Original Article

Effect Of Laparoscopic Tubal Disconnection For The Management Of Hydrosalpinx Before ICSI On Ultrasonographic Markers Of Endometrial Receptivity, Ovarian Blood Flow And Volume

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Abstract

Objective The aim of this study was to investigate the effect of laparoscopic tubal disconnection for the management of hydrosalpinx before ICSI on ultrasonographic markers of endometrial receptivity, ovarian blood flow and volume. **Methods** Infertility treatment candidate women were divided into two groups, the hydrosalpinx group (HxG) and the non-hydrosalpinx group, totaling 120 women (nHxG). 60 women in the HxG experienced hydrosalpinx, whereas 60 women in the nHxG had unexplained infertility. LH levels in urine samples were used to identify an LH peak. On cycle day LH+6, the TVUS examination was solely done in the HxG. Laparoscopic tubal disconnection was then carried out. On day LH+6 of the cycle, which came before the ICSI cycle, the same ultrasonographic measurements were then collected in both groups. **Outcome measures** Uterine a. RI and PI, spiral a. RI and PI, ovarian a. RI and PI, endometrial thickness, pattern and volume, endometrial VI, FI and VFI and ovarian VI, FI, VFI and volume and zone of vascular penetration. **Results** We found no measurably massive contrasts between the two gatherings in the uterine a. RI and PI, winding a. RI and PI, ovarian a. RI and PI, endometrial thickness and volume (p=0.642), or the nHxG following tubal separation.endometrial VI (p=0.887), FI (p=0.646) and VFI (p=0.652) and ovarian VI (p=0.648), FI (p=0.646) , VFI (p=0.638) and ovarian volume (p=0.646), endometrial example and zone of vascular infiltration. **Conclusions** Laparoscopic tubal disconnection has no significant effect on endometrial, subendometrial, uterine, ovarian blood flow, endometrial and ovarian volumes, endometrial pattern and zone of vascular penetration.

Keywords: laparoscopic tubal disconnection, hydrosalpinx, endometrial receptivity, VOCAL.

INTRODUCTION

Tubal illness may now make up as few as 20% of cases in some facilities. (Strandell and others, 2000) The last stage of pyosalpinx is known as hydrosalpinx, which is an accumulation of watery fluid in the uterine tube. (Mark & Wendy, 2019) The impact of hydrosalpinges on IVF pregnancy outcomes has been the subject of many retrospective research, the majority of which reveal a bad outcome (Strandell et al., 1994). According to the hypothesis that the hydrosalpingeal fluid hinders implantation and/or embryo development in patients with hydrosalpinx, the leakage of the hydrosalpingeal fluid would be stopped by any surgical procedure that cut off the communication to the uterus, increasing the likelihood of pregnancy (Gardner et al., 2018).

The only surgical procedure that has been examined in a suitably sizable randomised controlled trial is salpingectomy before IVF (RCT).(Gardner et al., 2018).The impact of salpingectomy on ovarian function has been disputed, and the findings of research that have been published up to this point have not all reached a consensus. **(Kontoravdis et al., 2006; Orvieto et al., 2011)**..

At the moment, an ultrasonographic examination is the major method used to determine the uterus' health during IVF treatment. Although endometrium assessment by sonography has been utilised, it is not practical to entirely rely on this technique to estimate the possibility of pregnancy. Endometrial blood flow studies are now therapeutically viable using either traditional colour Doppler sonography (Applebaum, 1995) or the more recent power and three-dimensional (3-D) power Doppler sonography techniques (Schild et al., 2000; Kupesic et al., 2001).

In spite of original research' encouraging predictions of the pregnancy outcome of IVF-ET therapies (Applebaum, 1995), some subsequent studies were unable to reveal a difference between pregnant and non-pregnant patients. **(Contart et al., 2000; Schild et al., 2001)**.

Patients and Methods

Study setting
From June 2018 to December 2019, the Kasr Al Ainy maternity hospital at Cairo University's department of obstetrics and gynaecology conducted this study.

Type of the study
This study is a prospective cohort study.

Patients and methods
Patients' enrolment in the study is shown in the flow chart below **(Figure Error!** No text of specified style in document.**-1)**.

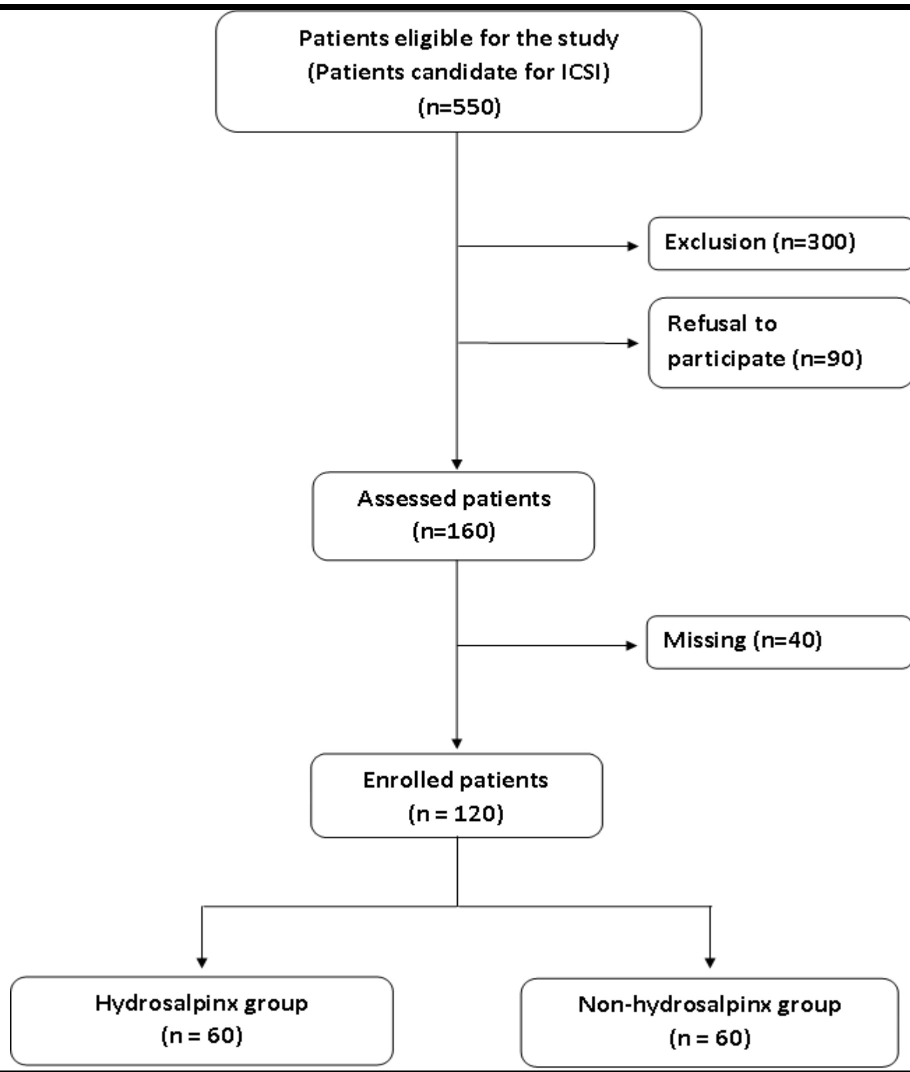


Figure Error! No text of specified style in document.**-1** Patients enrolment flow chart.

