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Comparative Study between Endometrial Resection and Electrocoagulation in Patients with Abnormal Uterine Bleeding

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Abstract

Objective: To compare clinical outcomes between two first-generation endometrial ablation techniques. **Design:** Prospective comparative coorte. **Setting:** Tertiary public hospital, university teaching center. Seventy-three patients with abnormal uterine bleeding unresponsive to clinical treatment submitted to endometrial ablation from October 2011 to September 2013. **Methods and Main Outcome Measures:** Patients were assigned to either monopolar U-shaped electrode resection with rollerball electrocoagulation (group A, n = 36) or rollerball electrocoagulation alone (group B, n = 37). Mean follow-up length was 359 (280 - 751) and 370 days (305 - 766) in groups A and B, respectively. Bleeding pattern, associated symptoms, failure/success rates were assessed 30, 90, 180 and 360 days post-procedure. **Findings:** Patient characteristics were similar in both groups ($P \geq 0.05$). Surgery duration (mean of 48.5 [±12.0] vs. 31.9 [±5.6] min, $P < 0.001$) and medium distention use (5.700 mL vs. 3.500 mL, $P < 0.01$) were decreased in group B. Post-ablation clinical improvement was considerable in both groups. Vaginal discharge incidence after the procedure was lower in group B (30.5% vs. 8.1%, $P < 0.05$). Hysterectomy rate was 9.6%. Overall success rate was 86.1% and 88.1% in groups A and B, respectively. **Conclusions:** Endometrial ablation using rollerball electrocoagulation alone may be considered safer than resection with rollerball electrocoagulation, which requires shorter surgical time and less distention medium, and is associated with lower postoperative vaginal discharge incidence. Success rate did not

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statistically differ between groups, but study parameters in absolute values and percents were superior in group B.

Keywords

Uterine Bleeding, Hysteroscopy, Surgical Procedures, Endometrial Ablation Techniques, Patient Satisfaction

1. Introduction

Abnormal uterine bleeding (AUB) is defined as any deviation from the normal menstrual cycle pattern including changes in the frequency, duration or volume of blood flow [1] [2]. Excessive menstrual blood loss, which can be accompanied by other symptoms, very often interferes with a woman's physical and mental well-being bringing limitations to daily life activities and changes in social behavior that might reduce health-related quality of life—HRQOL [3] [4] [5].

AUB affects one woman in five, and most commonly occurs around menarche and menopause [3] [5] [6]. In the general population, AUB prevalence is estimated at 11% - 13% and increases with age, reaching 24% in women aged 36 - 40 years [6] [7]. The management for AUB has been widely investigated over the past years with the goals of stopping bleeding or promoting regular menstrual cycles with adequate flow volume, taking into account the patient's desire for future fertility [1]. Initial medical therapy includes the use of non-steroidal anti-inflammatory drugs (NSAIDs), antifibrinolytic drugs, combination oral contraceptives (COC) or oral progestins, levonorgestrel intrauterine system (LNG-IUS), and hormone replacement therapy during climacterium [6] [8]. However, when medications are not effective, surgical treatment might be indicated.

In the past, the first option was curettage, which has a reasonable diagnostic performance, but is of little therapeutic value. The final and definitive treatment is hysterectomy, especially in women without reproductive desire. Over the last two decades, diagnostic tools have significantly advanced and new therapy modalities have been developed. These new procedures are less invasive and offer the possibility of preserving the uterus and avoiding the morbidity related to hysterectomy, which varies between 5.2% to 9.4%, reaching up to 40% in some series [9] [10] [11]. One of the alternatives to hysterectomy is endometrial ablation, which destroys the endometrium using different sources of energy [12].

The first-generation endometrial ablation techniques include endometrial resection, rollerball electrocoagulation, and Nd:YAG laser ablation [13]. Second-generation procedures are less invasive and easy to perform, but are performed without direct hysteroscopic visualization [14]. They include the use of thermal energy, cryosurgery and microwave energy. Patient satisfaction rate after endometrial ablation ranges from about 87% to 93% [15]. According to follow-up studies, satisfaction rate after endometrial ablation is 86.4% and 80.6% at 2.5 and 5 years, respectively [15] [16]. Moreover, endometrial ablation has been demon-

strated to improve quality of life even among obese women (BMI > 30 kg/m^2) and those with coagulopathies [17]-[22]. Nonetheless, between 9.3% and 13.6% of the patients undergoing endometrial ablation may need retreatment consisting from medical therapy or repeat endometrial ablation to hysterectomy, at intervals ranging from 1 to 8 years [23] [24] [25] [26].

Although a large number of studies have compared first-generation with second-generation ablation techniques, comparisons between the first-generation procedures endometrial resection and electrocoagulation using rollerball alone were performed by a limited number of studies [13] [27] [28] [29] [30]. The type of electrical current used in the procedure may interfere with surgical outcome as the currents used in endometrial resection and rollerball coagulation differ in maximum peak tension and modulation [31]. Thus, this study consisted of a prospective comparative analysis between clinical outcomes of two different first-generation techniques in AUB patients unresponsive to medical therapy.

2. Material and Methods

This prospective analytic study included AUB patients who underwent endometrial ablation at the Gynecological Endoscopy and Family Planning Sector of Botucatu Medical School, São Paulo State University—UNESP, from October 2011 to September 2013. The study was approved by the institutional Committee of Research Ethics in 2011 September 5, process number 3966-2011, and written informed consent was obtained from all participants.

