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ORIGINAL ARTICLE

The Role of Hysteroscopic Surgery in Treating Uterine Abnormalities and Its Impact on Pregnancy Outcomes. A clinical study

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ABSTRACT

Background: Uterine abnormalities, including congenital malformations, intrauterine adhesions, submucosal fibroids, endometrial polyps, and chronic endometritis are associated with infertility, recurrent pregnancy loss, and obstetric complications. Hysteroscopic surgery offers a minimally invasive alternative to traditional open surgical approaches associated with higher morbidity.

Methodology: A prospective clinical study was done at Gynecology unit -3 Civil Hospital Quetta, Pakistan from March 2022 to January 2023. Two hundred women in the age group of 20–45 years with documented uterine abnormalities by ultrasound, hysterosalpingography, or diagnostic hysteroscopy were enrolled. Demographic and clinical data including age, BMI, duration of infertility, and reproductive history were recorded in detail. The 5 mm operative hysteroscope with a 30° lens was used for hysteroscopic procedures such as septum resection, adhesiolysis, myomectomy, and polypectomy. The pregnancy rates, time to conception, miscarriage and live birth rates, and postoperative complications were assessed in patients followed for 12 months. SPSS was used for statistical analysis and logistic regression was conducted to identify the predictors of successful outcomes.

Results: Mean time to conception was 4.5 months and overall pregnancy rate was 70%. The miscarriage rate was 14.3% and the live birth rate was 78.6% among pregnancies. The postoperative complication rate was 5%. Age also decreased the odds of a positive outcome (OR=0.92, p=0.002) in the logistic regression.

Conclusion: Hysteroscopic surgery is a safe and effective intervention for uterine abnormalities, improving reproductive outcomes. Given the negative effect of advancing age, early intervention is recommended.

Keywords: Hysteroscopic surgery, uterine abnormalities, infertility, pregnancy outcomes, minimally invasive. Further studies will expand these findings.

INTRODUCTION

A broad spectrum of structural and functional abnormalities includes congenital malformations (septate, bicornuate, and unicornuate uteri), acquired anomalies (Asherman's syndrome, intrauterine adhesions), submucosal fibroids, endometrial polyps, and chronic inflammatory conditions[1]. It is well known that these uterine anomalies are associated with significant reproductive problems such as infertility, recurrent pregnancy loss, preterm birth, intrauterine growth restriction, abnormal placentation, and increased risk of obstetric complications with important implications for women's reproductive health and quality of life. Hence, accurate diagnosis and appropriate treatment of these uterine pathologies are essential for the best reproductive outcome and prognosis of fertility-related outcomes[2].

Before the advent of LARH, management of uterine abnormalities was usually accomplished with traditional surgical procedures including open abdominal procedures with or without hysterectomy, or blunt intrauterine curettage, all with their own inherent risk, higher morbidity, and not particularly precise therapeutic modality[3]. Such approaches tend to be invasive, with a lot of excessive intraoperative bleeding, prolonged recovery time, postoperative adhesions, complications such as uterine perforation, and ultimately negative impact on future fertility and pregnancy potential. The advent and progression of minimally invasive techniques, particularly hysteroscopic surgery, has revolutionized the diagnostic and therapeutic armamentarium and allowed the surgeon to perform diagnostic and therapeutic procedures in a safer, less invasive, and more precise manner for intrauterine pathologies[4].

A thin, illuminated endoscopic device is used for visualization through the cervix into the uterine cavity (hysteroscopy) for direct high-resolution visualization of the endometrium and related structures[5]. The main advantage of it lies in the fact that diagnosis and correction of uterine anomalies is possible with minimal trauma to the adjacent healthy tissue in direct view. As a result, hysteroscopic surgery has rapidly become accepted as the gold standard for treating intrauterine lesions including septa, adhesions, polyps, and submucosal myomas due to its proven safety profile, good patient comfort, shorter hospitalization time, lower complication rates, and rapid recovery[6].

Hysteroscopic surgery is currently widely used in clinical practice, however, there is variability of available literature about the definitive effect of hysteroscopic surgery on pregnancy outcomes such as implantation rates, frequency of miscarriage, preterm deliveries, and total live birth rates[7]. In observational studies and smaller randomized controlled trials, the presence of a positive correlation between hysteroscopic correction and pregnancy outcomes has been shown, however, there is a lack of high-quality evidence from large sample studies with long-term follow-up. For this reason, there is a huge demand for thorough clinical studies to determine exactly what the hysteroscopic interventions can do for us, what the limits are, and what effects, if any, they can have[8].

