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Hysteroscopic Polypectomy Prior to Infertility Treatment: A Cost Analysis and Systematic Review

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Abstract

The cost of fertility treatment is expensive and interventions that reduce cost can lead to greater efficiency and fewer embryos transferred. Endometrial polyps contribute to infertility and are frequently removed prior to infertility treatment. It is unclear whether polypectomy reduces fertility treatment cost and if so, the magnitude of cost reduction afforded by the procedure. The aim of this study was to determine whether performing office or operative hysteroscopic polypectomy prior to infertility treatment would be cost-effective. PubMed, Embase, and Cochrane libraries were used to identify publications reporting pregnancy rates after hysteroscopic polypectomy. Studies were required to have a polypectomy treatment group and control group of patients with polyps that were not resected. The charges of infertility treatments and polypectomy were obtained through infertility organizations and a private healthcare cost reporting website. These charges were applied to a decision tree model over the range of pregnancy rates observed in the representative studies to calculate an average cost per clinical or ongoing pregnancy. A

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sensitivity analysis was conducted to assess cost savings of polypectomy over a range of pregnancy rates and polypectomy costs.

Pre-treatment office or operative hysteroscopic polypectomy ultimately saved €6,658 (\$7,480) and €728 (\$818), respectively, of the average cost per clinical pregnancy in women treated with four cycles of intrauterine insemination. Polypectomy prior to intrauterine insemination was cost-effective for clinical pregnancy rates greater than 30.2% for office polypectomy and 52.6% for operative polypectomy and for polypectomy price <€4,414 (\$4,959). Office polypectomy or operative polypectomy saved €15,854 (\$17,813) and €6,644 (\$7,465), respectively, from the average cost per ongoing pregnancy for in vitro fertilization/intracytoplasmic sperm injection treated women and was cost-effective for ongoing pregnancy rates greater than 26.4% (office polypectomy) and 31.7% (operative polypectomy) and polypectomy price <€6,376 (\$7,164).

These findings suggested that office or operative hysteroscopic polypectomy was cost-effective when performed prior to both intrauterine insemination and in vitro fertilization over a range of plausible pregnancy rates and procedural costs.

Keywords

hysteroscopic polypectomy; infertility; cost-effectiveness; in vitro fertilization; intrauterine insemination; endometrial polyps

INTRODUCTION

Infertility, defined as the failure to achieve a clinical pregnancy after 12 months or more of regular unprotected intercourse, affects 5–15% of couples internationally ¹ and infertility treatment poses a huge economic burden to these individuals ². The cost of infertility treatment is expected to increase as more and more couples elect for assisted reproductive technologies (ART) such as in vitro fertilization (IVF). Oftentimes, all or at least some portion of IVF is paid out-of-pocket and can amount to as much as 20% of an individual's disposable income in Europe and 46% of a couple's disposable income in the United States ³. Given these figures, it is clear that any intervention which may reduce expenditures for fertility treatments would have great impact on the population's access to both non-ART and ART technologies.

One common intervention conducted prior to fertility treatment is polypectomy, as there is evidence that uterine structural abnormalities contribute to implantation failure and infertility. Endometrial polyps are among the most common intra-cavitary lesions of the uterus. Polyps are localized outgrowths of the endometrial mucosa consisting of glands and stroma and are thought to develop as a result of a defective response to estrogen and progesterone ⁴. Their exact prevalence is not known, as polyps can be asymptomatic; however, they have been diagnosed hysteroscopically in 4% ⁵ of all women with unexplained infertility and 14.8% ⁶ of infertile women with eumenorrhea.

Although data are limited, considerable evidence suggests that endometrial polyps may interfere with implantation, whether in spontaneous or in assisted reproduction ^{7,8}. Multiple mechanisms have been proposed to explain how polyps may cause subfertility. Molecular

studies have linked polyps to defective uterine receptivity. Rackow et al.⁹ showed a marked decrease in HOXA 10 and HOXA 11 mRNA levels, which were earlier linked to implantation¹⁰. Richlin et al.¹¹ found altered levels of glycodelin in women with endometrial polyps, which inhibits natural killer cells at the time of implantation. Other studies proposed that polyps might present a defective implantation site⁴, a physical obstacle deforming the cavity, or a hindrance in sperm migration¹². In line with these molecular studies, endometrial polyps were the most common uterine abnormality detected in patients with recurrent implantation failures after IVF¹³.