ICSI was used to recruit 60 women with hydrosalpinx-related tubal infertility (the hydrosalpinx group) and 60 women without the condition (the non-hydrosalpinx group).

Patients recruited fulfilled the following inclusion and exclusion criteria

Inclusion criteria

1. Between the ages of 25 and 35.
2. Primary or secondary infertility that has lasted longer than two years.
3. A regular, healthy menstrual period.
4. A BMI of less than 30 kg/m2
5. Regular hormonal baseline profile
6. TVUS ovulation confirmation and regular mid-luteal serum progesterone levels
7. Documentation of a normal uterine cavity using hysteroscopy, HSG, and/or TVUS Documentation of hydrosalpinx by HSG and TVUS.
8. Necessity of an ICSI procedure.

Exclusion criteria

1. Patients with uterine factor infertility e.g.: Uterine fibroids.
2. Patients with endometriosis.
3. Patients with ovarian cysts or polycystic ovary disease.
4. 1. A history of caesarean sections and pelvic surgery.
5. Any general illness or medicine that may have an impact on pelvic blood flow, such as
6. Budd-Chiari syndrome with thrombosis of the left renal vein .Patients with male factor infertility.
7. Lactation.
8. Smoking.
9. Poor responders according to reference criteria **(Ferraretti et al., 2011)**. Two out of the following three requirements must be met:
   • Maternal age (>40 years) or any other factor that increases the probability of a subpar ovarian response (POR).
   • A prior POR (few than three oocytes stimulated using a standard technique)
   • AMH 0.5 to 1.1 ng/ml or AFC 5-7 follicles on an abnormal ovarian reserve test.

Methodology in details

1. One hundred and twenty women who were candidates for ICSI for treatment of infertility for ≥ 2 years were recruited at the department of Obstetrics and Gynecology, Cairo University, Kasr Al Ainy maternity hospital in the period from June 2018 till March 2020.
2. Those women were allocated to two groups, hydrosalpinx group (HxG) and non-hydrosalpinx group (nHxG).
   - In the HxG, 60 ladies had one-sided or two-sided hydrosalpinx, while in the nHxG, 60 ladies had unexplained barrenness.
   - Unexplained barrenness was characterized as the shortfall of a perceptible reason for a couple's inability to accomplish pregnancy following a year of endeavoring origination notwithstanding an exhaustive assessment, or following a half year in ladies 35 and more established (Note: patients ≥ 35 years of age patients were prohibited) (Practice-Board of trustees of-the-American-Culture for-Conceptive Medication, 2013).
   - The shortfall of tubal not set in stone by hysterosalpingography (HSG) or potentially laparoscopy was alluded to as tubal element fruitlessness.
   - A distally obstructed fallopian tube that is obsessively enlarged on a HSG or on the other hand, if conceivable, a laparoscopy is alluded to as a hydrosalpinx.Hydrosalpinx was distinguished on transvaginal ultrasonography (TVUS) when a stretched cylindrical mass with an echogenic wall and straight reverberates in the lumen was seen.Each patient's educated assent was gotten subsequent to being educated regarding the review's motivation and nature.
- Full history was taken with special focus on the age, gravidity, parity, duration of infertility, menstrual history, hirsutism, medical history, surgical history, history of lactation and special habits.
- General examination was done with special focus on weight, height, hair distribution, and acne.

- Abdominal and pelvic examinations were done.
- Investigations were done which included CBC, coagulation profile, liver and kidney functions, hormonal profile (FSH, LH, E2 on day 3, progesterone on day 21, prolactin, TSH and AMH), HSG, TVUS, and/or hysteroscopy and semen analysis for the husband.

• Starting on the day a leading follicle was larger than 14 mm in diameter by transvaginal ultrasound, an LH peak was identified by the presence of LH in urine samples using a quick, semi-quantitative self-test (Oview, UniComs Switzerland GmbH, Bahnhofplatz, 6300 Zug, Switzerland) every day.

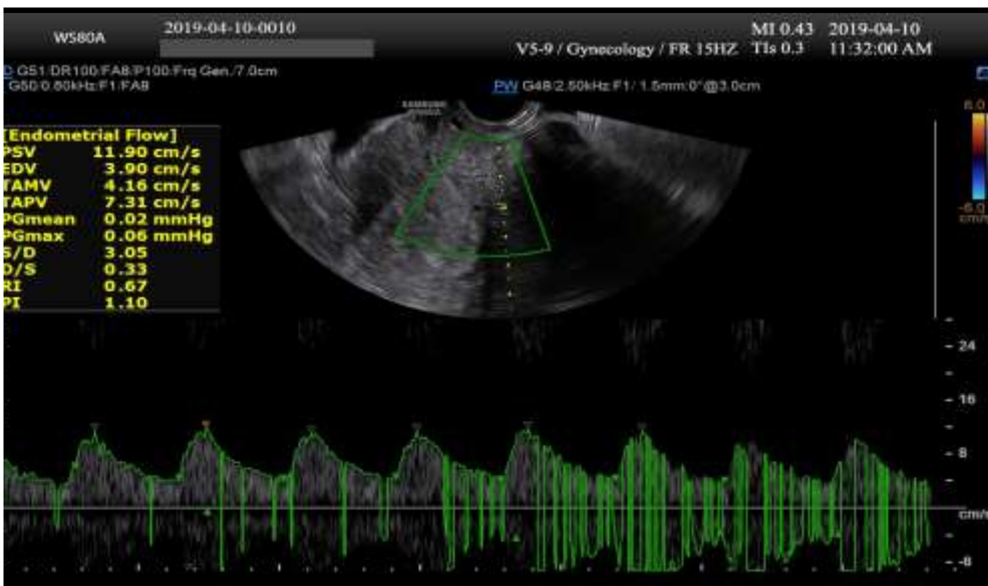
• On day LH+6 (implantation window) of the cycle, on the HxG only, a TVUS examination was carried out using power colour Doppler ultrasonic diagnostic equipment with a TVUS probe of 5-7.5 MHz (Samsung ultrasound WS80A with Elite, Samsung electronics corporation (SEC), Suwon-si, Gyeongii-do, Korea) at around 12 PM after they had emptied their bladders. The same operator conducted each ultrasonic measurement.

