

# Diagnostic findings in adenomyosis: a pictorial review on the major concerns

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**Abstract.** – Adenomyosis is a benign pathology with a marked impact on women in reproductive age.

The prevalence of adenomyosis ranges from 5 to 70%. Dysmenorrhea, metrorrhagia, chronic pelvic pain, dyspareunia and infertility often occur, while a third of the women is asymptomatic.

This pictorial review focuses on the peculiar patterns of presentation in adenomyosis. They are identified by means of non-invasive or minimally invasive techniques, with particular reference to 2D- and 3D-transvaginal sonography, sonohysterosalpingography, magnetic resonance imaging, and endoscopic techniques (i.e. hysteroscopy and laparoscopy).

*Key Words:*

Adenomyosis, Transvaginal sonography, Junctional zone, Magnetic resonance, Endoscopy.

## Introduction

Adenomyosis is a benign gynaecological disease in which the uterine myometrium contains endometrial glands and stroma surrounded by hypertrophic and hyperplastic smooth muscle<sup>1</sup>. The prevalence of adenomyosis ranges from 5 to 70%<sup>2</sup>; this high variability depends on several factors, such as the diagnostic criteria, the characteristics of the sample analysed, and the investigator's skills<sup>3</sup>.

In origin, adenomyosis was diagnosed on histological specimens<sup>4</sup>. To date, the improvement of diagnostic techniques allows the physicians to identify the disease by means of non-invasive and equally reliable instruments<sup>5</sup>. Adenomyosis has a dramatic impact on women in reproductive

age. Dysmenorrhea, metrorrhagia, chronic pelvic pain, dyspareunia and infertility often occur, while a third of the women is asymptomatic<sup>6</sup>.

This pictorial review focuses on the peculiar patterns of presentation in adenomyosis. They are identified by means of non-invasive or minimally invasive techniques, with particular reference to 2D- and 3D-transvaginal sonography, sonohysterosalpingography, magnetic resonance imaging, and endoscopic techniques (i.e. hysteroscopy and laparoscopy).

## Adenomyosis and Main Presenting Patterns

Adenomyosis appears to be related to alterations in the endometrium-myometrium junctional zone (JZ). As the JZ presents physiological variability in thickness, the exact diagnostic criteria are still controversial. However, a penetration of endometrial glands deeper than 2,5 mm or than one-quarter of the JZ-thickness is suggestive for this pathologic condition<sup>7-9</sup>. It is possible to recognize both diffuse form and focal manifestations (Figure 1). In diffuse pattern the uterus is globally enlarged, with coexistence of glandular tissue and hypertrophic myometrium. Several patterns of focal adenomyosis are described in literature, including the "pseudowidening" form, the cystic form and the adenomyoma. In the first case, only one uterine wall is affected, more often the posterior one. The cystic forms are characterized by the storage of coagulated blood into uterine cavitations (similar to the chocolate cysts in the adnexa). In 1860, Rokitanski<sup>10</sup> was the first to describe the adenomyoma, that is a focal core of endometrial glands and stroma surrounded by smooth muscle cells. Each of these patterns is recognizable using the diagnostic criteria presented below.