Hysteroscopy is the gold standard for diagnosing polyps; it offers direct visualization of the lesions with the advantage of polyp excision and restoration of the integrity of the uterine cavity in the same procedure to improve fertility. Hysteroscopic polypectomy can be conducted as either an office procedure or as an operative procedure under anesthesia. Clinical studies evaluating fertility outcomes of women who underwent hysteroscopic polypectomy before assisted reproduction treatment versus those who did not are scant. Study designs vary greatly and the majority of studies are observational. With the limited availability of clinical evidence to guide patient care, the additional cost of polypectomy and its efficacy in reducing overall fertility treatment cost may help clinicians determine the best course of management for their patients. For this purpose, we sought to review the available literature and conduct a cost-analysis to determine whether office or operative hysteroscopic polypectomy offered a cost savings when added to infertility treatments of intrauterine insemination (IUI) and IVF/intracytoplasmic sperm injection (ICSI). In the past, similar analyses have been carried out to evaluate the cost-effectiveness of polyp removal to reduce abnormal uterine bleeding, but no studies have comprehensively examined the economic value of hysteroscopic polypectomy in a fertility setting¹⁴.

MATERIALS AND METHODS

Search Strategy and Data Collection

A systematic literature review was performed in August 2016. The analysis was based on publically accessible and previously published data, thus an Institutional Review Board approval was not necessary. The PubMed, Embase, and Cochrane libraries were extensively searched with the broad terms: *endometrial polyp*, *uterine polyp*, *hysteroscopy/HSC*, *hysteroscopic polypectomy*, *infertility*, *in vitro fertilization/IVF*, *intracytoplasmic sperm injection/ICSI*, *intrauterine insemination/IUI*, *fertility outcome*, *miscarriage*, and *pregnancy rate*. Only articles in English or with available English translations were utilized. Two authors assessed the titles and abstracts for relevance and relevant articles were analyzed in detail to determine which studies could be included in the proposed cost analysis model. Furthermore, the references cited in the relevant studies and review articles were hand searched to identify further studies of interest.

Cost Analysis Model

For the purposes of our cost analysis, charges were used. Charges are defined as the monetary amount billed to an insurance company or individual patient for a given medical service. This is different than cost, which is the monetary amount it actually costs a given

medical center or hospital to provide a service. Charges were used instead of costs because costs vary across medical facilities depending on their efficiency and profitability. Cost-effectiveness was defined as the course of action resulting in lowest charged amount (all values are expressed in 2016 US dollars and converted 2016 Euros). The aim of this study was to calculate the overall average cost per clinical or ongoing pregnancy when hysteroscopic polypectomy was performed prior to infertility treatment (IUI or IVF/ICSI) versus the cost when the polyp was not removed. A decision tree model was constructed using charges and pregnancy rates reported in the literature. Cost per clinical or ongoing pregnancy was calculated by dividing charge of IUI or IVF/ICSI +/- polypectomy by the clinical or ongoing pregnancy rate. For the IUI studies, the charge of four cycles of IUI was used even though some women were pregnant before completing all four cycles. The effects of this strategy on the results are explained in the Comment section of this paper.

Charges

We examined the direct charges of hysteroscopic polypectomy and infertility treatments. These are detailed in Table 1. Data were abstracted from infertility organizations^{15,16} and a private healthcare cost reporting website¹⁷ to acquire necessary charges for our calculations. In the United States, the charge of office polypectomy is €732 (\$823) and the charge of operative polypectomy with anesthesia is €4,011 (\$4,507)¹⁷. The median charge of an IUI cycle based on 30 clinics was estimated to be €24 (\$1,038)¹⁶. The American Society for Reproductive Medicine (ASRM) estimated a charge of €5,450 (\$17,360) for an average IVF/ICSI cycle based on a survey of 140 clinics. This estimate included costs for initial consultation, cycle management, medications, ultrasounds, endocrinology and embryology lab fees, facility fee, sperm preparation, oocyte retrieval, anesthesia, embryo transfer, HCG testing, and OB sonograms. It uses the assumption that 50% of cycles require ICSI, 30% assisted hatching, and 25% cryopreservation and storage of embryos and included these costs into the estimate¹⁵.

