Review Article

Prevention, diagnosis, and management of complications in hysteroscopic myomectomy: a literature review

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Background and Objectives: Submucous myomas, even if representing only 5.5–15% of all uterine myomas, are usually those related to the most severe symptoms. Hysteroscopy is considered the gold standard for removing submucous leiomyomas and is associated with a low incidence of adverse events. Nevertheless, hysteroscopic myomectomy (HM) can be complex and complicated. This article aims to review the potential complications of HM to help surgeons prevent and manage them appropriately.

Methods: A review of the literature from November 1993 to July 2023 was conducted on PubMed and Embase databases, searching for keywords which were then combined into pairs. Other articles from other databases were included when relevant. Only articles published in English were included in this review.

Key Content and Findings: Complications during hysteroscopy are rare. More than 50% of complications are due to mechanical trauma. Cervical trauma and cervical or uterine perforation can occur during cervical dilation, with the introduction of the scope, or with excessive resection of the myoma. The distance between the myoma and the uterine serosa [free myometrial margin (FMM)] is crucial to assess the risk of uterine wall perforation during the procedure. However, it has been demonstrated that FMM is a parameter that tends to increase during the hysteroscopic excision of the myoma. Other potential severe complications are fluid overload and venous gas embolism. Scrupulous supervision of fluid balance during the procedure is crucial to minimize this rare but possible event. Deficits of 1,000–2,500 mL with saline solution as a medium require careful monitoring and surgery must be stopped at the first sign of possible embolism. Surgery must be stopped immediately with a deficit of 2,500 mL or more (Grade 1C evidence). When dealing with older women and patients with cardiovascular, renal, or other comorbidities, the threshold for fluid deficit must be lowered to 750 mL (Grade 1B evidence). The complication rates mainly depend on the technique used, the surgeon's expertise, the patient's characteristics, and the overall complexity of the procedure.

Conclusions: Preoperative planning and diagnostic assessment are crucial for minimizing the complication rate as well as a conscious choice of the most adequate and suitable hysteroscopic technique, with a personalized approach for each patient.

Keywords: Hysteroscopy; myomectomy; submucous myomas; complications

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Introduction

Uterine leiomyomas (also known as uterine fibroids or simply myomas) are one of the most common benign pathologies of the female genital tract, affecting 20–30% of women of reproductive age and representing a significant cause of morbidity in women's gynecological and general health (1,2). At fifty years, about three out of four women have uterine fibroids, but prevalence seems to be markedly influenced by factors such as age and race (3). The clinical manifestation of myomas strongly depends on their number, dimensions, and location. Submucous myomas, even if representing only 5.5–15% of all uterine myomas, are usually those related to the most severe symptomatology, frequently causing abnormal uterine bleeding (AUB), dysmenorrhea, and subfertility (4-6). Due to their partial or total protrusion into the uterine cavity, submucous myomas are often approachable through hysteroscopic surgery (7). Presurgical evaluation and characterization of submucous myomas are crucial in order to optimize their management and to increase the success of the surgical procedure. According to the European Society for Gynecological Endoscopy (ESGE) Classification (inspired by Wamsteker *et al.*'s classification, which was elaborated in 1993), submucous leiomyomas can be classified as type 0, 1, or 2, depending on their degree of penetration into the myometrium (8). In 2005, Lasmar *et al.* drew up a new classification system for submucous myomas, the STEP-W Classification, which considers five fundamental characteristics of the lesions: Size, Topography, Extension of the base, Penetration and lateral Wall position (9). The hysteroscopic approach has revolutionized the management of submucous uterine fibroids. Hysteroscopic myomectomy (HM) is considered the gold standard for the treatment of submucous myomas, being, in most cases, a safe and minimally invasive surgical solution to the disease (10). Hysteroscopy is associated with a low incidence of adverse events. Nevertheless, especially in the case of hysteroscopic type 1 and 2 uterine fibroid removal, it can be very complex and burdened by complications (11). The complication rates mainly depend on the technique, surgeon's expertise, patient's characteristics, and the overall complexity of the procedure (12). Complications such as uterine perforation and cervical trauma, fluid overload, and postsurgical adhesions, among the others, can occur when an HM is performed (13). Knowing the possible complications of HM allows one to predict and prevent them, and enables the surgeon to adopt the appropriate measures to manage them best.

