Chapter 6
Advanced Imaging Techniques Used in the Infertile Female

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6.1 Uterine Imaging

Uterine factor infertility comprises a small portion of infertility diagnoses. Uterine abnormalities that may impact fertility and pregnancy outcomes include congenital uterine anomalies, uterine leiomyomata, adenomyosis, endometrial polyps, and uterine synechiae. No single imaging modality is optimal for evaluating all of these, and when there is a finding of concern, multiple imaging tests may be required to ascertain the correct diagnosis and determine optimal management.

6.1.1 Uterine Anomalies

The uterus and fallopian tubes are formed in utero by fusion of the bilateral Mullerian ducts, followed by canalization and resorption of the septum between these two tubes, under the influence of the HOX family of genes [1]. Approximately 5.5% of women have an anomaly of the formation of the uterus, and thus these are among the most common congenital anomalies [2]. There is wide variability among anomalous uteri, as well as varying impact on reproduction and options for treatment. Multiple classification systems for uterine anomalies have been developed over the past 40 years [3–7], with increasing emphasis on objective imaging findings for classification. It is vital to correctly classify each uterine anomaly in order to counsel a woman about her risks and select appropriate candidates for surgery. In

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Table 6.1 Uterine anomalies, implications, and management [2, 7]

Uterine anomaly	ESHRE definition	Reproductive implications	Management
Arcuate uterus	Internal indentation ≥1 cm; ≤ 1.5 cm External cleft <1 cm	Increased second trimester loss, RR 2.39 (1.33–4.27) Malpresentation RR2.53 (1.54–4.18)	Expectant
Septate uterus	Internal indentation ≥1.5 cm External cleft <1 cm	First trimester miscarriage RR 2.89 (2.02–4.14) Preterm birth RR 2.14 (1.48–3.11) Malpresentation RR 6.24 (RR 4.05–9.62) Conception RR 0.86 (0.77–0.96)	Surgical (hysteroscopic metroplasty)
Bicornuate uterus	Internal indentation ≥1.5 cm External cleft ≥1 cm	First trimester miscarriage RR 3.40 (1.18–9.76); Second trimester miscarriage RR 2.32 (1.05–5.15); preterm birth RR 2.55 (1.57–4.17) Malpresentation RR 5.38 (3.15–9.19)	Expectant
Didelphys uterus	Two separate unicornuate uterine cavities Two corpus bodies with double cervix	Preterm birth RR 3.58 (2.00–6.40) Malpresentation RR 3.70 (2.04–6.70)	Expectant
Unicornuate	Single well-formed uterine cavity with a single interstitial portion of the fallopian tube and concave fundal contour Asymmetric ellipsoidal shape with our without smaller horn	First trimester miscarriage RR 2.15 (1.03–4.47) Preterm birth 3.47 (1.94–6.22)	Expectant

Table 6.1, the most common types of uterine anomalies are described according to the ESHRE/with their impact on reproductive outcomes and amenability to surgical repair. Reproductive outcomes appear to be improved after hysteroscopic surgery for uterine septum [8], and this procedure may be considered in women with a history of infertility, pregnancy loss, or poor pregnancy outcome [9]. Historically, reunification procedures were commonly performed for bicornuate and didelphys uteri, but these invasive procedures have not been demonstrated to increase the chances of a live birth and have largely been abandoned [10].

Imaging techniques for uterine anomalies are summarized in Table 6.2, including their sensitivities and specificities as well as positive predictive value (PPV) and negative predictive value (NPV), relative to a gold standard of laparoscopy and hysteroscopy. In the evaluation of a woman with infertility, two-dimensional (2D), transvaginal ultrasound is often the first test performed, due to its availability, low cost, and lack of radiation, as well as its ability to provide information on a number

Table 6.2 Sensitivity and specificity of imaging modalities for uterine anomalies [11]

Modality	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)	Comments
2D ultrasound	67.3 (51.0–83.7)	98.1 (96.0–100)	94.6 (89.4–99.8)	86.0 (73.7–98.3)	86.6 (81.3–91.8)	Inexpensive and easily accessible
3D ultrasound	98.3 (95.6–100)	99.4 (98.4–100)	99.2 (97.6–100)	93.9 (84.2–100)	97.6 (94.3–100)	Requires specialized transducer
Hysterosalpingo-contrast sonography (saline infusion sonohysterography)	95.8 (91.1–100)	97.4 (94.1–100)	97.8 (93.3–100)	94.6 (87.6–100)	96.5 (93.4–99.5)	
Hysterosalpingography	84.6 (74.4–94.9)	89.4 (80.0–100)	83.6 (74.6–92.6)	89.1(79.7–98.5)	86.9 (79.8–94.0)	Limited to internal uterine contour; painful; requires radiation
MRI					85.8	

of anatomic findings that impact fertility, as discussed later in the chapter. 2D ultrasound offers high specificity, but relatively poor sensitivity for uterine anomalies, and is dependent upon the skill of the operator. Three-dimensional ultrasound improves sensitivity in the diagnosis of uterine anomalies but is less widely available than 2D ultrasound. Image acquisition is typically simple, but processing and interpretation of images requires training and experience [11]. If available, a 3D ultrasound image may be acquired at the time of standard 2D ultrasound and reviewed later if concerns arise. Alternatively, 3D ultrasound may be used as an adjunct to 2D sonographic imaging in the case of indeterminate findings or clinical suspicion.

Saline infusion sonohysterography, also known as hysterosalpingo-contrast sonography (HyCoSy), similarly provides improved sensitivity and accuracy in diagnosing uterine anomalies, as compared with 2D ultrasound. It is relatively low cost and requires specialized training of the operator. Compared with hysterosalpingography, it is less likely to cause pain or infection [11]. This technique is also advantageous in definitively diagnosing other intracavitary lesions. Some authors advocate the use of HyCoSy as a standard, first-line tool in the investigation of infertility [12], while others suggest this modality should be reserved for those with concerning findings on 2D ultrasound or hysterosalpingography [9].