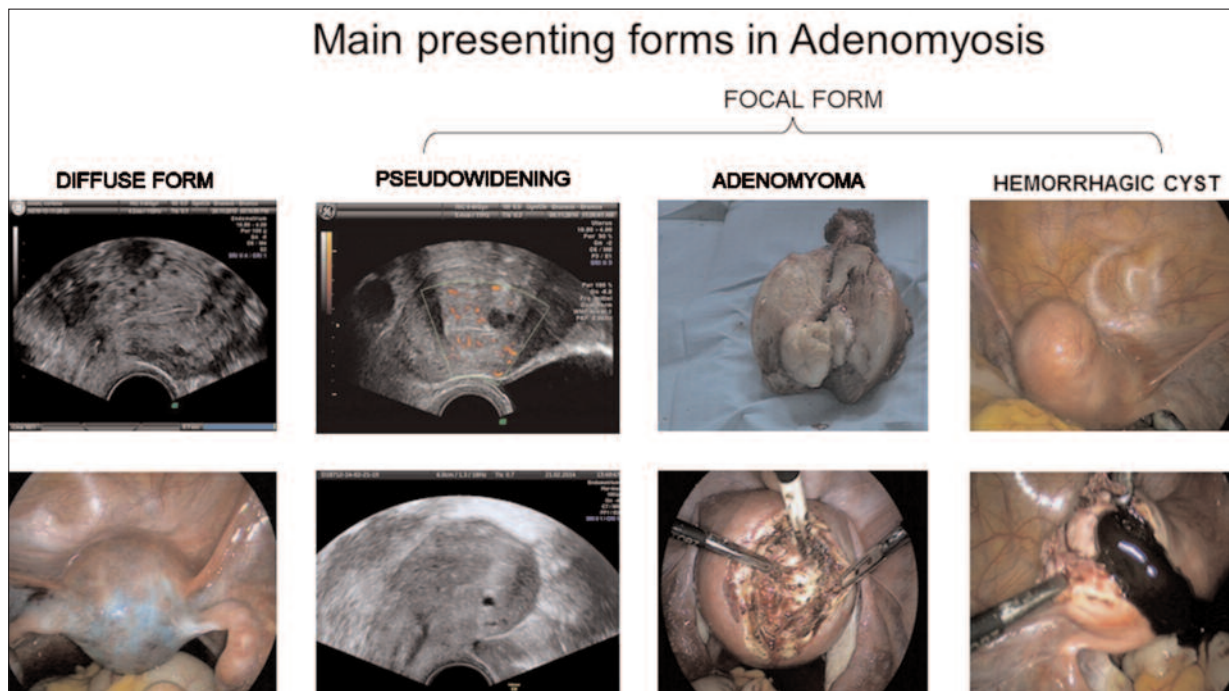


Figure 1. Main presenting forms in adenomyosis.

### Two-dimensional Transvaginal Sonography

To date, transvaginal sonography (TVS) is the most common diagnostic technique used in outpatient clinics, and hence it has become an important tool in gynaecologic examination<sup>11</sup>. In fact, TVS allows the physician to screen women affected by dysmenorrhoea, chronic pelvic pain, menorrhagia or infertility. According to recent studies<sup>12,13</sup> TVS is as sensitive and specific as magnetic resonance imaging (MRI) but it is associated to a higher patient compliance and to lower execution costs.

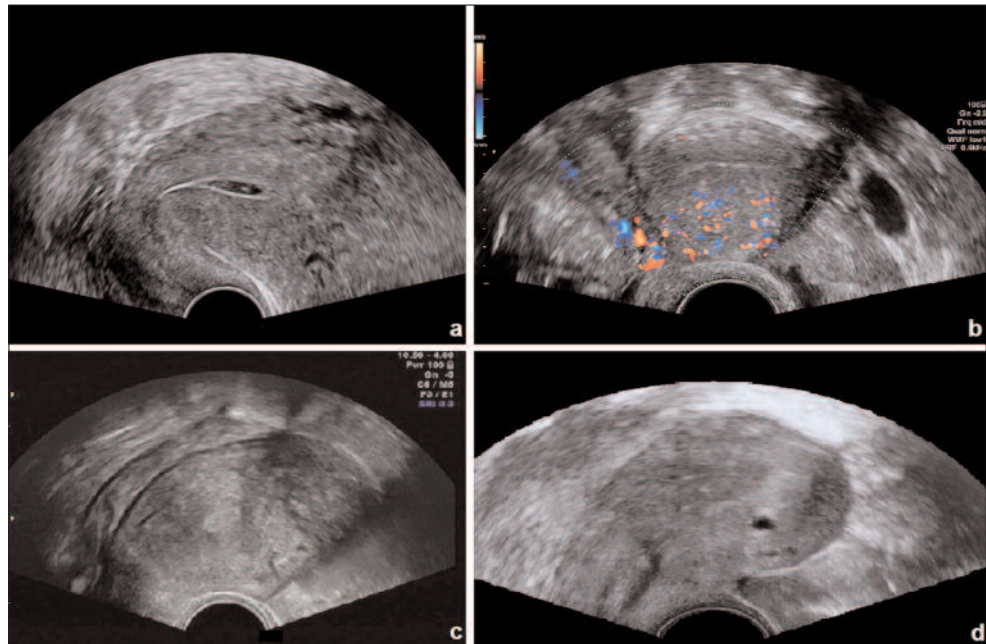
In the case of adenomyosis, the myometrium has an inhomogeneous echotexture under two-dimensional sonography (Figure 1). This suggestive finding is due to presence of heterotopic endometrial tissue and myometrial cell hypertrophy. According to previous studies, the main diagnostic findings of adenomyosis are the following:

