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Comparison of laparoscopic and hysteroscopic surgical treatments for isthmocele: A prospective cohort

İstmoselde laparoskopik ve histeroskopik cerrahi tedavilerin karşılaştırılması: Prospektif bir kohort

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Abstract

Objective: To evaluate the clinical outcomes of laparoscopic and hysteroscopic surgical approaches for treating symptomatic isthmocele and identify their associated factors.

Materials and Methods: Forty-six patients with symptomatic isthmocele diagnosed using transvaginal saline infusion sonohysterography were enrolled in this prospective cohort study. Patients underwent either laparoscopic or hysteroscopic isthmoplasty based on their residual myometrial thicknesses and fertility desires and were subsequently followed by clinical and ultrasonographic examinations.

Results: Twenty-two patients underwent laparoscopy and 24 underwent hysteroscopic surgery. At baseline, there was no significant difference in the mean age and years since the last cesarean section between the two groups. However, the hysteroscopy group had a higher mean parity and previous cesarean sections (p=0.00, 0.03). The most common symptoms were abnormal uterine bleeding, infertility, and dysmenorrhea. The mean baseline residual myometrial thickness was significantly higher in the laparoscopy group (p=0.00), and only laparoscopic surgery led to a significant increase in residual myometrial thickness in patients (p=0.00). Both procedures significantly reduced abnormal uterine bleeding (p=0.00), but only laparoscopy reduced infertility (p=0.00) and hysteroscopy reduced dysmenorrhea (p=0.03). Hysteroscopy showed better symptom resolution in younger patients (p=0.01), whereas age did not affect laparoscopy outcomes.

Conclusion: Both approaches showed similar effectiveness in resolving abnormal uterine bleeding, with laparoscopy excelling in infertility resolution and hysteroscopy excelling in dysmenorrhea resolution.

Keywords: Cesarean section, hysteroscopy, laparoscopy, postcesarean section, scar

Öz

Amaç: Bu çalışmanın amacı semptomatik istmosel tedavisinde laparoskopik ve histeroskopik cerrahi yaklaşımların klinik sonuçlarını değerlendirmek ve ilişkili faktörleri belirlemektir.

Gereç ve Yöntemler: Bu prospektif kohort çalışmasına transvajinal salin infüzyon sonohisterografi kullanılarak semptomatik istmosel tanısı konan 46 hasta dahil edildi. Hastalara rezidüel miyometrial kalınlık ve doğurganlık isteklerine göre laparoskopik veya histeroskopik istmoplasti uygulandı ve ardından hastalar klinik ve ultrasonografik muayenelerle takip edildi.

PRECIS: Our study found laparoscopic and hysteroscopic isthmoplasty equally effective for abnormal uterine bleeding, with laparoscopy superior in infertility resolution and hysteroscopy in dysmenorrhea relief.

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Bulgular: Yirmi iki hastaya laparoskopi, yirmi dört hastaya ise histeroskopik cerrahi uygulandı. Başlangıçta, iki grup arasında ortalama yaş ve son sezaryenden bu yana geçen yıllar açısından anlamlı bir fark yoktu. Ancak histeroskopi grubunda ortalama parite ve önceki sezaryenlerin sayısı daha yüksekti (p=0,00, 0,03). En sık görülen semptomlar anormal uterin kanama, kısırlık ve dismenore idi. Başlangıçtaki ortalama rezidüel miyometrial kalınlık laparoskopi grubunda anlamlı derecede yüksekti (p=0,00) ve yalnızca laparoskopik cerrahi hastalarda anlamlı rezidüel miyometrial kalınlık artışına yol açtı (p=0,00). Her iki prosedür de anormal uterin kanamayı önemli ölçüde azalttı (p=0,00), ancak yalnızca laparoskopi kısırlığı azalttı (p=0,00) ve histeroskopi dismenoreyi azalttı (p=0,03). Histeroskopi genç hastalarda semptomlarda daha fazla düzelme sağladı (p=0,01), yaş ise laparoskopi sonuçlarını etkilemedi.

Sonuç: Her iki yaklaşım da anormal uterin kanamanın çözümünde benzer etkinlik göstermiştir; laparoskopi kısırlığın çözümünde ve histeroskopi dismenorenin çözümünde üstündür.

