal parts[18,27].

Lateral parametrial endometriosis is suspected if there is a regular or irregular shape (star shaped) hypoechoic nodule. It may or may not infiltrate the ipsilateral ureter. The internal appearance can be homogeneous or heterogeneous, usually not vascularized and with or without hyperechoic buds related to embedded endometrial foci. These lesions are localized at the level of the attachment of the parametrium to the cervix at the uterine arterial bifurcation and medially limited by the cervical vascular plexus[21,22] (Fig. 6). Well-defined parametrial nodules are more commonly located cranially to the uterine artery (Fig. 7) while fan-shaped lesions with retraction of the surrounding tissues, are more frequently found in a caudal location (para-cervix). In the latter case, ovarian mobility is often reduced[27]. Lateral parametrium endometriosis can be classified depending on the level of infiltration: no infiltration, partial infiltration (with < 50% of nodule within USL thickness), and significant infiltration (with ≥ 50% of nodule within USL thickness)[26]. Evaluation of the ureters should always be performed (see reference 1). The kidneys should be assessed for hydronephrosis[26].

3. Evaluation of the posterior parametrium

The ultrasonographic evaluation of the posterior parametrium can be performed in transverse and midsagittal planes moving the probe cranially and caudally[18,26] .

First, the probe is placed in midsagittal plane in the posterior vaginal fornix visualizing the posterior vaginal fornix and the uterine cervical canal from internal to external cervical ostia.

Rotating the probe 90º, and moving the probe cranially and caudally, the uterosacral ligaments are identified as well as the recto-vaginal ligaments. Uterosacral- and rectovaginal ligaments appear as linear hyperechoic structures starting from the posterior cervical- and vaginal border respectively. By moving the probe laterally and angling it at 45°, these ligaments (uterosacral ligaments or recto-vaginal ligaments) can be identified for their entire lateral extension[18, 26].

The transverse section at 90° rotation of the probe is obtained to evaluate the lateral extension of the posterior parametrium from the uterus to iliac vessels. Subsequently, the sonographer moves the probe cranially from posterior vaginal fornix towards the internal cervical ostium to analyze the posterior parametrium's cranial and caudal parts.

Lateral rectal ligaments are localized posteriorly to the lateral caudal portion of the parametrium and can be identified with ultrasound as lateral extensions of the vagino-rectal ligaments to pelvic wall.

Recently Szabò et al[28] described a standardized method to study normal pelvic sacral nerve roots of the posterior parametrium. During the study of posterior paremetrium in the transverse section, it is possible to identify in the most lateral part of the pelvic wall the obturator internus muscle, a hypoechoic thin band lateral to utero sacral ligaments. Lateral to the obturator muscle the body of the ischium is seen as a continuous bright white band. Pushing the probe medially and superior to the obturator muscle, the branches of anterior division of internal iliac vessels are recognized in a tranverse and oblique section. In addition, using Color Doppler, the sonographer can differentiate internal iliac vessels from the ureter on pelvic wall. The piriformis muscle, a hypoechoic structure, and the anterior surface of the sacrum, a hyperchoic line, are located deeper to the internal iliac vessels. At this level, the sacral roots of sacral plexus are recognized in the longitudinal section as hypoechoic bands with echogenic septae ("bundle of straw" appearance). In transverse section, the same structure has a "honeycomb" appearance[28] .

Posterior parametrial deep endometriosis is suspected if the posterior sliding sign is negative (the anterior rectum glides freely across the posterior aspect of the cervix, posterior vaginal wall, for an anteverted uterus, or uterine fundus for a retroverted uterus).

Posterior parametrial endometriosis is suspected if infiltrating, regular or irregular, homogeneous or heterogeneous hypoechoic nodes are identified in the retro-cervical part or in the structures (uterosacral ligaments, vagino-rectal ligaments, posterior vaginal fornix) that we have described as posterior parametrial limits.

Posterior parametrial deep endometriosis could be associated with pelvic nerve involvement[18]. Therefore, pelvic nerve involvement with endometriosis should be sought in the posterior parametrium.

CONCLUSION

In summary, ultrasound assessment of the parametrium should be performed in women with suspected pelvic endometriosis in order to detect the involvement of this structure. Herein, we describe how this assessment should be performed and how abnormal findings should be described. We hope that this consensus could help the researchers to obtain more reproducible results in the evaluation of diagnostic accuracy of ultrasonography in this compartment but also help the clinician in the daily practice.