Eligibility criteria for endometrial ablation were as follows: abnormal uterine bleeding unresponsive to medical treatment for at least 12 months, absence of pregnancy desire; normal oncologic colpocytology; no genital infection on physical examination, having undergone transvaginal ultrasonographic examination and office hysteroscopy with endometrial biopsy to rule out malignant processes and hysterometric measurement ≤ 12 cm. The presence of benign conditions such as endometrial polyps and submucosal fibroids < 2 cm did not contraindicated the inclusion in the study [7]. Patients with cardiovascular problems as well as those who refused to participate were excluded. During the study period 80 women adequately fulfilled the eligibility criteria and were selected for screening. After proper counseling about the purposes of research and interventions to be performed, only 73 women agreed to participate and were included in the evaluation.

The procedure was performed under spinal anesthesia and no endometrial preparation prior to surgery was carried out. Antisepsis was performed using 10% povidone-iodine in aqueous solution. Cervical dilatation to Hegar number 9 was performed for the easy passage of the resectoscope with no leaking of the distention medium through the cervix. Depending on availability, either 3% sorbitol or 5% mannitol was used as distention medium. Prophylactic antibiotic therapy with cefazolin 2 grams I.V. was administered 30 minutes before surgery according to our operative room routine.

With the patient already in the operating room a sealed envelope containing

one of the two techniques surveyed and previously prepared without the prior knowledge of the medical team was opened by the surgeon in order to select the type of surgery to be performed. Ablations were performed using a monopolar Karl Storz 26040 SL gynecologic continuous flow resectoscope with 30˚ Storz Hopkins II optic, U-shaped cutting loop and rollerball 5 mm. A Hamou Endomat 263310 20 (Karl Storz, Tuttlingen, Germany) was used to keep pressure similar to average arterial pressure and constant flow at 400 mL/min. A WEM SS-501S electrosurgical generator (Covidien, Dublin, Ireland) with the power of electrodes adjusted to 110 volts, 100 W of intensity for cutting and 60 W for coagulation, blend 1 monopolar current, was used in group A. In group B, a 60 W coagulation fulguration current was applied.

The rollerball electrode was used to coagulate around the tubal ostia and margin of the inner cervical os, determined as the inferior resection limit. The electrode was then switched to the U-shaped loop, set at the same current as in group A. The laterals were removed from the tubal ostia to the isthmus, and the posterior and anterior walls were resected. Hemostasis was attained moving a rollerball electrode set at coagulation current over the entire uterine cavity and bleeding sites. In group B, a rollerball electrode was used to cauterize the laterals, from the tubal ostia to the isthmus, and the posterior and anterior walls. Intrauterine lesions such as polyps and submucosal fibroids found in group B patients were previously removed using the U-shaped loop electrode with a cutting current of 100 W, blend 1. Patients stayed in hospital for 12 - 24 hours after surgery for observation of bleeding and recovery from anesthesia, and were instructed to resume normal daily activities after 3 days. Based on each patient's menstrual calendar, menstrual pattern was assessed over a mean period of 12 months (30, 90, 180, and 360 days) after the surgical procedure.

Urinary tract infection was considered to be present if both urinalysis and urine culture were positive in patients with clinical signs suggestive of urinary infection within 30 days after surgery. Surgical site infection was diagnosed in the presence of lower abdominal pain and/or uterine or cervical tenderness on bimanual examination performed 30 days after the procedure. Any vaginal discharge with positive Whiff test and vaginal pH change was also highlighted in the first postoperative revaluation. Satisfaction/success was defined as reduced or infrequent menstrual flow, absence of menstruation and/or normal menstrual pattern, as reported by the patient. Dissatisfaction/failure was characterized as abnormal uterine bleeding recurrence or need for further surgical treatment (endometrial re-ablation or hysterectomy) during the follow-up period.

For data analysis, measures of locations and variability were calculated. Mean, standard deviation, median and minimum-maximum values for quantitative variables, and absolute frequency and percentage for qualitative variables were estimated. Qualitative variables were analyzed using the Goodman test for contrast between multinomial populations. Normally distributed quantitative variables were compared using the Student *t*-test, and non-normally distributed variables were compared using the Mann-Whitney nonparametric test supplemented by

the test of Dunn or the test of Bonferroni for multiple comparisons in independent groups [32] [33] [34] [35]. Data analysis was performed using commercially available software (SPSS for Windows, version 21.0; SPSS, Inc., Chicago, IL), with significance level set at 5%.

3. Results

During the study period, 73 endometrial ablations were performed. Participants were submitted to endometrial resection + rollerball coagulation (group A, n = 36) or rollerball electrocoagulation alone (group B, n = 37). Mean follow-up length was 359 days (280 - 751) in group A and 370 days (305 - 766) in group B. Clinical/epidemiological characteristics were similar between groups, except for a higher mean number of children in group B (Table 1).

No significant differences between groups were observed regarding ultrasonographic variables and hysterometric measures routinely taken after diagnostic hysteroscopy (Table 2). The incidence of hysteroscopic findings was similar in both groups ($P \geq 0.05$). To estimate the likelihood of successful hysteroscopic fibroid removal, the classification system described by Lasmar *et al.* was used, taking into account fibroid size, topography, extension of the base in relation to the uterine wall, penetration into the myometrium, and location on lateral walls (STEPW) [36]. Lasmar score ranged from 2 to 6 in group A, and from zero to 6 in group B (Table 2).

Table 1. Clinical and epidemiological data on the 73 patients who underwent either endometrectomy with rollerball coagulation (Group A, 36 patients) or rollerball coagulation alone (Group B, 37 patients).