Anahtar Kelimeler: Sezaryen, histeroskopi, laparoskopi, sezaryen sonrası, skar

Introduction

The cesarean section (C/S) is one of the most commonly performed surgeries worldwide, with a growing prevalence[1]. Elective C/S, in contrast to natural vaginal delivery, offers mothers the benefits of pain avoidance, control over delivery timing, and reduced maternal anxiety[2]. In addition, C/S can benefit neonates by reducing the risks of chorioamnionitis, fetal heart rate issues, and cord prolapse, contributing to the increasing preference for C/S over vaginal delivery[2].

Performing C/S when medically indicated (e.g., prolonged labor, or fetal distress) significantly reduces maternal and neonatal complications and mortality[3]. However, performing C/S without medical indications increases the risk of complications[3]. One emerging complication is isthmocele (or cesarean scar defect), where a pouch-like structure forms at the prior C/S scar site on the uterine wall[4,5]. Isthmocele affects up to 70% of women undergoing C/S, with approximately 30% of them experiencing symptoms like abnormal uterine bleeding (AUB), dysmenorrhea, secondary infertility, and chronic pelvic pain[6].

The primary approach to managing symptomatic isthmoceles involves surgical interventions[6]. Laparoscopy is typically the preferred surgical approach for patients with large isthmoceles, whereas hysteroscopy is commonly performed on patients with smaller isthmoceles[7]. Previous research indicates that both laparoscopic and hysteroscopic procedures effectively alleviate symptoms[7]. However, a knowledge gap exists regarding the comparative effectiveness and advantages of these two approaches in symptom resolution, necessitating further investigation.

Consequently, our objective was to assess and compare the clinical outcomes and symptom relief achieved through laparoscopic and hysteroscopic surgery for isthmocele treatment.

Materials and Methods

Design and Setting

This prospective study was conducted at Arash Hospital, Tehran, Iran. We included patients who underwent either laparoscopic or hysteroscopic excision of the isthmocele between December 2021 and September 2022. Before commencement, this research received approval from the Research Deputy and the Ethics Committee of Tehran University of Medical Sciences under the reference number IR.TUMS.MEDICINE.REC.1402.106 and strictly adhered to the ethical standards described in the 1964 version of the Declaration of Helsinki, as revised in 2013[8]. In addition, explicit informed verbal and written consent was obtained from all participants. This study was conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology guideline for cohort studies[9].

Participants

This study examined consecutive patients who had undergone either laparoscopic or hysteroscopic isthmocele resection and met specific inclusion criteria. These criteria comprised women with a history of at least one C/S and confirmed isthmocele diagnosis by an experienced radiologist based on saline infusion sonohysterography (SIS) characteristics between December 2021 and September 2022 at Arash Hospital in Tehran, Iran. Indications for laparoscopic or hysteroscopic isthmocele excision were significant symptoms, such as AUB, dysmenorrhea, and secondary infertility, which could not be attributed to alternative causes. Patients with residual myometrial thicknesses (RMT) ≥3 mm at the C/S scar site underwent hysteroscopic surgery, whereas those with RMTs less than 2 mm underwent laparoscopic intervention[7]. For individuals falling within the RMT range of 2-3 mm, the choice between laparoscopic and hysteroscopic approaches was based on reproductive intentions; laparoscopic procedures were preferred for patients desiring fertility, whereas hysteroscopic procedures were administered to those without the fertility desire[10].

The exclusion criteria encompassed patients whose symptoms could be explained by other gynecological conditions, including uterine polyps, cervical dysplasia, cervical infection, atypical endometrial cells, or endometriosis, as well as those with uncontrolled comorbidities.

Data Collection

The patients' baseline characteristics were assessed, including age, parity, number of previous C/S surgeries, time elapsed since their last C/S, and the presence or absence of AUB, dysmenorrhea, and secondary infertility. This information

was gathered through direct interviews with the patients and a thorough review of their medical records. Secondary infertility was defined as the inability to conceive after 6 months of unprotected sexual intercourse. Subsequently, patients were reevaluated 3 following the ischiocele excision procedure to determine the presence of AUB and dysmenorrhea. Furthermore, patients were visited 12 months after the surgery to evaluate the presence or absence of secondary infertility.