This article aims to review the potential complications of HM to help surgeons prevent and manage them appropriately. We present this article in accordance with the Narrative Review reporting checklist (available at https://gpm.amegroups.com/article/view/10.21037/gpm-23-27/rc).

Methods

This article aims to provide an up-to-date review regarding the intraoperative and perioperative complications of HM. The authors conducted a review of the literature checking PubMed (National Library of Medicine) and Embase from November 1st, 1993 to July 15th, 2023, searching for the following keywords: "hysteroscopy", "myomectomy", "complications", "uterine perforation", "intravascular absorption syndrome", "intravasation", "venous intravasation", "venous air embolism", "bleeding", "infection", "adhesions". During the search, the keywords were combined into pairs and the results were analyzed. Our research resulted in 473 articles by matching the words "Hysteroscopy and Myomectomy"; 2,502 for "Hysteroscopy and Complications"; 290 for "Hysteroscopy and Uterine perforation"; 16 for "Hysteroscopy and Intravascular Absorption Syndrome"; 7 for "Hysteroscopy and Venous Intravasation"; 2,335 for "Hysteroscopy and Bleeding"; 330 for "Hysteroscopy and Infection"; 804 for "Hysteroscopy and Adhesions"; 28 for "Hysteroscopy and Venous Air Embolism". All the articles dealing with other intrauterine pathologies than submucous myomas (e.g., endometrial polyps, uterine septa, retained products of conception, etc.) were excluded from this review. Only articles published in English were included in the review. For a search strategy summary of our literature research, please check *Table 1*.

Discussion

Entry-related complications and uterine perforation

The vast majority of complications (more than 50%) during a hysteroscopic procedure for myomectomy are due to mechanical trauma (14). Cervical trauma and cervical or uterine perforation can occur during cervical dilation and entrance into the uterine cavity, with the introduction of the scope, or with the resection of the myoma (15). Cervical dilation can be complex due to an extreme version of the uterus, intrinsic anatomic variations, or a narrow or stenotic canal. Factors such as nulliparity, postmenopausal

Table 1 The search strategy summary

Items	Specification
Date of search	July 15th, 2023
Databases and other sources searched	PubMed; Embase
Search terms used	"Hysteroscopy" and "Myomectomy"; "Hysteroscopy" and "Complications"; "Hysteroscopy" and "Uterine perforation"; "Hysteroscopy" and "Intravascular Absorption Syndrome"; "Hysteroscopy" and "Venous Intravasation"; "Hysteroscopy" and "Venous Air Embolism"; "Hysteroscopy" and "Bleeding"; "Hysteroscopy" and "Infection"; "Hysteroscopy" and "Adhesions"
Timeframe	November 1st, 1993–July 15th, 2023
Inclusion and exclusion criteria	Only articles dealing with submucous myomas were included in the research. All the articles dealing with other intrauterine pathologies (e.g., endometrial polyps, uterine septa, retained products of conception, etc.) were excluded. Only articles published in English were included in the review
Selection process	All the abstracts and the full texts were screened by G.S., and reviewed and classified by A.L. and G.S., independently. The concordance for plausible relevance was accomplished by consensus. All the inconsistencies were discussed by the reviewers and the consensus was reached by asking a third author (S.A.)

state, history of cesarean section, and previous surgical procedures on the cervix can exacerbate the difficulty in cervical dilation, increasing the risk of entry-related complications (16).

A multicenter study conducted on 21,676 patients, even if registering a lower incidence of uterine perforation compared to other past studies (0.12%, rather than 0.73–1.4%), showed that HM was the procedure with the highest rate of uterine perforation (0.15%) (17). A prospective multicenter study by Jansen *et al.* about the complications of operative hysteroscopy evidenced that about half of the complications (18 of 33) were access-related (even with a low overall incidence of complications (0.3%) (15).

