



Hysteroscopic tubal electrocoagulation versus laparoscopic tubal disconnection for the management of hydrosalpinx and subsequent pregnancy outcomes: A randomized clinical trial

Hidrosalpinksin yönetiminde histeroskopik tubal elektrokoagülasyon ile laparoskopik tubal bağlantı kesilmesinin karşılaştırılması ve sonraki gebelik sonuçları: Randomize bir klinik çalışma

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Abstract

Objective: Hydrosalpinx impairs the success of in vitro fertilization (IVF) embryo transfer. Various surgical approaches, such as fluid aspiration or isolation of the affected fallopian tubes, have been used to enhance the outcome. This study was conducted to evaluate and compare the efficacy of laparoscopic tubal disconnection (LTD) and hysteroscopic tubal electrocoagulation (HTE) for hydrosalpinx before IVF.

Materials and Methods: After obtaining ethical committee approval, we assessed 112 women who were subfertile due to hydrosalpinx to check their adherence to our selection criteria. Eligible patients were allocated into two groups (LTD vs. HTE). Both groups underwent extensive assessment before the operative procedure. IVF and subsequent embryo transfers were performed in both groups. Live birth and pregnancy rates were evaluated.

Results: Patients who underwent LTD prior to IVF embryo transfer had significantly higher live birth (41%), clinical pregnancy (57%), and chemical pregnancy (61%) rates in the LTD group than in the HTE group (12%, 35%, 41%, respectively). However, we could not find a significant difference between the two groups regarding the miscarriage (17% vs. 28%, $p=0.33$) and multiple pregnancy (14% vs. 12%, $p=0.79$) rates. No major complications with HTE were observed, except for a case of uterine perforation, whereas two cases of surgical complications occurred in the LTD group. Additionally, we found a significantly shorter operative time and hospital stay (0.5 ± 0.7 days, $p=0.012$) in the HTE group.

Conclusion: LTD may be a more effective approach compared with hysteroscopic tubal electrocoagulation for improving birth and pregnancy rates in patients with IVF and hydrosalpinx.

Keywords: Hydrosalpinx, tubal infertility, IVF, embryo transfer, laparoscopy

Öz

Amaç: Hidrosalpinkin, in vitro fertilizasyon (IVF) embriyo transferinin başarısını bozar. Sonucu iyileştirmek için sıvı aspirasyonu veya etkilenen fallop tüplerinin izolasyonu gibi çeşitli cerrahi yaklaşımlar kullanılmıştır. Bu çalışma, IVF öncesinde hidrosalpink için laparoskopik tubal bağlantının kesilmesinin (LTBK) hidroskopik tubal elektrokoagülasyona (HTE) karşı etkinliğini değerlendirmek ve iki yöntemi karşılaştırmak için yapıldı.

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Gereç ve Yöntemler: Etik kurul onayını aldıktan sonra, hydrosalpinx nedeniyle kısır olan 112 kadını, seçim kriterlerimize uygunluklarını kontrol etmek için değerlendirdik. Uygun hastalar 2 gruba ayrıldı (LTBK ve HTE). Her iki gruba da operasyon öncesi kapsamlı bir değerlendirme yapıldı. Her iki grupta da IVF ve ardından embriyo transferleri yapıldı. Canlı doğum ve gebelik oranları değerlendirildi.

Bulgular: Tüp bebek embriyo transferi öncesinde LTBK uygulanan hastalarda, HTE grubuna (sırasıyla %12, %35 ve %41) kıyasla canlı doğum (%41), klinik gebelik (%57) ve kimyasal gebelik (%61) oranları anlamlı derecede daha yüksekti. Ancak düşük (%17 vs. %28, $p=0,33$) ve çoğul gebelik (%14 vs. %12, $p=0,79$) oranları açısından 2 grup arasında anlamlı bir fark yoktu. HTE grubunda uterus perforasyonu dışında majör bir komplikasyon görülmezken, LTBK grubunda 2 olguda cerrahi komplikasyon meydana geldi. Ayrıca HTE grubunda anlamlı olarak daha kısa ameliyat süresi ve hastanede kalış süresi ($0,5\pm 0,7$ gün, $p=0,012$) saptandı.