	Group A	Group B	P value
Age[a]	45 (34 - 54)	44 (33 - 55)	0.54
Gestation[a]	3 (0 - 6)	3 (1 - 11)	0.89
Parity[a]	**2 (0 - 6)**	**3 (1 - 8)**	**0.04**
C-section[a]	1 (0 - 4)	1 (0 - 4)	0.71
Abortion[a]	0 (0 - 3)	0 (0 - 3)	0.91
BMI[b]	28.84 (±5.72)	28.64 (±5.73)	0.89
Tubal ligation[c]	17 (47.2)	20 (54)	0.05
Arterial hypertension[c]	12 (33.3)	20 (54)	0.05
Diabetes mellitus[c]	3 (8.3)	4 (10.8)	0.05
Hypothyroidism[c]	4 (11.1)	2 (5.4)	0.05
Dyslipidemia[c]	5 (13.9)	2 (5.4)	0.05
Coagulopathy[c]	4 (11.1)	3 (8.1)	0.05
Smoking[c]	5 (13.9)	10 (27)	0.05

[a]**Mann-Whitney non-parametric test.** Mean value; minimum and maximum within parentheses; [b]**Student's t test for independent groups.** Mean values; standard deviation within parentheses; [c]**Goodman test.** Absolute number; percent within parentheses; **BMI:** body mass index.

Table 2. Analysis of transvaginal ultrasonography and diagnostic hysteroscopy parameters between endometrectomy with rollerball coagulation (Group A, 36 patients) and rollerball coagulation alone (Group B, 37 patients).

	Group A	Group B	P value
Longitudinal uterinal measure in cm (TVUS)[a]	9.06 (±1.09)	9.11 (±0.93)	0.86
Uterine volume in cm^3 (TVUS)[a]	152.71 (±61.3)	148.44 (±56.04)	0.76
Fibroid (TVUS)[c]	17 (47.2)	18 (48.6)	0.05
Submucous fibroid (TVUS)[3]	9 (25)	5 (13.5)	0.05
Hysterometry (cm)[a]	8.33 (±1.12)	8.5 (±1.26)	0.55
Endometrial polyp (OH)[b]	14 (38.9)	18 (48.6)	0.05
Polyp size in mm (OH)[a]	19.25 (±12.26)	14.2 (±8.6)	0.26
Number of polyps (OH)[b]	1 (0 - 7)	1 (0 - 6)	0.71
Endocervical polyp (OH)[c]	1 (2.8)	4 (10.8)	0.05
Submucous fibroid (OH)[c]	5 (13.9)	6 (16.2)	0.05
Fibroid size in cm (OH)[c]	2 (1.5 - 7)	1.5 (0.8 - 4)	0.05
Lasmar *et al.* score[c]	3 (2 - 6)	4 (0 - 6)	0.05

[a]**Student's t test for independent groups.** Mean; standard deviation within parentheses; [b]**Mann-Whitney non-parametric test.** Absolute values; percent within parentheses; [c]**Goodman test.** Absolute number; percent within parentheses; **TVUS:** Transvaginal ultrasonography; **OH:** Office hysteroscopy.

Surgery duration (group A = 48.5 min. [±12.0] and group B = 31.9 min [±5.6], $P < 0.001$) was shorter and the volume of distention medium used during surgery (group A = 5.700 mL [2.000 - 9.000] and group B = 3.500 mL [1.250 - 12.000], $P < 0.01$) was lower in group B. No difference in fluid deficit was noted between groups (Table 3). At the time of surgery, endometrial pattern was similar in both groups, with 27.8% of the patients in group A, and 35.1% of those in group B having undergone preoperative uterine curettage due to exuberant secretory endometrium.

Histopathological examination revealed statistical similarities between groups (Table 3). Whereas 5 patients from group A (13.9%) had endometrial hyperplasia without atypia, 3 patients in group B (8.1%), also diagnosed with endometrial polyp, showed endometrial hyperplasia with atypia present in one case (2.7%) ($P \geq 0.05$). This patient later underwent hysterectomy, which confirmed the presence of a lesion restricted to the endometrium. Adenomyosis, associated with endometrial polyp, was found in only 3 patients (8.1%) from group B. There were no cases of surgical site infection and the incidence of vaginal discharge after procedure was lower in group B (30.5% vs. 8.1%, $P < 0.05$) (Table 3).

The revaluation rate was 86.1% in the first visit after the procedure (T1 = 38 days [26 - 49]), 75% in the second visit (T2 = 98 days [75 - 126]), 80.5% (T3 = 189 days [180 - 427]) and 97.2% (T4 = 359 days [280 - 751]) in the third and fourth visits in the group A whereas in group B was 83.8% (T1 = 38 days [26 - 52]), 67.6% (T2 = 98 days [84 - 168]), 73% (T3 = 193 days [144 - 487]) and

Table 3. Surgical procedure data in patients undergoing endometrectomy with rollerball coagulation (Group A, 36 patients) and rollerball coagulation alone (Group B, 37 patients).

	Group A	Group B	P value
Time (minutes)[a1]	**48.5 (±12.0)**	**31.9 (±5.6)**	**<0.001**
HB/In (mL)[a2]	**5700 (2000 - 9000)**	**3.500 (1.250 - 12.000)**	**<0.01**
HB/Retained (mL)[b]	300 (0 - 3000)	200 (0 - 600)	0.23
Proliferative endometrium (SH)[c]	12 (33.3)	15 (40.5)	0.05
Secretory endometrium (SH)[c]	22 (61.1)	17 (45.9)	0.05
Uterine curettage (before SH)[c]	10 (27.8)	13 (35.1)	0.05
Proliferative endometrium (AP)[c]	10 (27.8)	4 (10.8)	0.05
Secretory endometrium (AP)[c]	16 (44.4)	10 (27)	0.05
Atrophic endometrium (AP)[c]	2 (5.6)	3 (8.1)	0.05
Polyp (AP)[c]	14 (38.9)	20 (54)	0.05
Poly size in mm (AP)[a1]	18.75 (±11.57)	18.07 (±9.86)	0.88
Fibroid (AP)[c]	4 (11.1)	9 (24.3)	0.05
Fibroid size in cm (AP)[a1]	3.33 (±2)	3.42 (±1.39)	0.93
Hyperplasia (AP)[c]	5 (13.9)	3 (8.1)	0.05
Atypic hyperplasia (AP)[c]	0	1 (2.7)	0.05
Polyp hyperplasia (AP)[c]	0	2 (5.4)	0.05
Adenomyosis (AP)[c]	0	3 (8.1)	0.05
Urinary tract infection (UTI)[c]	1 (2.8)	2 (5.4)	0.05
Vaginal discharge[c]	**11 (30.5)**	**3 (8.1)**	**<0.05**

