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Original research

Predicting success of single step hysteroscopic myomectomy: A single centre large cohort study of single myomas

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HIGHLIGHTS

- A retrospective cohort study of 1244 women undergoing hysteroscopic myomectomy is described.
- We analysed the feasibility of performing the hysteroscopic myomectomy in a single-step procedure.
- Grading and size of myomas and age of patients influence the feasibility of one step procedure.
- G2 myomas greater of 3 cm are correlated to a higher risk of a multiple procedure.

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ABSTRACT

Introduction: Submucous myomas represent one of the main indications of operative hysteroscopy. Hysteroscopic resection of submucous fibroids should be a simple, well-tolerated and effective procedure and ideally accomplished in in only one surgical step.
Methods: Retrospective cohort single Centre study of 1244 women undergoing hysteroscopic myomectomy. Data analysis included patients' and the myomas characteristics. A multiple logistic regression was carried out in order to assess which variables were able to determine a multiple step procedure.
Results: 1090 myomas (87.62%) were completely resected in a single-step procedure (SS group) whereas a multiple-step procedure (MS group) was needed for the removal of 154 fibroids (12.38%). The mean size of myomas resected in the SS group was 22.83 ± 9.36 mm whereas fibroids of the MS group measured 29.67 ± 10.76 mm. The overall feasibility of hysteroscopic myomectomy in one surgical procedure was 88.28%. All hysteroscopic myomectomies of G0 fibroids were completed in a single step. The chance of success to accomplish the treatment in a single-step for G1 and G2 myomas were 88.59% and 82.55%, respectively. The multivariate analysis revealed an inverse correlation between age and multiple step procedures and size of myomas were all directly correlated to multiple step procedures.
Conclusion: The grading, the size of the myomas and the age of patients play a crucial role in completing the hysteroscopic myomectomy in a single step. Only the diameter greater than 3 cm in G2 myomas is correlated to a higher risk of a multiple procedure.

1. Introduction

With the advent of hysteroscopy, surgeons had the possibility to selectively remove intrauterine pathologies, avoiding a great number of hysterectomies. Operative hysteroscopy offered numerous advantages for both the patient and the surgeon [1].

Submucous myomas represent one of the main indications of operative hysteroscopy. Since 1976 when Neuwirth and Amin reported the first five cases of excision of submucous myomas [2], several techniques have been developed in order to render hysteroscopic myomectomy a safe and effective procedure [3].

Hysteroscopic resection of submucous fibroids should be a simple, well-tolerated and effective procedure [4]. It is known that the number and the size of myomas may influence the final surgical

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outcome, but it is the treatment of myometrial portion the main obstacle faced by surgeon [1,3,5], as long as it reduces the chance of achieving a complete resection in one surgical session. In order to improve the control of related symptoms as menorrhagia, complete resection of fibroids is desirable [3,6]. However, regardless of the intramural development of myoma, hysteroscopic myomectomy should be ideally accomplished in only one surgical step.

We have therefore analysed procedures where only single myomas had been removed in order to report the chance of completing the treatment in a single step, according to the size and intramural development of myomas.

2. Material and methods

We retrospectively reviewed the series of consecutive patients who underwent hysteroscopic myomectomy at the "Arbor Vitae" Centre for Endoscopic Gynecology between January 2003 and December 2010. Institutional Review Board approval was obtained for data collection.

Differently from a previous report, in which the main outcome analysed was the safety and efficacy of the cold loop technique and therefore only myomas with intramural development were collected [7], a new series of patients was selected with the following criteria.

2.1. Inclusion criteria

Only patients with histologic confirmation of a myoma were collected. Intramural development was catalogued in accordance with the classification of the European Society of Gynaecological Endoscopy: G0: completely endocavitary, pedunculated myoma, with no intramural extension; G1: submucous myoma with less than 50% intramural extension; G2: submucous myoma with more than 50% intramural extension [6].

All myomas (G0, G1 and G2) were considered, but, in order to reduce a potential confounding factor and better analyse the feasibility in a single procedure of hysteroscopic myomectomy, only patients with a single myoma were enrolled in the study.