Sonuç: Hydrosalpinxli IVF hastalarında doğum ve gebelik oranlarının iyileştirilmesinde LTBK HTE'ye göre daha etkili bir yaklaşım olabilir.

Anahtar Kelimeler: Hydrosalpinx, tubal infertilite, IVF, embriyo transferi, laparoskopi

Introduction

Hydrosalpinx is the most serious type of tubal disease, accounting for more than 35% of female infertility cases^(1,2). It occurs when the ampullary part of the fallopian tube is abnormally enlarged and filled with fluid due to blockage. This blockage causes tubal fluid to build up and reverse its flow into the uterus. Symptoms of hydrosalpinx include dyspareunia, persistent pelvic discomfort, and pelvic pressure. It can be diagnosed by hysterosalpingography (HSG), sonohysterosalpingography, or vaginal ultrasonography (TVUS)⁽³⁾.

With regard to infertility treatments, the development of in vitro fertilization (IVF) was initially motivated by tubal factor infertility. However, individuals with hydrosalpinx, compared with those without hydrosalpinx, have worse outcomes with IVF^(4,5). The reason for this is that the transferred embryos can be washed away by the tubal-uterine reflux of the fluid present in the hydrosalpinx. Additionally, the hydrosalpinx can affect endometrial receptivity, leading to lower implantation rates⁽⁶⁾. The standard treatment for women with hydrosalpinx is laparoscopic salpingectomy, which involves removing the affected fallopian tube⁽¹⁾. This procedure increases the chances of a successful pregnancy after IVF by approximately 50%⁽⁷⁾. Alternatively, laparoscopic proximal tubal ligation can also improve IVF success rates. However, both procedures have invasive risks, such as anesthesia-related complications and technical difficulties due to pelvic adhesions⁽⁸⁾.

To mitigate the risks associated with laparoscopic surgery, a less invasive method for treating hydrosalpinx before IVF may be beneficial⁽³⁾. One such method is the hysteroscopic implantation of Essure® intratumoral devices. These devices block the tubes, preventing fluid leakage into the uterine cavity. Essure® is a safe and effective method of permanent tubal ligation with minimal invasiveness⁽⁹⁾.

In cases where laparoscopy is not feasible, hysteroscopy with an Essure implant or electrocoagulation can be considered as an alternative to the traditional treatment. This provides a viable option for individuals who cannot undergo laparoscopic procedures because of technical difficulties or contraindications⁽¹⁰⁾.

Overall, the treatment options for hydrosalpinx vary from surgical interventions to less invasive methods. The choice of

treatment depends on the individual's circumstances and the expertise of the medical professionals. In the current study, we investigated the efficacy of hysteroscopic tubal electrocoagulation (HTE) compared with laparoscopic tubal disconnection (LTD) in patients with tubal infertility due to hydrosalpinx.

Materials and Methods

Ethical approval was obtained from the Ethical Committee and Institutional Review Board (IRB) of Al-Azhar University Hospitals under the reference code (430) to conduct a prospective clinical trial on women with infertility due to hydrosalpinx diagnosis. The study was conducted from September 2022 to January 2023 at Al-Hussein University Hospital, Cairo, Egypt.

Eligibility Criteria

Patients were eligible to be enrolled if they fulfilled the following inclusion criteria; (1) women aged 18-34 years, (2) diagnosed with tubal factor infertility due to hydrosalpinx, (3) an indication for assisted reproductive technology (e.g., IVF). HSG and TVUS confirmed the diagnosis. Patients were excluded if they had infertility due to other factors, such as uterine or male factors. Women with tubal obstruction were also excluded.

Patient Allocation

Following history taking, clinical examination, and confirmatory investigations, including routine and fertility lab profiles and imaging studies, patients were allocated to one of two groups (A or B) by a nurse who was not involved in the research team. We used sealed opaque envelopes to randomly allocate the enrolled patients to one study group. Group A (LTD) included 51 patients and group B (HTE) included 49 patients. The enrolled women underwent further evaluation and laboratory investigations to ensure their adherence to our preselected eligibility criteria.