[a1]**Student's t test for independent groups.** Mean; standard deviation within parentheses; [a2]**Student's t test for independent groups.** Median; minimum and maximum values within parentheses; [b]**Mann-Whitney non-parametric test.** Median; minimum and maximum values within parentheses; [c]**Goodman test. Absolute number; percent within parentheses**; **HB:** Hydric balance; **SH:** surgical hysteroscopy; **AP:** Anatomopathology.

89.2% (T4 = 370 days [305 - 766]), respectively. After endometrial ablation, considerable clinical improvement was observed in both groups, with the number of days bleeding dropping from 9 (3 - 20) to 2 (0 - 10) in group A, and from 9 (5 - 39) to 1 day (0 - 25) in group B ($P < 0.01$) by the end of follow-up. Reductions were also observed in the number of pads used on the day of heaviest menstrual bleeding (from 8 [3 - 16] to 1 [0 - 8] in group A, and from 8 [4 - 18] to 1 [0 - 7] in group B, $P < 0.01$), and the number of pads used throughout the menstrual cycle (from 40 [12; 60] to 10 [0 - 32] in group A, and from 38 [4 - 50] to 4 [0 - 12] in group B, $P < 0.01$) (Table 4). By the end of follow-up, no differences were observed between groups regarding the menstrual pattern achieved, such as absence of menstruation (40% vs. 51.5%), reduced bleeding or infrequent menstruation (42.9 vs. 39.4%), and normal menstrual cycle (8.6% vs. 9.1%) ($P \geq 0.05$).

Table 4. Pre- and post-procedure clinical parameters in group A (36 patients) and group B (37 patients).

Time of assessment	GROUP A					GROUP B					P
	T0	T1 38˚ PO (26 - 49) *n* = 31	T2 98˚ PO (75 - 126) *n* = 27	T3 189˚ PO (180 - 427) *n* = 29	T4 359˚ PO (280 - 751) *n* = 35	T0	T1 38˚ PO (26 - 52) *n* = 31	T2 98˚ PO (84 - 168) *n* = 25	T3 193˚ PO (144 - 487) *n* = 27	T4 370˚ PO (305 - 766) *n* = 33	
Prolonged flow[a]	21 (58.3)	4 (12.9)	2 (7.4)	2 (6.9)	2 (5.7)	26 (70.3)	1 (3.2)	3 (12)	2 (7.4)	1 (3)	0.05
Increased volume[a]	36 (100)	2 (6.4)	2 (7.4)	4 (13.8)	2 (5.7)	34 (91.9)	1 (3.2)	4 (16)	3 (11.1)	2 (6.1)	0.05
Intermenstrual bleeding[a]	4 (11.1)	1 (3.2)	1 (3.7)	1 (3.4)	0	7 (18.9)	0	2 (8)	1 (3.7)	0	0.05
Spotting[a]	1 (2.8)	8 (25.8)	1 (3.7)	0	3 (8.6)	2 (5.4)	4 (12.9)	2 (8)	1 (3.7)	0	0.05
Increased menstrual frequency[a]	11 (30.6)	2 (6.4)	0	1 (3.4)	0	9 (24.3)	0	0	0	0	0.05
Absence of menstruation[a]		16 (51.6)	8 (29.6)	11 (37.9)	14 (40)		15 (48.4)	9 (36)	12 (44.4)	17 (51.5)	0.05
Reduced volume/Infrequent menstruation[a]		4 (12.9)	9 (33.3)	13 (44.8)	15 (42.9)		6 (19.3)	10 (40)	9 (33.3)	13 (39.4)	0.05
Normal menstruation[a]		3 (9.7)	5 (18.5)	1 (3.4)	3 (8.6)		6 (19.3)	2 (8)	3 (11.1)	3 (9.1)	0.05
Dysmenorrhea[a]	14 (38.9)	1 (3.2)	4 (14.8)	6 (20.7)	4 (11.4)	10 (27)	0	2 (8)	5 (18.5)	2 (6.1)	0.05
Pelvic pain[a]	1 (2.8)	0	1 (3.7)	2 (6.9)	0	1 (2.7)	1 (3.2)	1 (4)	2 (7.4)	3 (9.1)	0.05
Use of medication[a]*			5 (18.5)	7 (24.1)	4 (11.4)			5 (20)	5 (18.5)	5 (15.1)	0.05
Hysterectomy[a]	0	0	0	1 (3.4)	2 (5.7)	2 (5.4)	0	0	1 (3.7)	1 (3)	0.05
Endometrial reablation[a]	0	0	0	0	0	0	0	0	1 (3.7)	0	0.05
Days bleeding[b]	9 (3 - 20)	1 (0 - 36)	3 (0 - 15)	3 (0 - 15)	2 (0 - 10)	9 (5 - 39)	0 (0 - 37)	3 (0 - 25)	3 (0 - 30)	1 (0 - 25)	0.05
Pads on the day of heaviest flow[b]	8 (3 - 16)	2 (0 - 15)	2 (0 - 14)	1 (0 - 22)	1 (0 - 8)	8 (4 - 18)	0 (0 - 7)	2 (0 - 14)	1 (0 - 7)	1 (0 - 7)	0.05
Pads throughout menstruation[b]	40 (12 - 60)	17 (0 - 41)	13 (0 - 38)	9 (0 - 35)	10 (0 - 32)	38 (4 - 50)	5 (0 - 22)	5 (0 - 20)	2 (0 - 30)	4 (0 - 12)	0.05

