CEOG Clinical and Experimental Obstetrics & Gynecology

MRI in the assessment of prolapsed pedunculated submucous leiomyomas: two case reports

V. Fiaschetti[1], M. Fornari[1], V. Cama[1], M. Rascioni[1], V. Liberto[1], G. Sorrenti[2], G. Simonetti[1]

[1] Department of Diagnostic Imaging, Interventional Radiology and Radiation Therapy, University of Tor Vergata, Rome
[2] Department of Obstetrics and Gynecology, University of Tor Vergata, Rome (Italy)

Summary

Uterine leiomyomas are the most common benign gynecological tumors affecting 20-30% of women in reproductive age. Despite their benignity, in some cases several symptoms may require surgical intervention. Submucosal leiomyomas are less frequent (5-10%), but are usually symptomatic. Approximately 2.5% of the myomas are pedunculated and can protrude in the cervical canal. Symptomatic leiomyomas can be treated either by hysterectomy or myomectomy, and these procedures can be performed with several techniques. Whenever possible, hysteroscopic myomectomy is better because it has many advantages, as it also preserves future fertility. Two interesting cases of prolapsed pedunculated submucous leiomyomas are reported in order to prove that magnetic resonance imaging (MRI) is essential to choose the most appropriate treatment and to perform an adequate presurgical planning, which must be based on an overall assessment of the leiomyoma's characteristics (number, location, size and presence or absence of a stalk) and the patient's characteristics.

Key words: Prolapsed pedunculated submucous leiomyomas; Magnetic resonance imaging; Stalk; Hysteroscopic myomectomy.

Introduction

Uterine leiomyomas (myomas or fibroids) are the most common benign gynecological tumors affecting 20-30% of women in reproductive age [1, 2]. They are composed of whorls of smooth muscle cells with varying amounts of fibrous connective tissue. Usually they involve the myometrium of the uterine corpus, but they can also occur in the cervix (8%) [2].

Only 20-50% of uterine leiomyomas are symptomatic and the most common symptoms include menorrhagia, sometimes with associated anaemia, pressure symptoms (including urinary frequency, urgency, pressure on the bowel and on the back, and lower abdominal pain), dysmenorrhea, and infertility; but the precise relationships between their sizes and locations and their clinical implications are still not clear. Despite the benignity of uterine leiomyomas, in some cases several symptoms may require surgical intervention [2-4].

Leiomyomas may be classified into: submucosal, intramural or subserosal. The intramural leiomyomas are the most common and often asymptomatic (occasionally causing menorrhagia and infertility) and are located within the myometrium. The Subserosal leiomyomas are located beneath the serosa and are usually asymptomatic; but the pedunculated ones, however could undergo stalk torsion with acute pain [2]. Submucosal leiomyomas project into the endometrial canal. These are the less frequent (only 5-10%) [2,5], but usually symptomatic (dysmenorrhea, menorrhagia, and infertility) [2]. Approximately 2.5% of the myomas are pedunculated and [6] can protrude in the cervical canal (gradually dilating the cervix), or in the vagina [2]. When this occurs, the myoma becomes usually necrotic and sometimes infected, because an adequate blood supply is difficult through a long pedicle [7]. Moreover, although the pathogenesis of leiomyomas is still not clear, it is evident that estrogen and progesterone promote their growth [1, 2]. If they outgrow their blood supply or if there is stalk torsion, a degeneration could occur [2, 8]. The following two interesting cases of prolapsed pedunculated submucous leiomyomas are reported in order to prove that magnetic resonance imaging (MRI) is essential to choose the most appropriate treatment and to perform an adequate presurgical planning, which must be based on both the leiomyoma type and the patient's characteristics [8].