HTE Surgical Technique

In cases where confirmatory laparoscopy was not possible because of contraindications, HTE was directly planned for patients during the second week of their menstrual cycle. The procedure involved the use of a 4-mm diameter hysteroscope and a lipotrope 5 Fr reusable bipolar electrode. During the procedure, the ocular end of the fallopian tube and the surrounding area of the uterine horn were subjected to unilateral or bilateral electrocoagulation.

To optimize embryo development and implantation, hysteroscopic fulguration was performed to treat the internal orifice of the fallopian tubes. This technique used hysteroscopic bipolar coagulation with a power of 40 W for 20 s. The goal was to degrade the tissue of the diseased tube's internal orifice using electric heat energy, resulting in scar formation. Instead of dilating the cervix, it was softened with misoprostol tablets taken 3 h before the procedure. The surgical duration and anesthesia time were minimized by inserting a bipolar electrode into the operative channel before admission. During the procedure, a saline solution was used as an irrigating medium in the uterine cavity to enhance the conductivity of the bipolar electrode. The electrode was inserted at the tubal ostia, and closure was ensured through coagulation using a 40-W electric current. Patients were closely monitored for 24 h after the operation for any signs of bleeding, severe discomfort, or fever, and they were prescribed antibiotics and anti-inflammatory pain relievers before being discharged⁽¹¹⁾.

LTD Surgical Technique

Laparoscopy was scheduled for patients to confirm the presence of hydrosalpinx, but it was not always possible because of certain factors. Tubal occlusion, either on one or both sides, was performed during laparoscopy using bipolar coagulation and a proximal tubal incision. However, laparoscopy is not recommended for patients with severe obesity or pelvic and abdominal adhesions resulting from prior surgery, pelvic inflammatory disease, or endometriosis. These conditions made the procedure technically challenging or unsuitable^(11,12).

The afflicted fallopian tube(s) were located under general anesthesia by employing 5 mm ports for entrance at the right and left lower quadrants. Gripping the tube, about 2-3 cm away from the cornua, we administered monopolar diathermy. We then used scissors to cut off the diathermized tip⁽³⁾.

Statistical Analysis

The data obtained from the history, clinical examination, and outcome measures were coded, entered, and analyzed using

Microsoft Excel software. Subsequently, the data were imported into SPSS software for further analysis. Qualitative data are presented as numbers and percentages, while quantitative data are presented as mean \pm standard deviation. To determine significant differences, various statistical tests were employed. The chi-square test was used to assess the difference and relationship of qualitative variables, whereas the t-test was used to compare differences between quantitative independent groups. A level of significance of 0.05 was set for significant results, and a significance level of 0.001 was set for highly significant results.

Results

Patients' Characteristics

Of the 112 assessed women, 101 were found to be eligible for inclusion. Fifty-one patients were assigned to group A (LTD), whereas group B (HTE) included 49 patients. There was no statistically significant difference between the study groups regarding all baseline assessed data, including age, body mass index, cycle duration, hormonal profile related to infertility (e.g., follicle-stimulating hormone, luteinizing hormone, progesterone, prolactin), antral follicle count, and hydrosalpinx laterality. The duration and type (secondary) of subfertility were significantly higher in the HTE group. Table 1 summarizes the baseline characteristics of the study participants.

Birth and Pregnancy Outcomes

Thirty-one women tested positive for β -hCG (chemical pregnancy) in the LTD group. The live birth rate was found to be statistically significantly higher in the LTD group (41%) than in the HTE group ($p < 0.001$). Both chemical (61%) and clinical (57%) pregnancy rates were also significantly higher in women treated with LTD compared with patients in the HTE group (p -values were 0.004 and 0.046, respectively). A higher but not significant difference was found among pregnant women in the HTE group regarding the miscarriage rate ($p = 0.33$).