2.2. Exclusion criteria

Absence of histologic confirmation of a myoma; presence of multiple myomas in the uterine cavity; a free myometrial margin (FMM) of 2 mm or lower.

Before being scheduled for hysteroscopic myomectomy, all patients in the database were managed following our Institutional protocol:

Ultrasonography and outpatient diagnostic hysteroscopy were performed in order to diagnose the presence of myomas and to evaluate the characteristics of myomas (number, grading and size) and to measure the FMM. The diagnosis was wrong only in 35 cases where an adenomyosis was hystologically detected and patients were excluded from the study. In case of myomas greater than 2 cm, three consecutive injections of gonadotropin-releasing hormone (GnRH) agonist (triptorelin 3.75 mg IM) were administered 28 days apart. Informed consent was obtained from all patients before the surgery.

In case of G0 myomas, hysteroscopic myomectomy was carried out by classical slicing using an electric loop powered by a 100 W monopolar current in pure cutting. The G1 and G2 myomas were removed by the cold loop technique, as described in previous reports [7]. All the procedures were performed by 4 surgeons with the same experience and skill level. A 9 mm resectoscope with 0° optical system (HOPKINSII® Karl Storz Tuttlingen, Germany) and 1.5% glycine as distension media were utilized to carry out hysteroscopic myomectomies.

In case of 1000 cc of distension media deficit or sodium concentration lower than 125 mEq/l, the procedure was interrupted and a second-step was scheduled to accomplish the hysteroscopic treatment.

Antibiotic prophylaxis was never administered except for specific indication (e.g. cardiac valvulopathies).

Characteristics of patients were collected. Size, grading and duration of surgery (from the introduction of the resectoscope in the uterine cavity until the end of the procedure) for each myoma were analysed according to the number of procedures needed to accomplish the treatment (single-step or multiple-step). Multivariate analysis was carried out in order to assess which variables were able to determine a multiple step procedure.

2.3. Statistical analysis

The Mann–Whitney test was used to compare ordinal and non-normally distributed continuous variables (deviation from Gaussian distribution was checked by using the Shapiro–Wilk test). Categorical data were analysed by a χ^2 test with Yate's correction. A multivariate logistic regression model was fit to the prediction of a hysteroscopic myomectomy in a single-step surgical procedure (coded as yes = 1 and no = 0), incorporating as explanatory variables all the variables that showed a p-value $\leq$0.25 in bivariate analysis (nota). The goodness of fit for logistic regression models was checked using the Hosmer and Lemeshow test. Statistical analyses were performed using IBMSPSS® version 22.0 (IBM Corp., Armonk, NY, USA, 2013). A two-sided p-value <0.05 was considered significant.

3. Results

A total of 1244 patients satisfied the above-mentioned criteria and were selected from our database.

The main indications for the surgery were menometrorrhagia, intermenstrual spotting, infertility and post-menopausal bleeding. Characteristics of patients are reported in Table 1. 1090 myomas (87.62%) were completely resected in a single-step procedure (SS group) whereas a multiple-step procedure (MS group) was needed for the removal of 154 fibroids (12.38%). Patients in SS group were significantly older than in MS group (p = 0.0001). A significant correlation with MS procedure was seen with a longer duration of surgery (p = 0.0001) and with GnRHa administration (OR 3.839; 95% CI 2.595–5.680; p = 0.0001).

Characteristics of myomas resected according to the grading, the size and the number of procedures needed to accomplish the treatment are summarized in Table 2. A total of 1409 procedures were performed in order to remove 1244 myomas. Among the MS group, one patient needed four procedures to accomplish the treatment while nine needed three. The mean size of myomas

Table 1
Characteristics of study groups.