Case Report

Case 1

In November 2013, a 44-year-old woman came to the present institute to perform a transvaginal ultrasound (TVUS). She reported regular menses every 28-30 days with smelling, vaginal bleeding, between menses, for several months. She also reported the presence of mucus during menses. She complained of mild chronic pelvic pains increasing during menstruation. The obstetric history of the patient revealed four miscarriages, between the second and the fifth month of pregnancy. Later, in 2007, she had a cesarean section at 36 weeks, with prophylactic deltacortene. In her general medical history she reported multiple sclerosis. The

Revised manuscript accepted for publication July 23, 2014

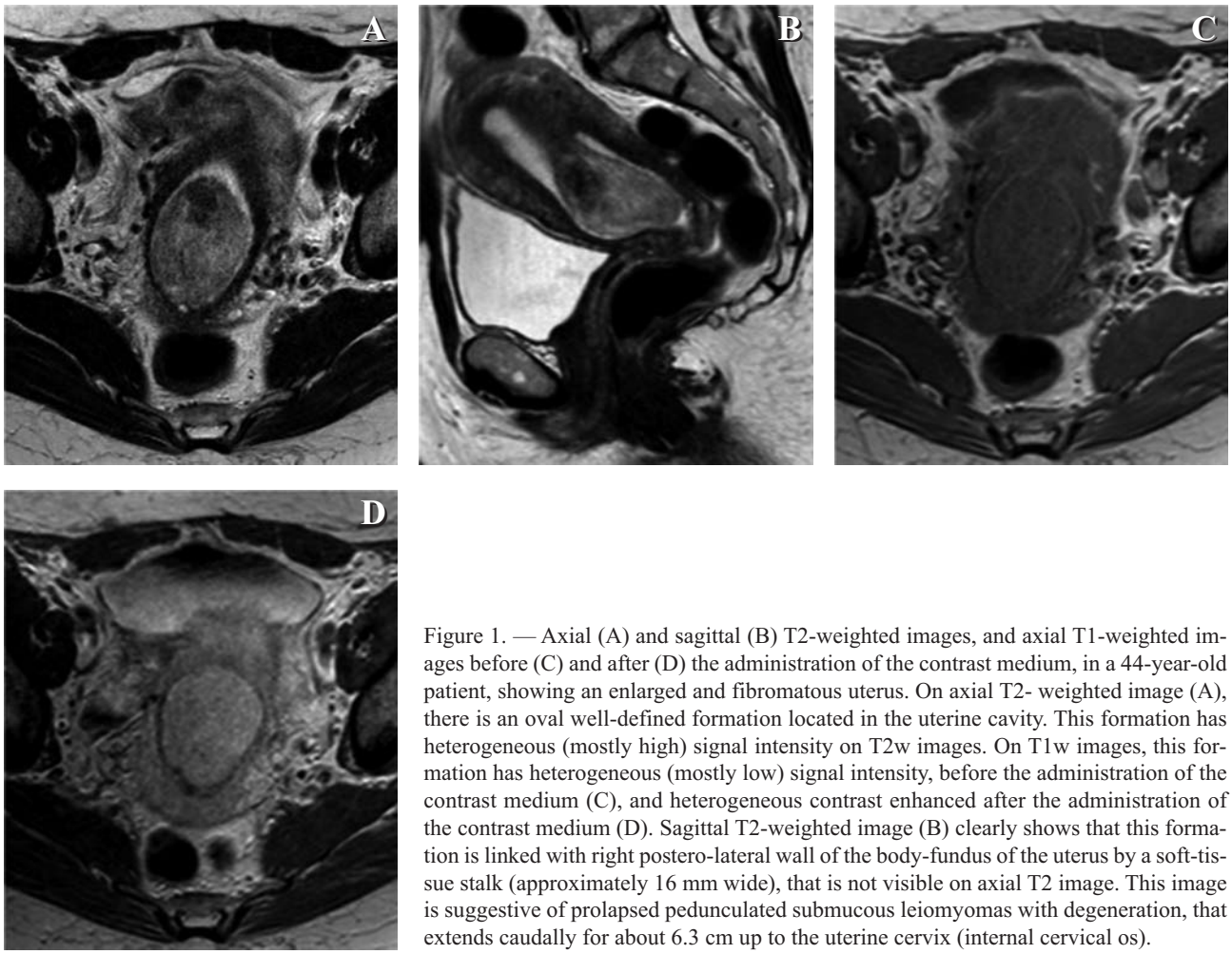

Figure 1. — Axial (A) and sagittal (B) T2-weighted images, and axial T1-weighted images before (C) and after (D) the administration of the contrast medium, in a 44-year-old patient, showing an enlarged and fibromatous uterus. On axial T2- weighted image (A), there is an oval well-defined formation located in the uterine cavity. This formation has heterogeneous (mostly high) signal intensity on T2w images. On T1w images, this formation has heterogeneous (mostly low) signal intensity, before the administration of the contrast medium (C), and heterogeneous contrast enhanced after the administration of the contrast medium (D). Sagittal T2-weighted image (B) clearly shows that this formation is linked with right postero-lateral wall of the body-fundus of the uterus by a soft-tissue stalk (approximately 16 mm wide), that is not visible on axial T2 image. This image is suggestive of prolapsed pedunculated submucous leiomyomas with degeneration, that extends caudally for about 6.3 cm up to the uterine cervix (internal cervical os).

patient reported a previous gynecological examination, in which no significant findings were evidenced, except for the presence of a bulky uterus and vaginal bleeding after the introduction of the speculum. On TVUS an inhomogeneous and ill-defined, mainly hypo-echoic, gross area was found in the body of uterus, close to the endometrial line, displacing it. Since this area was suggestive of adenomyosis, although dubious, the authors decided to perform a pelvic MRI. It was performed using a 1.5T scanner with a surface coil (pelvic phased-array coil). A peristaltic inhibitor (ten mg of