Prior cervical ripening with misoprostol (either by vaginal or oral route) has been proposed to facilitate the entrance into the uterine cavity and the placement of the scope, hence lowering the rate of access-related complications (18-20). The use of misoprostol as a cervical-ripening agent could be beneficial, especially in premenopausal patients (20-22). However, in patients where cervical dilation and entrance are expected to be easy, the routine administration of misoprostol may only subject patients to the side effects of the drug (nausea, vomiting, diarrhea, and abdominal cramps being the most common) without any actual advantage. While waiting for more reliable data, there is no recommendation for a routine administration of vaginal misoprostol as a cervical-ripening agent before HM. However, its use may be considered in some categories of women with a patient-targeted approach (14).

If the cervical canal is very narrow, the operator can use miniaturized instruments to perform a mild synechiolisis, to clear the path to the passage of the scope, avoiding the need to force it through the cervix, with the risk to perforate the uterus or create a "*via falsa*" (23).

In the most difficult cases, when facing a very narrowed cervical canal, performing the access into the uterine cavity under ultrasonographic guidance can extremely minimize the risk of creating false passages or unwanted trauma (24).

When perforation of the uterine wall occurs during a hysteroscopy, despite increasing the amount of fluid released into the cavity, the distension of the uterus becomes very difficult, and in most cases, the procedure cannot be completed.

When cervical or uterine perforation occurs during dilation or insertion of a blunt, cold (inactivated) instrument, with no significant bleeding, and in hemodynamically stable patients, a conservative approach and observation seem justified and are recommended. Patients must be monitored, and any symptoms like fever, nausea, vomiting, or abdominal pain must be referred. Once a mechanical injury of the uterine wall is detected, right before retracting the instrument, a careful check of the area surrounding the lesion must be performed, in order to rule out active bleeding. However, in the case of perforation (especially when using an activated instrument), any injury to the other abdominal anatomical structures and organs (such as the bowel, the lower urinary tract or major vessels) cannot be

excluded. An emergency laparoscopy (or laparotomy) is hence strongly advised (25). In some cases, thermal injury can manifest only 5 to 14 days after hysteroscopic surgery, even without perforation (10,26): even if thermal injury without complete uterine perforation is extremely less frequent, an injury can still occur if an organ such as bowel loop is deeply adherent to the serosa and intense current is applied in the deepest myometrial layers.

Moreover, when using a monopolar instrument, the current can be unintentionally diverted to another path, resulting in an area of intense current density on the vagina or vulva, with a possible undesired electrosurgical trauma (the so-called "capacitive coupling" effect) (27). The operator must avoid an overdilation of the cervix to maintain direct contact between the canal walls and the external sheath of the resectoscope: a too-broad canal compared to the maximum diameter of the scope can facilitate the occurrence of the current dispersion and hence a possible unintentional thermal injury.

To reduce the risk of electrosurgical injuries, the pedals controlling the electrodes should be carefully placed in a safe location to avoid unintentional start-up. Since the use of unipolar current is linked to a higher risk of current diversion and unintentional thermal injuries, the surgeon, when possible, should prefer bipolar electrosurgery. In any case, when using a monopolar current, the electrode must be activated only when close or even in contact with the targeted lesion. Moreover, the intensity of the current is directly proportional to the risk of thermal injury, so high-voltage energy ("coagulation") should be avoided as much as possible (12).

Uterine perforation (both from mechanical and electrosurgical trauma) may also come from resection of the uterine wall during myomectomy. The thickness of the free myometrial margin (FMM), which is the distance between the myoma and the uterine serosa, is crucial to assess the risk of uterine wall perforation during HM (28). However, it has been demonstrated that FMM is a parameter that tends to increase during the hysteroscopic excision of the myoma (29). A careful preoperative assessment of the total volume of the fibroid and the FMM by ultrasound (US) [or, in some cases, with magnetic resonance imaging (MRI)] is fundamental to decrease the overall complication rate. A three-dimensional (3D) US scan has been proven to be a useful preoperative tool (30). Different FMM cut-off values for a safe HM have been considered over time. According to Mazzon *et al.*, a safe FMM must be not less than 10 mm. On the other hand, according to other data, even an FMM not less than 5 mm can be considered approachable (25,28). In the case of a very thin FMM, using intraoperative ultrasonography (either transabdominal or transrectal) can be of great help and is recommended (31). Either way, a surgeon who deals with high-risk hysteroscopic myomectomies should have great laparoscopic skills to face any complication as required.