	Single step	Multiple step	p
Patients	1090	154	–
Age (years)[b]	43.23 ± 8.35	40.16 ± 6.32	0.0001
Nulliparous. n(%)	670 (61.47)	104 (67.53)	0.172
Pluriparous. n(%)	420 (38.53)	50 (32.47)	
Previous cesarean section. n(%)	172 (15.77)	20 (12.98)	0.583
GnRH agonist therapy. n(%)	502 (46.05)	118 (76.62)	0.0001[a]
Lenght of procedure (min)[b]	13.74 ± 9.23	19.9 ± 15.82	0.0001

[a] O.R. 3.839 (2.595–5.680).
[b] Data are reported as mean ± SD.

Table 2
Characteristics of treated myomas and the chance of completing the treatment in a single step, according to the size and intramural development of myomas.

Patients (n)	Grading of myomas	Size group (mm)	Single step (n)	Size of myomas (mm)*	Multiple steps (n)	Size of myomas (mm)*	p	Procedure (n)	Number of resections to accomplish the treatment (ratio)		Chance of success to accomplish the treatment in single step (%)	
94	G0	≤20	94	17.14 ± 3.80	0	–	–	94	94/94	1	94/94	100
65		21–30	65	27.22 ± 2.48	0	–	–	65	65/65	1	65/65	100
20		31–40	20	37.30 ± 2.63	0	–	–	20	20/20	1	20/20	100
11		>40	11	55.27 ± 8.39	0	–	–	11	11/11	1	11/11	100
190		tot	190	24.92 ± 10.74	0	–	–	190	190/190	1	190/190	100
395	G1	≤20	371	16.01 ± 4.28	24	15.25 ± 3.71	0.211	423	423/395	1.07	395/423	93.33
216		21–30	185	26.82 ± 2.41	31	27.65 ± 2.49	0.101	248	248/216	1.14	216/248	87.09
62		31–40	42	36.62 ± 2.16	20	36.15 ± 2.08	0.694	84	84/62	1.35	62/84	73.8
26		>40	18	50.72 ± 4.25	8	50.38 ± 5.55	0.807	34	34/26	1.3	26/34	76.47
699		tot	616	21.68 ± 9	83	28.3 ± 11.06	0.0001	789	789/699	1.12	699/789	88.59
135	G2	≤20	123	16.14 ± 4.37	12	16.67 ± 3.89	0.771	147	147/135	1.08	135/147	91.83
151		21–30	126	27.14 ± 2.50	25	27.40 ± 2.41	0.536	177	177/151	1.17	151/177	85.31
49		31–40	23	36.13 ± 1.93	26	35.77 ± 2.02	0.351	77	77/49	1.57	49/77	63.63
20		>40	12	47.08 ± 3.34	8	50.63 ± 8.28	0.305	29	29/20	1.45	20/29	68.96
355		tot	284	23.95 ± 8.8	71	31.27 ± 10.24	0.0001	430	430/355	1.21	355/430	82.55
Total												
1244			1090	22.83 ± 9.36	154	29.67 ± 10.76	0.0001	1409	1409/1244	1.13	1244/1409	88.28

*Data are reported as mean ± SD.

resected in a single-step procedure was 22.83 ± 9.36 mm whereas fibroids that needed a multiple step procedure measured 29.67 ± 10.76 mm. Regardless the size, all hysteroscopic myomectomies of G0 fibroids were completed in a single step. The chance of success to accomplish the treatment in a single-step for G1 and G2 myomas was 88.59% and 82.55%, respectively. The overall feasibility of hysteroscopic myomectomy in one surgical procedure was 88.28% (Figs. 1 and 2).

Neither clinical intravasation syndrome nor uterine perforation with thermal loop occurred in our series. Three uterine perforations in SS group were recorded, one of which occurred during the enucleation of myoma with the cold loop and two with Hegar dilators. Bowel injury was avoided in all cases and the patients were discharged the following day. Two incomplete perforation with Hegars occurred in the same group. One case of postsurgical hemorrhage successfully treated with uterotonics drugs was registered in MS group. The multivariate analysis revealed an inverse correlation between age and multiple step procedures (O.R. 1.544; 95% CI 0.928–0.982; p = 0.001), whereas grading (O.R. 2.376; 95% CI 1.772–3.186; p = 0.0001) and size of myomas (O.R. 1.052; 95% CI 1.028–1.077; p = 0.0001) were all directly correlated to multiple step procedures (Table 3).