• In a longitudinal plane, the best endometrial thickness on one or the other side of the midline was surveyed. The endometrium either showed a homogenous example or a triple-line design (hyperechogenic outside lines and a center echogenic line) (homogeneous endometrium)**(Figure Error!** No text of specified style in document.**-2)**.

Figure Error! No text of specified style in document.**-2** Triple-line pattern of endometrium.

- By displaying pulsatile colour signals in the subendometrial and endometrial areas, it was possible to determine the endometrial-subendometrial blood flow distribution pattern.The following list of Applebaums' criteria is provided:1. Vessels accessing the endometrium's hypoechogenic interior while avoiding its hyperechogenic outside.2. Vessels that pierce the endometrium's hyperechogenic outer border but not its hypoechogenic interior.3. (**Error! Reference source not found.**) (**Error! Reference source not found.**) **(Applebaum, 1995)**.

- Endometrial-subendometrial blood flow pattern as evaluated by colour Doppler ultrasound, shown in Figure 2-3.
  • Flow velocity waveforms from the ascending main branch of the uterine artery at the level of the internal os were captured using colour Doppler in the 2D mode.
  • Using the pulsatility record (PI) and opposition file (RI) of the right and left uterine and ovarian conduits, as well as the normal of right and left esteems, the ovarian supply route was recognised as the principal channel at the ovarian hilum..Within 10 mm of the endometrial echogenic margins, endometrial spiral artery blood flow was found intra-endometrially or in the surrounding sub-endometrial regions. When a vessel with strong colour signals was located on the screen, the Doppler gate was placed. Pulsatility index (PI) and resistive index (RI) were selected from an average of three to five cardiac cycles (RI).The analysis employed mean levels. (**Error! Reference source not found.**).



- Endometrial spiral artery Doppler indices are shown in Figure 2-4.
  • The 3D power Doppler method of the ultrasonography was then selected.Standardized trial boundaries incorporated a recurrence of 5-7.5 MHz, a heartbeat redundancy recurrence of 0.6 kHz, an increase of - 4.0, and a low 1 wall movement channel.
  • The endometrium and ovaries' volume and blood stream files were estimated utilizing the VOCAL (virtual organ PC supported investigation) imaging apparatus that is as of now included into the gadget (Figure 2 5).
  • The middle value of ovarian volume was determined using 3D power Doppler data.
  The presence of veins may be shown in the vascularization file (VI), which calculates the proportion of variety voxels to all voxels (%). (vascularity). The average Doppler signal power (0–100) is estimated by the stream list (FI), which depicts the blood flow strength. By duplicating VI and FI, the vascularization stream file (VFI), which includes vascularity and stream force, was created (0-100). Once the hydrosalpinx was confirmed, a laparoscopy was scheduled for the hydrosalpinx group. When it was physically possible, unilateral or bilateral tubal disconnection was then carried out utilising bipolar coagulation and a proximal tubal incision. The same ultrasonographic measurements were then obtained in both groups on day LH+6 (the implantation window) of the cycle that preceded the ICSI cycle.