1. The uterus is globally enlarged in the absence of other pathologies (i.e. fibroids): Sakhel et al<sup>14</sup> postulated that a uterine length up to 12 cm in absence of leiomyomata could be a characteristic feature (Figure 2a);
2. The anterior and posterior walls of the uterus show an asymmetric thickness with the posterior wall being usually thicker than the anterior one ("pseudo-widening sign", Figure 2b)<sup>9</sup>;

3. The junctional zone (endometrial-myometrial junction) is not clearly visible;
3. The myometrium shows hyperechoic linear near the endometrial–myometrial interface, possibly indicating the presence of ectopic endometrial tissue striations (Figure 2c);
4. The myometrium can present cysts (especially located in the so-called subendometrial zone) defined as a round anechoic areas sized 1-7 mm<sup>15-18</sup> and further anechoic areas due to cystic glandular dilatation (Figure 2d);
5. The myometrium can appear heterogeneous as it presents areas with decreased or increased echogenicity (Figure 2c);
6. "The corpus uteri is flexed backwards, the fundus of the uterus faces the posterior compartment, and the cervix is directed frontally towards the bladder". This sign, called "the question mark form of the uterus", was recently described by Italian Authors and related to high sensitivity and specificity (92% and 75%, respectively)<sup>15,19</sup>;
7. The junctional zone is altered in a way that mimics endometrial hyperplasia. Sonohysterosalpingography can be an useful tool in the differential diagnosis of such a peculiar pattern, referred to as "pseudo-endometrial thickening"<sup>20-22</sup>.

The diagnosis of adenomyosis is suggested by the presence of three or more of these signs<sup>11</sup>.

**Figure 2.** Globally enlarged uterus (*a*); asymmetry between anterior and posterior uterine walls (*b*); decreased or increased echogenicity in the myometrium, and myometrial striations (*c*); myometrial cysts and subendometrial cysts (*d*).



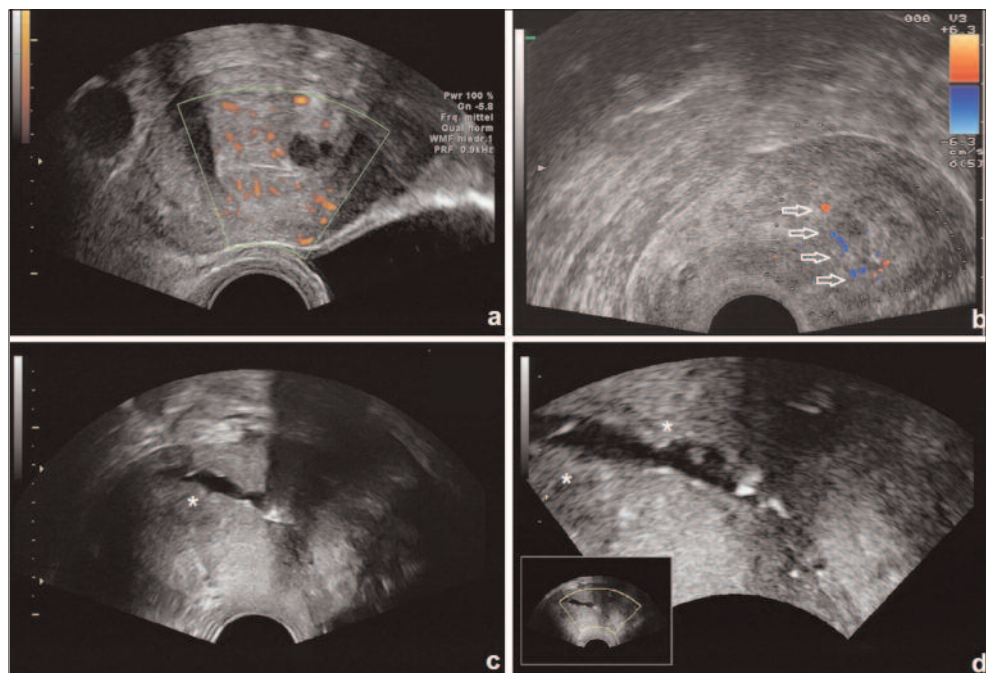
However, localized forms of adenomyosis are more difficult to diagnose. In fact, adenomyomas are often similar to fibroids, and adenomyotic cysts are confused with colligated myomas<sup>9</sup>. Local forms of adenomyosis usually present an elliptic form, a low definition of the margins, and no calcifications. Moreover, Color and Power Doppler ultrasound examination can be helpful

in distinguishing these two forms: in adenomyosis, the vessels spread through the myometrium, whereas in fibroids they surround the lesion without penetrating it (Figure 3a, b)<sup>5,9</sup>.