4. Discussion

The aim of this retrospective cohort study was to analyse the feasibility of performing the hysteroscopic myomectomy in only one-surgical procedure, according to the grading and the size of myoma. In this way we would like to offer a practical report and a landmark to all surgeons, in performing hysteroscopic myomectomy. Moreover, differently from previous studies [6,8], in order to avoid possible bias, only patients with single myomas were considered.

In our series, the overall chance to accomplish the treatment in a single-step procedure was 88.28%. Due to the lack of the intramural component of myomas, which minimizes the risk of intravasation, all G0 myomas were resected in only one surgical procedure by classical slicing.

Concerning G1 and G2 myomas, the size of the vessels of the uterine wall progressively increases deepening into the myometrium with a higher risk of intravasation [9]. This issue could explain the risk of a multiple procedure associated to G2 myomas. In our series, all myomas with intramural development were treated with the cold loop technique. Recently the cold loop

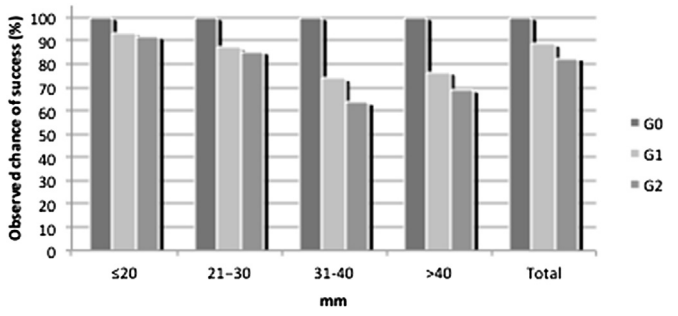

Fig. 1. Observed chance of success (%) according to the grading (G0 – G1 – G2) and size (mm) of myomas.

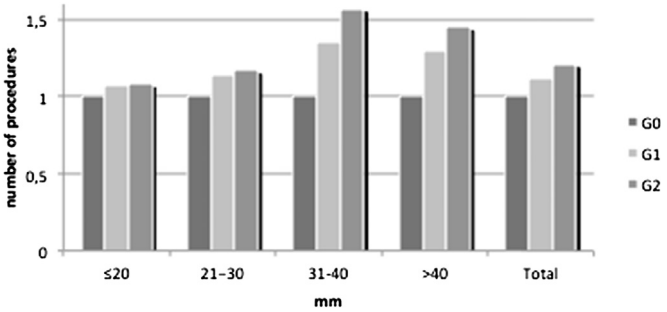

Fig. 2. Number of procedures needed to achieve a complete resection according to the grading (G0 – G1– G2) and size (mm) of myomas.

Table 3
Mutivariate analysis considering a multiple step procedure as the dependent variable.

	B	p	OR	95% C.I.	
				Lower	Upper
Grading	0.865	0.0001	2.376	1.772	3.186
Size	0.051	0.0001	1.052	1.028	1.077
GnRHa	0.435	0.121	1.544	0.891	2.677
Age	−0.046	0.001	0.955	0.928	0.982
Parity	−0.053	0.802	0.949	0.628	1.432

hysteroscopic myomectomy was described as a safe and effective procedure for the removal of submucous myomas with intramural development, respecting the anatomical and functional integrity of myometrium [7,10]. Our findings show a high probability of success in one surgical step (88.59% and 82.55% respectively) even in case of G1 and G2 myomas.

The cold loop myomectomy was developed in order to prevent the thermal damage of the healthy myometrium surrounding the myoma. The mechanical enucleation of the intramural part of myoma offers indisputable advantages in terms of safety and efficacy compared to the classical slicing, preventing serious complications as thermal loop uterine perforation. Moreover, as reported in our previous reports [7,10], our procedure prevents electrical energy (of either type, monopolar or bipolar) from being in contact with the myometrium and inducing thermic damage, which may increase the formation of intrauterine synechiae. In this context, the type of electrical energy used during the slicing phase, in which the only the intracavitary component of myoma is resected, appears of minor importance. Nevertheless, several authors support the use of bipolar energy because may better prevent the intravasation syndrome (known as TURP syndrome) [11,12]. We believe that surgical complications related to the hysteroscopic myomectomy could be avoided following a rigorous intraoperative control of distension medium balance (of either type, saline solution or glycine) [13] and sodium concentration in case of monopolar energy is used.