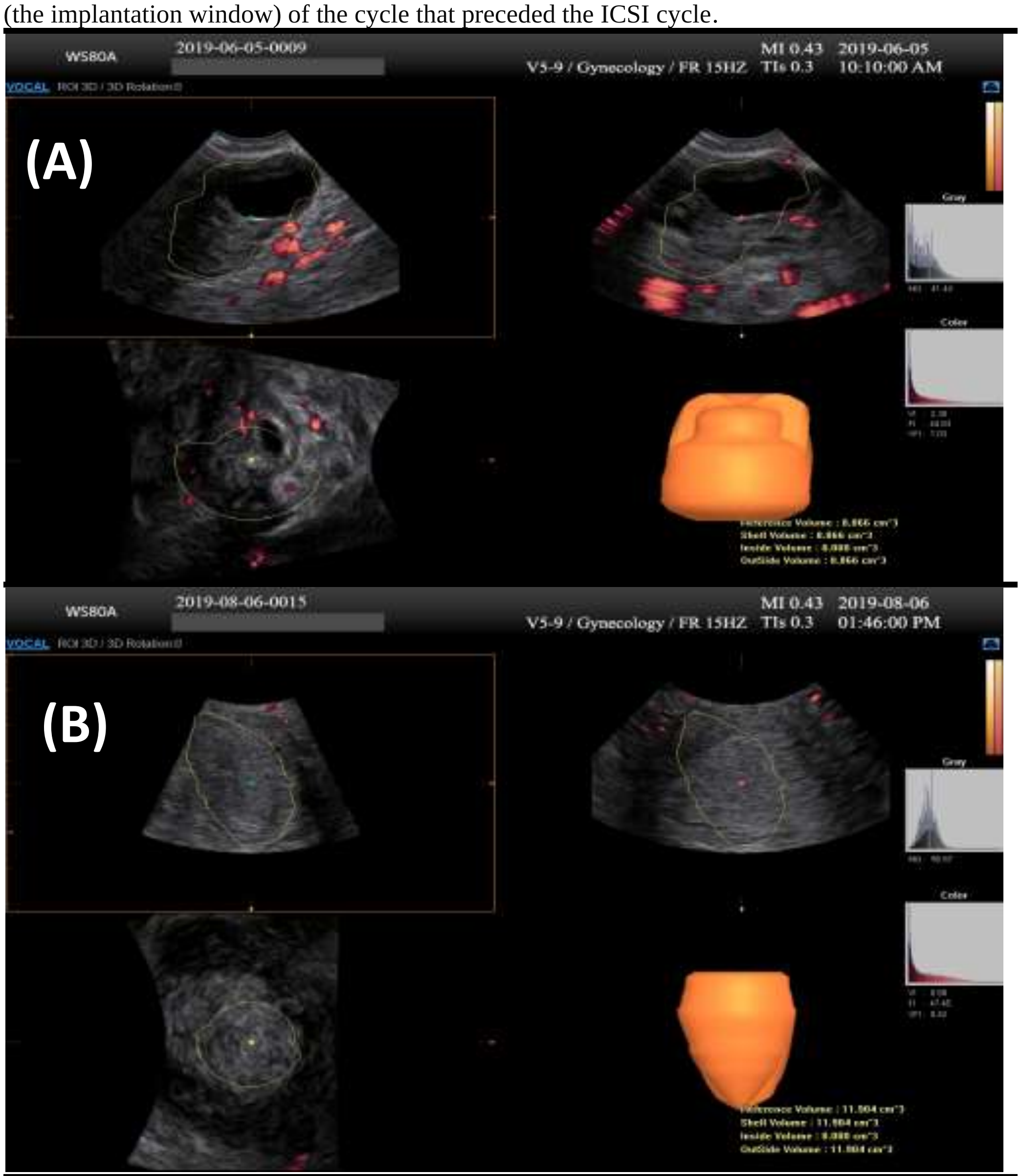


Figure Error! No text of specified style in document.**-3:** VOCAL imaging (volume and 3D power Doppler indices).

(A) Ovarian volume and 3D power Doppler indices.

(B) Endometrial volume and 3D power Doppler indices.

- An ICSI cycle was started with long agonist protocol and quantitative βHCG 14 days after embryo transfer was done with the assessment the following ICSI outcomes:

Cancellation rate: extent of Workmanship cycles in which ovarian excitement or checking has been done with the aim to treat, yet didn't continue to follicular goal or, on account of a defrosted incipient organism, to incipient organism move **(Zegers-Hochschild et al., 2009)**.

1. **No. of oocytes retrieved**
2. **No. of MII oocytes.**
3. **Fertilization rate:** (no. oocytes with 2PN and 2PB/ no. MII oocytes injected) × 100 **(Zegers-Hochschild et al., 2009)**.
4. **Morphological quality of embryonic lot**.
5. **Embryo transfer:** the transfer of one or more embryos, selected from a larger cohort of available embryos **(Zegers-Hochschild et al., 2009)**.
6. **Chemical pregnancy:** Pregnancy that is solely determined by the presence of HCG in serum or urine but does not progress to a clinical pregnancy**(Zegers-Hochschild et al., 2009)**.
7. **Chemical pregnancy rate:** the number of chemical pregnancies expressed per 100 initiated cycles, aspiration cycles or embryo transfer cycles **(Zegers-Hochschild et al., 2009)**. Note: we adopted initiated cycles as a denominator.
8. **Implantation rate:** (no. of sacs seen on ultrasound/ no. embryos transferred) × 100 **(Zegers-Hochschild et al., 2009)**.

Clinical pregnancy: a pregnancy analyzed by ultrasonographic perception of at least one gestational sacs or conclusive clinical indications of pregnancy. It incorporates ectopic pregnancy **(Zegers-Hochschild et al., 2009)**.
Clinical pregnancy rate: the number of clinical pregnancies expressed per 100 initiated cycles, aspiration cycles or embryo transfer cycles **(Zegers-Hochschild et al., 2009)**. Note: we adopted initiated cycles as a denominator.

Outcome measures

1. Primary outcome

- Ovarian artery Doppler studies: RI and PI.
- Ovarian volume, VI, FI and VFI.
- Uterine artery Doppler studies: RI and PI.
- Endometrial thickness and endometrial pattern.
- Spiral artery Doppler studies: RI and PI.
- Zone of vascular penetration.
- Endometrial volume, VI, FI and VFI.

In the HxG these markers were measured twice – one time on day LH+6 (implantation window) of the cycle before undergoing laparoscopic tubal disconnection and another time on day LH+6 (implantation window) of the cycle which preceded the ICSI cycle.
While in the nHxG, these markers were measured once on day LH+6 (implantation window) of the cycle which preceded the ICSI cycle.

2. Secondary outcome

- Cancellation rate.
- No. and mean of oocytes retrieved
- No., mean and rate of MII oocytes.
- No. and mean of 2PN zygote
- Fertilization rate (2PN zygote rate).
- Morphological quality of embryo/s.
- No. of embryo transfer cycles.
- Chemical pregnancy rate.
- Implantation rate.
- Clinical pregnancy rate.

Sample size calculation statistical statement

Sample size calculation was done using the comparison of vascularization flow index (VFI) between infertile women with hydrosalpinx treated with laparoscopic tubal disconnection before doing IVF and non-pretreated matched controls. As reported in the paper published by El-Mazny and his colleagues in 2016, the mean ±SD of VFI in pre-treated group was approximately 0.18 ± 0.46, while in un-pretreated group it was approximately 0.34 ± 0.23. Appropriately, we determined that the base legitimate example size was 56 ladies in each arm to have the option to dismiss the invalid speculation with 80% power at α = 0.05 level utilizing Understudy's t test for free examples. Test size estimation was finished utilizing StatsDirect factual programming adaptation 2.7.2 (2008) for MS Windows, StatsDirect Ltd., Cheshire, UK. **(El-Mazny et al., 2016)**

The statistical Analysis

When appropriate, data were statistically reported using frequencies (number of occurrences) and percentages, median and range, mean and standard deviation (MSD), or median and range. The Kolmogorov-Smirnov test was used to evaluate numerical data in relation to the normal assumption (Shapiro Wilk test). Using a Student t test for independent samples, the research groups' numerical variables were compared.The paired t test was used to compare numerical variables within groups. An analysis using the Chi-square (2) test was done to compare categorical data. When the anticipated frequency is less than 5, an exact test was utilised in its place. Statistical significance was defined as two-sided p values less than 0.05. The software IBM SPSS (Statistical Package for the Social Science; IBM Corp., Armonk, NY, USA) v22 (2013) for Microsoft Windows was used for all statistical calculations.

Result

This planned companion study was led for a gathering of 60 ladies with hydrosalpinx-related tubal fruitlessness (hydrosalpinx gathering) and 60 ladies with unexplained barrenness (non-hydrosalpinx bunch) going through ICSI. Patients were selected from the division of Obstetrics and Gynecology, Cairo University, Kasr Al Ainy maternity hospital from June 2018 to December 2019.

The aim of this study was to investigate the effect of laparoscopic tubal disconnection for the management of hydrosalpinx before ICSI on ultrasonographic markers of endometrial receptivity, ovarian blood flow and volume and ICSI outcomes.

Table Error! No text of specified style in document.**-1:** Comparison of clinical characteristics between patients of HxG and nHxG.