In addition, patients underwent transvaginal SIS conducted by an experienced radiologist from the center. Data regarding the RMT and dimensions (length, width, and depth) of the C/S scar site were collected at the initial assessment. In addition, according to previous studies, we calculated the volume of the C/S scar site using the formula "length*width*depth*0.52"[11]. Furthermore, the RMT of the C/S scar site was measured during the 3-month follow-up visits.

To determine the RMT during sonographic examination, the myometrial thickness at the C/S with the lowest measurement was assessed. The RMT at the C/S scar location was calculated by drawing a vertical line from the serosa to the isthmocele. In addition, we selected the sonographic view with the greatest length and depth to measure the residual myometrium dimensions. To measure the isthmocele length, we drew a line parallel to the cervical line. The isthmocele depth was calculated by measuring the vertical distance between the base of the lesion and the myometrial layer on the uterine fundus. Finally, the width of the isthmocele was measured. All measurements excluded endometrial thickness from isthmocele dimensions.

Procedures

a. Hysteroscopic resection of the isthmocele: Following procedural sedation analgesia, a hysteroscope was inserted into the uterine cavity to locate the isthmocele. Using a cutting current, we meticulously excised the upper and lower edges of the isthmocele until it was flattened and the muscular layer was exposed. Subsequently, the floor of the isthmocele was electrocoagulate using a roller ball. These procedures were performed under the direct vision of experienced obstetrics and gynecology specialists.

b. Laparoscopic isthmocele repair: Following the administration of general anesthesia, a hysteroscope was carefully inserted into the uterine cavity to precisely locate the ischiocele. Subsequently, trocars were placed in the peri-umbilical area to establish pneumoperitoneum, allowing assessment of the abdominal cavity. The isthmocele was then visually identified using the hysteroscope's light source, with the bladder gently pushed beneath the uterus. Once the isthmocele was located within the abdominal cavity, the uterine tissue was incised using a monopolar hook, and the upper and lower edges of the isthmocele were excised. After the excision, the incision site was meticulously repaired using a continuous suture technique employing 1/0 VICRYL® stitches. These surgical procedures were conducted by laparoscopic fellows with a minimum of 1 year of experience in laparoscopic surgeries, under the supervision of attending gynecologists with expertise in laparoscopic procedures.

Statistical Analysis

We used IBM® SPSS® version 25 for statistical analyses. Patients were categorized into two main groups: Laparoscopic and hysteroscopic surgeries. Baseline characteristics, isthmocele sonographic features, and clinical outcomes were compared between the groups. Continuous variables were summarized using mean and standard deviation. We compared the means of continuous variables between the groups using an independent t-test. Categorical data were compared using the chi-square test or Fisher's exact test, based on their characteristics. In addition, a non-parametric McNemar's test and paired sample t-test were used to compare paired categorial and continuous data between the two groups, respectively. The statistical significance level for all analyses was set at p-value <0.05.

In addition, we used binary logistic regression to assess the applicability values of different variables in predicting the response to surgical treatment, which was defined as the resolution of the symptoms of patients. The area under the receiver operating characteristic curve (AUROC) and 95% confidence interval (CI) were calculated to assess the strength of the predictive power of different variables. In addition, the statistical significance level in these analyses was set at p-value <0.05.

Results

Baseline Data

A total of 46 patients were included. Of them, 22 (47.8%) underwent laparoscopic surgery and 24 (52.2%) underwent hysteroscopic isthmocele excision surgery. The mean age of the patients was 38.6±4.2 years, with a range of 32-50 years, with no significant difference between the groups (p-value >0.05). The mean amount of parity and previous C/S surgeries in the studied population were 2.1±0.9 and 1.9±0.8, respectively. Notably, the hysteroscopy group exhibited notably higher values in both categories (p-values of 0.00 and 0.03, respectively). Additionally, the mean duration elapsed since the last C/S procedure was 8.7±5.9 years, with no statistically significant difference observed between the groups (p-value >0.05) Table 1. provides more detailed information regarding the baseline characteristics of the study participants.

In terms of isthmocele symptoms and surgical indications, among all patients, 35 (76.1%) presented with AUB, 22 (47.8%) experienced secondary infertility, and 14 (30.4%) reported dysmenorrhea at baseline assessment. Notably, there was a statistically significant difference between the groups in terms of the prevalence of infertility before surgery, with the laparoscopy group demonstrating a higher prevalence (p-value=0.00). However, no statistically significant differences were observed between the groups with regard to the prevalence of AUB and dysmenorrhea (p-value >0.05) (Table 1).