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FIGURE LEGENDS

Figure 1. Schematic drawing of female pelvic structures with identification of parametrial areas (anterior, posterior and lateral parametrium) in a transversal pelvic section.

Figure 2. Schematic drawing of female pelvic parametrial ligaments in transversal pelvic section. Abbreviations: A1:common iliac artery; A2: internal iliac artery; A3:external iliac artery; A4: uterine artery; C: cardinal ligament; P: lateral pelvic bone; Sy: symphysis; Sa: Sacrum; U: ureter; USL: uterosacral ligament; VUL: vesico-uterine ligament

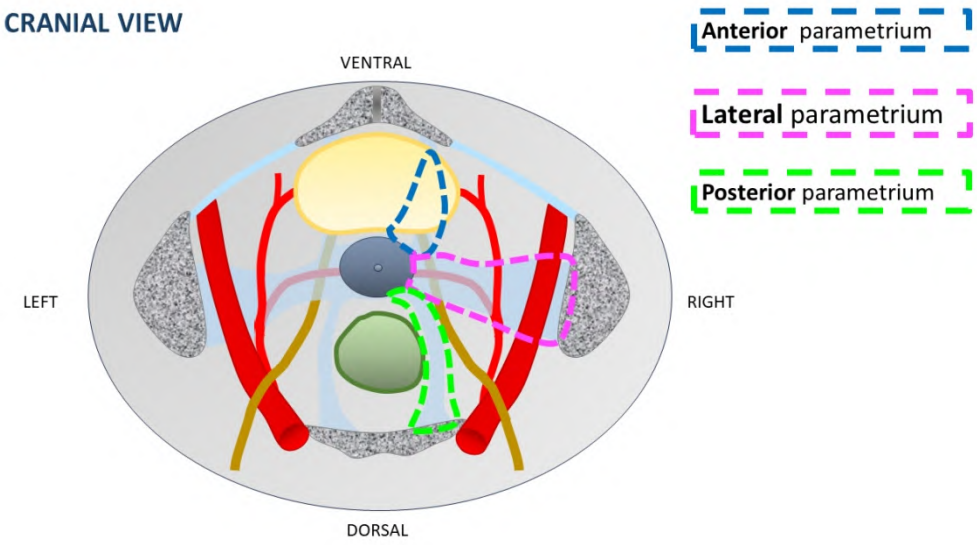
Figure 3. Schematic drawing of female pelvic structures with identification of lateral parametrial area in a coronal section. Abbreviations: A1: common iliac artery; A2: internal iliac artery; A3:external iliac artery; A4: uterine artery; B: bladder; C: cardinal ligament; P: lateral pelvic bone; S: sacral nerve roots; U: ureter; V: vagina

Figure 4. Ultrasound longitudinal visualization of normal lateral parametrium. Figures show lateral parametrial vessels using color Doppler. Figure A is marked image of figure B. Internal iliac vessels are in red; uterine vessels are in purple. Abbreviations: I, Internal iliac vessels; UV, Uterine vessels; U:uterus

Figure 5. Ultrasound transverse visualization of normal lateral parametrium. Figures show lateral parametrium anatomical landmarks using color Doppler. Figure A is marked image of figure B. Internal iliac vessels are in red; uterine vessels are in purple; pelvic ureter is in yellow. Abbreviations: I internal iliac vessels; UV, uterine vessels; U, pelvic ureter

Figure 6. Ultrasound transverse visualization of lateral para-cervical endometriosis. Figures show lateral caudal parametrial endometriosis nodule infiltrating ipsilateral ureter and rectal nodule of endometriosis. Figure A is marked image of figure B. Ureter stented is in yellow, fan shaped lesion of paracervix is in black, rectal nodule of endometriosis is in blue. Abbreviations: PE lateral parametrial endometriosis; RE, rectal nodule of endometriosis

Figure 7. Ultrasound longitudinal visualization of lateral parametrial endometriosis. Figures show lateral cranial parametrial endometriosis nodule infiltrating ipsilateral ureter and lateral parametrial vessels using color Doppler. Figure A is marked image of figure B. Ureter is in yellow, lateral parametrial nodule of endometriosis is in black,internal iliac vessels are in red, uterine vessels are in blue. Abbreviations : PE lateral parametrial endometriosis ; I internal iliac vessels; UV, uterine vessels; U, pelvic ureter stented



