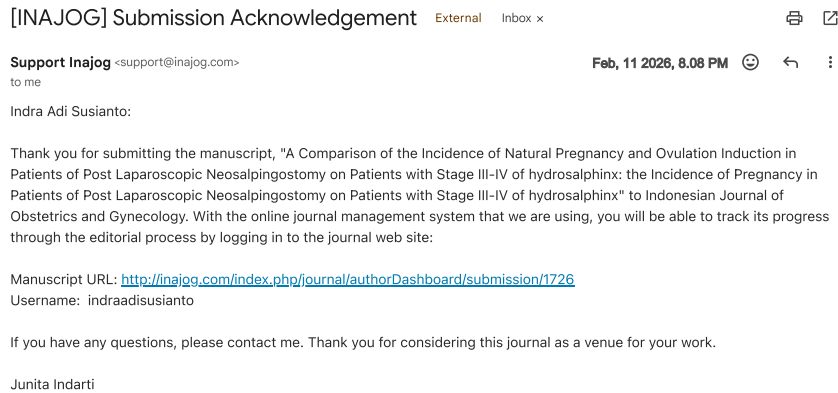


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A Comparison of the Incidence of Spontaneous Pregnancy Between Ovulation Induction and No Ovulation Induction in Patients After Post-Laparoscopic Neosalpingostomy with Stage III-IV Hydrosalpinx

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Abstract

Objective:

To compare pregnancy outcomes between natural conception and ovulation induction following laparoscopic neosalpingostomy in women with stage III–IV hydrosalpinx.

Methods:

A quasi-experimental study was conducted from 2014–2019 including 70 infertile women undergoing laparoscopic neosalpingostomy. Participants were divided into natural cycle and ovulation induction groups (clomiphene citrate plus estradiol valerate). Follow-up lasted six to seven months. Pregnancy outcomes were analyzed using chi-square and multivariate logistic regression, with $p < 0.05$ considered significant.

Results:

The overall pregnancy rate was 83% within seven months postoperatively. Forty-one pregnancies occurred without induction. No significant association was found between ovulation induction or maternal age > 35 years and term pregnancy ($p > 0.05$). Ectopic pregnancy occurred in 4–5% of cases. Multivariate analysis showed no independent predictors of term pregnancy.

Conclusion:

Laparoscopic neosalpingostomy remains a viable fertility-preserving option for women with advanced hydrosalpinx, with comparable outcomes between natural conception and ovulation induction.

Key words : Spontaneous pregnancy, hydrosalpinx, Laparoscopic Neosalpingostomy, Pregnancy outcomes

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INTRODUCTION

Infertility remains a health issue worldwide, including in Indonesia. Although it does not affect physical activity and is not life-threatening, it significantly impacts family life for many couples due to medical, economic, and psychological problems. Infertility is defined as the failure to conceive after 12 months of regular, unprotected sexual activity in the absence of reproductive pathology^{1,2}. Infertility can be caused by women, men, or both. However, among the many infertile couples, most cases are due to female factors. A woman may be infertile because of various risk factors. These factors include age, occupation, stress level, body mass

index related to nutritional status, and reproductive organ abnormalities, such as disorders of ovulation, tubal and pelvic issues, and uterine problems disorders.³⁻⁵

Factors related to abnormalities of female reproductive organs also contribute to infertility. According to the study's findings, women with reproductive organ disorders have a higher risk of infertility compared to those without such disorders. The issue of blocked fallopian tubes, often accompanied by swelling or hydrosalpinx, can lead to embryo damage through embryotoxic effects and mechanical disruption of ciliary hair movement within the fallopian tubes.⁶⁻¹² It is advised to perform corrections such as peritubal adhesiolysis, fimbrioplasty, and neosalpingostomy in cases of fallopian tube obstruction with hydrosalpinx, typically done laparoscopically. It is also recommended for patients who want to conceive naturally. Neosalpingostomy is a strategic alternative for those who are not willing to undergo salpingectomy but still desire a natural pregnancy without assisted technologies like IUI or IVF.¹³⁻¹⁵

The purpose of this study was to compare the pregnancy rates between patients who conceived naturally and those who successfully induced ovulation following laparoscopic neosalpingostomy for hydrosalpinx.