Table 1 overview of the baseline sonographic characteristics of the patient cohort. The mean isthmocele dimensions encompassed 8.2±3.8 mm in length, 7.1±3.8 mm in width, and 6.0±2.5 mm in depth for the entire cohort. Moreover, the mean calculated isthmocele volume amounted to 227.6±203.3 mm^3, with the laparoscopy group exhibiting markedly greater values (p-value <0.00). Furthermore, the mean RMT across the entire cohort was 2.8±1.4 mm, within a range of 1.5-8 mm. Notably, the laparoscopy group displayed a mean RMT of 2.0±0.2 mm (range: 1.5-2.7), whereas the hysteroscopy group exhibited a mean RMT of 3.6±1.6 mm (range: 2-8 mm). Significantly, the laparoscopy group demonstrated a notably higher mean RMT value (p-value <0.00).

Follow-up Data

All 46 patients participated in the follow-up visits (Figure 1). At the follow-up visits, 9 patients (19.5%) experienced AUB, whereas 8 (17.4%) and 5 (10.8%) reported infertility and dysmenorrhea after surgery, respectively. Specifically, 3 (13.6%), 5 (22.7%), and 2 (9.1%) of the laparoscopy group, and 6 (25%), 3 (12.5%), and 3 (12.5%) of the hysteroscopy group reported AUB, infertility, and dysmenorrhea after surgery, respectively (Table 2). The results of Fisher's exact test indicated no significant differences between the two groups in terms of AUB, infertility, and dysmenorrhea frequencies during follow-up visits (p-values >0.05) (Table 2).

The mean postoperative RMT of the patients was 5.3±2.0 mm (increased by 89.2%), with the laparoscopy group showing a mean of 6.7±1.3 mm (increased by 235%) and the hysteroscopy group 4.0±1.7 mm (increased by 13.9%). An independent

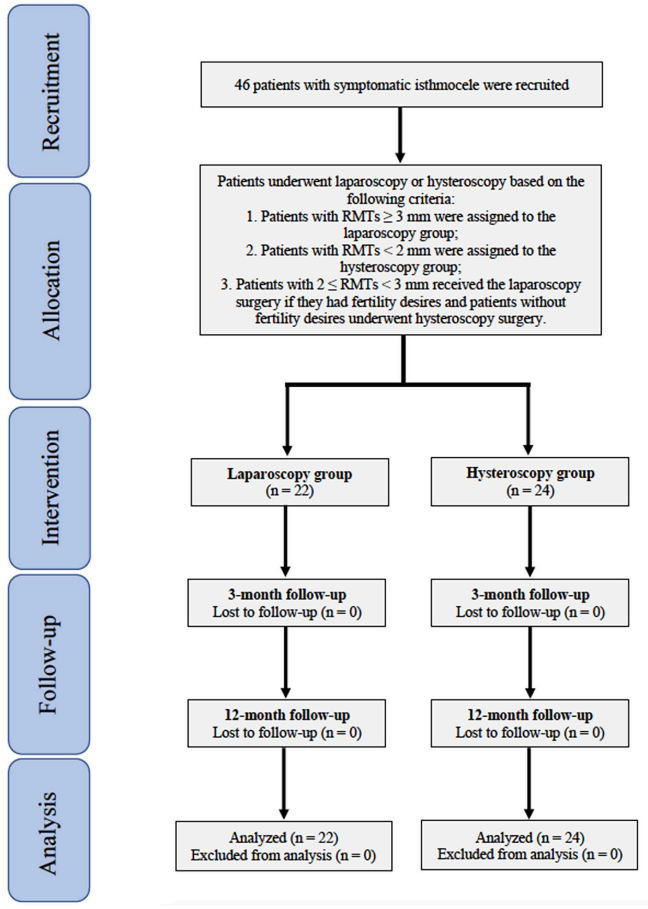

Figure 1. Flowchart of the study
RMT: Residual myometrial thickness

Table 1. Baseline characteristics of the included patients[a]

