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Chapter

New Hysteroscopic Approaches to Uterine Fibroids

Razvan Socolov, Ioana Pavaleanu, Demetra Socolov, Mona Akad and Ciprian Ilea

Abstract

The hysteroscopic myomectomy is a very important application of the gynecologic endoscopy, as it allows minimal invasive removal of the type 0, 1, and 2 fibroids with minimal damage to the uterine wall. In the last decade, new developments of this method allowed an even less invasive approach, with possibility of ambulatory procedure. We discuss the importance of these new developments, based very much on the pseudocapsule of the myoma, and analyze the literature data regarding the outcome. The cold loop resection is a technique that could be used in type 1 and type 2 myomas, with less complications and limitations than the classical electrical resectoscope. Another development, more useful for type 0 and 1 myoma, is the hysteroscopic morcellator, similar to the laparoscopic one, but providing a faster and safer procedure. We also update the complications of hysteroscopic myomectomy and their management, including long-term and obstetrical complications related to hysteroscopic myomectomy. In conclusion, new developments and studies show that hysteroscopic myomectomy has become a valid endoscopic technique ready to be used by many specialists.

Keywords: hysteroscopy, myomectomy, morcellator, cold loop resection, complications

1. Introduction

Since 1976, the fibroids were accessible to hysteroscopic approaches as a conservative treatment, especially for type 0 and type 1 of the European Society of Gynaecological Endoscopy (ESGE) classification [1]. But the instruments needed an approach requiring anesthesia and dilatation, exposing to numerous complications, especially when using monopolar electric energy. Further developments, like miniaturization of resectoscopes or the large introduction of bipolar energy, have opened new and more accessible approaches with more and more specialists using the hysteroscopic techniques and with lesser and lesser complications.

The recent years have brought a revolution in operative hysteroscopy, and myoma treatment benefitted as well as other intrauterine pathologies. We will try to point some of these developments and their applications in fibroid treatment.

2. Limits for office hysteroscopic myomectomy

The myomas are fibrotic tumors of the myometrium, with an incidence varying a lot in function of different factors (age, race, family background, etc.). Their

particular structure has an outside pseudocapsule, which makes the myomectomy through enucleation a rather simple technique in laparoscopy. For the fibroids protruding into the uterine cavity (except the complete intracavitary type 0 ones), although the capsule exists, the classical approach involved a slicing technique which could impair also the surrounding myometrium, which is something not to be desired especially in young patients that want to retain a good reproductive prognostic.

The introduction of bipolar smaller resectoscopes allowed a more targeted technique. The new resectoscopes have an outer diameter of 7 mm, and this allows minimal dilatation and anesthesia. Another possibility is the bipolar probe which allows myolysis and separation from the pseudocapsule.

The use of the pseudocapsule has several advantages:

- The myoma can "move" in between the myometrial fibers, allowing its persistence during uterine contractions. During the intervention, this constitutes a cleavage plan that allows enucleation.

- Once disrupted, this pseudocapsule does not "protect" the myoma, and uterine contractions expel the tumor toward the cavity. This principle was described by as the auto-expulsion of the myoma—defined as the Office Preparation of Partially Intramural Uterine Myoma (OPPIUM) by Bettocchi et al. [2], which leaves the intramural part of the fibroid untreated in the first step. After the next menstrual cycle, the protrusion allows the hysteroscopist to resect the rest of the tumor.

This latest element is recommended in tumors exceeding 1.5 cm and with a large implantation (type 1 or type 2). Although it generally requires a two-step intervention, it offers security and facilitates the favorable final result.

Other limits to office hysteroscopic are [3]:

- Patient's sensitivity to pain, which may require some form of paracervical anesthesia and/or preoperative analgesic and antispasmodic drugs.

- The type of fibroid. Beside the cited ESGE classification, another classification is the STEP-W, which was proposed for submucous myomas by Lasmar et al. [4] and takes into account:

    - Size—largest diameter of the nodule in cm (scored as 0 if <2 cm, 1 if 2–5 cm, and 2 if >5 cm).

    - Topography in the uterine cavity (inferior part, 0; middle uterus, 1; and upper part, 2).

    - Extension of the base of the fibroid and proportion in which it covers the corresponding uterine wall (scored as 0 if <1/3, 1 if 1/3–2/3, and 2 if >2/3).

    - Penetration in the uterine wall—corresponding to the ESGE classification (0, 1, or 2 type scored as such)

    - Attachment of the fibroid to the lateral wall—if present add 1 point.

- The final score of STEP-W suggests the complexity of the case: if 0–4, easy to perform hysteroscopic myomectomy; 5–6, complex procedure, possible

two-step approach; and 7–9, difficult case, and the specialist should consider alternatives to hysteroscopy.