Distension fluid-related complications

Operative hysteroscopy intravascular absorption (OHIA) is a rare and serious complication of HM and hysteroscopy in general. The uterine cavity must be distended by a medium in order to perform a hysteroscopic procedure. Gas and fluid media have been used over time, each with its features and properties. They allow the distension of the cavity in order to permit an adequate diagnosis of intrauterine pathologies, facilitate the maneuverability of hysteroscopic instruments inside the cavity and ensure a proper hysteroscopic surgery. Moreover, fluid media, thanks to continuous irrigation, permit a better intracavitary vision and, last but not least, allow the use of electrosurgery. On the other hand, gas media, such as carbon dioxide, cannot be used in operative hysteroscopy, and their use is strongly limited (10).

Large volumes of fluid can be absorbed and released during operative hysteroscopy into the circulatory system (32). Fluid intake can result from the absorption through the endometrial mucosa, the fallopian tubes, or even direct entry into the bloodstream through opened vessels, such as myometrial venous sinuses. It is well known that the endometrium, just after a few minutes from the start of the operative procedure, tends to absorb fluid and become swollen. The thicker the endometrium, the higher the risk of fluid absorption and the harder the procedure to be performed (33). For this reason, many Authors have underlined the importance of proper endometrial preparation before hysteroscopy over time. An adequate endometrium can be obtained by scheduling the procedure in the immediate first days after menstruation or by administrating hormonal endometrial-thinning agents such as gonadotropin-releasing hormones analogs (GnRH-a), danazol, progestins alone or combined with estrogens, among others (34-38).

The risk of fluid absorption is higher during HM than the other hysteroscopic surgery, due to the intrinsic features of the technique. During the resection of the fibroid, large vessels can be opened, thus facilitating the entry into the

circulatory system of large volumes of fluid under high pressure (39). Moreover, the duration of the procedure is key: the risk of OHIA becomes progressively higher the longer the procedure lasts (39). The data show that the risk of OHIA is directly proportional to the operating time, the maximum diameter of the myoma, and the depth in the myometrium (40).

Fluid overload can have catastrophic consequences, leading to heart failure, pulmonary edema, electrolyte imbalance, cerebral edema, coma, or even death. Patients' morbidities can have a strong influence in assessing the intravascular absorption risk: even more attention must be paid when dealing with patients with cardiovascular or renal diseases because the susceptibility to fluid overload is, unsurprisingly, even higher.

Clinically, OHIA can manifest with both respiratory (with dyspnea, pulmonary edema) and cardiovascular symptoms (increased blood or central venous pressure, shock). If hyponatremia occurs (with a blood sodium concentration <120 mEq/L), the patient can manifest confusion, nausea, vomiting, headache, agitation, numbness, convulsion, or even coma.

Fluid media can be hypotonic or isotonic. Up to 2003, the only electrosurgery that was used was the monopolar one, with only hypotonic solutions used as distension media. More recently, with the advent of bipolar electrosurgery, isotonic irrigation media started to be used (0.9% saline solution being the most preferred) (41).

Hypotonic, non-conductive, low-viscosity fluids (such as glycine 1.5% or sorbitol 3%) may lead to an even more severe osmotic and electrolytic imbalance, with additional hypoosmolality, hyponatremia, and hypokalemia (42). The use of glycine as distension media has been related to the so-called "gynecological TURP syndrome", very similar in etiopathogenesis and symptomatology to the TURP (Transurethral Resection of the Prostate) syndrome, which was observed for the first time by the urologists. The clinical manifestation of this clinical condition is due to a progressive hemodilution which causes hyponatremia from asymptomatic to severe, and it involves neurological (confusion, numbness or even coma, focal or generalized seizures), respiratory, and cardiovascular symptoms (32). Isotonic distention media (such as Ringer and 0.9% saline solution) have been proven safer than hypotonic solutions and reduce the risk of OHIA, and thus should be preferred (10,41,43). In addition, they are suitable for bipolar toolkits.