Variable	HxG (n=60)	nHxG (n=60)	P-value
Age (y)	28.80 ± 3.07 (25 - 34)	29.03 ± 3.38 (25 - 34)	0.69
BMI (Kg/m^2)	29.13 ± 0.58 (28 - 30)	28.93 ± 0.75 (28 - 30)	0.10
Duration of infertility (m)	43.30 ± 11.65 (24 - 60)	42.68 ± 11.07 (24 - 60)	0.76
FSH(mIU/mL)	7.767 ± 1.42 (4.7 - 10.1)	8.065 ± 1.29 (5.5 - 11.0)	0.23
LH (mIU/mL)	4.51 ± 1.63 (1.2 - 8.2)	4.46 ± 1.92 (1.2 - 8.3)	0.87
E2 (pg/mL)	52.76 ± 17.21 (27.3 - 94.6)	52.9 ± 19.38 (27.1 - 102.7)	0.96
TSH (mIU/L)	1.96 ± 0.26 (1.5 - 2.6)	1.95 ± 0.27 (1.5 - 2.6)	0.81
PRL (ng/mL)	13.58 ± 6.74 (2.3 - 26.2)	13.51 ± 6.74 (2.2 - 25.7)	0.95
AMH (ng/mL)	2.98 ± 0.79 (2 - 4)	2.80 ± 0.68 (2 - 4)	0.17
Gravidity	0 (0 – 1)	0 (0 – 1)	1.00
Parity	0 (0 – 1.25)	0 (0 – 1)	0.86
Menstrual cycle length (d)	27.45 ± 1.66 (25 - 31)	27.75 ± 1.66 (25 - 31)	0.32
1^{ry} infertility	22 (36.7%)	38 (63.3%)	0.85

Abbreviation: HxG = hydrosalpinx group, nHxG = non-hydrosalpinx group, BMI = body mass index, FSH = follicular animating chemical, LH = luteinizing chemical, TSH = thyroid invigorating chemical, E2 = estradiol, PRL = prolactin, AMH = against mullerian chemical

Values are given as mean ± SD (Range) or n (%)

As shown in **(**

Table Error! No text of specified style in document.**-1)**, there were no statistically significant differences between the two groups in age, BMI, duration of infertility, type of infertility, gravidity, parity, duration of menstrual cycle, Day 3 FSH, LH and E2, TSH, prolactin and AMH.

For the HxG, Thirty eight patients (63.3%) underwent unilateral tubal disconnection while twenty two patients (36.7%) underwent bilateral tubal disconnection.

Table 2-2 Comparison of ultrasonographic markers between patients of HxG prior to tubal disconnection and nHxG.

Variable		HxG before tubal disconnection (n=60)	nHxG (n=60)	P-value
ET (mm)		9.94 ± 1.63 (7.3 – 12.99)	9.57 ± 1.70 (7.06 – 14.45)	0.227
Endometrial pattern (triple line)		33 (55%)	52 (86.7%)	0.000*
Spiral a. RI		0.537 ± 0.16 (0.3 – 0.9)	0.50 ± 0.16 (0.3 – 1.0)	0.239
Spiral a. PI		1.40 ± 0.37 (0.74 – 1.98)	1.29 ± 0.37 (0.72 – 1.98)	0.129
Zone of vascular penetration	1	12 (20%)	2 (3.3%)	
	2	24 (40%)	44 (73.3%)	0.000*
	3	24 (40%)	14 (23.3%)	
Endometrial volume (cm^3)		2.99 ± 0.44 (2.27 – 3.72)	3.21 ± 0.51 (2.32 – 4.15)	0.013*
Endometrial VI		0.30 ± 0.07 (0.18 – 0.43)	0.55 ± 0.08 (0.41 – 0.71)	0.000*
Endometrial FI		22.53 ± 2.87 (17.8 – 27.1)	26.23 ± 1.98 (22.7 – 29.7)	0.000*
Endometrial VFI		0.17 ± 0.06 (0.06 – 0.29)	0.27 ± 0.06 (0.17 – 0.39)	0.000*
Uterine a. RI		0.81 ± 0.27 (0.30 – 1.19)	0.81 ± 0.10 (0.6 – 1.09)	0.874
Uterine a. PI		2.66 ± 0.80 (1.51 – 4.37)	2.39 ± 0.76 (1.50 – 4.69)	0.056
Ovarian a. RI		0.83 ± 0.07 (0.71 – 0.96)	0.77 ± 0.07 (0.63 – 0.88)	0.000*
Ovarian a. PI		1.5143 ± 0.13 (1.29 – 1.74)	1.44 ± 0.10 (1.27 – 1.63)	0.002*
Ovarian volume (cm^3)		8.01 ± 1.17 (6.09 – 9.93)	8.84 ± 1.37 (6.46 – 11.31)	0.001*
Ovarian VI		1.20 ± 0.25 (0.80 – 1.62)	1.60 ± 0.39 (0.92 – 2.30)	0.000*
Ovarian FI		30.81 ± 2.92 (26.04 – 35.56)	32.11 ± 1.96 (28.70 – 35.63)	0.005*
Ovarian VFI		0.75 ± 0.11 (0.6 – 0.9)	0.91 ± 0.11 (0.7 – 1.1)	0.000*

Abbreviation: HxG = hydrosalpinx group, nHxG = non-hydrosalpinx group, RI = Resistance Index, PI = Pulsatility index, VI = Vascularity Index, FI = Flow Index, VFI = Vascularity Flow index, ET = Endometrial Thickness. Values are given as mean ± SD (Range) or n (%)

As introduced in (Table 2 2), on contrasting the ultrasonographic markers of the HxG (before tubal disengagement) versus nHxG the ovarian a. RI (p=0.000) and PI (p=0.002) were altogether higher in the HxG (before tubal disengagement), while the endometrial VI (p=0.000), FI (p=0.000) and VFI (p=0.000), the endometrial volume (p=0.013), the ovarian volume (p=0.001) and the ovarian VI (p=0.000), FI (p=0.005) and VFI (p=0.000) were fundamentally lower in the HxG (before tubal separation).

Moreover, the level of triple line endometrium verus homogenous endometrium was altogether lower in the HxG (before tubal separation) contrasted with the nHxG (p=0.000). Likewise, there was a measurably tremendous distinction in the zone of vascular entrance between the two gatherings (p=0.000) with propensity towards lower level of zone 2 in the HxG (before tubal detachment) contrasted with the nHxG (Table 2 2).