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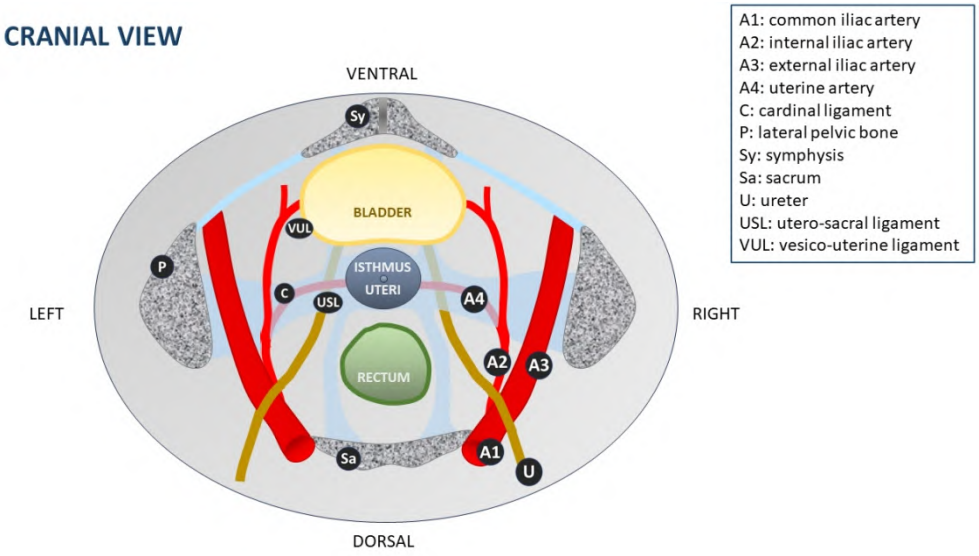

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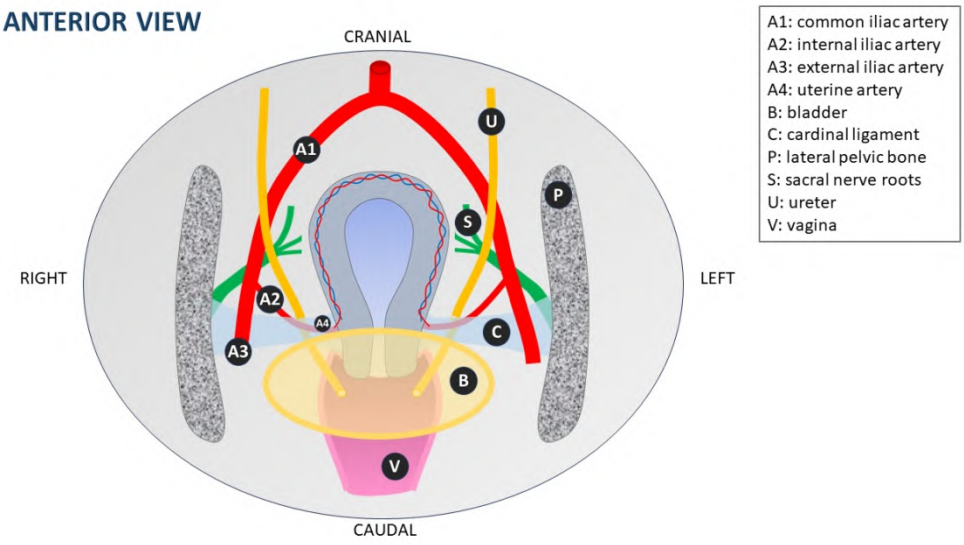