### Sonohysterosalpingography

As mentioned above, adenomyosis can result in a pseudoendometrial thickening under ultra-

**Figure 3.** Different vascularization patterns in adenomyosis (*a*) and myomas (*b*) under Doppler TVS: the white arrows indicate the typical peripheral vascularization of fibroids. Flame-shaped diverticula extending from the endometrial layer to the myometrial wall (white asterisks), under SHG (*c,d*).



sound vaginal sonography. Thus, the differential diagnosis with endometrial hyperplasia is often difficult; sonohysterosalpingography (SHG) allows the physician to make a proper distinction between these two diseases<sup>20-22</sup>. SHG is held to be a sensitive tool, providing a rapid, easily performed and reliable screen for myometrial (adenomyosis and myomas) and endometrial lesions. If adenomyosis foci are adjacent to the endometrial cavity, the instillation of a contrast medium (i.e. saline solution) shows flame-shaped or lollipop diverticula extending from the endometrium layer to the myometrial wall (Figure 3c,d). These clinical findings cannot be identified with a conventional TVUS because the uterine cavity is collapsed. In fact, the contrast medium is injected to open the communication between the endometrial cavity and echogenic lesions previously identified under TVUS<sup>20,22</sup>.

### 3D-transvaginal Sonography

While MRI evaluates objective parameters (i.e. thickness of the junctional zone) in the diagnosis of adenomyosis, 2D-TVUS focuses on specific morphological patterns. 3D-transvaginal sonography offers the additional advantage of evaluating the coronal plane of the uterus, allowing the physician to analyse the modifications of the JZ (Figure 4a,b).

The JZ appears on the coronal plane like a hypoechoic halo around the endometrium, whose thickening and integrity can be assessed under 3D-TVUS. It has been proved that when the thickness of the JZ is excessive ( $\geq 8$  mm), or inhomogeneous (difference between the thicker and the thinner parts of the JZ  $\geq 4$  mm) adenomyosis is highly probable<sup>5,12,13,23</sup>.

As a further advantage, 3D-TVUS enables the evaluation of adenomyotic lesions on the three planes of space and, hence, it allows an accurate removal by means of resectoscopic surgery.

Such a surgical approach is of major importance for fertility sparing purposes in the case of uterine factor subfertility (Figure 5).

### Magnetic Resonance Imaging (MRI)

MRI is an accurate and non-invasive technique usually applied for the diagnosis of adenomyosis (sensitivity 78-88%, specificity 67-93%)<sup>18,24,25</sup>. Even though MRI was traditionally considered more accurate than TVS, recent studies have proved that the two techniques are comparable (especially when a 3D-TVUS is performed)<sup>5,12,13,23</sup>. Moreover, TVS could be a useful to screen the patients and identify the cases that should be addressed to an additional MRI evaluation. In this way MRI, that is characterized by high costs, could be applied only in selected cases.

Adenomyosis is associated to patognomonic findings that can be detected by both MRI and 2D- and 3D-TVUS, as (1) the enlargement of the uterus and (2) a typical modification of the interface between endometrium and myometrium. The evaluation of the thickness of the JZ plays a major role in the diagnostic process. The junctional zone is detectable on T2-sequences as a low intensity signal band, covering the inner layer of myometrium. In 1980 some Authors proposed that the maximum threshold of the JZ should range between 2 and 5 mm<sup>26</sup>. Nowadays, a thickness  $\leq 8$  mm is considered normal<sup>18,27</sup> (Figure 4a). Therefore, a thickness  $> 12$  mm is highly predictive of adenomyosis and a thickness  $< 8$  mm allows the radiologists to exclude the disease<sup>28</sup>.