Then again, we tracked down no genuinely massive contrasts between the two gatherings in the uterine a. RI (p=0.874), PI (p=0.056), winding a. RI (p=0.239) and PI (p=0.129) and ET (p=0.227) **(Error! Reference source not found.)**.

Table 2-3 Comparison of ultrasonographic markers of the HxG after tubal disconnection and nHxG.

Variable		HxG after tubal disconnection (n=60)	nHxG (n=60)	P-value
ET (mm)		10.01 ± 1.84 (7.04 – 15.52)	9.57 ± 1.70 (7.06 – 14.4)	0.176
Endometrial pattern (triple line)		51 (85%)	52 (86.7%)	0.793
Spiral a. RI		0.54 ± 0.17 (0.30 – 0.90)	0.50 ± 0.16 (0.3 – 1.0)	0.137
Spiral a. PI		1.407 ± 0.35 (0.70 – 1.99)	1.29 ± 0.37 (0.72 – 1.98)	0.129
Zone of vascular penetration	1	2 (3.3%)	2(3.3%)	
	2	39 (65%)	44 (73.3%)	0.589
	3	19 (31.7%)	14 (23.3%)	
Endometrial volume (cm^3)		3.26 ± 0.55 (2.36 – 4.17)	3.21 ± 0.51 (2.32 – 4.15)	0.642
Endometrial VI		0.55 ± 0.09 (0.41 – 0.71)	0.55 ± 0.08 (0.41 – 0.71)	0.887
Endometrial FI		26.40 ± 2.12 (22.95 – 29.86)	26.23 ± 1.9 (22.7 – 29.7)	0.646
Endometrial VFI		0.28 ± 0.06 (0.17 – 0.39)	0.27 ± 0.06 (0.17 – 0.39)	0.652
Uterine a. RI		0.83 ± 0.11 (0.57 – 1.03)	0.81 ± 0.10 (0.6 – 1.09)	0.275
Uterine a. PI		2.60 ± 0.78 (1.50 – 4.20)	2.39 ± 0.76 (1.50 – 4.69)	0.131
Ovarian a. RI		0.75 ± 0.07 (0.63 – 0.88)	0.77 ± 0.07 (0.63 – 0.88)	0.149
Ovarian a. PI		1.44 ± 0.10 (1.30 – 1.60)	1.44 ± 0.10 (1.27 – 1.63)	0.924
Ovarian volume (cm^3)		8.96 ± 1.47 (6.56 – 11.36)	8.84 ± 1.37 (6.46 – 11.3)	0.646
Ovarian VI		1.63 ± 0.42 (0.95 – 2.32)	1.60 ± 0.39 (0.92 – 2.30)	0.648
Ovarian FI		32.28 ± 2.10 (28.85 – 35.70)	32.1 ± 1.96 (28.7 – 35.6)	0.646
Ovarian VFI		0.92 ± 0.12 (0.73 – 1.12)	0.91 ± 0.11 (0.7 – 1.1)	0.638

Abbreviation: HxG = hydrosalpinx group, nHxG = non-hydrosalpinx group, RI = Resistance Index, PI = Pulsatility index, VI = Vascularity Index, FI = Flow Index, VFI = Vascularity Flow index, ET = Endometrial Thickness. Values are given as mean ± SD (Range) or n (%)

As presented in **(Error! Reference source not found.)**, on comparing the ultrasonographic markers of the HxG after tubal disconnection and nHxG, we found no statistically significant differences between the two groups in the uterine a. RI (p=0.275) and PI (p=0.131), spiral a. RI (p=0.137) and PI (p=0.129), ovarian a. RI (p=0.149) and PI (p=0.924), endometrial thickness (p=0.176) and volume (p=0.642), endometrial VI (p=0.887), FI (p=0.646) and VFI (p=0.652) and ovarian VI (p=0.648), FI (p=0.646) , VFI (p=0.638) and ovarian volume (p=0.646), endometrial pattern (p=0.793), zone of vascular penetration (p=0.589).

Table 2-4 Comparison of ultrasonographic markers of the HxG before and after tubal disconnection.

Variable		Before tubal disconnection (n=60)	After tubal disconnection (n=60)	P-value
ET (mm)		9.94 ± 1.63 (7.3 – 12.99)	10.01 ± 1.84 (7.04 – 15.52)	0.087
Endometrial pattern (triple line)		33 (55%)	51 (85%)	0.000*
Spiral a. RI		0.537 ± 0.16 (0.3 – 0.9)	0.54 ± 0.17 (0.30 – 0.90)	0.028*
Spiral a. PI		1.4 ± 0.37 (0.74 – 1.98)	1.4 ± 0.35 (0.70 – 1.99)	0.955
Zone of vascular penetration	1	12(20%)	2 (3.3%)	
	2	24(40%)	39 (65%)	0.000*
	3	24 (40%)	19 (31.7%)	
Endometrial volume (cm3)		2.99 ± 0.44 (2.27 – 3.72)	3.26 ± 0.55 (2.36 – 4.17)	0.000*
Endometrial VI		0.30 ± 0.07 (0.18 – 0.43)	0.55 ± 0.09 (0.41 – 0.71)	0.000*
Endometrial FI		22.53 ± 2.87 (17.86 – 27.19)	26.4 ± 2.12 (22.9 – 29.8)	0.000*
Endometrial VFI		0.17 ± 0.06 (0.06 – 0.29)	0.28 ± 0.06 (0.17 – 0.39)	0.000*

Uterine a. RI	0.81 ± 0.27 (0.30 – 1.19)	0.83 ± 0.11 (0.57 – 1.03)	0.485
Uterine a. PI	2.66 ± 0.80 (1.51 – 4.37)	2.60 ± 0.78 (1.50 – 4.20)	0.018*
Ovarian a. RI	0.83 ± 0.07 (0.71 – 0.96)	0.75 ± 0.07 (0.63 – 0.88)	0.000*
Ovarian a. PI	1.5143 ± 0.13 (1.29 – 1.74)	1.44 ± 0.10 (1.30 – 1.60)	0.000*
Ovarian volume (cm3)	8.01 ± 1.17 (6.09 – 9.93)	8.96 ± 1.4 (6.56 – 11.36)	0.000*
Ovarian VI	1.20 ± 0.25 (0.80 – 1.62)	1.63 ± 0.42 (0.95 – 2.32)	0.000*
Ovarian FI	30.81 ± 2.92 (26.04 – 35.56)	32.28 ± 2.1 (28.8 – 35.7)	0.000*
Ovarian VFI	0.75 ± 0.11 (0.6 – 0.9)	0.92 ± 0.12 (0.73 – 1.12)	0.000*

Abbreviation: HxG = hydrosalpinx group, RI = Resistance Index, PI = Pulsatility index, VI = Vascularity Index, FI = Flow Index, VFI = Vascularity Flow index, ET = Endometrial Thickness.
Values are given as mean ± SD (Range) or n (%)

As shown in **(Error! Reference source not found.)**, on comparing the ultrasonographic markers of the HxG before and after tubal disconnection the ovarian a. RI (p=0.000) and PI (p=0.000) and uterine a. PI (p=0.018) were significantly higher before tubal disconnection, while the spiral a. RI (p=0.028), endometrial VI (p=0.000), FI (p=0.000) and VFI (p=0.000), the endometrial volume (p=0.000), the ovarian volume (p=0.000) and the ovarian VI (p=0.000), FI (p=0.000) and VFI (p=0.000) were significantly lower before tubal disconnection.