Hysterosalpingography (HSG) is frequently performed in the evaluation of the infertile woman, as a primary assessment of tubal patency. This test is performed in the radiology suite. The cervix is canalized with a catheter, and radio-opaque contrast material is injected through the cervix to fill the uterus and ultimately spill from the fallopian tubes into the uterine cavity. An abnormal internal uterine contour

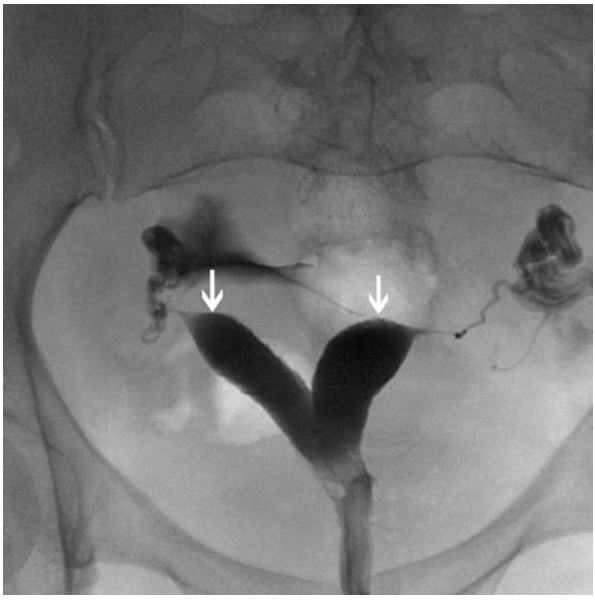

Fig. 6.1 Nonspecific Mullerian duct anomaly. A hysterosalpingogram shows divergent uterine horns (arrows), suggestive of either a septate or bicornuate uterus. Because the external contour of the uterus is not visible, these two anomalies cannot be differentiated on HSG

may be noted. However, because HSG does not define the external contour of the uterus, this technique cannot distinguish a bicornuate from a subseptate uterus (Fig. 6.1) nor a unicornuate uterus from a uterine didelphys or complete uterine septum [11].

MRI (magnetic resonance imaging) offers a slight increase in accuracy of diagnosis of Mullerian anomalies relative to 3D ultrasound [13]. The internal and external contours of both uterus and cervix can be completely imaged with MRI. While intravenous contrast is not necessary, T2-weighted images and use of vaginal gel allow for optimal contrast imaging. Both axial and oblique coronal images should be obtained and reviewed, with 4–5 mm slice thickness and a 24–26 cm field of view. Because of the association between uterine and renal anomalies, consideration should be given to imaging the kidneys as well at the time of MRI [14]. Because of increased cost, MRI should be reserved for cases in which less expensive techniques have not adequately defined uterine and cervical anatomy, and a key management decision relies on the distinction, e.g., a complete uterine septum (Fig. 6.2) versus didelphys uterus (Fig. 6.3) in a patient with recurrent pregnancy loss. In this case, MRI imaging confirmation would enable hysteroscopic septum incision.

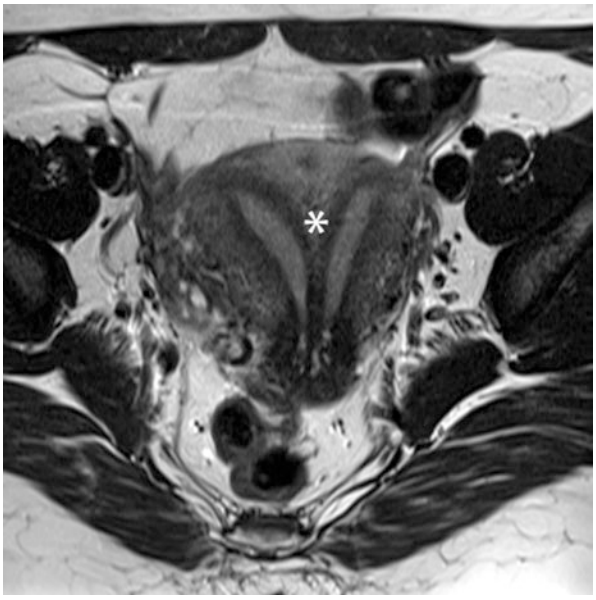

Fig. 6.2 Septate uterus. Axial T2-weighted MR shows a prominent septation (asterisk) with separation of the uterine cavities extending through the cervix

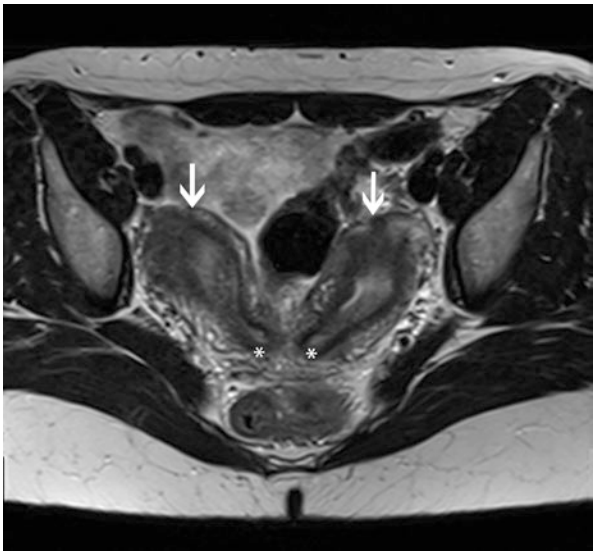

Fig. 6.3 Uterine didelphys. Oblique axial T2-weighted MR demonstrating two widely divergent uterine horns (arrows) and two separate cervices (asterisk) in the setting of uterine didelphys

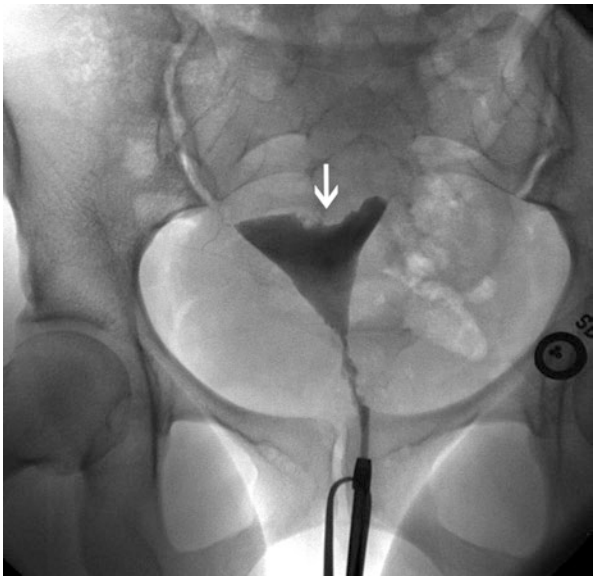

Fig. 6.4 Uterine leiomyoma. A hysterosalpingogram shows focal contour irregularity along the fundal aspect of the endometrial cavity (arrow) consistent with a partially submucosal fibroid