hyoscine-N-butylbromide, buscopan) diluted in ten ml of saline solution, was intravenously administered to the patient, to reduce gastrointestinal tract peristalsis. The imaging protocol consisted of T1-weighted (w) Turbo Spin-Echo (TSE) on axial (perpendicular to the major axis of the uterus) (TR/TE 1035/15 ms; section thickness 3.5 mm; intersection gap 0 mm) and sagittal plane (TR/TE 606/14 ms; section thickness 3.5 mm; intersection gap 0.35 mm) and T1w spectral presaturation inversion recovery (SPIR) on axial (TR/TE 1280/15 ms; section thickness 3.5 mm; intersection gap 0 mm) and sagittal plane (TR/TE 606/14; section thickness four mm; intersection gap one mm); T2w TSE sequences on axial (TR/TE 4406/90 ms; section thickness 3.5 mm; intersection gap 0.35 mm), sagittal (TR/TE 3814/90 ms; section thickness 3.5 mm; intersection gap 0 mm) and coronal plane (TR/TE 3790/90 ms; section thickness 3.5 mm; intersection gap 0.35 mm); T1 high-resolution isotropic volume excitation (THRIVE) dynamic three-dimensional sequence turbo gradient echo with fat suppression (TR/TE 4/1 section thickness four mm; intersection gap one mm), after gadolinium bolus injection (gadopentetic acid and dimeglumine salt) of 0.1 mM/kg at two ml/second, followed by saline solution (20 ml), and axial T1w TSE after contrast media (TR/TE 575/10 ms; section thickness 3.5 mm; intersection gap 0 mm). On MRI an oval well-defined and pedunculated formation was found in the uterine cavity (Figures 1A-D). It was linked with the uterus by a soft-tissue stalk, approximately 16 mm wide and located in correspondence with the right postero-lateral wall of the body-fundus (Figure 1B). It extended caudally for about 6.3 cm up to the uterine cervix (internal cervical os). This formation had heterogeneous signal intensity, mostly low signal intensity on T1w images (Figure 1C), high signal intensity on T2w images (Figures 1A-B), and heterogeneous contrast enhanced (Figure 1D). The images were suggestive of prolapsed pedunculated submucous leiomyomas with degeneration. Another very small pedunculated submucous leiomyoma (approximately six mm), at the postero-lateral left wall of the fundus, was found. MRI also showed a uterus increased in size and noticeably fibromatous. Then the patient was hospitalized in the Department of Gynecology and Obstetrics of the present Institute and laboratory exams revealed an