Pregnancy Rates

Clinical and ongoing pregnancy rates for each arm were estimated from the available studies described previously. The included studies defined a clinical pregnancy as a gestational sac with cardiac activity noted on ultrasound. Ongoing pregnancy rate was calculated from the clinical pregnancy rate corrected for first trimester spontaneous miscarriages.

Statistical Tests and Sensitivity Analysis

The sensitivity analysis was carried out in Excel and varied either average pregnancy rate or charge of polypectomy. To compare the two IUI study baseline characteristics, the Pearson's Chi-Squared Test was used for proportions and the Student's t-test was used for mean values. Statistical analysis used RStudio Version 0.98.1091.

RESULTS

Search Results and Study Selection

The initial search yielded a total of 247 titles of possible interest. The search was narrowed down to two studies related to IUI^{18,19} and seven studies related to IVF/ICSI^{20–26}. We only

included studies with proper control groups, which were defined as patients with a diagnosed polyp who received no intervention prior to fertility treatment. We did not draw a distinction between studies using office or operative hysteroscopy because both modalities have demonstrated equal efficacy in polyp removal and thus choice of modality would be unlikely to influence pregnancy rates²⁷. We did, however, account for differences in costs of these two modalities in our models. Both randomized controlled trials investigating the effects of endometrial polypectomy on fertility outcomes in IUI cycles were analyzed^{18,19}. The studies related to IVF/ICSI outcomes were more heterogeneous in their design. Of the seven studies of interest, two had mismatched control groups^{20,21} while another two were case series^{22,23} and therefore were excluded from the analysis. The remaining three studies^{24–26} had properly matched control groups and thus were included in the analysis.

Baseline Characteristics

In order to control for differences in baseline characteristics of patients in the two IUI studies, available data were used to compare mean age and infertility etiology (cervical, ovulatory, endometriosis, male factor, or idiopathic). The only difference found was that the Perez-Medina et al.¹⁸ study had a greater percentage of patients with idiopathic infertility than the Shohayeb and Shaltout study¹⁹ for both polypectomy (48.5% vs. 28.3%, $p=0.01$) and control (54.3% vs. 21.7%, $p=0.0001$) groups. The same analysis could not be carried out for the IVF/ICSI studies because data needed for statistical comparison were not reported.

Hysteroscopic Polypectomy and IUI

Clinical pregnancy rates for women with endometrial polyps who underwent up to four IUI cycles after polypectomy or no intervention were estimated from the literature and formed the basis for the cost calculations. Perez-Medina et al.¹⁸ randomized 215 subfertile women with polyps to either hysteroscopic polypectomy or biopsy followed by up to four IUI cycles. Shohayeb and Shaltout¹⁹ randomized 120 subfertile patients with polyps to either polypectomy or no intervention followed by up to four IUI cycles. Both trials calculated the cumulative clinical pregnancy rates after four IUI cycles, and their characteristics are summarized in Table 2. The average cumulative pregnancy rates from both studies combined was 55.3% for the women who had hysteroscopic polypectomy versus 25.2% for women who did not have polyp removal. Office hysteroscopic polypectomy saved €6,658 (\$7,480) per clinical pregnancy and operative hysteroscopic polypectomy saved €728 (\$818) per clinical pregnancy (Table 3). Notably, both studies found that polyp size did not affect pregnancy rate; the effect of polyp location was not explored. We conducted a sub-analysis stratified by polyp size, demonstrating similar cost savings as in Table 3. For office hysteroscopic polypectomy, for polyps ≤ 1 cm cost savings was €6,909 (\$7,763) and for polyps >1 cm cost savings was €6,643 (\$7,464). For operative hysteroscopic polypectomy, for polyps ≤ 1 cm cost savings was €1,167 (\$1,312) and for polyps >1 cm cost savings was €703 (\$790).