If the myoma remains enucleated and free in the uterine cavity, there are authors that advocate leaving it for spontaneous expulsion, in the Haimovich series (after laser myomectomy) the median duration to expulsion being 68 days, with no complication [5].

An important help for better assessing the pseudocapsule could be brought by computer-aided imaging. A recent study of Török et al. [6] showed a very good accuracy, of more than 86%, using fully convolutional neural networking and high-resolution endoscopic image, which is promising for faster and safer future resections.

3. Assisting hysteroscopic myomectomy: preparation and safety

The hysteroscopic myomectomy is a method depending highly on several factors, some related to the patient (tumor size and number, consistency, position) and some to the equipment and experience of the gynecologist.

So, it is important that the preparation and safety are tackled with care.

One of the preparatory methods is the pre-treatment of fibroids. Several strategies have been proposed, and here we will discuss especially the new ones:

a. Ulipristal acetate, an orally active selective progesterone receptor modulator, could act through different mechanisms on myoma cells, inducing apoptosis, changing the expression of pro-angiogenic proteins, and reducing the production of collagen tissue. All these actions are obtained without significantly diminishing the estrogen level, unlike other therapies (i.e., GnRH agonists). According to a systematic review by Ferrero et al. [7], there are advantages and disadvantages in prescribing this treatment before hysteroscopic myomectomy. The favorable effects are the amenorrhea and diminished size of the fibroid, which would facilitate the resection. On the other hand, the endometrium appears to increase, which could create difficulties for visualization. Another mentioned change under medical pre-treatment of myomas is the "myoma migration" which means that the position and the type of fibroids could change after therapy and therefore change the approach of the surgeon, from hysteroscopy to laparoscopy and vice versa. As mentioned, this effect was also noted in the ulipristal-treated group [8] as well as in those treated by GnRH analog or embolization [9].

b. Regarding the effect of GnRH analog, the effects on the facility and duration of the hysteroscopic procedure is uncertain. As mentioned above, and in other studies [10], most of the time, for type 2 myomas, the difference was not significant in favor of the pre-treated group, but most of the series in literature are rather small. As for other types of myomas, as no important volume decrease was found, it should be emphasized that the only major advantage of the pre-treatment is reducing or stopping the associated hemorrhage.

c. For the safety increase of the procedure, the use of ultrasound vaginal scan has been shown to be of the greatest value. This allows estimation of the operating time; for example, in a study by Isono et al. [11], using the cubic value for the average diameter of the myoma was useful both in estimating the total weight of the tumor and the operating time, with differences from those with diameter of 1–2, 2–3, or >3 cm). During the procedure, the

ultrasound scan has been proposed by Korkmazer et al. [12], for assessing the limits of the remaining myometrial tissue after resection of type 1 and especially type 2 myomas.

d. The 5 mm limit for safety from the serosa is the most accepted one for a safe procedure diminishing the risk of perforation [13]. Although this was considered a proven fact, new researches underline that the moment of assessing could influence this parameter. The limited use of electric energy, accompanied by squeezing the myoma from its pseudocapsule by hydro-pressure fluctuation, and other pharmacological means could, according to Casadio et al. [14], allow myomectomies of tumors with <5 mm security margin.

4. Cold loop resection: principles and limits

With this procedure, the slicing done by electrical energy is replaced by a mechanical dislocation assisted by the "natural" myometrial reaction to uterine distension that helps push the tumor toward the uterine cavity.

This technique, first described by Mazzon in 1995, had overcome the limits of classical slicing technique. It has several advantages, as described by Mazzon et al. [15]:

- Less uterine perforations, as the mechanical energy allows the myometrial tissue to contract.
- Sparing the myometrial fibers diminishes the hemorrhage associated, as it allows the natural hemostasis done by myometrial contraction and avoids damaging tortuous vessels in the deep myometrium.
- Diminishing vascular injuries also decrease the risk of distension media intravasation.
- The intramural component of the myoma loses its importance and allows smaller myoma-serosa interface than the 5 mm limit.
- The postoperative occurrence of intrauterine adhesions, a common complication of large hysteroscopic myomectomies, is also lower after cold loop technique.

The retrospective study of Mazzon [16] of 1244 cases showed a 87% of one step myomectomy in general, and 82% for type 2 myoma. Other series also allowed large myomas of >3 cm to be resected in one step by this technique, with an operating time of 10–58 min [17].

In conclusion, the cold loop method offers advantages compared to the classical electrical resectoscope one, and although it requires getting used to the use of mechanical dissection of the tumor from its pseudocapsule, with appropriate force and angle of insertion of the loop, it could have important benefit especially for large and intramural fibroids—type 1 and 2.