6.1.2 Leiomyoma

Uterine leiomyomata are an extremely common finding among women of reproductive age, with a cumulative incidence of nearly 60% in black women and approximately 30% in white women by age 40 [15]. Leiomyoma are classified as submucosal, intramural, or subserosal based on their location relative to the myometrium, with subclassifications for the proportion of each fibroid in each location [16]. The impact of intramural and subserosal uterine fibroids on fertility is somewhat controversial, and it is not certain whether myomectomy for these types of fibroids improves the chances of successful pregnancy. In contrast, hysteroscopic myomectomy for submucosal leiomyomata has been demonstrated to increase the chances of clinical pregnancy in infertile women [17–19]. Therefore, a precise delineation of the location of uterine is imperative for selecting candidates who are likely to benefit from surgical management.

Uterine leiomyomata are often initially diagnosed on 2D ultrasound, which allows measurement of the size of fibroids but is often inadequate for classification of the location. Hysterosalpingography may identify intracavitary filling defects that might represent leiomyoma but cannot differentiate submucosal fibroids from endometrial polyps, as noted in Fig. 6.4 [20]. Saline infusion sonohysterography has nearly 100% sensitivity, and approximately 90% specificity for diagnosing submucosal fibroids [21, 22], and is the optimal second imaging study for characterization of uterine fibroids.

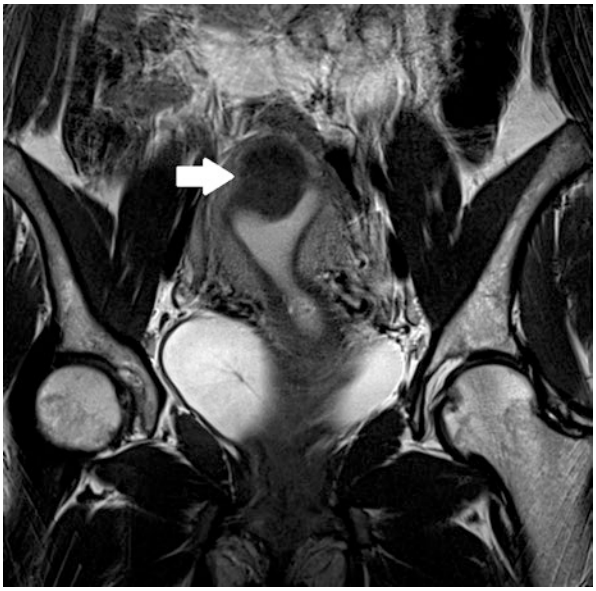

Fig. 6.5 Uterine leiomyoma. Coronal T2-weighted MR shows a prominent intramural hypointense mass (arrow) within the uterine fundus

While MRI provides high resolution imaging of uterine fibroids with clear classification of location (Fig. 6.5), its high cost mandates selective utilization. T2-weighted images provide the greatest contrast between leiomyoma and surrounding myometrium; T1-weighted images should also be obtained to differentiate uterine fibroids from other types of pelvic masses [23]. Unlike ultrasound, MRI has high accuracy in differentiating benign leiomyoma from uterine malignancies [24] and adenomyosis [25, 26], particularly with the use of diffusion-weighted imaging. Utilization of MRI for confirmation of an ultrasound diagnosis of fibroids prior to abdominal or laparoscopic myomectomy may avoid unnecessary surgeries for adenomyosis and inadvertent spread of malignant cells.

6.1.3 Adenomyosis

Adenomyosis is the growth of endometrial glands and stroma within the uterine myometrium, which can lead to menorrhagia and dysmenorrhea. It may be focal, creating an adenomyoma, or diffuse throughout the uterus. While it is more commonly found in parous women, adenomyosis has been hypothesized to contribute to infertility [27] and is associated with decreased chances of clinical pregnancy among women undergoing in vitro fertilization [28, 29]. Hysterectomy is the definitive treatment of adenomyosis, but in infertile women, conservative uterine surgery

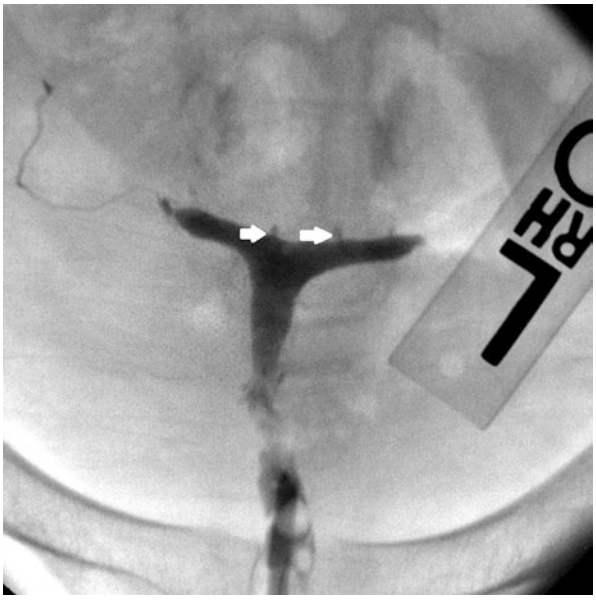

Fig. 6.6 Adenomyosis. A hysterosalpingogram shows multiple outpouchings from the endometrial cavity (arrows), consistent with heterotopic endometrium in the setting of adenomyosis

[30, 31] and the use of GnRH agonists [32, 33] have been found to be beneficial in small studies.