As previously reported by Wamsteker [6] in 1993, the G2 myomas were the most difficult fibroids to treat, especially when greater than 30 mm. Moreover, in order to assess the complexity of hysteroscopic myomectomy, it should be taken in consideration the grading together with the size of myoma. As recently stressed by Emanuel [1], with an increase in myoma diameter the volume increases much faster. A diameter of 2 cm is equivalent to 4.18 cm^3 in volume, 3 cm−14.14 cm^3. Indeed, size and grading of myomas were significantly correlated to the feasibility of hysteroscopic myomectomy in a one-step procedure. The multivariate analysis revealed a significant correlation with the size and the grading of myomas. Our findings were consistent with the results previously reported by Murakami et al. [8]. Indeed, in a study with the aim to analyse variables for successful one-step hysteroscopic myomectomy in a series of submucous myomas, the Authors reported a significant association between FMM, size and grading of myomas and one-step procedure. Moreover, differently from Murakami et al., in order to eliminate the bias offered by multiple myomas, in our cohort only patients with a single myoma were selected.

An inverse correlation was shown between the age of patients and a multiple step procedure. A reduced uterine vascularization, detectable in women 40 years or older, could offer a protection to intravasation, explaining this finding [14,15,16].

It is noteworthy that in this series no uterine perforation with thermal loop or intravasation syndrome was recorded. Avoiding multiple procedures allows to reduce the risk of intraoperative complications and greatly improves patients' satisfaction.

The procedures were performed by four different surgeons and this may represent a limitation of this retrospective study. Nevertheless, it should be highlighted that those physicians have been working in the same Institution since several years, with the same experience and skill level. We speculate that results arising from this study may demonstrate not only the efficacy but also the repeatability of hysteroscopic myomectomy for treating submucous myomas.

5. Conclusions

Our results seem to confirm that hysteroscopic myomectomy is a valid option for treating submucous myomas with a high possibility to accomplish the treatment in a one-surgical procedure. All G0 myomas can be removed in only one surgical procedure, independently on the size. The grading and the size of the myomas and the age of patients play a crucial role in completing the procedure in a single step. Only the diameter greater than 3 cm in G2 myomas is correlated to a higher risk of a multiple procedure.

The development of new techniques of hysteroscopic myomectomy in the last decades, have allowed to reach an high success rate and a better performance with the possibility to completely remove, in a single step, myomas which were previously considered not treatable. Moreover, the improvement of the surgeons has reduced the number of intraoperative complications rendering the hysteroscopic myomectomy a safe and effective procedure.

Conflicts of interest

Ivan Mazzon reports non-financial support from STORZ, Tuttlingen, Germany, outside the submitted work.

Alessandro Favilli, Mario Grasso, Stefano Horvath, Vittorio Bini, Gian Carlo Di Renzo and Sandro Gerli report no conflict of interest.

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None.

Ethical approval

Institutional Review Board approval was obtained for data collection.

Author contribution

Ivan Mazzon: conception and design of the study, interpretation of data, final approval of the version to be submitted.

Alessandro Favilli: conception and design of the study, interpretation of data, drafting the article.

Mario Grasso: acquisition of data, or analysis and interpretation of data.

Stefano Horvath: acquisition of data, or analysis and interpretation of data.

Vittorio Bini: acquisition of data, or analysis and interpretation of data.

Gian Carlo Di Renzo: revising the article critically for important intellectual content.

Sandro Gerli: conception and design of the study, interpretation of data, final approval of the version to be submitted.

Guarantor

Ivan Mazzon.
Alessandro Favilli.
Sandro Gerli.

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