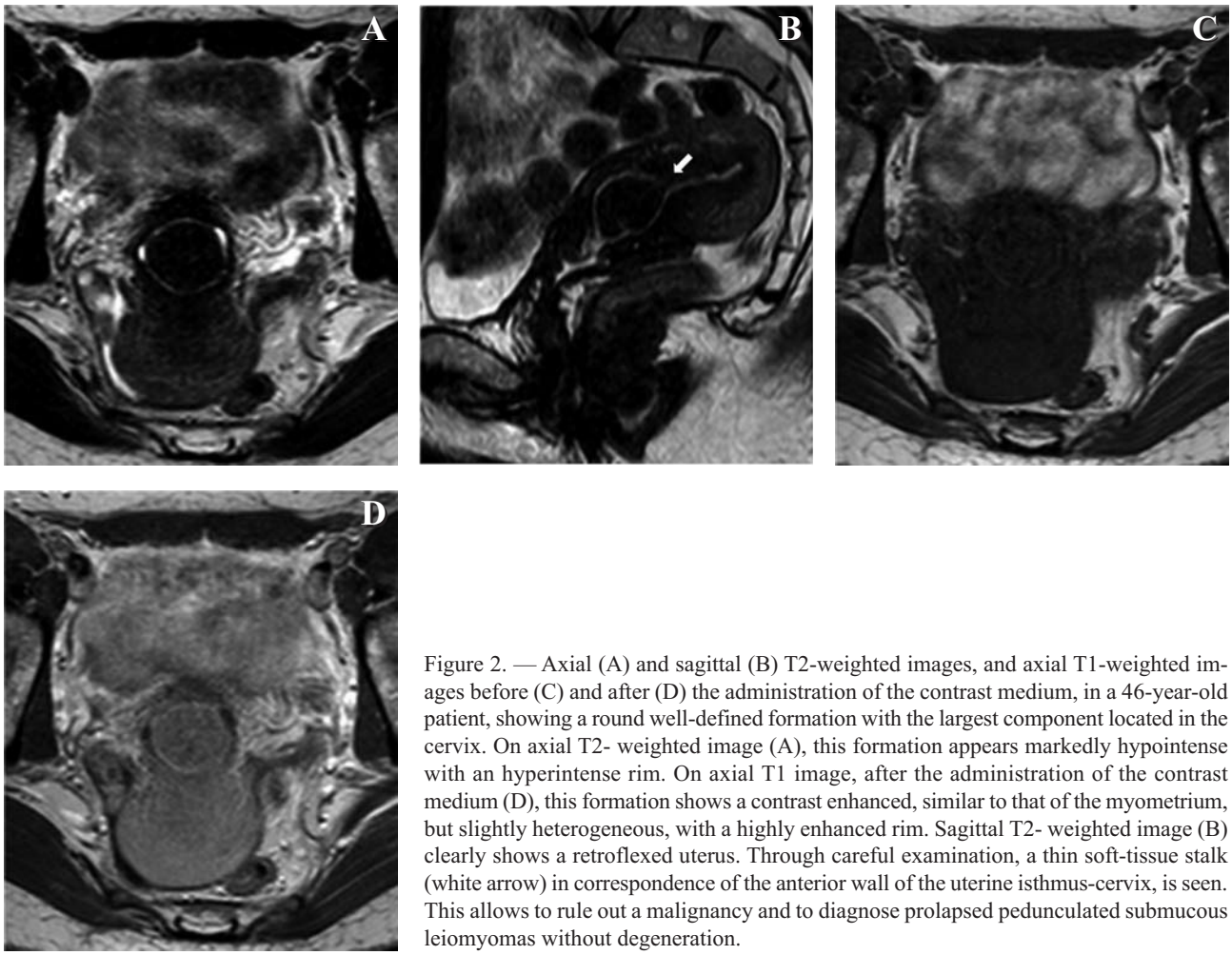

Figure 2. — Axial (A) and sagittal (B) T2-weighted images, and axial T1-weighted images before (C) and after (D) the administration of the contrast medium, in a 46-year-old patient, showing a round well-defined formation with the largest component located in the cervix. On axial T2- weighted image (A), this formation appears markedly hypointense with an hyperintense rim. On axial T1 image, after the administration of the contrast medium (D), this formation shows a contrast enhanced, similar to that of the myometrium, but slightly heterogeneous, with a highly enhanced rim. Sagittal T2- weighted image (B) clearly shows a retroflexed uterus. Through careful examination, a thin soft-tissue stalk (white arrow) in correspondence of the anterior wall of the uterine isthmus-cervix, is seen. This allows to rule out a malignancy and to diagnose prolapsed pedunculated submucous leiomyomas without degeneration.

iron deficiency anemia (hemoglobin 9.8 g/dl). Given the patient's age and the diffuse uterine fibromatosis, it was decided to perform a hysteroscopic hysterectomy under general anesthesia. Histological examination confirmed the diagnosis of fibromatous uterus with a large prolapsed pedunculated submucous leiomyomas, with areas of ischaemic infarction. The patient made an uneventful recovery and was able to go home on the second day after surgery.

Case 2

In December 2013, a 46-year-old woman, with the suspicion of a uterine cervical mass, was referred for a pelvic MRI from the Department of Gynecology and Obstetrics of the present Institute. She reported irregular menses with vaginal bleeding between menses for several months and mild anemia. She did not report pelvic pain. The obstetric history of the patient revealed two normal pregnancies with vaginal delivery. In 2005, the patient was subjected to