Hysterosalpingography may provide evidence of adenomyosis with small outpouchings from the uterine cavity representing the invasion of endometrial glands into the myometrium (Fig. 6.6). Transvaginal ultrasound findings suggestive of adenomyosis include myometrial heterogeneity and myometrial anechoic cysts [34], as well as enlargement of the uterine corpus and asymmetric anterior or posterior myometrial thickening [35]. A meta-analysis found transvaginal ultrasound to be 82.5% sensitive and 84.6% specific for the diagnosis of adenomyosis.

MRI offers decreased sensitivity (46%) but increased specificity (99%) in the diagnosis of adenomyosis, leading to a positive predictive value of 92% among women with an enlarged uterus planning hysterectomy [36]. MRI findings include a junctional zone between the endometrium that is thicker than 12 mm, poorly defined margins of the lesion, and the absence of deformity of the endometrium, as demonstrated in Fig. 6.7. In contrast, Fig. 6.8 depicts MRI findings consistent with focal adenomyosis. When managing adenomyosis in a patient with infertility, the high specificity of MRI allows certainty in diagnosis to facilitate appropriate medical or surgical treatment.

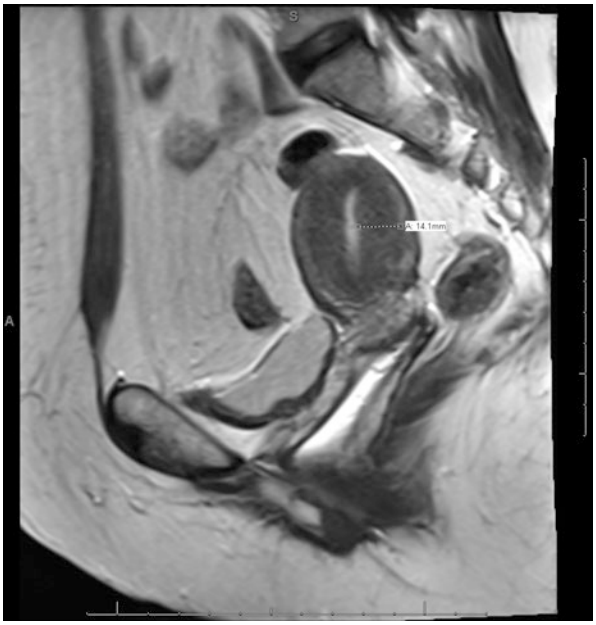

Fig. 6.7 Adenomyosis. Sagittal T2-weighted MR shows diffuse thickening of the junctional zone up to 14 mm, consistent with adenomyosis

6.1.4 Endometrial Polyps

Endometrial polyps are outgrowths of the endometrium that project into the uterine cavity. They are found in approximately 10% of women with infertility [37] and may present with abnormal uterine bleeding. Among premenopausal women, over 98% are benign, while less than 2% represent cancerous or premalignant lesions [38]. While polyps may spontaneously regress, and clearly pregnancy can be achieved in the presence of polyps, a randomized controlled trial has demonstrated higher pregnancy rates with intrauterine insemination among women who underwent hysteroscopic resection of endometrial polyps than in those whose polyps were left in situ [39]. Because hysteroscopic resection of endometrial polyps is a low risk procedure that can be performed in an office setting, many authors advocate that endometrial polyps be removed prior to fertility treatment [40, 41].

Saline infusion sonohysterography offers the optimal visualization of endometrial polyps, with sensitivity and specificity at 90% or greater, as shown in Fig. 6.9. This technique has greater sensitivity than transvaginal ultrasound, and there is no statistically significant increase with the use of 3D versus 2D sonohysterography [22, 42]. HSG cannot differentiate endometrial polyps from submucosal fibroids. MRI is not indicated in the evaluation of suspected endometrial polyps.

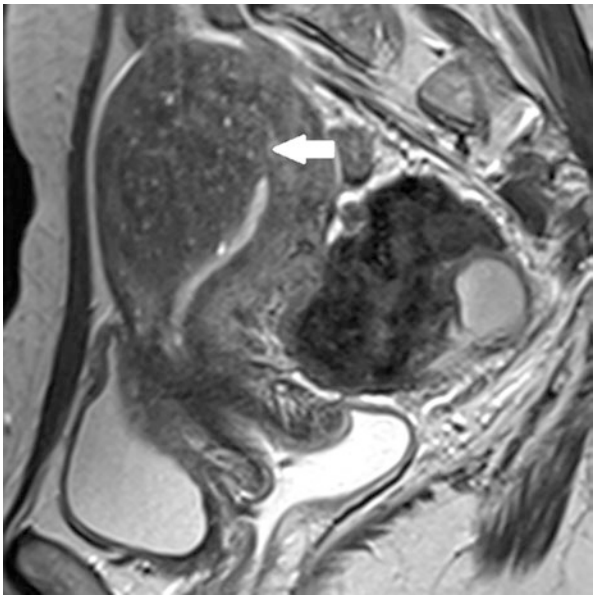

Fig. 6.8 Adenomyosis. Sagittal T2-weighted MR shows poor delineation of the uterine zonal anatomy with marked thickening of the junctional zone within the anterior myometrium (white arrow). Multiple punctate hyperintense foci are noted within the myometrium, consistent with heterotopic endometrial glands

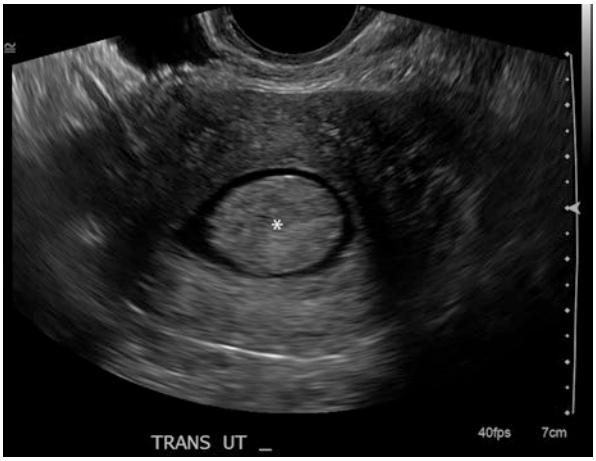

Fig. 6.9 Endometrial polyp. A transvaginal US from a saline-infused sonohysterogram shows fluid outlining a prominent endometrial polyp (asterisk)