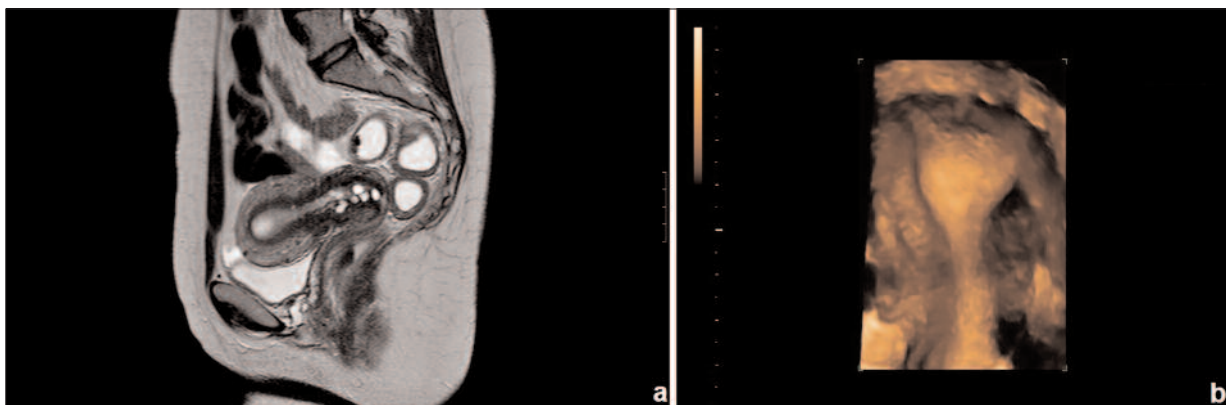
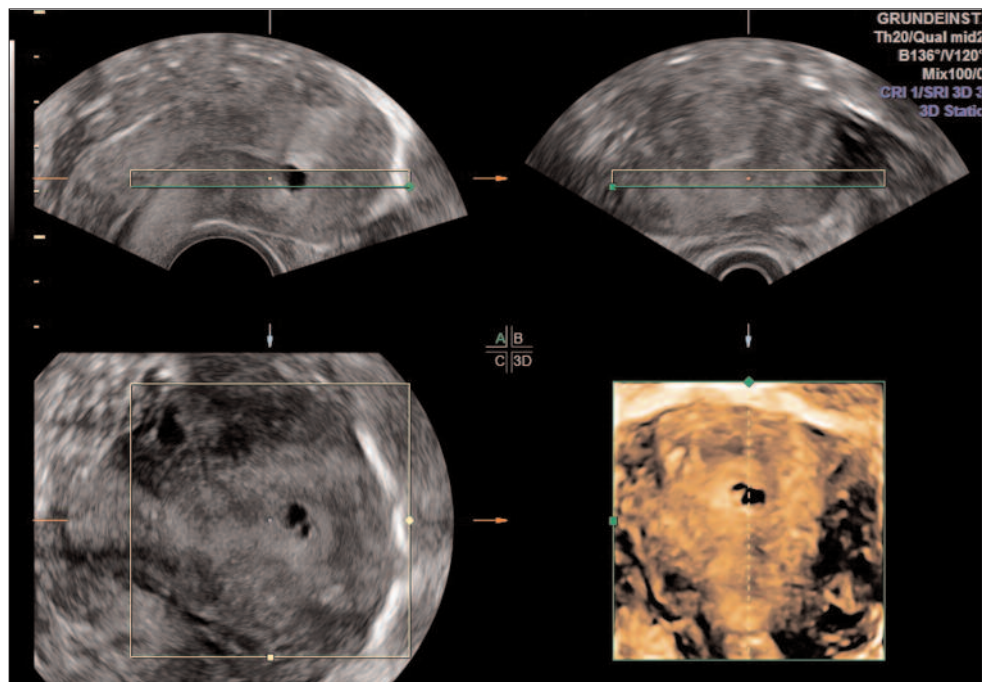