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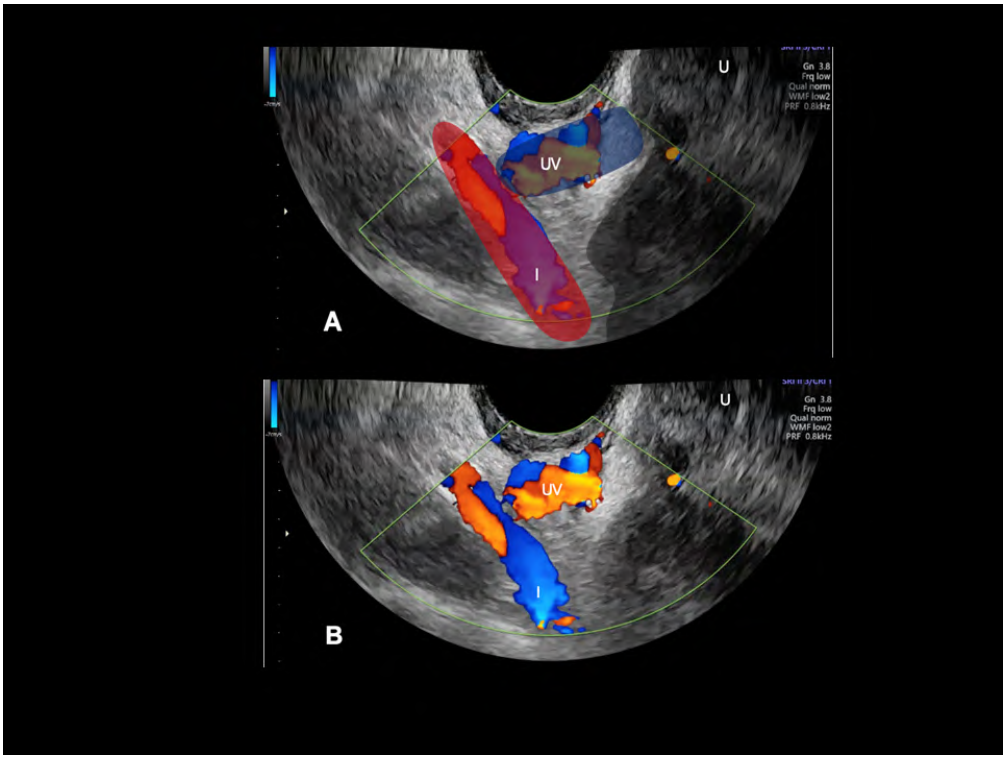

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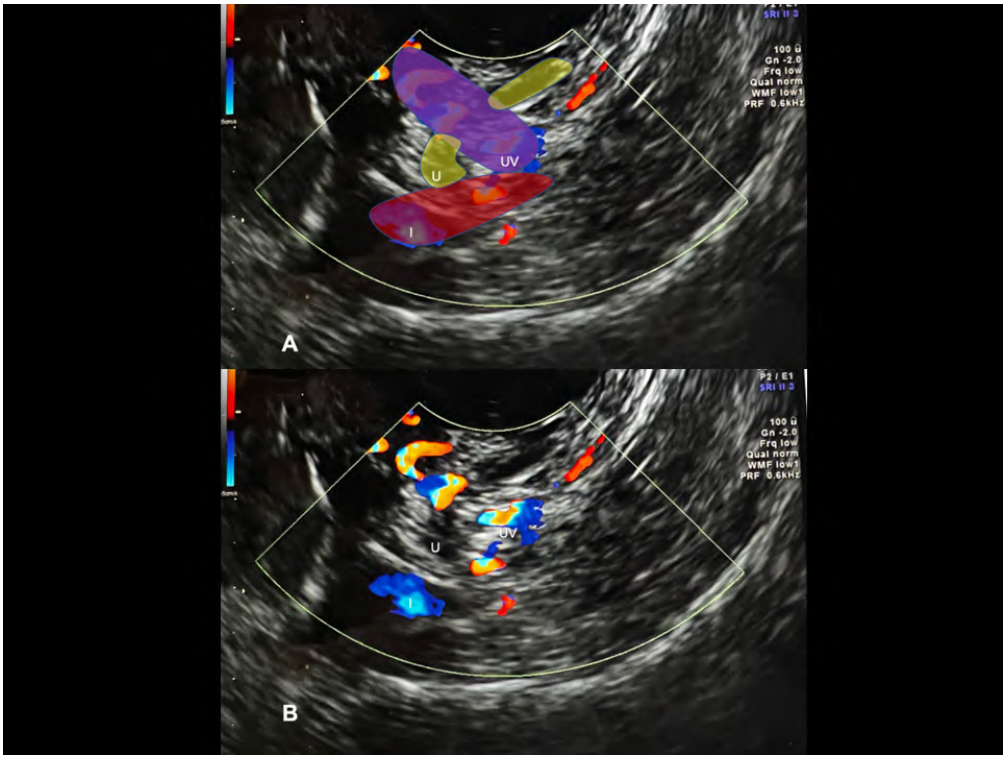