IUI Sensitivity Analysis

For the sensitivity analysis, expectant management cost for IUI was set to €14,664 (\$16,476) derived using average clinical pregnancy rate of 25.2% for the control group (Table 3). Average clinical pregnancy rate was varied from 0–100% and divided into cost of IUI plus

office or operative polypectomy. For IUI, office polypectomy and operative polypectomy were cost-effective when the clinical pregnancy rate with these procedures was greater than 30.2% (Figure 1) and 52.6% (Figure 2), respectively. Charge of polypectomy was varied from €0 (\$0) to €6,230 (\$7,000) for IUI and divided into treatment group pregnancy rate of 55.3% (Table 3). Performing hysteroscopic polypectomy was cost-effective as long as the procedure was less than €4,414 (\$4,959) (Figure 3).

Hysteroscopic Polypectomy and IVF/ICSI

The likelihood of ongoing pregnancy for women with polyps who underwent IVF/ICSI after either hysteroscopic polypectomy or no intervention were estimated from the literature and formed the basis for the cost calculations. Specifically, Lass et al.²⁴ retrospectively analyzed the effects of endometrial polyp removal in a group of subfertile women undergoing IVF. 21 women had hysteroscopic polyp removal followed by frozen embryo transfer three months after the procedure and 49 women underwent IVF and fresh embryo transfer without polyp removal. In the second study, Isikoglu et al.²⁵ performed a retrospective analysis of the effect of polyp removal on ICSI success. ICSI cycles were performed in 40 women after hysteroscopic polypectomy and 15 women without intervention. In the third study, Ghaffari et al.²⁶ performed a cross-sectional analysis comparing 43 patients who received hysteroscopic polypectomy and 43 polyp size-matched patients undergoing ICSI. All three studies reported clinical pregnancy rates and spontaneous miscarriage rates as outcomes of the infertility treatment. Table 4 summarizes details of the studies and the ongoing pregnancy rates that form the basis for the cost analysis. These studies did not report if polyp size affected pregnancy rates. Ghaffari et al.²⁶ reported no significant difference in pregnancy rates by polyp location.

The ongoing pregnancy rate abstracted from an average of the three studies was 35.6% in the group that had the polyp removal versus 25.2% for the group that did not. The average cost savings per ongoing pregnancy was €15,854 (\$17,813) in the office hysteroscopy group and €6,644 (\$7,465) in the operative hysteroscopy group (Table 5).

IVF/ICSI Sensitivity Analysis

For the sensitivity analysis, expectant management cost for IVF/ICSI was set to €61,311 (\$68,889) derived from an ongoing pregnancy rate of 25.2% in the control group (Table 5). Average ongoing pregnancy rate was varied from 0–100% and divided into cost of IVF/ICSI plus office or operative polypectomy. For IVF/ICSI, office polypectomy and operative polypectomy were cost-effective when the ongoing pregnancy rates with these procedures were greater than 26.4% (Figure 4) and 31.7% (Figure 5), respectively. Average charge of polypectomy was varied from €0 (\$0) to €16,020 (\$18,000) for IVF/ICSI and divided into treatment pregnancy rate of 35.6% (Table 5). Performing hysteroscopic polypectomy was cost-effective as long as the charge was less than €6,376 (\$7,164) (Figure 6).

COMMENT

Main Findings

We found that performing either office or operative hysteroscopic polypectomy prior to infertility treatment was cost-effective for both IUI and IVF/ICSI treated women. Sensitivity analysis showed that hysteroscopic polypectomy was cost-effective over a range of plausible pregnancy rates and polypectomy costs. Polypectomy prior to IUI is recommended from a clinical and cost standpoint, as the procedure doubles the pregnancy rate, shortens time to pregnancy^{18,19}, and is cost-effective across a range of polyp sizes. On the other hand, even though clinical data are equivocal^{24–26} our analysis revealed that performing a hysteroscopic polypectomy prior to IVF/ICSI was cost-effective, especially for office hysteroscopy.