[a]**Goodman test. Absolute number; percent within parentheses**; [b]**Non-parametric repeated measures anova in independent groups followed by the Dunn test.** Median, minimum and maximum within parentheses; *Non-hormonal anti-inflammatory agent (NHAA), tranexamic acid, combination oral contraceptives or oral progestins; **Flow duration (d)—prolonged** > 8 days; **Flow volume (mL)—increased** > 80 mL; **Increased menstrual frequency:** < 24 days; **Reduced volume/Infrequent menstruation:** < 4.5 days/> 38 days; **Normal menstruation:** 24 - 38 days duration; variation of 2 - 20 days per menstrual cycle in 12 months; flow duration of 4.5 - 8 days; volume of 5 - 80 mL (Munro *et al.*, 2012); **T:** Time elapsed; **PO:** Postoperative.

Seven patients (9.6%) underwent hysterectomy, 3 in group A, and 4 in group B. Of the 4 group B patients, 2 (5.4%) underwent hysterectomy at the time of ablation due to technical difficulties and intraoperative bleeding. The other 2 patients from group B, and the 3 patients from group A underwent hysterectomy during the follow-up period, at least 181 days after the procedure, due to persistent AUB, post-ablation incapacitating dysmenorrhea and/or pelvic pain. In only 1 case from group B, endometrial re-ablation was performed after 144 days due to persistent AUB (Table 4).

Hemoglobin levels significantly improved in both groups, increasing from 12.72 g/dL (±1.96) to 14.09 g/dL (±1.15) ($P < 0.01$) in group A, and from 12.59 g/dL (±1.6) to 13.62 g/dL (±0.82) ($P < 0.01$) in group B, on days 189 (180 - 427) and 193 (144 - 487), respectively. However, there were no differences between pre- and post-procedure hematocrit levels between groups ($P \geq 0.05$). One group B patient, who had a history of pulmonary thrombosis, had to stay longer in hospital due to postoperative acute deep vein thrombosis of a lower limb. Additionally, an obese patient (BMI = 35 kg/m^2) from group A, who underwent ablation combined with myomectomy, had water intoxication. The rate of satisfaction/success was 86.1% in group A and 88.6% in group B, with no significant difference between groups ($P \geq 0.05$).

4. Discussion

Endometrial ablation was first performed by Goldrath and colleagues in 1981. However, the efficacy of the procedure was established in 1983 by De Cherney and Polan, who reported that of 11 patients treated with ablation, 6 remained amenorrheic for a sustained period [37] [38]. The technique of endometrial resection includes removal of the functional and basal layers of the endometrium, as well as underlying 2 - 3 mm myometrium. Predictive factors of successful endometrial ablation, defined as reduction or absence of menstrual flow, include age older than 40 - 45 years and uterus with a volume under 200 cm^3 without intramural fibroid. In contrast, history of menstrual pain, adenomyosis, tubal ligation (association with post ablation tubal ligation syndrome), and parity greater than five are associated with failure [23] [39].

Endometrial ablation success rate has been reported to be around 80% - 90% [7] [39]. Shavell *et al.* found that, through five years of follow-up, hysterectomy was performed subsequently to endometrial ablation in 13.4% of the cases, primarily due to persistent bleeding and pelvic pain [24]. Longinotti *et al.*, in 8-year follow-up of 754 women, reported a 26% probability of hysterectomy subsequent to endometrial ablation, with pelvic pain being the main reason for the procedure in 22% of the cases [25]. According to the literature, reduced bleeding or infrequent menstruation is achieved in 48% - 60%, absence of menstruation in 20% - 48%, and normal menstrual pattern in 2% - 20% of the cases, while failure occurs in 2% - 11% [13] [16] [37] [39] [40].

In our study, there was no significant difference in menstrual pattern between groups 30, 90 and 180 days after endometrial ablation. By the end of the study period, no differences were observed between groups regarding menstrual absence (40% vs. 51.5%), reduced bleeding or infrequent menstruation (42.9% vs. 39.4%), and normal menstrual pattern (8.6% vs. 9.1%), in agreement with previous reports.

The rate of unsuccessful procedures/failure obtained in this study is also in line with the literature [37] [39] [40] [41]. Failure rate was 13.9% in group A, and 11.4% in group B, due to need of surgical re-approach and/or persistent abnormal uterine bleeding (no statistical difference between groups). Intraopera-

tively, 2 patients from group B (5.4%), who were undergoing endometrial ablation combined with myomectomy, required switch to hysterectomy because of technical difficulties and heavy intraoperative bleeding.

During postoperative follow-up, 5 patients (3 from group A and 2 from group B) underwent hysterectomy, and 1 patient from group B had an endometrial reablation. The reasons for hysterectomy were persistent AUB and incapacitating dysmenorrhea in the 3 patients from group A, and persistent severe pelvic pain in both patients from group B. Endometrial reablation was performed in one group B patient due to persistent heavy menstrual bleeding [7]. The procedure was followed by improved clinical condition and patient satisfaction.