5. Myomectomy using hysteroscopic morcellation

The morcellation of fibroids is a technique involving mechanical cutting of small slices of tumor, accompanied by powerful suction of the fragments. The sectional

mechanical effect is done, similar to laparoscopic morcellator, by rotation of an inner tube into an outer tube at high speed. The advantages of the technique, as mentioned in a large multicentric study coordinated by Scheiber et al. [18], are:

- A high efficacy, of 87% for fibroids and 99% for polyps
- The accessibility of the procedure, with similar results in ambulatory and clinical settings
- The high satisfaction of operators, up to 95%
- Low complication rate, as no repeated insertion is needed as in resectoscopic technique

A systematic review done by Vitale et al. [19] confirms the feasibility of the different morcellators in practice, especially for type 0 and 1 myomas, while type 2 myomas are more difficult, with multistep procedures, as for classical resectoscopic method. The diminished operating time, with an average of 22 min for over 280 patients in the included articles, is also an advantage.

An observation made by the authors of the cited review is that, due to the aspiration system of tissues, a larger quantity of fluid is needed. If, in classical resectoscopic myomectomy, the limit of 1000–1500 ml deficit should not be passed, in morcellating technique, even at 2500 ml deficit there was no side effect mentioned. Nevertheless, the mean deficit was much lower, around 760 ml.

Another recent prospective study of Maheux-Lacroix et al. [20] analyzed the follow-up for post-hysteroscopic morcellation patients for an average of 32 months and found a 12% rate of hysterectomies and 27% of additional surgery overall. The most significant factor for this outcome was the size of the myoma >5 cm, with odds ratio (OR) of 2.9.

There is a tendency of reducing the size of the morcellator; the new equipment with a diameter of 19 Fr (6.5 mm) allows minimal dilation and ambulatory procedures. Although this latest instrument is more suitable for polyps, Bigatti et al. [21] describes a case with type 2 fibroid resected with this shaver.

6. Postoperative follow-up and complications

6.1 Postoperative follow-up

The immediate postoperative care for patients having undergone hysteroscopic myomectomy includes surveillance of symptoms such as cramping, light bleeding, and vaginal discomfort.

The drugs of choice for postoperative pain control are usually acetaminophen or nonsteroidal anti-inflammatories. After discharge, patients are advised to use an anti-inflammatory medication such as ibuprofen, which should provide adequate pain control. Severe pain that does not respond to such medication can be a sign of a more serious complication and should be promptly evaluated.

Postoperative surveillance is further dependent upon the course of the procedure. If an imbalance of fluid was noted, then the patient should be monitored for signs and symptoms of fluid overload and hyponatremia: bradycardia, hypertension, nausea, vomiting, seizures, pulmonary edema, or cardiovascular abnormalities.

Routine activities are generally resumed within 24 h, and patients should follow standard postoperative instructions for gynecologic procedures.

Patients should be informed about further vaginal bleeding, which is anticipated for ~1 week after the surgery. The duration of bleeding may vary from a few days to 2 weeks, and the flow usually is very light.

A follow-up visit should be scheduled to take place 4–6 weeks postoperatively, when subsequent complications might be diagnosed and the pathology results reviewed and discussed with the patient, especially since cases of unexpected uterine malignancy in women undergoing hysteroscopic myomectomy were reported, with an incidence of 0.86% [22].

6.2 Complications

Operative hysteroscopy is generally considered a safe and minimally invasive procedure used for the treatment of uterine leiomyoma. Knowledge of early and late adverse events, alongside preventative measures, is crucial for the safety and quality of hysteroscopic surgery [23].

Studies regarding hysteroscopic myomectomy procedures report a complication rate of 0.8–2.6% [24, 25].

A retrospective study regarding the follow-up of 235 women with submucous fibroids at outpatient hysteroscopy who underwent a hysteroscopic transcervical resection reports a complication rate of 2.6%, and the rate is lower for procedures involving single versus multiple fibroids (1.4 vs. 6.7%) [24].

Among the gynecological procedures performed by hysteroscopy, myomectomy imposes a lower risk for complications: adhesiolysis carries the highest risk of complications (4.5%), followed by endometrial resection (0.8%), myomectomy (0.8%), and polypectomy (0.4%), as shown by a prospective study of 2515 operative hysteroscopies [25].

The most common complications of hysteroscopic myomectomy can be divided into early complications, such as uterine perforation, fluid overload, heavy bleeding, infection, and late complications and suboptimal outcomes, such as incomplete resection and intrauterine adhesions [23].

One of the most frequent complications of operative hysteroscopy is uterine perforation, with an incidence of 0.12–3% [24–26]. The incidence increases in the presence of risk factors for traumatic entry: menopausal status, cervical stenosis, retroversion, and nulliparity. Signs and symptoms of uterine perforation include a sudden increase in fluid deficit and loss of adequate intracavitary distention, which generally results in loss cavitary distention, leading to termination of the procedure. Nevertheless, it can result in bleeding and potentially significant injury to surrounding organs, depending mainly on the type of instrument used.