Additionally, the percentage of triple line endometrium verus homogenous endometrium was significantly higher in the HxG (after tubal disconnection) compared to the HxG (before tubal disconnection) (p=0.000). Also, there was a statistically significant difference in the zone of vascular penetration (p=0.000) with tendency towards higher percentage of zone 2 in the HxG (after tubal disconnection) compared to HxG (before tubal disconnection) **(Error! Reference source not found.)**.

On the other hand, we found no statistically significant differences in the uterine a. RI (p=0.485) before and after laparoscopic tubal disconnection, spiral a. PI (p=0.955) and ET (p=0.087) **(Error! Reference source not found.)**.

Discussion

In certain ART institutions nowadays, tubal disease may only represent 20% of cases, with other reasons driving the majority of therapy. (Strandell and others, 2000)
The severe condition affecting the fallopian tubes, hydrosalpinx, is the focus of particular attention in both clinical practise and research. The word "hydrosalpinx" is frequently used to refer to a broad spectrum of distal tubal occlusion pathologies. According to a formal definition, pyosalpinx is a collection of watery fluid that develops at the end of the uterine tube. The impact of hydrosalpinges on IVF pregnancy outcomes has been the subject of many retrospective research, the majority of which reveal a bad outcome (Strandell et al., 1994).

Patients with hydrosalpinges have significantly lower rates of implantation and pregnancy than those with other types of tubal damage, according to a meta-analysis of retrospective data. (Zeyneloglu et al., 1998).

Additionally, the studies consistently showed that women with hydrosalpinx had rates of spontaneous abortion that were twice as high and clinical pregnancy and delivery rates that had been cut in half. The only surgical procedure that has been examined in a suitably sizable randomised controlled trial is salpingectomy before IVF (RCT). Tubal ligation and transvaginal suction are two more procedures for hydrosalpinges before IVF that may be considered, in addition to salpingectomy, however these need to be tested in large-scale prospective trials. **(Gardner et al., 2018)**.
Given the hypothesis that the hydrosalpingeal fluid adversely affects IVF results, tubal ligation is probably useful in restoring pregnancy rates. Currently, the operation is advised when pelvic adhesions are too severe to do a salpingectomy.**(Gardner et al., 2018)**.

The impact of salpingectomy on ovarian capability has been discussed, and the aftereffects of distributed examinations up to this point are not completely in agreement (Kontoravdis et al., 2006; Orvieto et al., 2011). The hypothetical support for the chance of decreased ovarian capability following a medical procedure is areas of strength for the connection between the vascular and nerve supply to the cylinder and ovary.

A few improvements in controlled ovarian hyperstimulation (COH), treatment, and undeveloped organism culture methods have prompted an enhancement in the number and nature of undeveloped organisms accessible for incipient organism move (ET) (Fanchin, 2001). Conversely, endometrial receptivity has neglected to profit from equal enhancements, and its disarrangement is probably going to address a significant reason for the poor undeveloped organism implantation rates saw in-vitro treatment (IVF)- ET.

At the moment, an ultrasonographic examination is the major method used to determine the uterus' health during IVF treatment.Although endometrium assessment by sonography has been utilised, it is not practical to entirely rely on this technique to estimate the possibility of pregnancy.

It is now possible to assess uterine artery blood flow thanks to transvaginal Doppler ultrasound, and it was originally believed that changes in uterine arterial resistance would signify changes in uterine receptivity (Steer et al., 1992).Despite the fact that pregnancy outcomes tended to be bad in people with higher mean uterine artery impedance indices, there appears to be a limit to the predictive efficacy of using a specific resistance index (RI) or pulsatility index (PI) variable in predicting endometrial receptivity. **(Friedler et al., 1996)**.

One of the explanations is that the major uterine compartment is the myometrium and not the endometrium, and thus most of the blood passing through the uterine arteries never reaches the endometrium. A more logical approach would be to evaluate the vascularization around the endometrium directly in an attempt to assess endometrial receptivity.

Endometrial blood flow studies, either with conventional color Doppler sonography **(Applebaum, 1995; Zaidi et al., 1995)** Even the more recent methods of power Doppler sonography and three-dimensional (3-D) power sonography (Schild et al., 2000; Kupesic et al., 2001) have become practicable in clinical settings. Although preliminary research on IVF-ET therapies' ability to predict pregnancy outcomes was encouraging (Applebaum, 1995), several studies were unable to find any appreciable differences between pregnant and non-pregnant patients. **(Contart et al., 2000; Schild et al., 2001)**. Different approaches in measuring endometrial blood flow between these studies may have contributed to the inconsistent conclusions.

The aim of this study was to investigate the effect of laparoscopic tubal disconnection for the management of hydrosalpinx before ICSI on ultrasonographic markers of endometrial receptivity, ovarian blood flow and volume and ICSI outcomes.

At first, we explored the effect of hydrosalpinx on ultrasonographic markers of endometrial receptivity, ovarian blood stream and volume.

In our review, on looking at the ultrasonographic markers of the HxG after tubal disengagement and nHxG, we tracked down no genuinely huge contrasts between the two gatherings in the uterine a. RI (p=0.275) and PI (p=0.131), twisting a. RI (p=0.137) and PI (p=0.129), ovarian a. RI (p=0.149) and PI (p=0.924), endometrial thickness (p=0.176) and volume (p=0.642), endometrial VI (p=0.887), FI (p=0.646) and VFI (p=0.652) and ovarian VI (p=0.648), FI (p=0.646) , VFI (p=0.638) and ovarian volume (p=0.646), endometrial example (p=0.793), zone of vascular entrance (p=0.589).