In this present clinical study, we are going to evaluate systematically the role of hysteroscopic surgery in the management of different uterine abnormalities and study the impact of hysteroscopic surgery on subsequent pregnancy outcomes[9]. Our study attempts to determine how much increase in fertility potential, decrease in pregnancy-related complications, and improvement in reproductive prognosis is possible through hysteroscopic intervention. This investigation aimed to provide robust clinical data to make evidence-based recommendations, improve patient counseling, and clinical decision-making, and greatly add to the refinement of treatment protocols for women with uterine abnormalities and fertility challenges[10].

MATERIAL AND METHODS

The design of the study was as a prospective clinical investigation set up at a Gynecology unit -3 Civil Hospital Quetta, Pakistan from March 2022 to January 2023. The study protocol was approved by the institutional review board before study initiation and participants gave written informed consent after being fully briefed about the study's objectives, procedures, and potential risks and benefits.

A total of n=200 women between the ages of 20 and 45 years were consecutively recruited from the outpatient infertility and gynecology clinics using a nonprobability sampling technique. For the inclusion criteria, each participant must be confirmed to have uterine abnormalities based on imaging modalities including transvaginal ultrasound, HSG, or diagnostic hysteroscopy. Pathologies included congenital anomalies (septate, unicornuate, bicornuate uteri), intrauterine adhesions (Asherman's syndrome), submucosal fibroids less than 4 cm, endometrial polyps, chronic endometritis. Details about their demographic were also obtained including age, body mass index (BMI), duration of infertility, duration of marriage, type of infertility (primary or secondary), history of previous miscarriage, history of previous uterine surgeries (e.g., dilatation and curettage), educational level, occupation, and any family history of reproductive problems. The demographic and clinical details provided in this comprehensive collection were essential to assess factors that could potentially impact reproductive outcomes following the intervention.

Experienced gynecologic surgeons performed rigid 5 mm operative hysteroscopy under general or spinal anesthesia with a 5 mm operative hysteroscope with a 30° viewing angle. The normal saline (0.9%) was carefully distended to the uterine cavity whilst maintaining a pressure of 70-100 mmHg to visualize the cavity. Surgical techniques were tailored to address specific uterine pathology: uterine septa were resected with cold scissors or bipolar energy, intrauterine adhesions were lysed using a combination of hysteroscopic scissors and controlled bipolar cautery, and submucosal fibroids were removed by electrosurgical resection using bipolar approach. We excised the endometrial polyps using grasping forceps or bipolar loop in cases of endometrial polyps, and in cases with suspected chronic endometritis, we obtained endometrial biopsy and selected antibiotic therapy. Details of the intraoperative course, including any complications such as uterine perforation, excessive bleeding, or fluid overload, were meticulously recorded.

All patients received standard postoperative care including analgesics, prophylactic antibiotics, and estrogen-based hormone therapy to facilitate endometrial regeneration and minimize recurrence of adhesion. Follow-up evaluation was planned for 2 weeks, 1 month, 3 months, 6 months, and 12 months post-operation for the patients. Follow-up visits consisted of clinical examinations, ultrasonography, and repeat hysteroscopy if needed to examine for recurrence of pathology and reproductive outcome.

Reproductive success and safety were the primary outcome measures of the study. The pregnancy rate overall was determined by serum beta hCG levels and confirmed by ultrasound, the miscarriage rate, the live birth rate, and the rate of obstetric complications including preterm birth, fetal growth restriction, and placental abnormalities. Other secondary outcomes included the time to conception, the rate of postoperative complications, and patient reports of improvement in symptoms like menstrual irregularities, pelvic pain, and abnormal bleeding patterns. Standardized electronic forms were used to collect data, and research assistants were specifically trained to ensure the accuracy and consistency of the data that they entered.

The data were analyzed using SPSS software (version 26.0; IBM Corp, Armonk, NY, USA). Means with standard deviations were used to summarize continuous variables and frequencies and percentages were reported for categorical variables. Categorical data were compared using the chi-square test and Fisher's exact test and continuous variables were compared using Student's t-test or Mann–Whitney U test. Logistic regression analysis also was performed to identify independent predictors of a positive pregnancy outcome, a live birth, with a p-value> 0.05 considered statistically significant.