Five patients from group A and 2 patients from group B underwent endometrial ablation combined with polypectomy [7]. Histopathological examination showed simple hyperplasia with no atypia in the polyp. Therefore, they were clinically treated with medroxyprogesterone for an initial period of 6 months, and are still being followed up [42]. In the only case where histopathological examination revealed atypical complex hyperplasia, hysterectomy was performed and the patient's condition has evolved satisfactorily since then.

The patient with a history of pulmonary thromboembolism (group B) had to stay in hospital for longer. Despite adequate preoperative preparation, she had acute deep vein thrombosis of a lower limb. However, her condition evolved extremely well and she was discharged 13 days later with absent menstruation and still on warfarin. Consistently with the literature, the only case of water intoxication was seen in an obese patient undergoing endometrial ablation and myomectomy using 3% sorbitol as distention medium [7] [43]. This group A patient showed a BMI of 35 kg/m^2 and a immediate postoperative sodium plasma level of 116 mEq/L. Clinical support measures were taken, and the patient was discharged in good condition 4 days later.

Vaginal discharge is described as a normal clinical complaint within the first 30 days after endometrial ablation, provided that fever and fetid odor are absent. In this study, the incidence of vaginal discharge during the early postoperative period was higher in group A than in group B. However, good resolution was observed in all cases after clinical treatment with oral imidazole derivatives.

A major limitation of our study is not evaluating objectively menstrual bleeding before and after the procedure. As most patients referred to perform endometrial ablation held initial follow-up at primary care services of our region, the application of pictorial blood loss assessment chart (PBLAC) was not standardized preoperatively, hindering the use of this valuable tool in estimating bleeding. Alternatively, collection of used sanitary product with subsequent extraction of alkaline hematin should be considered. However, this method is much more complex, costly and not available in our service. Although being a semi-subjective assessment by counting the number of sanitary pads the reduction observed in the number of pads used in the day of heaviest flow and throughout the menstrual period associated with the increase in hemoglobin levels after the procedure confirms clinical improvement with both techniques used. Another issue to

highlight is the fact that our institution is a university center where novice doctors are instructed in minimally invasive techniques which can explain some of the observed complications and also the amount of distension medium used to complete the procedures.

5. Conclusion

Endometrial ablation using rollerball electrocoagulation alone, which is easier to perform, may be considered safer. Besides taking shorter time in surgery and requiring a smaller amount of distention medium, it is associated with a lower postoperative vaginal discharge incidence. The rate of clinical success did not statistically differ between groups. However, study parameters, both in absolute values and percents, were superior in group B.

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Conflict of Interest Statement

The authors have no commercial, proprietary, or financial interest in the products or companies describes in this article. All authors have no other conflict of interest.

References

[1] Fraser, I.S., Critchley, H.O. and Munro, M.G. (2007) Abnormal Uterine Bleeding: Getting Our Terminology Straight. *Current Opinion in Obstetrics and Gynecology*, **19**, 591-595. https://doi.org/10.1097/01.aids.0000299801.42415.8a

[2] Munro, M.G., Critchley, H.O. and Fraser, I.S. (2012) The FIGO Systems for Nomenclature and Classification of Causes of Abnormal Uterine Bleeding in the Reproductive Years: Who Needs Them? *American Journal of Obstetrics and Gynecology*, **207**, 259-265. https://doi.org/10.1016/j.ajog.2012.01.046

[3] NICE Guideline 44. (2011) Heavy Menstrual Bleeding. ISBN 978-1-904752-35-6. http://www.nice.org.uk.

[4] Cote, I., Jacobs, P. and Cumming, D.C. (2003) Use of Health Services Associated with Increased Menstrual Loss in the United States. *American Journal of Obstetrics and Gynecology*, **188**, 343-348. https://doi.org/10.1067/mob.2003.92

[5] Shapley, M., Jordan, K. and Croft, P.R. (2004) An Epidemiological Survey of Symptoms of Menstrual Loss in the Community. *British Journal of General Practice*, **54**, 359-363.

[6] Marret, H., Fauconnier, A., Chabbert-Buffet, N., Cravello, L., Golfier, F., Gondry, J., *et al.* (2010) Clinical Practice Guidelines on Menorrhagia: Management of Abnormal Uterine Bleeding before Menopause. *European Journal of Obstetrics and Gynaecology Reproductive Biology*, **152**, 133-137. https://doi.org/10.1016/j.ejogrb.2010.07.016

[7] Laberge, P., Leyland, N., Murji, A., Fortin, C., Martyn, P., Vilos, G., *et al.* (2015) Endometrial Ablation in the Management of Abnormal Uterine Bleeding. *Journal of Obstetrics and Gynaecology Canada*, **37**, 362-379.

https://doi.org/10.1016/S1701-2163(15)30288-7

[8] Cooper, K., Lee, A., Chien, P., Raja, E., Timmaraju, V. and Bhattacharya, S. (2011) Outcomes Following Hysterectomy Or Endometrial Ablation for Heavy Menstrual Bleeding: Retrospective Analysis of Hospital Episode Statistics in Scotland. *An International Journal of Obstetrics and Gynaecology*, **118**, 1171-1179. https://doi.org/10.1111/j.1471-0528.2011.03011.x

[9] Varol, N., Healey, M., Tang, P., Sheehan, P., Maher, P. and Hill, D. (2001) Ten-Year Review of Hysterectomy Morbidity and Mortality: Can We Change Direction? *Australian and New Zealand Journal of Obstetrics and Gynaecology*, **41**, 295-302. https://doi.org/10.1111/j.1479-828X.2001.tb01231.x

[10] Kafy, S., Huang, J.Y., Al-Sunaidi, M., Wiener, D. and Tulandi, T. (2006) Audit of Morbidity and Mortality Rates of 1792 Hysterectomies. *Journal of Minimally Invasive Gynecology*, **13**, 55-59. https://doi.org/10.1016/j.jmig.2005.10.003

[11] Aniuliene, R., Varzgaliene, L. and Varzgalis, M. (2007) A Comparative Analysis of Hysterectomies. *Medicina* (*Kaunas*), **43**, 118-124.