conization for grade III cervical intraepithelial neoplasia (CIN3). She reported normal follow-up smear results, although the last smear had been done two years earlier. She had no significant problems in her general medical history, but she reported family history of cervical cancer. A gynecological examination revealed the presence of vaginal bleeding after the introduction of a speculum and a palpable mass in the cervix. On TVUS, a homogeneous and well-defined area, mainly hypoechoic, was found in the cervix. Because of her personal and family history, it was decided to perform a pelvic MRI in order to quickly clarify the diagnosis. An imaging protocol similar to that of the previous patient was done. On MRI a round well-defined formation with the largest component located in the cervix was found (Figures 2A-D). This formation was markedly hypointense with an hyperintense rim on T2w sequences (Figures 2A-B) and had a contrast enhanced, similar to that of the myometrium, but slightly heterogeneous, with a highly enhanced rim on T1w sequences after the administration of the contrast medium (Figure 2D). Through careful examination, a thin soft-tissue stalk in correspondence of the anterior wall of the uterine isthmus cervix, was found (Figure 1B). The images, suggestive of prolapsed pedunculated submucous leiomyomas without degeneration, ruled out the diagnosis of malignancy. At the postero-lateral left wall of the fundus, another very small intramural leiomyomas (approximately seven mm), markedly hypointense on T2w sequences, was found. Given the likely benign nature, the patient preferred to avoid the hysterectomy. Therefore it was decided to perform an hysteroscopic myomectomy. Histological examination confirmed the diagnosis of leiomyoma without degeneration. The patient made an uneventful recovery and was able to go home the following day.