If the perforation was caused by a blunt instrument during dilation of the cervix, it can be managed conservatively if major bleeding is not suspected. In these cases of suspected uterine perforation without hemodynamic instability and suspicion of damage to major vessels, postoperative monitoring of red blood cell count is essential, and a single dose of prophylactic antibiotic may be considered [23].

Damage by electrosurgical electrodes may lead to more serious injuries [27]. In this case, if a thermal or mechanical injury to surrounding viscera is suspected, a diagnostic laparoscopy is necessary.

In the long term, uterine perforation is a potential cause of uterine rupture in pregnancy which should not be neglected [28].

The incidence of fluid overload during operative hysteroscopy ranges between 1.6 and 2.5%, making excess fluid absorption one of the most common complications associated with hysteroscopic procedures [29].

The term “operative hysteroscopy intravascular absorption syndrome” (OHIA) was introduced, regarding the excessive fluid overload caused by

intravasation of distension media [23, 30], which further leads to hyponatremia and volume overload [3] and, in severe cases, metabolic acidosis, pulmonary and cerebral edema, and severe OHIA being associated with a mortality of 25% [30].

Continuous fluid monitoring, as well as thoughtful consideration of the distention media used, is an essential measure in preventing fluid overload. Isotonic media and bipolar equipment are preferred in order to reduce the risk of hyponatremia and its consequences [23]. Recent guidelines by the British Society of Gynaecological Endoscopy (BSGE) and the European Society of Gynaecological Endoscopy on fluid management in operative hysteroscopy recommend an upper threshold of 2500 ml for isotonic media and for of 1000 ml hypotonic fluids, in healthy women [31]. For patients with comorbidities or at an advanced age, lower thresholds are recommended: fluid deficit levels of 750 ml for hypotonic solutions and 1500 ml for isotonic solutions [31].

Heavy bleeding is uncommon after operative hysteroscopy but might occur due to mechanical trauma to the endometrium and/or myometrial vessels. Management options include intracervical injection of a prostaglandin F2α analog, resulting in uterine contraction with subsequent decrease in uterine bleeding or an intracavitary placement of a Foley catheter with a 30-ml balloon providing counterpressure. The balloon can be deflated, and the Foley removed after the bleeding has subsided for 4 hours. In rare cases, the bleeding may persist and require uterine arterial embolization or hysterectomy [23].

The incidence of infection following operative hysteroscopy varies between 0.01 [5] and 1.42% [32]. Prevention of infection may be possible by reducing the duration of the intervention. Currently, there is no established role for prophylactic antibiotic use.

Attention should be given to the possibility of postoperative uterine adhesion formation, especially in patients with a desire for future fertility. This complication is more likely to occur when lesions on opposing uterine walls have been resected so that the surfaces are juxtaposed after the procedure is completed. In these instances, estrogen therapy could be utilized immediately postoperatively, causing a rapid development of the endometrium. Another method attempted in the past was the placement of an intrauterine Foley catheter to prevent the contact between the opposing surfaces. Performing a hysteroscopy 6 weeks after surgery can be helpful both for diagnosis and for treatment by blunt dissection of adhesions with the tip of the hysteroscope [33].

Although rare, cases with abnormal placentation following hysteroscopic resection of myomas have also been reported. In 2013, Mathiesen et al. have reported the first case of placenta increta (associated with placenta previa) in a pregnancy after hysteroscopic myomectomy, concluding that patients with a history of hysteroscopic myomectomy are at an increased risk for abnormal placentation [34]. Tanaka et al. have reported in 2016 a case of placenta accreta without placenta previa during a pregnancy subsequent to hysteroscopic myomectomy, which was obtained with cryopreserved embryo transfer, which has been reported as an independent risk factor for placenta accreta. The authors suggest that any patient with previous hysteroscopic myomectomy should be considered to be at high risk for placenta accreta, even if she does not develop placenta previa [35].

Regarding the efficacity of hysteroscopic treatment of myomas, studies show a high success rate of hysteroscopic resection of uterine leiomyoma, of >94% [24], depending on prognostic factors such as the size, location, and number of myomas. The incidence of incomplete resection rates ranges from 5 to 20.5% [23, 36]. Reinterventions are usually performed, but may not always be necessary [23]. Comorbid conditions such as adenomyosis or dysfunctional uterine bleeding can

result in persistent menorrhagia that may indicate a subsequent hysterectomy for definitive treatment.

7. Conclusion

The hysteroscopic myomectomy has benefitted from the technical developments in equipment, and things appear to continue. Both new instrumentations and a more physiological approach to the myoma enucleation could be increasing the safety and the efficacy of this type of procedures.

Conflict of interest

The authors declare no conflict of interest.

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