Table 1. Baseline characteristics of study participants

	Group A (LTD) (n=51)	Group B (HTE) (n=49)	p-value
Age (years)†	26.3 \pm 4.7	29.6 \pm 3.4	0.06
Subfertility duration (months)†	28.6 \pm 2.8	39.2 \pm 3.9	0.03*
Subfertility type	Primary	16 (34%)	0.01*
	Secondary	33 (67%)	
Hydrosalpinx type	Unilateral	37 (75%)	0.13
	Bilateral	12 (25%)	
BMI (kg/m ²)†	28.7 \pm 1.9	27.9 \pm 2.6	0.09
AFC†	20.1 \pm 2.4	15.8 \pm 6.3	0.11
Cycle duration (days)	28.6 \pm 3.1	29.1 \pm 4.4	0.32

LTD: Laparoscopic tubal disconnection, HTE: Hydrosalpinx tubal electrocoagulation, BMI: Body mass index, AFC: Antral follicle count, †: Continuous variables reported in (mean \pm standard deviation), *: Statistically significant p-values

No significant difference was observed between the two study groups regarding the multiple pregnancy rate (14% vs. 12%, $p=0.79$). Table 2 shows the difference between the two study groups regarding live birth and pregnancy outcomes.

Complications and Secondary Outcomes

No surgical or procedure-related complications were reported in patients treated with HTE except for one woman who developed uterine perforation, whereas two patients in the LTD group developed serosal bowel injury and one patient reported port site infection. Regarding the operative time, a statistically significant decrease was observed in HTE patients compared with the LTD group (6.6 ± 2.1 vs. 16.9 ± 4.3 mins, $p<0.001$). The average hospital stay duration in LTD was 1.32 ± 0.57 days which was significantly higher than that duration among HTE patients 0.81 ± 0.4 days, $p=0.012$).

Discussion

Findings Summary

We can summarize our study findings in 3 points; (1) Significantly higher live birth, clinical pregnancy, and chemical pregnancy rates in the LTD group than in the HTE group, (2) no significant difference between the two groups in miscarriage and multiple pregnancy rates, (3) no major complications with HTE except for a case of uterine perforation, while two cases of surgical complications occurred in the LTD group. However, we found a significantly shorter operative time and hospital stay in the HTE group.

Our Findings in the Context of Previous Literature

Hydrosalpinx, a common symptom of infertility, can result from various diseases like vaginal infections, endometriosis, or pelvic surgeries⁽¹⁾. Enlargement of the fallopian tube's distal portion due to fimbrial blockage leads to hydrosalpinx, which potentially impacts pregnancy rates after IVF⁽¹³⁾. Surgical procedures that block communication between the fallopian tubes and the uterus may enhance the chances of successful pregnancy in individuals with hydrosalpinx. Diagnostic techniques, such as HSG and laparoscopy, aid in assessing the prognosis of pregnancy success. Laparoscopic surgeries like salpingectomy or tubal ligation, have shown better pregnancy outcomes post-IVF for patients with hydrosalpinx^(14,15).

Rosenfield et al.⁽¹⁶⁾ examined the impact of intracytoplasmic sperm injection on pregnancy outcomes following hysteroscopic tubal electrocoagulation versus LTD in individuals with hydrosalpinges, aligning with the current study. The hysteroscopic tubal electrocoagulation and LTD groups did not display significant differences in age or type of infertility ($p>0.05$), as reported in the study.

Our results are consistent with those of Bao et al.⁽²⁾, who conducted a comparative analysis of hysteroscopic and laparoscopic tubal occlusion in hydrosalpinx before IVF. The study did not observe a significant discrepancy in the age distribution of infertility between the laparoscopic and hysteroscopic groups ($p>0.05$). When assessing the duration of infertility and the presence of hydrosalpinx on either side, no statistically significant differences were found between the two groups ($p>0.05$).

Dreyer et al.⁽⁸⁾ also reported similar outcomes; 85 women were analyzed and divided into two groups. Forty-two women underwent laparoscopic salpingectomy, whereas 43 women underwent hysteroscopic proximal occlusion with the insertion of an intratubal device (Essure). The group that underwent hysteroscopic proximal occlusion had a significantly shorter median operation time than the laparoscopic salpingectomy group (7 vs. 41 minutes, $p<0.001$). While there was agreement on the duration of the procedures, there was no statistically significant difference in the length of postoperative hospital stays between the two groups. Only one woman who underwent laparoscopic salpingectomy experienced postoperative infection at the umbilical incision site, which resolved spontaneously.