Discussion

MRI is the most accurate imaging technique for the detection and localization of leiomyomas. It is more sensitive and has a wider field of view than the ultrasound (US) [2]. In both cases the MRI has proven to be better than TVUS, especially in the first case where the TVUS was not diagnostic. In both cases the MRI clearly showed the uterine submucosal leiomyoma prolapsing into the uterine cavity. Especially, the T2w sequences have allowed the present authors to carefully circumscribe and define the leiomyomas and to detect their stalk. On MRI, small and non-degenerated leiomyomas (composed of whorls of uniform muscle cells with various amounts of collagen) are well-circumscribed masses with homogeneous low or intermediate signal intensity on both T1w and T2w images. In the second case, the round well-defined formation, markedly hypointense on T2w sequences, was found to be a non-degenerated leiomyoma on the histological examination. Cellular leiomyomas (with dense muscle cells and little or no collagen) have relatively higher signal intensity on T2w images and enhancement after contrast media. The larger and degenerated leiomyomas had heterogeneous signal intensity, mostly low signal intensity on T1w images and high signal intensity on T2w images, corresponding to degeneration and infarction observed at pathologic examination [2, 8]. However, it was difficult to distinguish the type of degeneration (hyaline, myxomatous, fatty, mucinous, or malignant) on MRI [8]. In the first case, the oval well-defined formation, with heterogeneous signal intensity and heterogeneous contrast enhanced, was found to be a degenerated leiomyoma on the histological examination.

MRI is essential for an adequate pre-surgical assessment, because the choice of a surgical intervention is based on both leiomyoma and patient's characteristics [8]. Symptomatic leiomyomas, indeed, can be treated either by hysterectomy or myomectomy, or by uterine artery embolization (UAE) in selected cases. These procedures can be performed with different techniques, which have been significantly developed over the years. In the past, abdominal hysterectomy and laparotomic excisions were the two standard treatments for symptomatic submucous leiomyoma. The first successful vaginal myomectomy for prolapsed pedunculated submucous myoma was performed by Atlee in 1845 [7]. Whereas the first reported hysteroscopy myomectomy was performed in 1976, when Neuwirth and Amin resected a fibroid using an urologic resectoscope [5]. Since then, instrumentation evolution enabled the development of several techniques. Therefore the procedure and the technique must be chosen on the basis of an overall assessment of the leiomyoma characteristics (number, location, size, and presence or absence of a stalk) the patient's characteristics (age, desire to preserve fertility, and clinical condition), the surgeon's experience, and the equipment available [5, 8]. In order to preserve future fertility in young women or teenagers, the preferred surgical procedure for a submucosal myoma is a myomectomy [1]. Whenever possible, hysteroscopic myomectomy is better because it has many advantages, including the lack of an abdominal incision, short recovery time, and less blood loss [1]. Moreover, in the suspicion of a superadded infection of leiomyoma, the intervention through the vaginal route (compared to major abdominal surgical procedure), reduces the risk of infection spread, while minimizing the peritoneal exposure [9]. The possible complications, however, must not be forgotten, including bleeding, fluid overload (related to the complexity and duration of the procedure), incomplete removal of leiomyoma in one surgical time, and intrauterine adhesions (IUA) [1].

In order to perform a safe and complete hysteroscopic myomectomy, it is essential to establish the intramural extension that could considerably vary, influencing, therefore, the chance of achieving complete resection. The European Society for Gynaecological Endoscopy (ESGE) adopted a classification system, developed by Wamsteker *et al.* in 1993 [10], and is used worldwide. According to this classification, submucosal myomas are classified in the following types: G0, that is intracavitary with no intramural components, and appears joined with the cavity wall only through a thin pedicle (pedunculated submucous leiomyomas); G1, that is mostly intracavitary (>50%) with some intramural components and G2 with a larger intramural component (>50%) and lower intracavitary components (<50%). Lasmar *et al.* [11] recently proposed a new preoperative classification which considers also other parameters including the size of the nodule, the extension of its base with respect to the wall of the uterus, and the topography of the uterine cavity. A pedunculated submucous leiomyomas (G0) can be easily and safety treated with hysteroscopic myomectomy in a single procedure with fibroid size representing the main limiting factor [5, 7, 12]. In this case several effective techniques have been proposed (including resectoscopic slicing, ablation by neodymium-yttrium-aluminum-garnet laser, morcellation, and even outpatient procedure) [5,13].