A strength of this study is utilization of the best available data for pregnancy rates of women undergoing hysteroscopic polypectomy before infertility treatment. Both IUI studies used in this paper were randomized controlled trials. While the IVF/ICSI studies were retrospective case control and cross sectional studies, these were the only publications with proper control groups. By pooling the data from the reviewed studies, greater regional, patient, and treatment variation can be accounted for in the cost analysis, providing a more accurate picture. Data for charges, especially for the IVF/ICSI costs, encompassed all fees associated with the procedure. Finally, the sensitivity analysis accounts for variation in pregnancy rates across studies and polypectomy procedural costs across clinics. A limitation of the cost analysis was that we did not include indirect costs of the polypectomy procedure, such as that of time lost from work, histopathologic examination of the obtained specimens, and the cost of surgical complications. However, the procedure is usually a one-day outpatient procedure with a low complication rate²⁸, so we maintain that indirect costs are unlikely to negate the findings.

A limitation of the IUI analysis is that the Perez-Medina et al.¹⁸ study did not include pregnancy rates per IUI cycle. Therefore, we utilized the charge of four cycles. This assumption most likely underestimates the cost savings of polypectomy with IUI given that the majority of polypectomy patients became pregnant before completing all four cycles. The Perez-Medina et al.¹⁸ study states that 65% of polypectomy patients were pregnant even before their first cycle while control women only became pregnant with one or more IUI cycles. The Shohayeb and Shaltout¹⁹ study reported that all polypectomy patients were pregnant within their first two IUI cycles, while the pregnancies for control women were distributed across the four cycles. From these data, it is evident that our cost-analysis is conservative and polypectomy leads to clinical pregnancy in fewer IUI cycles and is predicted to result in lower average cost per clinical pregnancy.

There was some heterogeneity in design of the IVF/ICSI studies. There were differences in use of fresh versus frozen embryo transfer for the Lass et al.²⁴ study. While frozen embryo transfer has been shown to increase clinical pregnancy rates²⁹, we do not think this would account for the entire difference between polypectomy vs. control pregnancy rates reported in this study. Furthermore, there is controversy regarding whether frozen embryo transfer truly improves pregnancy rates for all types of patients and more data is needed before

routinely implementing it in practice³⁰. We do not believe that the use of IVF for the Lass et al.²⁴ study and ICSI for the Isikoglu et al.²⁵ and Ghaffari et al.²⁶ studies would substantially skew pregnancy rate outcomes used for the analysis given previous work showing no difference between the two methods^{31,32} and possible overuse of ICSI when IVF is equivalent³³.

Since pregnancy rates were not reported based on polyp size, number, or location for all studies, it was not possible to incorporate these factors into the cost analysis. We did conduct a sub-analysis for the two IUI studies based on polyp size and demonstrated similar costs savings as the aggregate analysis. In support that polyp characteristics may not affect pregnancy rates, Stamatellos et al.³⁴ found no difference in spontaneous abortion, spontaneous pregnancy, or delivery at term rates after hysteroscopic polypectomy based on polyp size or number. Similarly, Karakus et al.³⁵ reported that polyp size, number, or intrauterine location had no effect on post-polypectomy clinical pregnancy rates prior to IVF/ICSI with fresh embryo transfer. Ghaffari et al.²⁶ also reported no significant difference in pregnancy rates by polyp location for ICSI patients. However, a retrospective study by Yanaihara et al.³⁶ of 230 infertility patients concluded that pregnancy rate after polypectomy at the uterotubal junction was significantly higher than that of other uterine locations. Based on these data, polypectomy prior to both IUI and IVF/ICSI would likely offer a cost benefit irrespective of polyp size and number. Further clinical studies are needed for conclusive evidence regarding polyp location and pregnancy rates after resection.

Finally, it is meaningful to acknowledge that the timing of polyp occurrence may also affect polypectomy efficacy in improving fertility. In the Lass et al.²⁴ study, 48.2% had polyps detected at baseline scan while 51.8% of polyps were diagnosed during controlled ovarian stimulation. This difference in polyp timing was distributed across both treatment and control groups. The Isikoglu et al.²⁵ study's polypectomy patients had polyps diagnosed prior to their treatment cycle and control patients with polyps diagnosed during stimulation. The Ghaffari et al.²⁶ study, on the other hand, only included patients with polyps diagnosed during stimulation. It is unclear how timing of polyp occurrence may have affected the pregnancy rates reported in these studies. We did not find any polypectomy studies comparing outcomes between polyps diagnosed before vs. during stimulation and their corresponding control groups; this is an important distinction to be explored in future work.