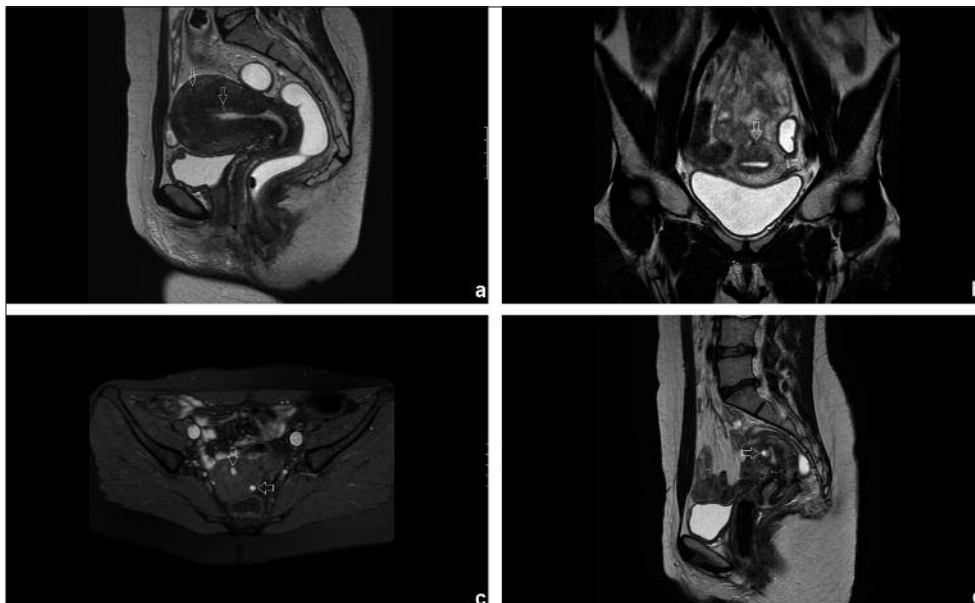
Figure 4. Regular junctional zone and normal signal intensity of outer myometrium (under MRI, *a*); altered JZ under 3D-TVUS (*b*).

**Figure 5.** Cystic hemorrhagic lesion, appearing as a subendometrial cyst under 3D-TVS.



The thickening of the JZ observed in the case of adenomyosis can involve the whole JZ (diffused adenomyosis, Figure 6a) or be limited to a part of it (focal adenomyosis, Figure 6b). In the diffuse form the thickness of the JZ can be ei-

ther homogeneous or inhomogeneous. Several factors could alter the typical appearance of the JZ, such as the use of gonadotropin-releasing hormone agonists, or the presence of menstrual bleeding. In fact, in this case the myometrium is



**Figure 6.** Diffuse thickening of the junctional zone as well as of the whole myometrium ventrally and dorsally consistent with severe diffuse adenomyosis; the two arrows show small foci of high signal intensity representing heterotopic endometrium (**a**). Focal localization of adenomyosis: the arrow indicates a focal thickening of the dorsal uterine wall with circumscribed adenomyosis (**b**). Round cystic foci with a typical hemorrhagic hyperintense content (arrows) in T1 fat suppressed images (**c**). Hyperintense focus with mixed signal caused by layered bloody content (arrows) on T2 weighted image (**d**).

frequently contracted and thickened and this transient, physiological event could simulate an abnormal JZ<sup>29</sup>.

Furthermore, adenomyosis is characterized by low signal intensity, ill-defined lesions on T2 weighted and T1 fat suppressed sequences. These areas correspond to round cystic foci (2-7 mm) with hyperintense hemorrhagic content. They are almost pathognomonic of adenomyosis, but detected in only half of the cases (Figure 6c,d).

The adenomyoma (focal adenomyosis) is a rare form of focal adenomyosis. It appears as a round lesion that is separated from the JZ and included in the myometrium; therefore it can often be confused with uterine leiomyoma. In fact, both of them are characterized by low signal intensity on T2-weighted imaging, but adenomyomas often present high intensity foci and leiomyomas have large peripheral vessels<sup>24,27</sup>.