Variable	Total (n=46)	Laparoscopy (n=22)	Hysteroscopy (n=24)	p-value
Age, years	38.6±4.2	37.8±3.7	39.2±4.5	0.25[b]
Parity	2.1±0.9	1.7±0.6	2.5±1.0	0.00[b]
Number of C/S	1.9±0.8	1.6±0.6	2.1±0.8	0.03[b]
Years since last C/S, years	8.7±5.9	8.2±5.4	9.1±6.4	0.63[b]
AUB	35 (76.1)	15 (68.1)	20 (83.3)	0.30[c]
Infertility	22 (47.8)	16 (72.7)	6 (25)	0.00[d]
Dysmenorrhea	14 (30.4)	5 (22.7)	9 (37.5)	0.34[c]
Isthmocele length, mm	8.2±3.8	9.9±3.9	6.6±2.9	0.00[b]
Ishtmocele width, mm	7.1±3.8	8.4±2.6	5.8±4.3	0.01[b]
Isthmocele depth, mm	6.0±2.5	7.4±1.5	4.7±2.5	0.00[b]
Isthmocele volume, mm^3	227.6±203.3	347.9±203.7	117.4±128.3	0.00[b]
RMT, mm	2.8±1.4	2.0±0.2	3.6±1.6	0.00[b]

AUB: Abnormal uterine bleeding, C/S: Cesarean section, mm: Millimeter, RMT: Residual myometrial thickness
[a]: Data are presented as mean ± standard deviation or as number (percentage)
[b]: Independent t-test
[c]: Fisher's exact test
[d]: Chi-square test

Table 2. Follow-up characteristics of the included patients[a]

Variable	Total (n=46)	Laparoscopy (n=22)	Hysteroscopy (n=24)	p-value
AUB	9 (19.5)	3 (13.6)	6 (25)	0.46[b]
Infertility	8 (17.4)	5 (22.7)	3 (12.5)	0.45[b]
Dysmenorrhea	5 (10.8)	2 (9.1)	3 (12.5)	0.00[b]
RMT, mm	5.3±2.0	6.7±1.3	4.1±1.7	0.00[c]
ΔRMT, mm	2.5±2.5	4.7±1.2	0.4±1.6	0.00[c]

AUB: Abnormal uterine bleeding, RMT: Residual myometrial thickness, ΔRMT: Follow-up residual myometrial thickness - baseline residual myometrial thickness
[a]: Data are presented as mean ± standard deviation or as number (percentage)
[b]: Fisher's exact test
[c]: Independent t-test

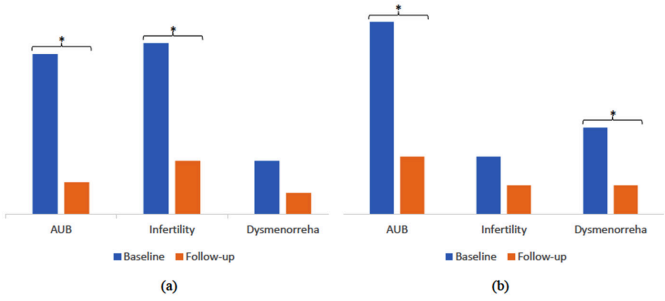

Figure 2. Prevalence of abnormal uterine bleeding, infertility, and dysmenorrhea at the baseline and follow-up points in the (a) laparoscopy and (b) hysteroscopy groups

t-test analysis revealed that the mean postoperative RMT in the laparoscopy group was significantly higher than that in the hysteroscopy group (p-value <0.00) (Table 2). Additionally, the mean RMT changes from baseline (ΔRMT: follow-up RMT-baseline RMT) were 2.5±2.5 mm for the entire cohort, 4.7±1.2 mm for the laparoscopy group, and 0.4±1.6 mm for the hysteroscopy group. Our analysis showed that laparoscopic surgery resulted in a significantly greater increase in RMT than hysteroscopic surgery (p-value <0.00) (Table 2).

Longitudinal Effects of Isthmocele Excision Surgery

Table 3 presents a comprehensive summary of our analyses regarding the impact of isthmocele excision surgery on symptom frequency among patients. The results of McNemar's test indicate a significant reduction in the frequencies of AUB (resolution rate: 74.2%, p-value <0.00), infertility (resolution rate: 63.6%, p-value <0.00), and dysmenorrhea (resolution rate: 78.5%, p-value: 0.00) in the entire cohort at follow-up compared with baseline. Both the laparoscopy and hysteroscopy groups experienced a substantial reduction in AUB frequency after surgery (resolution rates: 80% and 70%, p-value <0.00 for both). However, the frequency of infertility significantly decreased only in the laparoscopy group (resolution rate: 68.7%, p-value: 0.00), whereas the hysteroscopy group did not exhibit a significant reduction (resolution rate: 50%, p-values >0.05). Conversely, hysteroscopic surgery significantly reduced the frequency of dysmenorrhea (resolution rate: 60%, p-value=0.03), whereas laparoscopic surgery did not achieve a significant reduction (resolution rate: 67%, p-values >0.05) (Figure 2).