The best strategy to prevent OHIA is thorough supervision of a real-time (or at most every 10 minutes) fluid balance during HM. Deficits of 1,000–2,500 mL with saline solution as a medium require careful monitoring and surgery must be stopped at the first sign of possible intravascular absorption syndrome (primarily signs of electrolyte imbalance, which can emerge differently on the basis that the patient is under anesthesia or not). In case of suspected OHIA, a thorough monitoring of sodium, potassium and calcium must be performed. Surgery must be stopped immediately with a deficit of 2,500 mL or more (Grade 1C evidence) (14). A higher risk is encountered when hypotonic media and monopolar techniques are used because they show a more robust and rapid effect in the onset of hyponatremia (34,38). For this reason, the upper limit for the fluid deficit when using hypotonic solutions has been set at 1,000 mL (14). When dealing with older women and patients with cardiovascular, renal, or other comorbidities, the threshold for fluid deficit must be lowered to 750 mL (Grade 1B evidence) (14).

Also, a too high intracavitary pressure can facilitate the onset of intravasation syndrome. Therefore, a scrupulous surveillance of intracavitary pressure (which should range between 50–80 mmHg throughout the duration of the hysteroscopic surgery and generally not higher than the mean arterial pressure of the patient) should be carried out to reduce the risk of OHIA (44).

Minor OHIA caused by isotonic media can sometimes be solved only with the administration of diuretics. For more severe OHIA or if electrolyte imbalance occurs, multidisciplinary involvement of anesthetists and intensivists is mandatory, and the patient must be immediately transferred to the Intensive Care Unit (42). When correcting hyponatremia, slow compensation is key to avoid the risk of additional and even more severe complications, such as pons myelinolysis. Some authors evidenced that transcervical intralesional injection of vasopressin during HM, due to its vasoconstrictive effect, can be important in reducing fluid intravasation and blood loss (45,46). Vasopressin directly constricts the blood vessels of the myoma, thus leading to a lower amount of blood loss and intravasation of fluid, better visual clarity during surgery, and an overall reduction of the operative time (46).

Venous air embolism

Gas embolism is another severe potential complication that can occur during HM. The gas entering the systemic circulation can cause arrhythmia, pulmonary hypertension, gas exchange disorders, and can even lead to death (47,48).

Clinical manifestations include chest pain, dyspnea, and cough. In most cases, the gas that enters the circulating system comes from the distention medium when electrosurgery is used. Indeed, in monopolar systems, the electrons pass through the medium and the patient's body. On the other hand, in a bipolar system, the electrons travel from the active to the passive electrode, which are just some millimeters distant from one another. This intrinsic feature causes an intense overheating of the medium and leads to the formation of the typical "bubbles". For this reason, bipolar systems, while causing less OHIA, may nevertheless increase the risk of air embolism. When a suspicion of venous air embolism is guessed, the hysteroscopic procedure must be interrupted immediately, and the figure of the anesthesiologist is mandatorily required.

Moreover, electrocoagulation produces waste products that can be poured into the bloodstream. One of them, carbon monoxide, if reaching a critical blood level, can lead to the formation of carboxyhemoglobin. This can lead to abnormalities in the electrocardiogram and myocardial ischemia, and it has been noted a significant correlation between carboxyhemoglobin levels and the amount of intravasation (14,49,50).

In a prospective cross-sectional study Zelivianskaia *et al.* found that myomas of greater volume and higher fluid deficit are more likely to make the blood levels of carboxyhemoglobin rise in the postoperative period. Therefore, even more caution must be paid in these conditions to detect any first sign of carbon monoxide toxicity (51).

If a venous air embolism is suspected, the procedure must stop immediately, and the respiratory insufficiency that may occur must be treated with promptness. In order to relocate the retained air in the apex of the right ventricle, the Durant maneuver (with the patient positioned in left-lateral decubitus) must be performed (52).

Venous air embolism is a life-threatening condition that requires close monitoring, multidisciplinary management, and a prompt transfer of the patient in an intensive care unit.