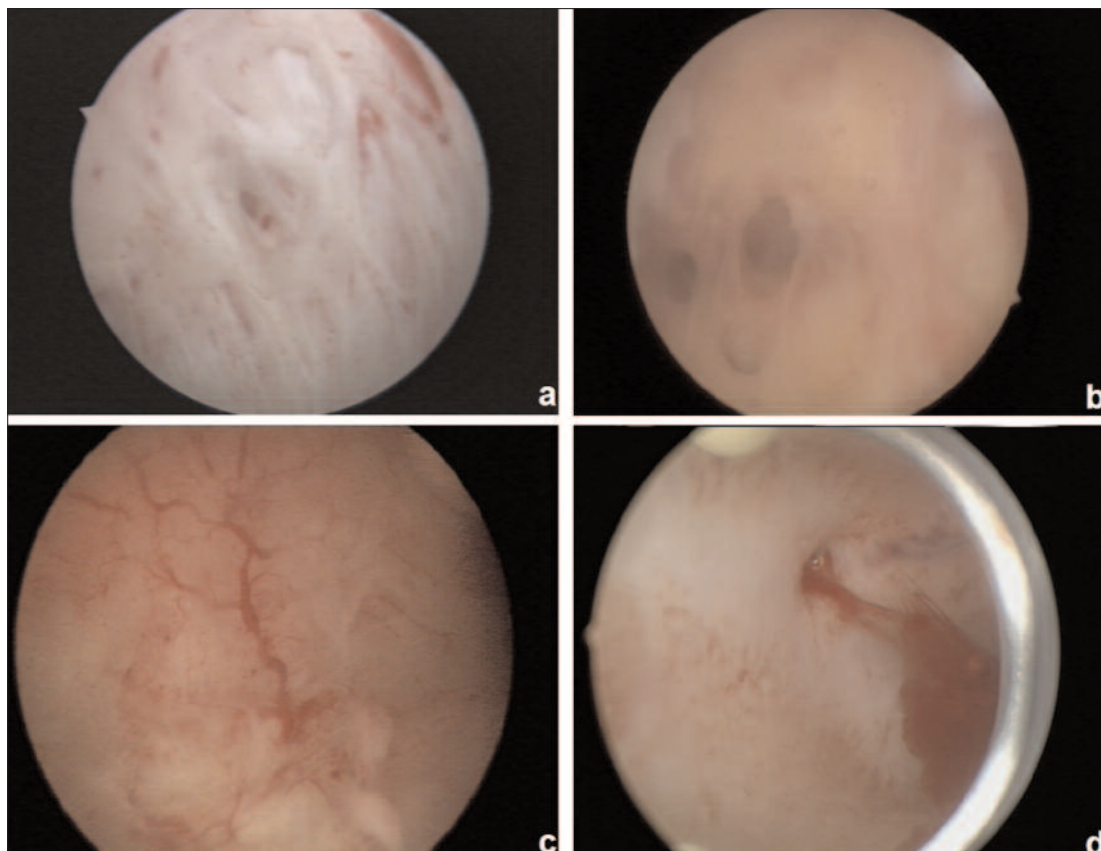
### Endoscopic Techniques

Endoscopic techniques allow both the precise evaluation of pelvic organs and the sampling of

histological specimens under visual control. In particular, a direct visualization of the uterine cavity is easily feasible with hysteroscopy, whereas laparoscopy assesses the external surface of the uterus and detects eventually concomitant pelvic endometriotic foci<sup>30</sup>.

Although diagnostic hysteroscopy should not be considered as the gold standard procedure in the diagnosis of adenomyosis, some Authors have recently proposed it as a useful diagnostic tool in suspected cases<sup>31</sup>. Moreover, the following findings are suggestive of adenomyosis under hysteroscopy:

1. superficial openings on the endometrial cavity, suggesting a disruption of endomyometrial surface (Figure 7a,b);
2. endometrial hypervascularization (Figure 7c), that is recognized when the uterine cavity is not completely expanded (low pressure of the dilatation mean)
3. cystic hemorrhagic lesions, sometimes draining directly into the endometrial cavity (Figure 7d).