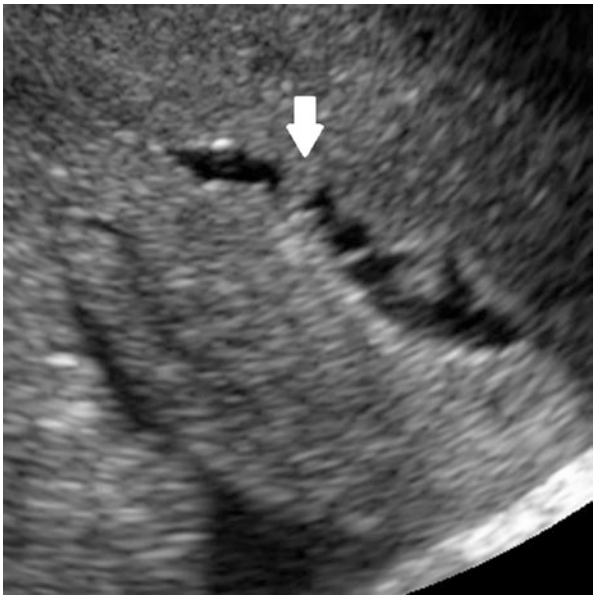

Fig. 6.10 Uterine synechiae. A transvaginal US from a saline-infused sonohysterogram shows multiple echogenic nodules lining the endometrial cavity (white arrow) consistent with uterine synechiae

6.1.5 Uterine Synechiae

Uterine synechiae are adherent fibrous bands crossing the uterine cavity, initially described by Asherman in 1948 in association with amenorrhea [43]. They are found in approximately 7% of women with infertility. Surgical procedures involving the uterine cavity are the primary risk factor, with the highest rates of adhesion formation after dilation and evacuation procedures for intrauterine fetal demise, dilation, and curettage for retained products of conception and postpartum dilation and curettage [44]. The risk of uterine synechiae among women who have undergone dilation and curettage to manage a miscarriage may be as high as 19% [45]. Uterine synechiae may present clinically with changes in menstrual bleeding patterns including amenorrhea or hypomenorrhea, infertility, cyclic pelvic, or recurrent pregnancy loss [46]. Treatment is surgical, with hysteroscopic lysis of adhesions.

Saline sonohysterography is the optimal imaging method for uterine synechiae, with sensitivity of 82–100% and specificity of 99–100% [47]. Uterine synechiae appear as hyperechoic bands crossing the uterine cavity (Fig. 6.10). Hysterosalpingography has demonstrated approximately 80% sensitivity and specificity for uterine synechiae, leading to a positive predictive value of 63% and negative predictive value of 84% in infertile women [48]. While 2D ultrasound lacks adequate sensitivity, relatively new data suggests that 3D ultrasound findings including irregularity at the endometrial margin, partial thinning and endometrial defects,

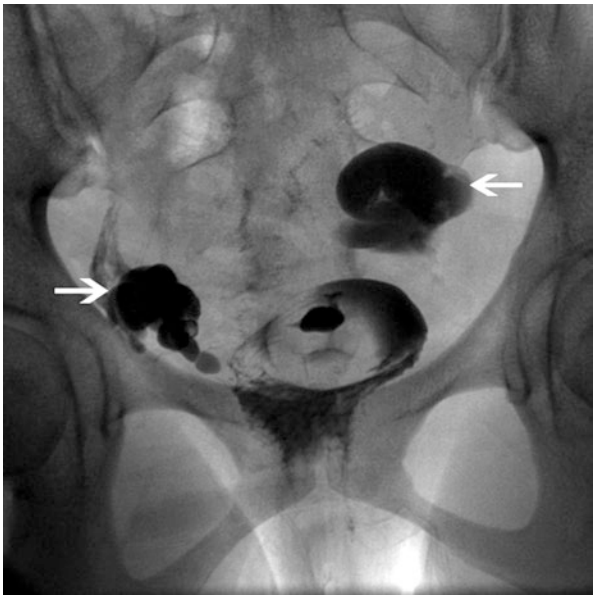

Fig. 6.11 Hysterosalpingogram with bilateral hydrosalpinges. The fallopian tubes are markedly dilated bilaterally (white arrows) with minimal spillage of contrast material from the right tube. The uterine cavity is poorly visualized on this delayed image

and hyperechoic lesions are highly predictive of a hysteroscopic diagnosis of intrauterine adhesions [49]. While MRI can be considered when the severity of intrauterine adhesions prevents catheter passage for saline-infused sonohysterography, this test has not been demonstrated to provide additional value in ascertaining individuals who may benefit from hysteroscopic evaluation and treatment.

6.2 Fallopian Tube Imaging

Evaluation of fallopian tube patency remains a cornerstone of the female fertility assessment. Hysterosalpingogram has long been the mainstay of this evaluation. Distal tubal obstruction with and the degree of hydrosalpinx can clearly be delineated by HSG (Fig. 6.11). Women with bilateral hydrosalpinges are presumed to have extremely low chances of conception without in vitro fertilization, and women with unilateral hydrosalpinx are 75% less likely to conceive with intrauterine insemination than those with bilateral tubal patency [50]. In women with hydrosalpinges, salpingectomy improves the odds of ongoing pregnancy with IVF [51]. Salpingectomy for proximal tubal obstruction has been hypothesized to improve the chance of spontaneous pregnancy in women with unilateral hydrosalpinx [52].

However, the specificity of HSG for proximal tubal obstruction is limited, as 60% of women with unilateral proximal tubal obstruction on initial HSG will have bilateral tubal patency on repeat HSG [53]. Tubal spasm is the hypothesized mechanism for this [54].

Various radiologic techniques have been proposed for the evaluation and management of proximal tubal obstruction. These include selective salpingography, in which a catheter is fluoroscopically guided to the cornu where proximal obstruction is detected and contrast material directly injected, tubal catheterization with a soft, Teflon catheter, and canalization with a guide-wire. Each of these techniques has relatively high success in achieving tubal patency, and approximately 40% of treated patients achieve spontaneous pregnancies within 1 year [55, 56]. However, an absence of randomized controlled trials or high quality observational studies comparing treated to untreated patients makes it impossible to assess whether these treatments actually improve the odds of successful pregnancy. Indeed, Ferraiolo et al. [57] found that 21% of women with bilateral proximal tubal obstruction that could not be relieved by selective salpingography spontaneously conceived an intrauterine pregnancy within 1 year after the procedure. Women with untreated unilateral proximal tubal obstruction on HSG have similar rates of clinical pregnancy with intrauterine insemination to women with bilateral tubal patency [50].