Bleeding

HM is a high bleeding-risk procedure. Bleeding can be caused by perforation or the resection of the myoma itself. The severity of bleeding can range from scarce to severe hemorrhage and managing it can be anything but easy. Intraoperative bleeding can lengthen the duration of the surgery, exposing the patient to all the time-depending complications, above all, the OHIA. Therefore, preoperative planning and intraoperative management of bleeding during an HM are essential.

Especially in anemic patients, it could be wise to recur to a previous administration of hormones such as GnRH-a, taking advantage of the transient menopausal status and the shrinkage of the myoma resulting from two-three months of treatment with these agents (34). Some Authors have suggested that the pre-treatment with GnRH-a and the consequent shrinking of the uterine myoma can lead to a more difficult surgery if the lesions have become too small to be easily identified, resulting in a non-recognition of the disease, a missed discernment of the lesions and its limits and then to a higher "recurrence" of the myoma after surgery (53). On the other hand, other studies from other articles have shown that the evidence of fibroid recurrence after GnRH-a pre-treatment was equivocal, while the effectiveness of the pre-surgical therapy with GnRH-a in reducing operative time, blood loss, and the complication rate has been clearly demonstrated (54).

In addition, iron supplementation can reinvigorate the iron stores of the patient (10). Even more attention must be paid when resecting the lateral uterine walls and the isthmus area where large branches of the uterine vessels are present: an injury at this level may cause a severe hemorrhage and oblige to a laparoscopic (or laparotomic) emergency access to manage bleeding (10). To manage the bleeding, agents such as vasopressin, uterotonics (e.g., oxytocin) or misoprostol may be administered (41,55) If uterotonics are insufficient, a mechanical tamponade with an intrauterine balloon (e.g., a Foley catheter filled with saline solution) can be attempted (10).

Also tranexamic acid (TXA) can play an important role in reducing bleeding during a myomectomy. Many studies have shown how TXA (both prophylactic or therapeutic) can reduce intraoperative blood loss and the requirement for blood transfusion during an open myomectomy (56-58). As regards HM, solid data about the efficacy of TXA in reducing blood loss during an HM are still missing. In a systematic review and meta-analysis from 2019, Fusca *et al.* found that in patients undergoing an HM TXA has been found not superior to oxytocin in lowering the need for blood transfusion and has resulted in lower hemoglobin levels in the postoperative period (59).

Infections

The incidence of infection after HM and hysteroscopic

surgery, in general, is very low and seems mainly to occur when the cervix is manipulated and forced during the procedure (60). Since the infection risk is shallow, achieving a shared consensus about antibiotic prophylaxis is challenging, and reliable data about this issue still need to be provided (61).

Adhesions

Intrauterine adhesions (IUAs) can be a late complication of HM, especially after a multiple myomectomy or in the case of large myomas. The onset of IUAs can be an issue of significant importance, particularly in the seeking-pregnancy population. To minimize the risk of postsurgical IUAs, excessive manipulation of the cervix must be avoided, and great attention must be paid to limit unintended trauma to the healthy tissue surrounding the lesion and to reduce the usage of electrosurgery to the minimum required. To avoid the formation of IUAs, different anti-adhesive agents have been evaluated (62). Some authors have shown how using auto-crosslinked hyaluronic acid gel can reduce the incidence of IUAs (63-65). A routine application of hyaluronic acid gel after HM is hence recommended, especially after multiple myomectomies (Grade 1B recommendation) (14).