Interpretation

To the best of our knowledge, this is the first analysis to address cost-effectiveness of office or operative hysteroscopic polypectomy before both IUI and IVF/ICSI treatments. In general, the accepted clinical practice for asymptomatic endometrial polyps is removal and this is supported by randomized controlled trials for IUI patients. However, the practice of polypectomy is also adopted in subfertile women before IVF/ICSI without strong, evidence-based support⁷. One reason existing evidence is limited regarding polyp removal for the IVF/ICSI population is because caregivers are reluctant to leave polyps behind given the high cost of IVF cycles. Given the paucity of robust clinical evidence surrounding polypectomy prior to IVF/ICSI, our results support a course of action for clinicians from a cost savings perspective across a wide range of clinical scenarios. Specifically, office

hysteroscopy for polyp removal was the most cost-effective intervention. A large cost-analysis of over 1000 patients provides additional evidence that outpatient (office) “see and treat” hysteroscopy lowers cost compared to operative hysteroscopy under general anesthesia³⁷. The finding that polypectomy reduces cost of IVF/ICSI is of paramount importance because cost has been associated with decreased access to care and a consequence of high out-of-pocket ART costs is increase in transfer of multiple embryos. Multiple gestations substantially increases the risk of multiple births and associated neonatal and maternal complications³. Using more cost-effective strategies for ART may therefore increase access to fertility care as well as decrease adverse health outcomes for mother and baby.

CONCLUSION

In conclusion, hysteroscopic polypectomy prior to IUI based on two randomized controlled trials proved both clinically significant and cost-effective. Our analysis for IVF/ICSI was based on pregnancy rates from two retrospective case control studies and one cross sectional study; therefore, a randomized controlled trial incorporating success rates of IVF/ICSI after hysteroscopic polypectomy stratified by polyp characteristics and timing of polyp occurrence would further strengthen our findings. A future direction would also be to analyze cost-effectiveness of specific hysteroscopy systems used in the outpatient and inpatient settings, such as micro-scissors, forceps, monopolar loop cautery, bipolar electrodes, hysteroscopic morcellators, and other techniques that are in development for polypectomy.

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Figure 1.

Sensitivity analysis: effect of variation in clinical pregnancy rate on average cost per clinical pregnancy in couples pursuing intrauterine insemination (IUI). Expectant management cost was €14,664 (\$16,476). Notably, office hysteroscopic polypectomy was cost-effective when the pregnancy rate after polypectomy was greater than 30.2%.

Hysteroscopic polypectomy before IUI (diamond); expectant management (square).

Figure 2.

Sensitivity analysis: effect of variation in clinical pregnancy rate on average cost per clinical pregnancy in couples pursuing intrauterine insemination (IUI). Expectant management cost was €14,664 (\$16,476). Notably, operative hysteroscopic polypectomy was cost-effective when the pregnancy rate after polypectomy was greater than 52.6%, respectively. Hysteroscopic polypectomy before IUI (diamond); expectant management (square).

Figure 3.

Sensitivity analysis: effect of variation in the cost of hysteroscopic polypectomy upon the average cost per clinical pregnancy in couples pursuing intrauterine insemination (IUI). Expectant management cost was €14,664 (\$16,476). Treatment clinical pregnancy rate was set to 55.3%. Hysteroscopic polypectomy was cost-effective compared to expectant management for procedural cost less than €4,414 (\$4,959). Hysteroscopic polypectomy before IUI (diamond); expectant management (square).

Figure 4. Sensitivity analysis: effect of variation in ongoing pregnancy rate on average cost per ongoing pregnancy in couples pursuing in vitro fertilization (IVF)/intracytoplasmic sperm injection (ICSI). Expectant management cost was €61,311 (\$68,889). Notably, office hysteroscopic polypectomy was cost-effective when the pregnancy rate after polypectomy was greater than 26.4%.
Hysteroscopic polypectomy before IVF/ICSI (diamond); expectant management (square).

Figure 5.