However, the hysteroscopic myomectomy for fibroids with intramural extension (G1, G2) may be sometimes a very technically complex procedure and the intramural extension influences the chance of achieving complete resection in one surgical time. This must only be done by expert surgeons and its real feasibility must be thoroughly evaluated preoperatively in order to minimize the incidence of complications, that are higher than in other hysteroscopic procedures. Several techniques have been developed to completely remove such fibroids but there is still no single technique proven to be unequivocally superior for treating these fibroids (G1-G2). Most techniques aim at transforming an intramural fibroid into a totally intracavitary lesion, to avoid a deep cut into the surrounding myometrium, thus reducing the risk of operative (i.e. bleeding, perforation) and long-term complications (i.e. IUA and uterine rupture). Unlike fibroids G0, advanced equipment must be used for a safe hysteroscopic

myomectomy. Whereas G1 fibroids may be often completely removed with one-step hysteroscopic myomectomy, G2 fibroids may require a two-step technique which is very effective and safe. Despite a second surgical step does not seem to be necessary in case of an incomplete removal, patients should always be advised of this possibility, because repeated hysteroscopies can cause greater distress in patients [5, 14].

Providing excellent delineation of the uterine zonal anatomy, a MRI enables accurate classification of leiomyomas and allows to determine their components (submucosal, intramural or subserosal) [1, 2]. However, attention must be paid because some prolapsed pedunculated submucous leiomyomas may have a considerable intramural component [7]. In both cases, the MRI enabled us to rule out the presence of a significant intramural component.

Hysterectomy is required in patients with multiple myomas [7], also because the myomectomy effectiveness is limited by the myoma recurrence rate, that is higher in women with multiple myomas, compared to those with a single myoma [1]. In the second case, a hysteroscopic myomectomy was decided instead of a hysterectomy to respect the patient desire, since only a further very small fibroid was found on MRI. Conversely, in the first case, given the diffuse uterine fibromatosis and the patient's age, it was decided to perform a hysteroscopic hysterectomy.

It is very important to obtain a correct assessment of the leiomyoma size. In 30% of the prolapsed tumors the mean diameter varies from three to five cm [15]. A tumor size over five cm in diameter is more often associated with lower hemoglobin level and usually it requires hysterectomy, such as in the first case. [16] In case of huge prolapsed leiomyoma it is imperative to have a thorough preoperative evaluation [12]. An underestimation of the leiomyoma size must be avoided with the imaging [15]. According to the present authors' experience, MRI is better than ultrasound for this purpose, especially in case of large leiomyomas (such as in the first case) because MRI has a wider field of view than US. In both cases the T2w sequences enabled the present authors to carefully circumscribe and determine the leiomyoma sizes.

Moreover also in the case where pedunculated submucosal leiomyoma is diagnosable from gynecologic examination because the mass has prolapsed into the vaginal canal, on gynecologic examination, it is not often possible to precisely identify the origin of the mass and the relationship of the mass with uterus and cervix. Therefore MRI can be really helpful to accurately delineate the stalk and uterine attachment of the prolapsed leiomyoma [8, 17]. In both cases it was possible to determine the stalk on T2 sequences, but in the second case a careful assessment of the images was necessary. This can help in planning a correct surgical approach [8]. Indeed the first-choice treatment for prolapsed pedunculated submucous leiomyomas is the hysteroscopic resection, but it is important to locate the stalk in order to avoid excessive bleeding by its ligation (avoiding hysterectomy) [15]. In particular, in the second case, the detection of a stalk and its exact localization prompted the present authors to perform a stalk ligation at the beginning of the procedure in order to avoid a heavy bleeding. Kim *et al.* suggested the "broccoli sign" as the radiologic findings of the prolapsed submucosal leiomyoma [17]. Indeed the "broccoli-like" appearance is due to a lobulated bulky mass (corresponding to the broccoli floret) connected to the endometrial cavity by a long stalk (corresponding to the broccoli stem) [17, 18]. This sign is readily identifiable on sagittal MRI or on reformatted sagittal CT scan [17]. CT is less accurate than MRI in the detection of the broccoli sign [18]. The broccoli sign is useful in differentiating an uterine tumor prolapsed inferiorly through the cervical canal for a primary cervical malignancy, because the largest component of the prolapsed uterine tumors is often in the cervix and it may be mistaken for a cervical cancer, both clinically and radiologically [18]. Therefore, the true origin of the mass must be identified by detecting the connecting stalk with a careful assessment of the images, in order to exclude the cervical origin. Cervical cancer usually involves the uterine body by simply direct mass-like growth and superficial endocavitary growth seems to be rare and without pedicle [18]. In the second case, the MRI findings and stalk detection allowed to rule out a malignancy, encouraging a less invasive surgery, as preferred by the patient. However the broccoli sign is not specific for prolapsed submucosal leiomyoma, and it may also be due to a malignant prolapsed uterine tumor (i.e. endometrial carcinoma, adenosarcoma, and carcinosarcoma) or it may be secondary to a complication of UAE [18]. The transcervical passage of leiomyoma after UAE can occur in 2.2% to 7.7%, over three years following the procedure [4]. Nonetheless, malignant prolapsed uterine tumors often appear to have a relatively good prognosis. Despite a bulky and aggressive imaging appearance, their growth pattern tend to be endoluminal (following the "path of least resistance" and prolapsing through the cervix), rather than systemic. However tumors do retain an invasive capacity and sometimes a uterine tumor prolapsed through the cervical canal may invade the cervix. Usually, a gross cervical invasion is evident on MRI [18].