Assessment of tubal patency by HyCoSy requires specialized training, and the technique involves instillation of air bubbles, which appear hyperechoic on ultrasound, through the fallopian tubes after completion of the uterine cavity assessment. Two meta-analyses have demonstrated 95–98% sensitivity and 90–93% specificity of HyCoSy for tubal obstruction relative to the gold standard of laparoscopic evaluation, which was equivalent to HSG [58, 59]. In the first meta-analysis, the addition of contrast media to HyCoSy did not improve diagnostic accuracy. Use of this technology to diagnose hydrosalpinx to select candidates for surgical treatment prior to in vitro fertilization may also prevent unnecessary surgeries, as only hydrosalpinges visible on ultrasound appear to impact the outcome of IVF [60, 61]. Some authors have noted higher pain scores in women undergoing HyCoSy relative to HSG [62], while others found the opposite with hysteron-foam-sonography [63]. Some authors advocate for the use of HyCoSy rather than HSG for assessment of tubal patency due to its ability to evaluate all pelvic anatomy and avoidance of radiation [64].

6.3 Ovarian Imaging

6.3.1 Infertility Evaluation and Monitoring

Transvaginal ultrasound is the standard of evaluation of the ovaries in the infertile female. Initial ultrasound is best performed in the early follicular phase in order to assess antral follicle count, a key measure of ovarian reserve, as well as ovarian volumes, in the absence of a dominant follicle or corpus luteum cyst that could impact these measurements (Fig. 6.12). Antral follicle count predicts response to

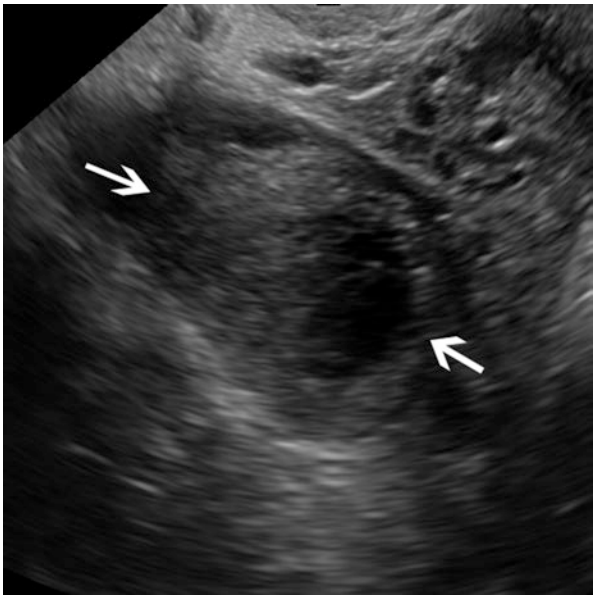

Fig. 6.12 Normal ovary. Transvaginal US demonstrating a typical appearance of a normal ovary (white arrows)

gonadotropins in in vitro fertilization cycles [65] and has been correlated with chances of live birth [66].

Antral follicle count and ovarian volume are elements of the ovarian morphology criterion for polycystic ovary syndrome, although societies debate on the antral follicle count that defines polycystic ovaries. The Endocrine Society requires an antral follicle count of 12 per ovary [67], while the Androgen Excess and Polycystic Ovary Syndrome Society utilizes 25 per ovary [68]. Both concur on an ovarian volume of at least 10 mL.

Ultrasound monitoring of the number and size of follicles in in vitro fertilization is the standard of care, for determining cycle cancelation, gonadotropin dose changes, risk of ovarian hyperstimulation syndrome, and timing of ovulation trigger [69]. In Fig. 6.13 is an ovary with multiple maturing follicles after treatment with gonadotropins, while Fig. 6.14 demonstrates the appearance of the ovary in ovarian hyperstimulation syndrome, with multiple corpus luteum cysts. Ultrasound monitoring may be used with clomiphene citrate in order to determine the timing of intrauterine insemination, but this has not been demonstrated to improve the chances of pregnancy compared to urinary LH monitoring [70, 71].

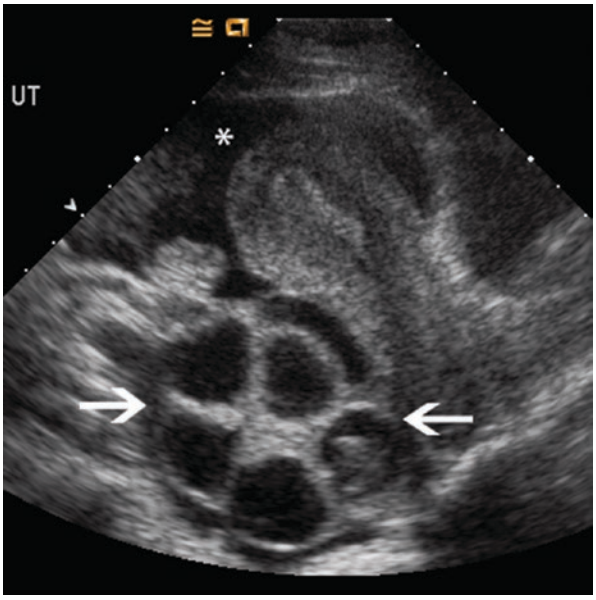

Fig. 6.13 Ovarian hyperstimulation. Transabdominal US demonstrating an enlarged ovary with multiple follicles (white arrows) in a patient undergoing controlled ovarian hyperstimulation for in vitro fertilization. Free fluid is noted (asterisk)