Sensitivity analysis: effect of variation in ongoing pregnancy rate on average cost per ongoing pregnancy in couples pursuing in vitro fertilization (IVF)/intracytoplasmic sperm injection (ICSI). Expectant management cost was €61,311 (\$68,889). Notably, operative hysteroscopic polypectomy was cost-effective when the pregnancy rate after polypectomy was greater than 31.7%.

Hysteroscopic polypectomy before IVF/ICSI (diamond); expectant management (square).

Figure 6.

Sensitivity analysis: effect of variation in the cost of hysteroscopic polypectomy upon the average cost per ongoing pregnancy in couples pursuing in vitro fertilization (IVF)/intracytoplasmic sperm injection (ICSI). Expectant management cost was €61,311 (\$68,889). Treatment clinical pregnancy rate was set to 35.6%. Hysteroscopic polypectomy was cost-effective compared to expectant management for procedural cost less €6,376 (\$7,164).

Hysteroscopic polypectomy before IUI (diamond); expectant management (square).

Table 1

Charges and sources used for the cost analysis.

	Charges in 2016 Euros	Charges in 2016 USD	Source
Office HSC Polypectomy	732	\$823	Healthcare Bluebook
Operative HSC Polypectomy	4,011	\$4,507	Healthcare Bluebook
IUI per Cycle	924	\$1,038	Resolve
IVF/ICSI	15,450	\$17,360	ASRM

HSC=hysteroscopic

IUI=intrauterine insemination

IVF=in vitro fertilization

ICSI=intracytoplasmic sperm injection

ASRM=American Society for Reproductive Medicine

Summary of two studies assessing clinical pregnancy rates with four cycles of IUI after polyp removal or expectant management.

Table 2

Study	Design	Patients	Intervention	Clinical Pregnancy Rate	
				Study Group	Control Group
Perez-Medina et al.	RCT	215 subfertile women age 30.8±4.1 (S) 30.9 ±4.4 (C) EP size 3–24 mm, undergoing IUI	Hysteroscopic polypectomy + 4 IUI vs. biopsy + 4 IUI	63.4% 64/101	28.2% 29/103
Shohayeb and Shaltout	RCT	120 subfertile women age 31.2 ±4.3 (S) 30.8 ±4.7 (C) EP size 5–30 mm, undergoing IUI	Hysteroscopic polypectomy + 4 IUI vs. 4 IUI	41.7% 25/60	20.0% 12/60
Average				55.3% 89/161	25.2% 41/163

S=Study Group

C=Control Group

RCT=randomized controlled trial

IUI=intruterine insemination

EP=endometrial polyp

Table 3

Calculated overall cost per clinical pregnancy after hysteroscopic polypectomy (office or operative) versus expectant management based on the pregnancy rates from both IUI studies.

	IUI							
Office Procedure	Hysteroscopic Polypectomy				Expectant Management			
	Study	Clinical Pregnancy Rate	Treatment Cost	Cost per Clinical Pregnancy	Clinical Pregnancy Rate	Treatment Cost	Cost per Clinical Pregnancy	Cost Savings
	Perez-Medina et al.	63.4%	€4,428 ¹ \$4,975	€6,984 \$7,847	28.2%	€3,695 ² \$4,152	€13,103 \$14,723	€6,119 \$6,876
	Shohayeb and Shallout	41.7%	€4,428 ¹ \$4,975	€10,618 \$11,930	20.0%	€3,695 ² \$4,152	€8,476 \$20,760	€7,858 \$8,830
	Average	55.3%	€4,428 ¹ \$4,975	€8,006 \$8,996	25.2%	€3,695 ² \$4,152	€4,664 \$16,476	€6,658 \$7,480
Operative Procedure	Hysteroscopic Polypectomy				Expectant Management			
	Study	Clinical Pregnancy Rate	Treatment Cost	Cost per Clinical Pregnancy	Clinical Pregnancy Rate	Treatment Cost	Cost per Clinical Pregnancy	Cost Savings
	Perez-Medina et al.	63.4%	€7,707 ³ \$8,659	€12,156 \$13,658	28.2%	€3,695 ² \$4,152	€13,103 \$14,723	€948 \$1,065
	Shohayeb and Shallout	41.7%	€7,707 ³ \$8,659	€18,480 \$20,765	20.0%	€3,695 ² \$4,152	€8,476 \$20,760	−€ −\$5
	Average	55.3%	€7,707 ³ \$8,659	€13,936 \$15,658	25.2%	€3,695 ² \$4,152	€4,664 \$16,476	€728 \$818