[12] Wortman, M. (2016) Hysteroscopic Endometrial Resection versus Laparoscopic Supracervical Hysterectomy Hysterectomy—A Flawed Conclusion. *Journal of Minimally Invasive Gynecology*, **23**, 288-289. https://doi.org/10.1016/j.jmig.2015.09.027

[13] Papadopoulos, N.P. and Magos, A. (2007) First-Generation Endometrial Ablation: Roller-Ball vs Loop vs Laser. *Best Practice & Research Clinical Obstetrics & Gynaecology*, **21**, 915-929. https://doi.org/10.1016/j.bpobgyn.2007.03.014

[14] Kumar, V., Chodankar, R. and Gupta, J.K. (2016) Endometrial Ablation for Heavy Menstrual Bleeding. *Women's Health* (*London, England*), **12**, 45-52. https://doi.org/10.2217/whe.15.86

[15] Ghazizadeh, S., Bakhtiari, F., Rahmanpour, H., Davari-Tanha, F. and Ramezanzadeh, F.A. (2011) Randomized Clinical Trial to Compare Levonorgestrel-Releasing Intrauterine System (Mirena) vs Trans-Cervical Endometrial Resection for Treatment of Menorrhagia. *International Journal of Women's Health*, **3**, 207-211.

[16] Penninx, J.P., Herman, M.C., Mol, B.W. and Bongers, M.Y. (2011) Five-Year Follow-Up after Comparing Bipolar Endometrial Ablation with Hydrothermablation for Menorrhagia. *Obstetrics & Gynaecology*, **118**, 1287-1292. https://doi.org/10.1097/AOG.0b013e318236f7ed

[17] Hoaglin, D.C., Filonenko, A., Glickman, M.E., Wasiak, R. and Gidwani, R. (2013) Use of Mixed-Treatment-Comparison Methods in Estimating Efficacy of Treatments for Heavy Menstrual Bleeding. European Journal of Medical Research, **18**, 17. https://doi.org/10.1186/2047-783X-18-17

[18] Donohoe, C.L., Feeney, C., Carey, M.F. and Reynolds, J.V. (2011) Perioperative Evaluation of the Obese Patient. *Journal of Clinical Anesthesia*, **23**, 575-586. https://doi.org/10.1016/j.jclinane.2011.06.005

[19] El-Nashar, S.A., Hopkins, M.R., Barnes, S.A., Pruthi, R.K., Gebhart, J.B., Cliby, W.A., *et al.* (2010) Health-Related Quality of Life and Patient Satisfaction after Global Endometrial Ablation for Menorrhagia in Women with Bleeding Disorders: A Follow-Up Survey and Systematic Review. *American Journal of Obstetrics and Gynecology*, **202**, 348 e1-348 e7.

[20] Madsen, A.M., El-Nashar, S.A., Hopkins, M.R., Khan, Z. and Famuyide, A.O. (2013) Endometrial Ablation for the Treatment of Heavy Menstrual Bleeding in Obese Women. *International Journal of Gynecology & Obstetrics*, **121**, 20-23. https://doi.org/10.1016/j.ijgo.2012.10.024

[21] Huq, F.Y., Al-Haderi, M. and Kadir, R.A. (2012) The Outcome of Endometrial Ab-

lation in Women with Inherited Bleeding Disorders. Haemophilia, **18**, 413-420. https://doi.org/10.1111/j.1365-2516.2011.02712.x

[22] Kouides, P.A. and Kadir, R.A. (2007) Menorrhagia Associated with Laboratory Abnormalities of Hemostasis: Epidemiological, Diagnostic and Therapeutic Aspects. *Journal of Thrombosis and Haemostasis*, **5**, 175-182. https://doi.org/10.1111/j.1538-7836.2007.02494.x

[23] Thomassee, M.S., Curlin, H., Yunker, A. and Anderson, T.L. (2013) Predicting Pelvic Pain after Endometrial Ablation: Which Preoperative Patient Characteristics Are Associated? *Journal of Minimally Invasive Gynecology*, **20**, 642-647. https://doi.org/10.1016/j.jmig.2013.04.006

[24] Shavell, V.I., Diamond, M.P., Senter, J.P., Kruger, M.L. and Johns, D.A. (2012) Hysterectomy Subsequent to Endometrial Ablation. *Journal of Minimally Invasive Gynecology*, **19**, 459-464. https://doi.org/10.1016/j.jmig.2012.03.013

[25] Longinotti, M.K., Jacobson, G.F., Hung, Y.Y. and Learman, L.A. (2008) Probability of Hysterectomy after Endometrial Ablation. *Obstetrics & Gynaecology*, **112**, 1214-1220. https://doi.org/10.1097/AOG.0b013e31818c1766

[26] Matteson, K.A., Abed, H., Wheeler 2nd, T.L., Sung, V.W., Rahn, D.D., Schaffer, J.I., *et al.* (2012) A Systematic Review Comparing Hysterectomy with Less-Invasive Treatments for Abnormal Uterine Bleeding. *Journal of Minimally Invasive Gynecology*, **19**, 13-28. https://doi.org/10.1016/j.jmig.2011.08.005