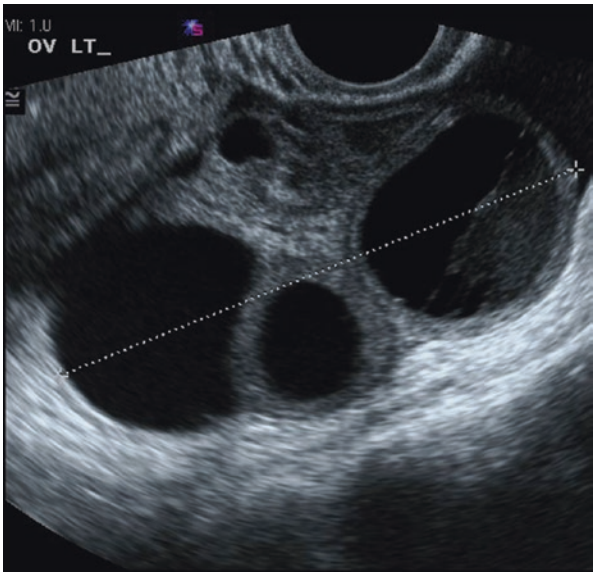

Fig. 6.14 Ovarian hyperstimulation. Transvaginal US image of an enlarged ovary with multiple prominent follicles in a patient with ovarian hyperstimulation syndrome

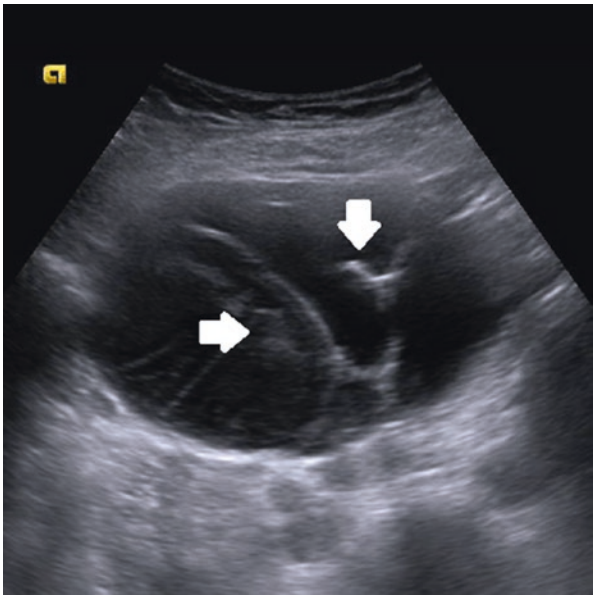

Fig. 6.15 Complex ovarian cyst. Transabdominal US image of a complex ovarian cyst concerning for malignancy. The horizontal arrow indicates a small, solid area, while the vertical arrow indicates a papillary excrescence

6.3.2 Ovarian Cysts

Ovarian cysts and other adnexal masses are common findings in women with infertility. While they may present with pain, often they are found incidentally, most commonly with transvaginal ultrasound performed in the evaluation of infertility [72]. The primary goal of imaging of ovarian cysts is to determine which cysts present with a significant risk of malignancy so that they may be appropriately managed surgically. A secondary goal is to determine whether an ovarian cyst contributes to the patient's infertility, and if so, determine an optimal management strategy.

The LR2 prediction model, developed from the International Ovarian Tumor Analysis study, uses patient age and ultrasound findings to predict the likelihood of malignancy in adnexal masses. Ascites, blood flow in a papillary projection, maximal diameter of the solid component, irregular internal cyst walls, and acoustic shadows each increase the risk of malignancy [73]. The LR2 model has demonstrated 94% sensitivity and 82% specificity for ovarian cancer, significantly better than a model that incorporates the serum markers CA-125 and HE4 [74] and can be performed by the clinician to determine which patients should be referred to gynecologic oncology. Figure 6.15 depicts a complex cyst with cystic and solid components and a papillary projection, highly concerning for malignancy.

Follicular cysts, corpora lutea, endometriomas, and dermoid cysts (mature cystic teratomas) are among the most common benign ovarian cysts found on ultrasound.

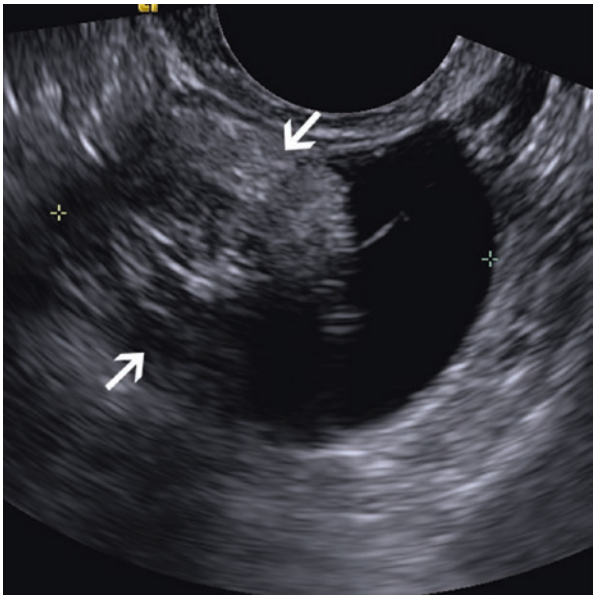

Fig. 6.16 Ovarian dermoid. Transvaginal US demonstrating a heterogeneous solid and cystic mass. An echogenic shadowing Rokitansky nodule or dermoid plug (white arrows) is a characteristic feature of a dermoid

Thirty to fifty percent of those who have both dysmenorrhea and infertility have endometriosis, and 20–40% of women with endometriosis will have an endometrioma [75]. Endometriomas may be unilocular or multilocular, and most commonly have a homogeneous, ground-glass appearance on ultrasound (Fig. 6.16), and may have hyperechoic wall nodules [76]. Transvaginal ultrasound is highly sensitive (87–99%) and specific (92–99%) for endometrioma, with a predictive value equivalent to MRI [77].

Endometriomas may have a negative impact on the surrounding ovarian stroma and follicles, as decreased follicular number and density has been reported in ovaries with endometriomas [78]. While measures of ovarian reserve are lower in women with endometriomas [79], the presence of an endometriomas does not decrease the chances of live birth with in vitro fertilization [80]. Moreover, it is well established that surgical excision of endometriomas decreases ovarian reserve [72], and a meta-analysis found that neither medical nor surgical treatment of endometrioma prior to in vitro fertilization improved the odds of clinical pregnancy [81].