METHODS

This study employed a quasi-experimental design. It was conducted at Anugerah Women & Children Hospital in Semarang, Indonesia, from January 2014 to December 2019, and was approved by the Health Research Ethics Committee under the Ethical Clearance for Research No. 380/EC/KEPK.FK-UNDIP/X/2021. All patients provided written informed consent prior to participation in the study. Patients were informed about the surgical procedure, postoperative monitoring, potential risks including ectopic pregnancy, and the option of ovulation induction therapy. Consent for teleconsultation follow-up and data use for research purposes was also obtained. Data were analyzed using STATA statistical software. Descriptive statistics were used to summarize demographic and clinical characteristics. Continuous variables were presented as mean $\pm$ standard deviation, while categorical variables were expressed as frequencies and percentages. Bivariate analysis was performed using the Chi-square test or Fisher's exact test (when appropriate) to assess associations between categorical variables such as age group, ovulation induction status, and pregnancy outcomes. Relative risks (RR) with 95% confidence intervals (CI) were calculated to estimate the strength of association. A p-value less than 0.05 was considered statistically significant. The 6-month follow-up period was selected based on clinical evidence suggesting that most spontaneous or induced conceptions following tubal reconstructive surgery occur within the first 6–12 months postoperatively. Monitoring during this early period allows for the assessment of tubal patency before the risk of re-adhesion or tubal re-occlusion increases. Patients are divided into two groups based on hydrosalpinx. The first group comprises patients who decline ovulation induction, while the second group includes patients undergoing ovulation induction therapy with 10 mg of clomiphene citrate (Pinfetil 50 mg, Novell pharmaceutical laboratories), taking two tablets daily for five days from the 2nd to the 6th day of their cycle. Additionally, they receive 1 tablet of 2 mg estradiol valerate (Progynova, BAYER) daily for 5 days, from the 8th to the 12th day of the cycle.

Patients will be monitored over three cycles using the same therapy. Monitoring includes egg assessment via transvaginal ultrasound on day 12 to evaluate follicle size and endometrial thickness, followed by a three-month period without therapy. The total monitoring period spans six months from the beginning of the intervention. All patients undergo basal transvaginal ultrasonography (TVS) The General Electric Voluson S10 Expert® on day 2 of their menstrual cycle before starting treatment. Serial TVS begins on cycle day 8 to assess follicular growth (number and diameter of follicles) and endometrial thickness. This assessment continues every

1–3 days until the mean follicular diameter (average of two orthogonal measurements) reaches ≥ 18 mm. The inclusion criteria for this study are patients who have undergone laparoscopic neosalpingostomy surgery due to bilateral fallopian tube phimosis with damage classified as grade III or grade IV. They are monitored in two groups and are willing to participate in teleconsultation. In addition to the wives' factors, the husbands' factors—specifically, normal sperm according to WHO criteria—are also required. Exclusion criteria include patients who are unwilling to be monitored by the teleconsultation system. They prefer to directly undergo pregnancy therapy with assisted technology due to abnormal sperm factors. If more than six months pass after the intervention in both groups and group 2 still has not achieved pregnancy, these patients will be excluded and advised to try pregnancy with assisted technology. Multivariate logistic regression analysis was conducted to identify independent predictors of term pregnancy following laparoscopic neosalpingostomy. Variables in the regression model included maternal age (>35 vs. ≤ 35 years), duration of infertility (>5 vs. ≤ 5 years), degree of hydrosalpinx (grade III vs. IV), and ovulation induction status. Adjusted odds ratios (AOR) with 95% confidence intervals were calculated. Variables with $p < 0.25$ in bivariate analysis were included in the multivariate model.

The study population comprises all women who self-referred for infertility evaluation at Anugerah Women & Children Hospital in Semarang, Indonesia. The control group consisted of women with problematic infertility examined at the same hospital's infertility clinic. The case subjects are women experiencing primary infertility with both non-patent tubal hydrosalpinx stages III and IV, confirmed by supporting examination, specifically HSG. The control group subjects are infertile women who underwent laparoscopic neosalpingotomy by Erbe VIRON 1 Laparoscopy System® without ovulation induction, operating on a natural cycle. They are compared with patients who receive ovulation induction with 10 mg of clomiphene citrate given on the 2nd day of menstruation and 2 mg of estradiol valerate on the 8th day of the cycle, according to inclusion criteria. The success of the procedure to open the fimbria in hydrosalpinx, as classified by Donnez and Casanas-Roux, based on preoperative HSG examination [table 1], is influenced by the degree of adhesion, according to the American Fertility Society classification adhesion.¹⁶

Table 1 presents the classification of the degree of fimbrial closure in the fallopian tube according to Donnez and Casanaz-Roux. In grade 1, the fimbrial ends are closed, but both tubes are open on a hysterosalpingography (HSG). At grade 2, both fimbriae are completely closed, and the HSG results show that both tubes are non-patent. Grades 3 and 4 are characterized by widening of the fallopian tubes. Meanwhile, in grade 5, there is thickening of the fallopian tube wall, leading to the loss of the folds in the entire ampulla of the fallopian tube.