In terms of complication rates, no statistically significant distinction was observed between the two groups, consistent with the findings of Dreyer et al.⁽⁸⁾. Among those who underwent hysteroscopic proximal occlusion using Essure, three women experienced complications (two failures and one case of pelvic inflammatory disease). However, only one woman in the laparoscopic salpingectomy group experienced a postoperative infection at the umbilical incision site, which resolved spontaneously.

In addition, Wu et al.⁽¹⁷⁾ explored alternative hysteroscopic tubal occlusion methods to Essure in a separate study involving 56 women with hydrosalpinx. They assessed the efficacy of platinum fiber coil placement in 106 fallopian tubes of 55

Table 2. Post-interventional birth and pregnancy outcomes in each group

	Group A (LTD) (n=51)	Group B (HTE) (n=49)	p-value
Live birth rate†	21 (41%)	6 (12%)	0.001*
Clinical pregnancy rate	29 (57%)	17 (35%)	0.004*
Chemical pregnancy rate	31 (61%)	20 (41%)	0.046*
Miscarriage rate	9 (17%)	14 (28%)	0.33
Multiple pregnancy rate	7 (14%)	6 (12%)	0.79

LTD: Laparoscopic tubal disconnection, HTE: Hydrosalpinx tubal electrocoagulation, †: Live birth rate was calculated per clinical pregnancy, *: Statistically significant p-values

patients undergoing IVF, with successful complete proximal occlusion detected in 52 patients via HSG examination after 3 months. Among them, 44 proceeded with IVF-ET, achieving a clinical pregnancy rate of 60.5% and a live birth rate of 60.87%. This study concluded that platinum fiber coil insertion is a safe and beneficial option for hysteroscopic proximal tubal occlusion in hydrosalpinx patients preparing for IVF.

Furthermore, a systematic review by Xu et al.⁽¹⁸⁾ involving over 3000 patients indicated that individuals with hydrosalpinx managed through hysteroscopic Essure device placement before IVF exhibited lower clinical pregnancy and live birth rates than those managed through laparoscopic salpingectomy and proximal tubal occlusion. Although our study did not directly compare pregnancy outcomes between the two groups, our results aligned with the aforementioned studies in highlighting the superiority of laparoscopic over hysteroscopic tubal occlusion for hydrosalpinx in patients undergoing IVF, particularly concerning the success of tubal occlusion.

Hysteroscopic tubal occlusion, particularly for the proximal portion of the hydrosalpinx, is a successful method to prevent backflow of fluid and improve implantation during assisted reproduction with minimal complications. Studies have supported the comparable effectiveness of hysteroscopic and laparoscopic procedures in addressing hydrosalpinx-related infertility and enhancing pregnancy outcomes after IVF⁽¹⁹⁻²¹⁾. Despite differences in some outcomes, such as tubal occlusion rates and procedure durations, both hysteroscopic and laparoscopic methods offer viable options to manage hydrosalpinx before IVF, tailored to individual patient conditions and preferences.

Conclusion

LTD may be a more effective approach than hysteroscopic tubal electrocoagulation for improving pregnancy rates in IVF patients with hydrosalpinx. However, individual patient factors, surgical expertise, and potential risks should be carefully considered when choosing the optimal treatment modality.

Ethics

Ethics Committee Approval: Ethical approval was obtained from the Ethical Committee and Institutional Review Board (IRB) of Al-Azhar University Hospitals under the reference code (430) to conduct a prospective clinical trial on women with infertility due to hydrosalpinx diagnosis.

Informed Consent: All participants provided informed consent before entering the study.

Authorship Contributions

Surgical and Medical Practices: R.A.H., A.M.S., A.A.E., A.S., Concept: R.A.H., A.M.S., A.A.E., A.S., Design: R.A.H., A.M.S., A.A.E., A.S., Data Collection or Processing: R.A.H., A.M.S., A.A.E., A.S., Analysis or Interpretation: R.A.H., A.M.S., A.A.E., A.S., Literature Search: R.A.H., A.M.S., A.A.E., A.S., Writing:

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