IUI=intrauterine insemination

¹Calculated cost of four IUI cycles with office hysteroscopic polypectomy

²Calculated cost of four IUI cycles

Cost savings is expectant management cost minus polypectomy cost and favors polypectomy

€=Converted 2016 Euros; \$=2016 US Dollars

Calculated cost of four IUI cycles with operative hysteroscopic polypectomy

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Table 4

Summary of three studies assessing reproductive outcome with IVF or ICSI after polyp removal or expectant management.

Study	Design	Patients	Intervention	Pregnancy Rate		Spontaneous Miscarriage Rate		Ongoing Pregnancy Rate	
				S	C	S	C	S	C
Lass et al.	RCC	70 subfertile women age 35.4±3.6 (S) 35.4±3.8 (C) EP <20 mm	HSC polypectomy + IVF + FET vs. IVF	7/21	11/49	1/7	3/11	28.6% 6/21	16.3% 8/49
Isikoglu et al.	RCC	55 subfertile women age 28-34 (S) 29-38 (C) majority of EP <15 mm	HSC polypectomy + ICSI vs. ICSI	18/40	8/15	0/18	1/8	45.0% 18/40	46.7% 7/15
Ghaffari et al.	CS	86 subfertile women age 33.9±3.9 (S) 32.5±4.4 (C) matched by polyp size, EP <20mm	HSC polypectomy + ICSI vs. ICSI	15/43	14/43	2/15	2/14	30.2% 13/43	27.9% 12/43
Average				40/104	33/107	3/40	6/33	35.6% 37/104	25.2% 27/107

S=Study Group, C=Control Group

RCC=retrospective case control

CS=cross-sectional

EP=endometrial polyp

HSC=hysteroscopic

IVF=in vitro fertilization

FET=frozen embryo transfer

ICSI=intracytoplasmic sperm injection

Table 5

Calculated overall cost per ongoing pregnancy after hysteroscopic polypectomy (office or operative) versus expectant management based on the pregnancy rates from three IVF/ICSI studies.

	IVF/ICSI						
Office Procedure	Hysteroscopic Polypectomy				Expectant Management		
	Study	Ongoing Pregnancy Rate	Treatment Cost	Cost per Ongoing Pregnancy	Ongoing Pregnancy Rate	Treatment Cost	Cost per Ongoing Pregnancy
	Lass et al.	28.6%	€16,183 ¹ \$18,183	€56,584 \$63,577	16.3%	€15,450 ² \$17,360	€94,788 \$106,503
	Isikoglu et al.	45.0%	€16,183 ¹ \$18,183	€55,962 \$40,407	46.7%	€15,450 ² \$17,360	€33,084 \$37,173
	Ghaffari et al.	30.2%	€16,183 ¹ \$18,183	€53,586 \$60,209	27.9%	€15,450 ² \$17,360	€55,378 \$62,222
	Average	35.6%	€16,183 ¹ \$18,183	€54,458 \$51,076	25.2%	€15,450 ² \$17,360	€61,311 \$68,889
Operative Procedure	Hysteroscopic Polypectomy				Expectant Management		
	Study	Ongoing Pregnancy Rate	Treatment Cost	Cost per Ongoing Pregnancy	Ongoing Pregnancy Rate	Treatment Cost	Cost per Ongoing Pregnancy
	Lass et al.	28.6%	€19,462 ³ \$21,867	€68,048 \$76,458	16.3%	€15,450 ² \$17,360	€94,788 \$106,503
	Isikoglu et al.	45.0%	€19,462 ³ \$21,867	€63,248 \$48,593	46.7%	€15,450 ² \$17,360	€33,084 \$37,173
	Ghaffari et al.	30.2%	€19,462 ³ \$21,867	€64,442 \$72,407	27.9%	€15,450 ² \$17,360	€55,378 \$62,222
	Average	35.6%	€19,462 ³ \$21,867	€64,667 \$54,667	25.2%	€15,450 ² \$17,360	€61,311 \$68,889

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