Furthermore, our paired sample t-test analysis demonstrated a significant increase in the mean RMT for the entire cohort after surgery (p-value <0.00) (Table 3). Subgroup analysis revealed that only the laparoscopy group experienced a significant post-surgical increase in RMT (p-value <0.00), whereas the mean RMT in the hysteroscopy group at the follow-up point did not significantly differ from their baseline mean RMT (p-values >0.05) (Table 3).

Effects of Different Variables on Treatment Response

To evaluate treatment responses and their associated factors, we categorized the study cohort into two groups: those with Complete Response to Treatment (CRT) and those with Incomplete Response to Treatment (IRT), based on their symptom status at follow-up compared with baseline. Patients without any of the three assessed symptoms (AUB, infertility, and dysmenorrhea) at follow-up were classified into the CRT group, whereas patients reporting any of these symptoms at follow-up were placed in the IRT group. This resulted in 29 patients in the CRT group and 17 patients in the IRT group (Table 4).

Based on the results of the chi-square test, neither the laparoscopic nor the hysteroscopic approaches demonstrated superiority in symptom resolution (p-values >0.05) (Table 4). Additionally, the CRT group had a significantly lower age compared with the IRT group in the entire cohort (p-value=0.00) and in the hysteroscopy group (p-value: 0.01). However, there was no significant difference in the mean age between the CRT and IRT groups among patients who underwent laparoscopic surgery (p-values >0.05) (Table 4). Furthermore, there were no significant differences between the CRT and IRT groups regarding parity, number of previous C/Ss, years since the last C/S, isthmocele dimensions (length, width, depth, and volume), and RMT in the entire cohort (p-values >0.05 for all) (Table 4).

We conducted an additional analysis to explore potential predictors of symptom resolution of each symptom individually in patients. The effects of the variables mentioned earlier were

Table 3. Comparison of the clinical and sonographic features before and after the isthmocele resection[a]

Variable		Total (n=46)	Laparoscopy (n=22)	Hysteroscopy (n=24)
AUB	Baseline	35 (76.1)	15 (68.1)	20 (83.3)
	1-year follow-up	9 (19.5)	3 (13.6)	6 (25)
	p-value	0.00[b]	0.00[b]	0.00[b]
Infertility	Baseline	22 (47.8)	16 (72.7)	6 (25)
	1-year follow-up	8 (17.4)	5 (22.7)	3 (12.5)
	p-value	0.00[b]	0.00[b]	0.25[b]
Dysmenorrhea	Baseline	14 (30.4)	5 (22.7)	9 (37.5)
	1-year follow-up	5 (10.8)	2 (9.1)	3 (12.5)
	p-value	0.00[b]	0.25[b]	0.03[b]
RMT, mm	Baseline	2.8±1.4	2.0±0.2	3.6±1.6
	1-year follow-up	5.3±2.0	6.7±1.3	4.0±1.7
	p-value	0.00[c]	0.00[c]	0.16[c]

AUB: Abnormal uterine bleeding, RMT: Residual myometrial thickness
[a]: Data are presented as mean ± standard deviation or as number (percentage)
[b]: McNemar's test.
[c]: Paired sample t-test

Table 4. Evaluating the effects of different variables on the treatment response[a]