Complication rate: a comparison between techniques

Traditionally, the resectoscopic excision of submucous leiomyomas has been performed with the slicing technique. Although it is generally presented as the gold standard for type 0 myomas, no overwhelming evidence about its superiority over the other techniques has been found in the literature (66). Intra Uterine Morcellator (IUM) seems superior when considering the duration of surgery and the learning curve (67,68). The time factor is crucial when considering the success rate of the hysteroscopic procedure and hence the risk of complications: the shorter the surgical time, the lower the risk of complications such as OHIA. There is a Grade 1C recommendation to use morcellation, in addition to the classic resectoscopic slicing technique for the type 0 myomectomies, because morcellation is faster and with a shorter learning curve (14). On the other hand, at present, for type 1–2 myomas, the slicing technique is recommended with respect to morcellation (Grade 1C recommendation), even if solid data about this issue are lacking (14). Mazzon *et al.* focused on the use of the cold (inactivated) loop for the treatment of submucous leiomyomas, believing that it can spare the surrounding endometrium from unintended trauma, decreasing the risk of uterine perforation and improving reproductive outcomes, thanks to a lower postoperative adhesions' rate (28). In 2017, Vitale *et al.* demonstrated that using morcellation for HM is safe and does not increase the intraoperative and late risk of complications (69). Nevertheless, it is necessary to weigh which kind of technique is the best according to the patients' and lesions' characteristics on an individual basis, to lower the risk of complications and improve the success rate of the procedure.

The role of imaging in the prevention of HM complications

Imaging is a crucial tool in the prevention of HM complications. A proper assessment of the patients undergoing an HM in order to prevent complications is crucial. Besides a scrupulous anamnesis and proper physical examination, US is a safe, non-invasive, and easily accessible imaging tool, considered the first-line diagnostic exam in the hysteroscopic evaluation of the patient (70). An adequate US scanning allows us to identify and characterize uterine lesions, congenital Müllerian anomalies, adnexal lesions, and other pelvic non-gynecological pathologies. The thorough evaluation of a uterine finding permits to distinguish lesions that may have similarities and differences in their ultrasonographic appearance. 3D US evaluation can be beneficial in assessing suspected congenital uterine anomalies and better investigating the uterine cavity and the junctional zone, allowing a more detailed analysis of the dimension, location, and size of uterine lesions (30,71). Thanks to the Morphological Uterus Sonographic Assessment (MUSA) group and the International Endometrial Tumor Analysis (IETA) group, two fundamental consensus statements on the terms, definitions, and measurements to describe the US findings of the myometrium, endometrium, and their lesions, have been provided (71,72). Two-dimensional (2D) saline-infusion sonohysterography (SIS) can offer important preoperative characterization to evaluate the features of a suspected submucous myoma (73,74). Based on US, SIS and diagnostic hysteroscopy findings, the STEP-W scoring system can be used to classify the submucous myoma on five features: Size, Topography, Extension of the base, Penetration and lateral Wall position (9). Prospective multicenter studies have shown that the STEP-W Classification, if compared to the previous classification

systems, permits a better prediction of the complexity of HM, duration of the surgery, risk of incomplete removal, risk of complications, and their severity, hence its use is recommended (Grade 1B recommendation) (14,75,76). In case of enlarged uteri, multiples nodes of myomas, patients with increased body mass index (BMI), questionable nature of the uterine tumor, and in case of the coexistence of uterine and other pelvic lesions, MRI can be very helpful (Grade 1A recommendation) (14,77).

Imaging can help during HM as well. Intraoperative ultrasound (IOUS) via transrectal or transabdominal route can be a handy guide for the surgeon performing a hysteroscopic procedure. In the context of an HM, IOUS increases the chance of complete one-step removal of myomas with a consistent intramural portion by detecting the intraoperative FMM, avoiding the risk of uterine perforation (31,78-80).

Conclusions

HM for removing submucous leiomyomas is a safe and minimally invasive procedure, which is not, however, free from complications. The surgeon needs to be aware of the rare but still possible complications that can occur during an HM, to recognize and manage them as well as possible. HM can be complex and should be best performed by an experienced surgeon to limit the complications' rate. Preoperative planning and diagnostic assessment are crucial for the procedure to be successful: a careful US evaluation, with the best attention to the FMM and the features of the lesion, is strongly recommended. Choosing the most adequate technique when approaching a myoma can significantly reduce the risk of complications, even if, to date, no technique has proven to be better than the others. It is strongly advised that surgeons who face an HM have good laparoscopic skills if a complication requiring an emergency laparoscopy is necessary.

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Footnote

Reporting Checklist: The authors have completed the Narrative Review reporting checklist. Available at https://gpm.amegroups.com/article/view/10.21037/gpm-23-27/rc

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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