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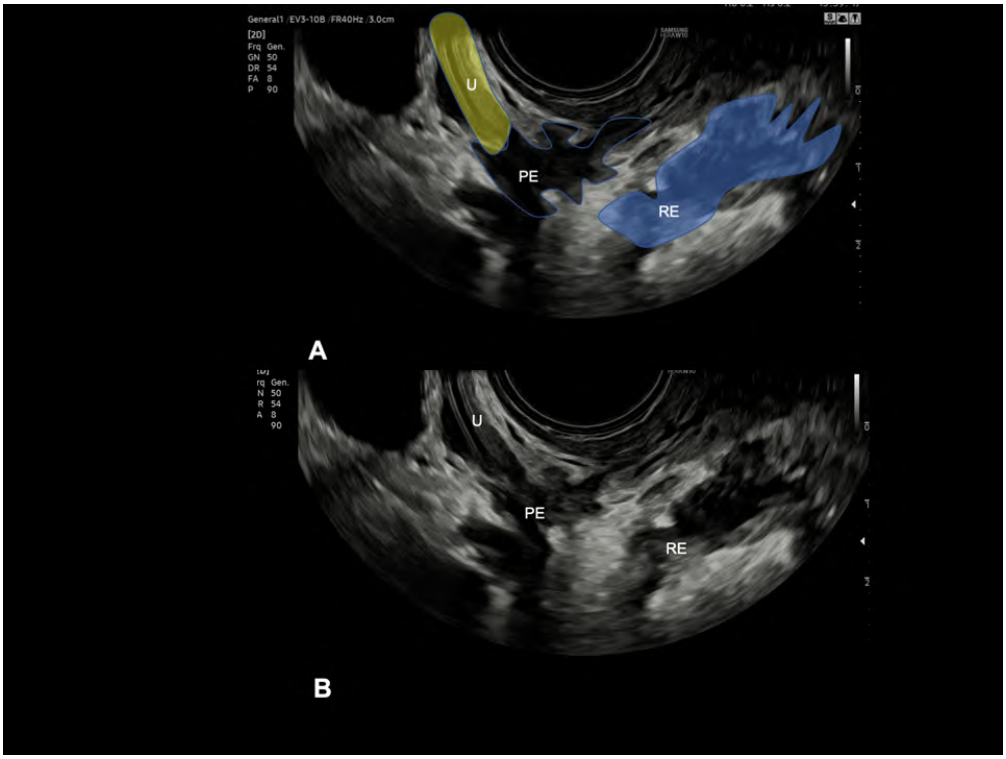

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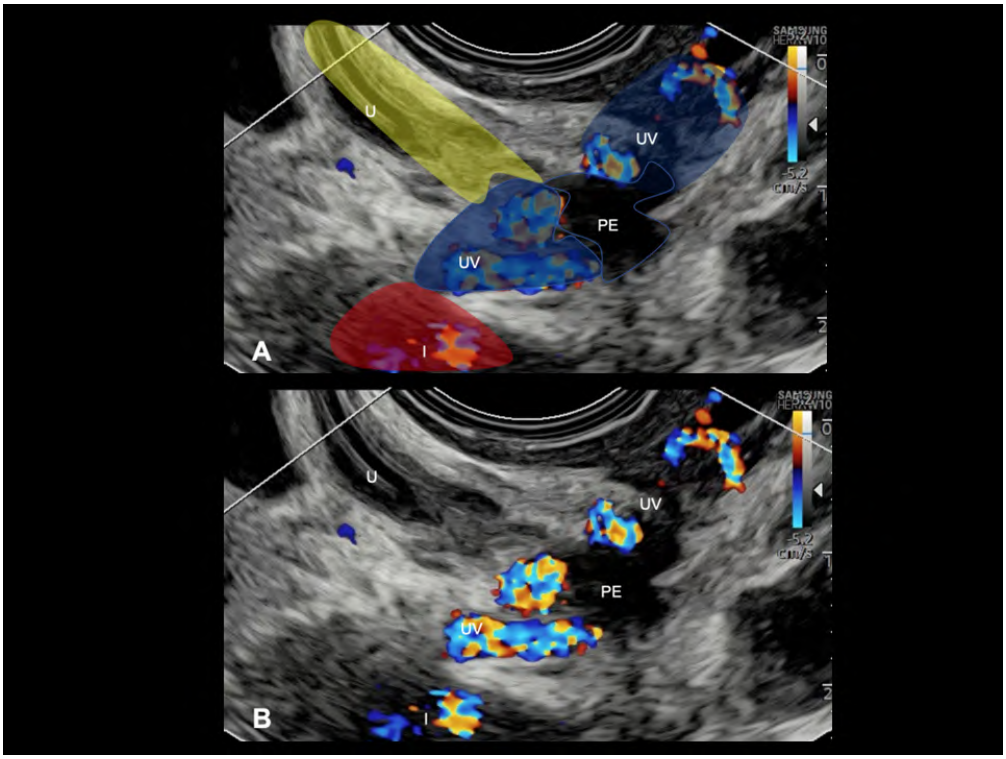

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