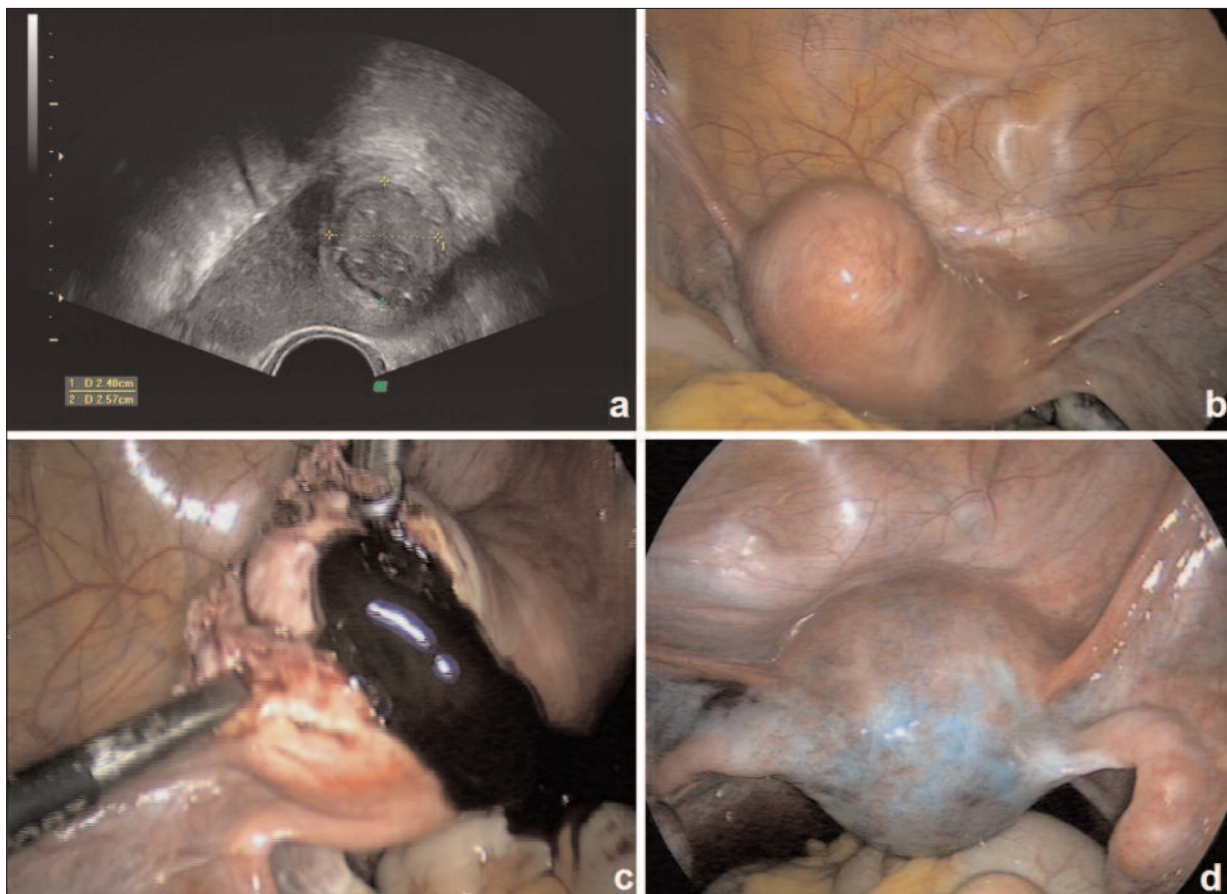
**Figure 7.** Hysteroscopic findings in adenomyosis: superficial openings on the endometrial cavity (*a, b*); endometrial hypervascularization (*c*), cystic haemorrhagic lesions (*d*).

Nonetheless, such a technique allows the physician to obtain visually guided-histological biopsies (endomyometrial samples), by means of the mechanical-punch technique or the electrical-loop resection<sup>30</sup>.

Laparoscopy is not traditionally considered a diagnostic tool for the diagnosis of adenomyosis, because the lesions rarely involve the external surface of the uterus. However, it provides characteristic findings, such as the gross deformation of the uterus (especially in the case of adenomyomas or haemorrhagic cysts) (Figure 8 a,b,c). The “blue sign” indicates the typical colour acquired by the adenomyotic uterus during the dye test (i.e. tubal patency test). In fact, the methilen-blue solution penetrates throughout the uterine body, due to the alteration in the myometrial tissue and JZ (Figure 8d). As a second sign, the consistence of the uterus appears reduced at the manipulation with endoscopic instruments.

## Conclusions

Adenomyosis was originally diagnosed only on the histological samples obtained by hysterectomy. To date, the development of the diagnostic tools allows the physicians to make an accurate diagnosis of adenomyosis by means of non invasive or minimally invasive techniques. This possibility represents a major breakthrough, especially in the light of the clinical consequences of this disease: infertility, dysmenorrhea, abnormal uterine bleeding, chronic pelvic pain. 2D- and 3D- TVS provide easily recognisable diagnostic signs enabling the diagnosis of adenomyosis, by every gynaecologist. MRI is an additional examination that detects the disruptions in the junctional zone and excludes concomitant benign gynaecologic diseases. Hysteroscopy and laparoscopy offer the further advantage of direct sampling and provide specific endoscopic findings.



**Figure 8.** Laparoscopic findings in adenomyosis. An haemorrhagic cyst causes a gross deformation of the uterus under TVS (a). Laparoscopic appearance of the cyst (b, c); the “blue-sign” in a pseudo-widening form of adenomyosis: the contrast medium stains mainly the posterior wall (d).

Currently, the gynaecologist should be able to apply office procedures such as 2D (and eventually 3D) TVS, SHG, and hysteroscopy in order to exclude adenomyosis, while more expensive or invasive techniques, such as MRI or laparoscopy, have a complementary in the diagnosis of this insidious pathology.

### Conflict of Interest

The Authors declare that there are no conflicts of interest.

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