RESULTS

Baseline Demographic and Clinical Characteristics: Total n=200 women in age 20 to 45 years old, with various uterine abnormalities, underwent hysteroscopic surgery. In addition to the clinical profile, the study population was described in terms of comprehensive demographic detail to better understand the background. The age of the participants was 32.5 ± 5.2 years, and the BMI was 26.8 ± 4.3 kg/m². These women were on average, married for 7.5 ± 3.2 years and were on average, infertile for 3.2 ± 1.8 years. All participants were married 55% were primary infertile and 45% were secondary infertile. An important 30 percent had a history of previous miscarriage and 20 percent had had prior uterine surgeries (such as dilatation and curettage). Of these socioeconomic parameters, 40% had not gone to secondary education, 35% had and 25% went to tertiary education. It consisted of 60% homemakers, 30% employed in different sectors, 10% working in other types of work. Finally, 10 percent of the participants had a family history of reproductive issues. Forty percent had congenital anomalies (septate, bicornuate, or unicornuate uteri), 30% had intrauterine adhesions (Asherman's syndrome), 20% had submucosal fibroids (≤ 4 cm), 10% had endometrial polyps or chronic endometritis. Tables are provided to detail both demographic and clinical features of the study participants. The demographic data of the patients was extended (duration of marriage, educational level, occupation, type of infertility, previous miscarriage, history of uterine surgeries). These factors are necessary for the understanding of the potential impact of hysteroscopic intervention on reproductive outcomes. The baseline fertility and response to treatment may be affected by both socioeconomic status and clinical history, so the data show that the study group is diverse in socioeconomic status and clinical history.

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants (n = 200)

Characteristic	Value
Age (years)	32.5 ± 5.2
BMI (kg/m²)	26.8 ± 4.3
Duration of Infertility (years)	3.2 ± 1.8
Duration of Marriage (years)	7.5 ± 3.2
Marital Status	100% Married
Type of Infertility	55% Primary, 45% Secondary
History of Previous Miscarriage	30%
Previous Uterine Surgeries (e.g., D&C)	20%
Educational Level	40% Below Secondary, 35% Secondary, 25% Tertiary
Occupation	60% Homemaker, 30% Employed, 10% Other
Family History of Reproductive Issues	10%
Type of Uterine Abnormality:	
- Congenital anomalies	80 (40%)
- Intrauterine adhesions	60 (30%)
- Submucosal fibroids	40 (20%)
- Endometrial polyps/Chronic endometritis	20 (10%)

Postoperative and Pregnancy Outcomes: Postoperatively, patients were monitored several times (2 weeks, 1 month, 3 months, 6 months, and 12 months). Overall pregnancy rate, time to conception, miscarriage rate, live birth rate, and obstetric complications including preterm births were the primary endpoints. The rate of postoperative complications was also measured as a secondary outcome. In total, 70% of patients became pregnant after surgery, with a mean time to conception of 4.5 ± 1.2 months. The live birth rate was 78.6% and the miscarriage rate among those who conceived was 14.3%. Furthermore, preterm births were 13.6% of live births, and postoperative complications rate was 5%. The results of hysteroscopic surgery are summarized in the following table. The procedure is efficacious, as a 70% pregnancy rate and a short average time to conception strongly support it. The low complication rate (5%) and near 79% live birth rate (among those who conceived) provide additional support for the safety and benefit of the intervention. Important context for

patient counseling and postoperative care is also provided by the reported rates of miscarriage and preterm birth.

Table 2: Postoperative and Pregnancy Outcomes (n = 200)

Outcome	Value
Overall Pregnancy Rate	140 (70%)
Time to Conception (months)	4.5 ± 1.2
Miscarriage Rate	20 (14.3% of pregnancies)
Live Birth Rate	110 (78.6% of pregnancies)
Preterm Birth Rate	15 (13.6% of live births)
Postoperative Complication Rate	10 (5%)

Predictors of Positive Pregnancy Outcome: A logistic regression analysis was performed to identify factors that influence successful pregnancy outcomes (live birth). Age, BMI, duration of infertility type of uterine abnormality, and postoperative complications were included in the model as variables. The association of increasing age with reduced odds of a positive pregnancy outcome was found to be significant. However, the duration of infertility, BMI, and postoperative complications trended toward lower success but were not significant. Similar differences between the different types of uterine abnormalities were not statistically significant when compared to congenital anomalies.