Variable		Total (n=46)	Laparoscopy (n=22)	Hysteroscopy (n=24)
Surgical approach	CRT	29 (63.0)	15 (68.1)	14 (58.3)
	NCRT	17 (37.0)	7 (31.9)	10 (41.7)
	p-value	0.48[b]	-	-
Age	CRT	37.3±3.7	37.2±4.1	37.5±3.4
	NCRT	40.7±4.2	39.3±2.5	41.8±4.9
	p-value	0.00[c]	0.23[c]	0.01[c]
Parity	CRT	2.2±0.9	1.7±0.6	2.6±1.1
	NCRT	2.1±0.9	1.7±0.7	2.3±0.9
	p-value	0.69[c]	0.94[c]	0.43[c]
Number of C/S	CRT	1.8±0.7	1.6±0.6	2.1±0.8
	NCRT	1.0±0.8	1.7±0.7	2.2±0.9
	p-value	0.48[c]	0.71[c]	0.72[c]
Years since last C/S	CRT	7.8±5.1	8.4±5.4	7.2±4.9
	NCRT	10.2±7.0	8.0±5.9	11.7±7.6
	p-value	0.20[c]	0.87[c]	0.09[c]
Isthmocele length	CRT	7.8±3.6	9.5±3.4	6.0±2.9
	NCRT	8.8±4.1	10.8±5.0	7.5±3.0
	p-value	0.38[c]	0.47[c]	0.24[c]
Isthmocele width	CRT	6.7±3.4	8.4±2.9	4.8±3.0
	NCRT	7.7±4.4	8.5±2.0	7.1±5.6
	p-value	0.40[c]	0.95[c]	0.21[c]
Isthmocele depth	CRT	6.0±2.4	7.5±1.5	4.4±2.2

Table 4. Continued

Variable		Total (n=46)	Laparoscopy (n=22)	Hysteroscopy (n=24)
	NCRT	6.1±2.7	7.4±1.5	5.1±3.1
	p-value	0.92[c]	0.94[c]	0.51[c]
Isthmocele volume	CRT	210.1±195.6	330.6±187.2	82.6±101.9
	NCRT	256.2±218.9	384.9±247.1	166.0±150.2
	p-value	0.47[c]	0.57[c]	0.11[c]
RMT-pre	CRT	2.9±1.5	2.0±0.3	3.7±1.8
	NCRT	2.9±1.3	2.0±1.0	3.5±1.4
	p-value	0.99[c]	0.55[c]	0.71[c]

CRT: Complete response to the treatment, C/S: Cesarean section, NCRT: Incomplete response to the treatment, RMT-pre: Residual myometrial thickness at the baseline
[a]: Data are presented as mean ± standard deviation or as number (percentage)
[b]: Chi-square test
[c]: Independent t-test

separately assessed for the resolution of AUB (n=35), infertility (n=22), and dysmenorrhea (n=14). Our findings revealed that none of the variables significantly affected the resolution of AUB, infertility, and dysmenorrhea, except for the number of previous C/Ss (p-value=0.02) and isthmocele volume (p-value=0.00) in the dysmenorrhea group. This analysis indicated that a lower number of previous C/Ss and a smaller ischiocele volume are associated with the resolution of dysmenorrhea in patients.

Prediction of the Treatment Response

We conducted binomial logistic regression analysis to evaluate the predictive capabilities of variables that exhibited significant effects on treatment response in the independent t-test analysis mentioned earlier. Univariate logistic regression revealed that the age of patients was a significant predictor of symptom resolution (CRT vs. IRT) using a cutoff of 31 years, both in the entire cohort and the hysteroscopy group, with p-values of 0.01 (95% CI: 1.046-1.481) and 0.03 (95% CI: 1.014-1.678), and AUROCs of 0.74 and 0.75, respectively.

However, in contrast, our bivariate logistic regression analysis did not identify significant predictive values for either the number of previous C/Ss or ischiocele volume in predicting the resolution of dysmenorrhea (p-value >0.05).

Discussion

Our findings demonstrated that both laparoscopic and hysteroscopic surgeries can significantly reduce the prevalence of AUB in patients with isthmocele. However, only the laparoscopy group showed a significant decrease in infertility rates post-surgery, and only the hysteroscopy group exhibited significantly lower dysmenorrhea rates at follow-up compared with baseline. In addition, the mean RMT of the patients significantly increased after surgery in the laparoscopy group, whereas the hysteroscopy group did not experience such a change. In addition, both laparoscopy (68.1%) and hysteroscopy (58.3%) groups demonstrated significant symptom resolution after the surgery. Among the assessed variables, only the age of the patients in the hysteroscopy group could predict the treatment response, with a cut-off age of 31 years, whereas no other clinical or sonographic features could predict the response in either the hysteroscopy or laparoscopy groups.