[27] Boujida, V.H., Philipsen, T., Pelle, J. and Joergensen, J.C. (2002) Five-Year Follow-Up of Endometrial Ablation: Endometrial Coagulation versus Endometrial Resection. *Obstetrics & Gynaecology*, **99**, 988-992. https://doi.org/10.1097/00006250-200206000-00007

[28] Furst, S.N., Philipsen, T. and Joergensen, J.C. (2007) Ten-Year Follow-Up of Endometrial Ablation. *Acta Obstetricia et Gynecologica Scandinavica*, **86**, 334-338. https://doi.org/10.1080/00016340601089701

[29] Onoglu, A., Taskin, O., Inal, M., Sadik, S., Simsek, M., Akar, M., *et al.* (2007) Comparison of the Long-Term Histopathologic and Morphologic Changes after Endometrial Rollerball Ablation and Resection: A Prospective Randomized Trial. *Journal of Minimally Invasive Gynecology*, **14**, 39-42. https://doi.org/10.1016/j.jmig.2006.06.027

[30] Bongers, M.Y. (2015) Hysteroscopy and Heavy Menstrual Bleeding (To Cover TCRE and Second-Generation Endometrial Ablation). *Best Practice & Research Clinical Obstetrics & Gynaecology*, **29**, 930-939. https://doi.org/10.1016/j.bpobgyn.2015.03.011

[31] Singh, S., Best, C., Dunn, S., Leyland, N., Wolfman, W.L., Clinical Practice—Gynaecology Committee, *et al.* (2013) Abnormal Uterine Bleeding in Pre-Menopausal Women. *Journal of Obstetrics and Gynaecology Canada*, **35**, 473-479. https://doi.org/10.1016/S1701-2163(15)30939-7

[32] Zar, J.H. (2010) Biostatistical Analysis. 5th Edition, Prentice-Hall/Pearson, Upper Saddle River, xiii, 944 p.

[33] Goodman, L.A. (1964) Simultaneous Confidence Intervals for Contrasts among Multinomial Populations. *Annals of Mathematical Statistics*, **35**, 716-725. https://doi.org/10.1214/aoms/1177703569

[34] Goodman, L.A. (1965) On Simultaneous Confidence Intervals for Multinomial Proportions. *Technometrics*, **7**, 247-254. https://doi.org/10.1080/00401706.1965.10490252

[35] Johnson, R.A. and Wichern, D.W. (2007) Applied Multivariate Statistical Analysis. 6th Edition, Pearson Prentice Hall, Upper Saddle River, xviii, 773 p.

[36] Lasmar, R.B., Barrozo, P.R., Dias, R. and Oliveira, M.A. (2005) Submucous Myomas: A New Presurgical Classification to Evaluate the Viability of Hysteroscopic Surgical Treatment—Preliminary Report. *Journal of Minimally Invasive Gynecology*, **12**, 308-311. https://doi.org/10.1016/j.jmig.2005.05.014

[37] Goldrath, M.H., Fuller, T.A. and Segal, S. (1981) Laser Photovaporization of Endometrium for the Treatment of Menorrhagia. *American Journal of Obstetrics and Gynecology*, **140**, 14-19. https://doi.org/10.1016/0002-9378(81)90251-9

[38] DeCherney, A. and Polan, M.L. (1983) Hysteroscopic Management of Intrauterine Lesions and Intractable Uterine Bleeding. *Obstetrics and Gynecology*, **61**, 392-397.

[39] Takahashi, W.H., Lopes, R.G., Depes, D. de B. and Martins e Castello Branco, H.K. (2012) Results of Hysteroscopic Endometrial Ablation after Five-Year Follow-Up. *Revista Brasileira de Ginecologia e Obstetrícia*, **34**, 80-85. https://doi.org/10.1590/S0100-72032012000200007

[40] Loffer, F.D. (1988) Laser Ablation of the Endometrium. *Obstetrics and Gynecology Clinics of North America*, **15**, 77-89.

[41] Smithling, K.R., Savella, G., Raker, C.A. and Matteson, K.A. (2014) Preoperative Uterine Bleeding Pattern and Risk of Endometrial Ablation Failure. *American Journal of Obstetrics and Gynecology*, **211**, 556.e1-556.e6.

[42] Pontes, A., Traiman, P., Franco, M., Nahás, E.A.P., Dias, R. and De Luca, L.A. (2000) Clinical Treatment and Follow-Up of Endometrial Hyperplasia. *Revista Brasileira de Ginecologia e Obstetrícia*, **22**, 325-331. https://doi.org/10.1590/S0100-72032000000600002

[43] Fonseca, M. de F., Andrade Junior, C.M., Nogueira, E. de A., Sessa, F.V. and Crispi, C.P. (2015) Predictors of Fluid Intravasation during Operative Hysteroscopy: A Preplanned Prospective Observational Study with 200 Cases. *Revista Brasileira de Ginecologia e Obstetrícia*, **37**, 24-29. https://doi.org/10.1590/S0100-720320140005139

List of Abbreviations

AUB: Abnormal Uterine Bleeding;
FIGO: International Federation of Gynecology and Obstetrics;
HRQOL: Health-Related Quality of Life;
NDAIDs: Nonsteroidal Anti-Inflammatory Drugs;
COC: Combination Oral Contraceptives;
LNG-IUS: Levonorgestrel Intrauterine System;
BMI: Body Mass Index;
PBLAC: Pictorial Blood Loss Assessment Chart;
TVUS: Transvaginal Ultrasonography;
OH: Office Hysteroscopy;
HB: Hydric Balance;
SH: Surgical Hysteroscopy;
HP: Histopathological;
T: Time Elapsed;
PO: Postoperative.