Additionally, on comparing ICSI outcomes of the HxG after tubal disconnection and the nHxG, we found no statistically significant differences between the two groups in the cancellation rate (p=0.69), the mean retrieved oocyte no. (p=0.7), mean MII oocyte no. (p=0.615), MII oocyte rate (p=0.827), mean 2PN zygote no. (p=0.357), 2PN zygote rate (p=0.714), mean GI embryo (p=0.486), mean GII embryo (p=606), mean GIII embryo (p=404), GI embryo rate (p=0.709), GII embryo rate (p=0.847), GIII embryo rate (p=1.00), chemical pregnancy rate (p=0.78), clinical pregnancy rate (p=0.41), implantation rate (p=0.666).

No previous study focused on the effect of interruption of utero-ovarian blood flow on endometrial or ovarian volume or hemodynamics using three-dimensional ultrasound reconstruction techniques and 3D power Doppler i.e. VI, FI, VFI and volume.Additionally, some studies used patients undergoing tubal ligation for sterilization as a study group studying uterine and ovarian blood flow changes. Although there are differences in the surgical procedure, the indications for the procedure, type of patient and the timing of doing ultrasound, the patient group can be used to study the effect of interruption of utero-ovarian blood flow per se.Our results continue to be strongly related to those of Surrey and Schoolcraft (2001), who oversaw a review that comprised 94 tubal-factor barren patients who had 104 fresh IVF-ET cycles in succession. Patients were divided into four groups: controlled ovarian hyperstimulation, laparoscopic salpingectomy (bunch 1: 35 cycles), bipolar proximal tubal obstruction (bunch 2: 17 cycles), and IVF-ET. Bunches of patients with tubal factors who did not have hydrosalpinges (bunch 3: 37 cycles) and those who had already undergone tubal ligation for sanitization made up the control bunches (bunch 4: 15 cycles).

They found no differences in either of the groups' mean uterine course pulsatility lists or ovarian reaction. The tendency in lot 1 toward a greater cycle scratch-off rate did not progress toward factual relevance. Clinical pregnancy and implantation rates between bunch 1, bunch 2, and control groups did not differ significantly. **(Surrey & Schoolcraft, 2001)**

In an exploration led in 2013 on 76 patients going through their most memorable IVF-ET cycle, Kamal and her colleagues. Twenty up-and-comers went through laparoscopic salpingectomy in bunch 1, 19 applicants went through proximal tubal division in bunch 2, and 37 competitors had tubal factors yet didn't have hydrosalpinx in bunch 3. She found no perceptible varieties in any of the gatherings' mean ovarian vein pulsatility lists, either previously or after activity. There were no obvious contrasts in the quantity of recuperated and prepared oocytes between bunch 1, bunch 2, and the benchmark group. Geber and Joao (1996), considered tentatively twenty patients going through laparotomy for tubal ligation. All patients had a Doppler blood stream evaluation when medical procedure, led in the mid-follicular period of their cycle. There was no genuinely huge contrast in ovarian a. PI when tubal ligation.In an examination distributed in 2004, Cevrioglu and his partners cleaned 36 ladies' cylinders utilizing minilaparotomy and laparoscopic methods. Ladies' uterine and ovarian corridor blood stream rates were surveyed before a medical procedure (D3) during their feminine cycle, after medical procedure (D 13-15) during their ovulation, and on D3 in the first and 6th months following tubal ligation. 15 workers in a similar age range who favored the obstruction approach and had their uterine and ovarian supply route blood stream estimations taken at similar times made up the benchmark group. The benchmark uterine and ovarian corridor PI levels and those got on day three of the period in the first and 6th months following tubal ligation were indistinguishable. (Cevrioglu et al., 2004)

Our discoveries agree with those of Dede and his partners (2006), who completed a planned examination on 90 successive prolific ladies who applied for willful tubal ligation. Contingent upon the patient's inclination, either Pomeroy tubal ligation through scaled down laparotomy (bunch 2) or laparoscopic tubal ligation utilizing bipolar electrocoagulation (bunch 1) was relegated. On the third day of the cycle before a medical procedure, the third day after medical procedure, and on the third day of the cycle three months after the fact, variety Doppler stream examination of the uterine and ovarian corridors were performed. Estimations of the uterine and ovarian courses required on the third postoperative day and the third month in bunches 1 and 2 didn't contrast genuinely fundamentally from preoperative qualities (p 0.05).

In an exploration distributed in 2001 by Tiras and his partners, 13 willing people had laparoscopic tubal cleansing between the 6th and eighth days of their monthly cycle. Three days before the method, on the third post-employable day, and 90 days after the activity, Doppler ultrasonography was utilized to gauge the degrees of serum ovarian chemicals and the blood stream rate through the ovarian corridors. Investigation of 10 people's results who finished the subsequent period was finished. After tubal disinfection, the pace of blood stream through the ovarian corridors didn't change in a measurably significant manner.

Conclusions and Recommendations

In conclusion, laparoscopic tubal disconnection has no significant effect on endometrial, subendometrial, uterine, ovarian blood flow, endometrial and ovarian volumes, endometrial pattern and zone of vascular penetration. Additionally, the HxG after tubal disconnection did not differ from the nHxG regarding ICSI outcomes. i.e. mean retrieved oocytes, mean MII oocyte, MII oocyte rate, mean 2PN zygote, 2PN zygote rate, mean GI,GII and GIII embryo, GI,GII and GIII embryo rate, chemical pregnancy rate, clinical pregnancy rate, implantation rate.Some recommendations have been made in light of the study's findings and observations. First off, it is advised to expand the study's duration in future studies and research in order to examine how laparoscopic tubal disconnection affects the live birth rate and how it has a long-lasting effect on endometrial and ovarian hemodynamics. Second, based on the present data, it is not possible to draw the conclusion that patients with a low ovarian reserve are more likely to experience a poor response to laparoscopic tubal disconnection. Theoretically, it appears critical to exercise extreme caution when performing a salpingectomy in order to prevent damage to the vascular and neurological supplies. To prevent harm to the medial tubal artery, a laparoscopic tubal disconnection should be conducted with careful electrocautery, using bipolar electrocautery, and very close to the real tube. Third, it would be appropriate to inquire as to which patient populations laparoscopic tubal disconnection should be avoided. It is unclear whether a patient who has less ovarian reserve is more likely to experience a poor response and cycle cancellation after laparoscopic tubal separation. This study is unable to provide a response because patients with low ovarian reserve were not included in the study population. Consequently, it is recommended that a future publication specifically focus on this group of patients.

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