A non-puerperal uterine inversion must also be excluded. Non-puerperal uterine inversion is a very rare event, usually secondary to a submucosal leiomyoma (71.6%), which can be classified as incomplete, complete, or prolapsed, depending on the degree of the extension of the uterine corpus beyond the cervix. It can be difficult, both clinically and sonographically, to determine the degree of the inversion and the point of the leiomyoma attachment causing the inversion. MRI may help in making a correct preoperative diagnosis and a proper plan of the surgery, which are both important to avoid damage to the uterus and surrounding organs (bladder, ureters), especially in the cases where the procedure by the vaginal route is chosen [9, 19].

The MRI allows the differential diagnosis with other possible causes of pain or pressure complaints, such as adeno-

myosis (which can be treated only with hysteroscopy, while for the leiomyoma, a myomectomy can be performed), endometriosis, adnexal masses, pelvic inflammatory disease, pelvic varices, or bowel- or spine-associated causes [2, 3]. In the first case at TVUS, the degenerated prolapsed pedunculated submucous leiomyomas was mistaken for adenomyosis, whereas the MRI allowed a correct diagnosis. Although irregular margin of a uterine leiomyoma on MRI, may suggest sarcomatous transformation, the diagnosis of leiomyosarcoma is often done on the histological examination of a resected mass (presumed benign) [2]. Finally, by pelvic MRI we can assess and monitor the results of a previous myomectomy to establish the need for further treatment [15].

Conclusion

MRI is an accurate imaging technique for the detection and localization of leiomyomas and is better than TVUS, because it is more sensitive and has a wider field of view. Especially the T2w sequences allow to carefully circumscribe and define the leiomyomas, to determine their components (submucosal, intramural or subserosal), to obtain a correct assesment of the their size, to detect their stalk and uterine attachment, to precisely identify the origin of the mass, and the relationship of the mass with uterus and cervix. Whenever possible, especially in young women, myomectomy is preferable (with respect to hysterectomy) for a submucosal prolapsed myoma because it is less invasive and enables future fertility preservation. Several techniques have been developed to completely remove such fibroids but in each case the real feasibility must be thoroughly evaluated preoperatively in order to minimize the incidence of complications. Therefore MRI is essential for an adequate pre-surgical assesment, allowing a thorough preoperative evaluation.

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Address reprint requests to:
V. CAMA, M.D.
Department of Diagnostic Imaging,
Interventional Radiology and Radiation Therapy
University of Tor Vergata
Viale Oxford, 81
00133 Rome (Italy)
e-mail: valentinacama@gmail.com