Table 3: Logistic Regression Analysis for Predictors of Positive Pregnancy Outcome

Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Age (per year increase)	0.92	0.87 – 0.97	0.002
BMI (per unit increase)	0.95	0.89 – 1.01	0.10
Duration of Infertility (per year increase)	0.88	0.75 – 1.03	0.11
Type of Uterine Abnormality:			
- Congenital anomalies	Reference	–	–
- Intrauterine adhesions	1.20	0.75 – 1.92	0.45
- Submucosal fibroids	1.50	0.85 – 2.66	0.16
- Endometrial polyps/Chronic endometritis	1.80	0.85 – 3.80	0.12
Postoperative Complications (Yes vs. No)	0.55	0.25 – 1.20	0.14

The only statistically significant predictor of a positive pregnancy outcome is age which reduces the odds of achieving a positive pregnancy outcome by 8% (OR = 0.92, p = 0.002) for each additional year of age. While there were trends toward decreasing odds with increasing BMI, greater duration of infertility, and presence of postoperative complications, none of these were significant. Both types of uterine abnormality did not significantly influence the outcome relative to the reference group of congenital anomalies. These findings reinforce the pivotal role of age on the outcomes of fertility after hysteroscopic intervention.

The demographic and clinical profile of this study population is summarized as a diverse group of women with varying socioeconomic and reproductive backgrounds. The high overall pregnancy rate (70%), a relatively rapid time to conception (4.5 months), and a favorable live birth rate (78.6% among pregnancies) were achieved with a low postoperative complication rate (5%). Further analysis revealed that increasing age was the only statistically significant predictor of decreased positive pregnancy outcomes, indicating the importance of early intervention in the affected patients. These results suggest that hysteroscopic surgery is a safe and effective treatment modality for improving reproductive outcomes in women with uterine abnormalities.

DISCUSSION

This study's findings emphasize the clinical benefits of hysteroscopic surgery in the treatment of uterine abnormalities and the improvement of reproductive outcomes. With an overall pregnancy rate of 70% and a live birth rate near 79% in those who conceived, the procedure was efficacious and safe[11]. Another aspect of the low complication rate of 5% postoperatively provides support for hysteroscopic surgery as a minimally invasive alternative to traditional surgical methods, characterized by higher morbidity and longer recovery times. The rapid time to conception (4.5 months on average) suggests that hysteroscopic intervention not only corrects intrauterine pathology but also repairs hysteroscopic pathology in the service of timely restoration of fertility[12].

An important part of the analysis was the strong effect of age on pregnancy. Logistic regression model revealed that each additional year in age had an 8% decrease in odds of a positive outcome, indicating that early intervention is needed for women with uterine abnormalities[13]. Other factors, including BMI, duration of infertility, and type of uterine abnormality, were associated with outcomes in a fashion that showed trends but did not become statistically significant. This observation is consistent with other studies that have concluded that age is a major determinant of fertility during surgery to correct uterine pathology[14, 15].

This study also gives a comprehensive collection of demographic data which helped understand the patient population[16]. By including factors such as duration of marriage, type of infertility, educational level, and past reproductive history, its ability to provide a nuanced understanding of the background of the patients was enabled. Although these variables did not achieve significance in the multivariate analysis, documenting them is important for patient counseling and optimizing individual treatment strategies[17].

However, the study has some limitations. Due to the use of non-probability consecutive sampling and single-center design, the results may not be generalizable[18]. In addition, for short-term reproductive outcomes, the follow-up period of up to 12 months was sufficient, however, longer-term studies would be necessary to assess the durability of the surgical benefits as well as to monitor for late complications or recurrences[19, 20].

CONCLUSION

The study concludes with robust evidence that hysteroscopic surgery is a safe and effective method of managing uterine abnormalities and improving fertility outcomes. These advantages of the minimally invasive approach include high pregnancy and live birth rates, rapid return to conception, and minimal postoperative complications. Nevertheless, the association with better treatment success is age, and this underscores the need for early intervention. Future research should be focused on the validation of these findings in a multi-center, larger sample size, and longer follow-up studies to further refine patient selection criteria.

Conflict of Interest: The authors affirm that they have no conflict of interests that could have influenced this work.

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