Isthmocele, a common condition affecting up to 70% of women with prior C/S, commonly remains asymptomatic[12]. Research using transvaginal sonography and SIS has reported prevalence rates ranging from 24% to 70% and 56% to 84%, respectively, in women with previous C/S[12]. In patients with symptomatic isthmocele, AUB, infertility, dysmenorrhea, dyspareunia, and chronic pelvic pain are the most commonly reported symptoms[13].

Surgical excision is the primary treatment for symptomatic isthmocele[7], but there is an ongoing debate about the optimal surgical approach. Recent systematic reviews have indicated that both procedures can significantly alleviate AUB and infertility, with success rates between 71-100% and 25-100% for the laparoscopy and 86-100% and 30-100% for hysteroscopy, respectively[13]. While some studies suggest no substantial difference in effectiveness between laparoscopy and hysteroscopy[7,14], others lean toward laparoscopic surgery for better symptom resolution rates[15]. Considering this discrepancy regarding the effectiveness of laparoscopy and hysteroscopy in resolving different isthmocele-related symptoms, future research with larger sample sizes is essential.

Based on our findings, laparoscopic intervention led to a significant increase in RMT, whereas the hysteroscopy group did not experience a significant increase in RMT. This corroborates earlier research showing a substantial RMT increase after laparoscopy[16], whereas hysteroscopy was associated with a notably smaller RMT increase[14]. This divergence chiefly arises from the differing surgical techniques. Laparoscopic procedures involve the resection of the entire uterine tissue housing the isthmocele lesion and suturing the remaining uterine tissues, whereas hysteroscopy excises the isthmocele

lesion from the uterine cavity, resulting in a significantly thinner residual myometrium at the C/S scar site[13]. Considering this, laparoscopy seems preferable for patients with larger isthmocles (lower RMT) aiming for future pregnancies because it reinforces the uterine wall and reduces the risk of rupture or dehiscence[14]. Nevertheless, smaller isthmocele lesions with sufficient RMT may be effectively managed with hysteroscopy, resulting in lower complications and favorable outcomes[10]. Given these divergent findings, there remains a crucial need to establish precise treatment guidelines based on isthmocele characteristics, symptoms, and fertility desires. Further comprehensive studies with larger populations are imperative for this purpose.

Furthermore, we assessed the predictive factors for treatment response in laparoscopic and hysteroscopic surgeries for isthmocele. Our findings reveal that, among hysteroscopy patients, age is a significant predictor of complete symptom resolution, with those 31 years experiencing better outcomes. This corresponds with the only published study in this field, which found a lower age (cut-off: 38 years) to predict infertility resolution after hysteroscopy surgery[13]. This underscores age as a vital factor for predicting surgical treatment response, particularly infertility resolution. However, more research is needed to explore the potential relevance of additional clinical and sonographic features in predicting treatment response for both laparoscopic and hysteroscopic isthmocele surgeries.

Study Limitations

Our study has some limitations. Small sample sizes, observational design, and baseline differences between groups can hinder the generalizability of our findings. Hence, further studies with larger samples and randomized controlled trials are needed to assess and compare the effectiveness of laparoscopic and hysteroscopic isthmocele treatments.

Conclusion

In conclusion, laparoscopic and hysteroscopic isthmoplasty showed similar effectiveness in addressing AUB, with laparoscopy excelling in infertility resolution and hysteroscopy in dysmenorrhea resolution. In addition, only age (younger) among all assessed demographic, clinical, and sonographic factors predicted better treatment outcomes in hysteroscopy patients.

Ethics

Ethics Committee Approval: Before commencement, this research received approval from the Research Deputy and the Ethics Committee of Tehran University of Medical Sciences under the reference number IR.TUMS.MEDICINE.REC.1402.106 and strictly adhered to the ethical standards described in the 1964 version of the Declaration of Helsinki, as revised in 2013.

Informed Consent: Explicit informed verbal and written consent was obtained from all participating individuals.

Authorship Contributions

Surgical and Medical Practices: R.H., N.R.A., Z.A., Z.V., N.H., S.M., M.B., Concept: R.H., Design: R.H., N.R.A., Data Collection or Processing: N.R.A., Z.A., Z.V., N.H., M.B., Analysis or Interpretation: M.P., Z.A., Literature Search: M.P., S.D., Writing: M.P., S.D.

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