Dermoid cysts, also known as mature cystic teratomas, are comprised of a variety of cell types and have a complex appearance on ultrasound, with bright calcifications and echogenic sebaceous material, as shown in Fig. 6.17 [82]. While studies of the impact of dermoid cysts on fertility are very limited, surgical resection of dermoid cysts has been reported to decrease ovarian reserve to a greater degree than cystectomy for endometrioma [83], and the presence of a dermoid does not appear

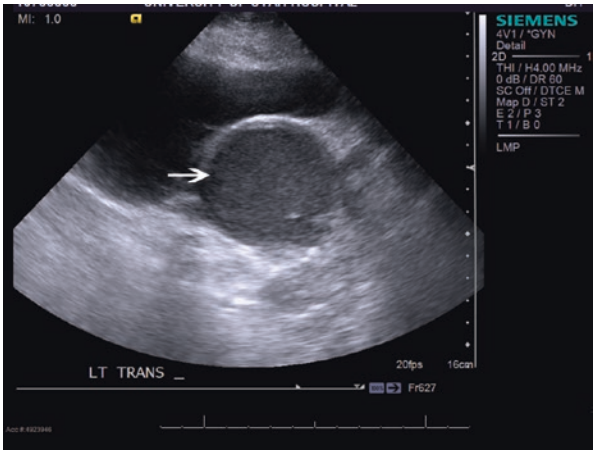

Fig. 6.17 Endometrioma. Transabdominal US demonstrating an ovarian endometrioma (arrow)

to decrease ovarian response to gonadotropin stimulation for IVF [84]. Therefore, dermoid cysts do not require surgical treatment in the infertile patient.

6.4 Endometriosis

As previously noted, the majority of cases of endometriosis are not associated with an ovarian endometrioma. Transvaginal ultrasound may detect large nodules of endometriosis, and the sliding sign technique (applying pressure of the vaginal ultrasound transducer to the posterior fornix to determine if the uterus moves independently from the rectum) demonstrates high sensitivity and specificity for deeply infiltrating endometriosis in the rectovaginal septum [85]. However, MRI ultimately demonstrates greater sensitivity for deeply infiltrating endometriosis than ultrasound, 94% versus 79% [77], as well as for posterior implants involving the uterosacral ligaments and cul-de-sac [76]. MRI can detect small endometrial implants on T1-weighted images, and adhesions resulting from endometriosis are visible on both T1- and T2-weighted images. In Fig. 6.18, a posterior endometrioma can be visualized on T2-weighted imaging, as well as deeply infiltrating endometriosis in the rectovaginal septum, as indicated by the arrow.

MRI may also improve identification of hematosalpinx due to endometriosis, as seen in Fig. 6.19. The detailed, 3-dimensional imaging provided by MRI is highly predictive of surgical findings [76]. Prospective studies are needed to demonstrate the utility of MRI assessment for endometriosis among infertile women, in order to select the optimal treatment for each woman.

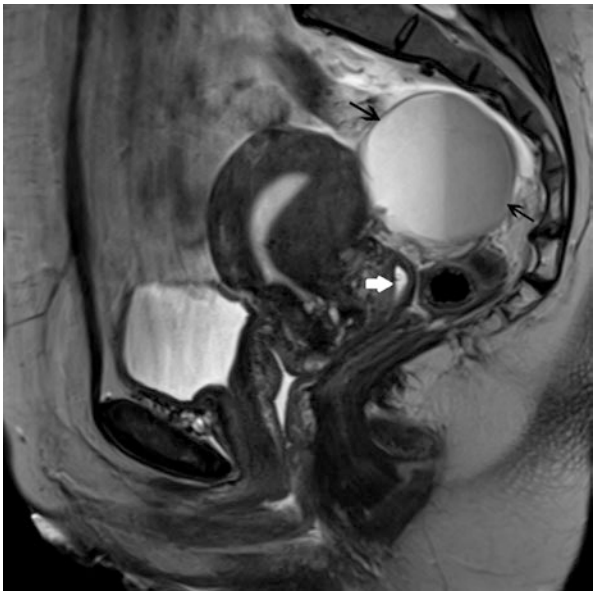

Fig. 6.18 Endometriosis. Sagittal T2-weighted MR shows a large posterior presacral endometrioma (black arrows) and deeply infiltrating endometriosis in the rectovaginal septum (white arrow)

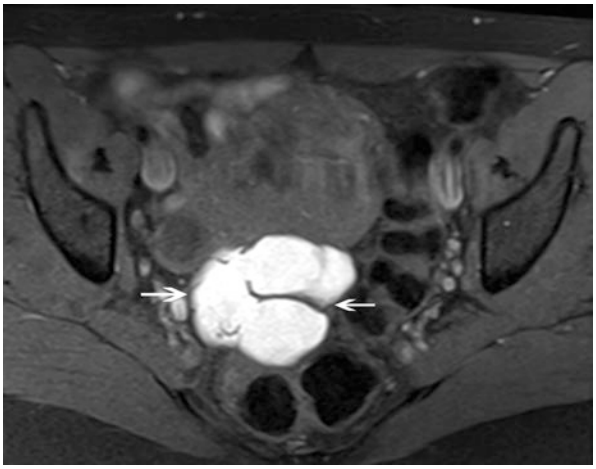

Fig. 6.19 Hematosalpinx. Axial T1-weighted MR with fat saturation shows a large, posterior hematosalpinx (arrows) due to endometriosis

6.5 Conclusions: A Practical Approach to Imaging

In a woman presenting with infertility, HyCoSy offers an opportunity to evaluate the uterus, fallopian tubes, and ovaries with a single, relatively low cost, minimally invasive test that can be performed in the office and does not require radiation exposure. As such, many authors advocate for this as the first-line test for all new infertility patients [12]. Because of the high sensitivity and specificity of this test, clinical management of abnormalities including adnexal masses, hydrosalpinges, and uterine anomalies can often be determined from HyCoSy alone. However, when specific abnormalities are suspected due to clinical history or uncertain findings, additional imaging may be beneficial to make a definitive diagnosis, and prior to surgery or other invasive procedures. Radiation exposure, need for contrast, patient discomfort, and cost are all important considerations in weighing imaging techniques, and a personalized approach is paramount, with selection of only those tests whose results will change clinical management.

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