In table 1, we can see the report during laparoscopic neosalpingostomy based on the American Fertility Society Classification of Adhesion, where the level of adhesion is higher. The closure of the distal part of the fimbria or phimosis of the fimbria, with or without hydrosalpinx, results from a chronic pelvic infection that causes adhesions. During laparoscopy, adhesiolysis is performed to free all parts of the fallopian tube from adhesions, followed by gently holding the distal part of the tube with phimosis. A tube is then opened with phimosis. This is done using a 40-watt Erbe VIO 3® monopolar needle set to “pure cut” mode, without coagulation, until the phimosis is opened. Cross-slices are made with a monopolar needle under laparoscopic guidance until the distal part of the tube is opened and the fimbriae are visible. This procedure is called a salpingostomy.^{10,17,18} To prevent re-closure of the phimosis, suturing is continued with 6-0 monofilament threads at four corners of the opened fimbria, a technique known as the Bruhat procedure or fimbrioplasty. This is why adhesion is divided into mild, moderate, and severe criteria. These procedures—the salpingostomy and fimbrioplasty—are referred to as a neosalpingostomy.^{19,20}

RESULTS

The entire study spans five years, during which participants are monitored via a teleconsultation system to track menstrual patterns and fertile period schedules until pregnancy occurs. A follow-up HSG examination is conducted one month after surgery to confirm that the laparoscopic neosalpingostomy was successful. Once the postoperative HSG confirms that the fallopian tubes are open, the patient is instructed to visit the infertility polyclinic during menstruation to consult with a doctor about a pregnancy plan. If a woman becomes pregnant, it is recorded whether the pregnancy happened naturally or through ovulation induction. Participants are also asked about the time between laparoscopy and pregnancy, gestational age, and pregnancy duration. They are invited to attend the hospital's antenatal care for pregnancy confirmation. Participants who do not become pregnant are encouraged to visit the polyclinic to discuss next steps, including options for pregnancy with assisted reproductive technology. The main outcome is that pregnancy occurs within six months after the HSG confirmation or within seven months following laparoscopic neosalpingostomy. Meanwhile, the live birth rate is the proportion of women who give birth to a live infant, and the ongoing pregnancy rate is the proportion of women with pregnancies extending beyond 24 weeks of gestation. The secondary result is the rate of clinical pregnancy, which is the proportion of women with an observed fetal heartbeat on ultrasound. Miscarriage is defined as the proportion of women who experience miscarriage before 20 weeks of pregnancy. Abnormal laparoscopic findings and surgery-related complications are also considered. The technique of data analysis involves using univariate, bivariate, and multivariate analysis. Univariate analysis aims to describe each characteristic data. Statistically, data is summarized in terms of standard deviation, or frequency (number of cases), and if necessary, the percentage. Bivariate analysis aims to examine the relationship between two variables in Stata using a chi-square test. Patients' characteristics that meet the proper criteria are outlined in Table 1 and Table 2. There are 72 patients included in the inclusion criteria, but two of them lost follow-up, so the total number of patients in the inclusion criteria is 70, all infertile patients who meet the proper criteria and are then analyzed. **No statistically significant association was observed between maternal age >35 years and pregnancy outcomes ($p > 0.05$). Although relative risks suggested a higher trend toward ectopic pregnancy in older patients (RR 2.33), the wide confidence interval (0.42–12.91)**

The pregnancy of the both group of patients with the high treatment is 83% happening in the span of 7 months after laparoscopic neosalpingostomy, in which 41 patients are successfully pregnant though without ovulation induction. However, there are only 38 patients who can continue the pregnancy completely, and there are 76% of them deliver the babies using cesarean section due to medical indication.

Similarly, ovulation induction was not significantly associated with improved term pregnancy rates ($p = 1.00$). Although there is no significant difference in table 4 ($p > 0.01$) from 70 patients with infertility due to hydrosalpinx on pregnancy, the relative ratio of age over 35 years old, compared with the ectopic pregnancy, is quite high with a wide range of confidence interval (CI). In multivariate logistic regression analysis, none of the evaluated variables reached statistical significance as independent predictors of term pregnancy ($p > 0.05$). However, maternal age >35 years showed a trend toward reduced likelihood of term pregnancy (AOR 0.74; 95% CI 0.41–1.68). Ovulation induction demonstrated a higher adjusted likelihood of term pregnancy, although not statistically significant (AOR 1.32; 95% CI 0.52–3.01).

Meanwhile, in table 5, it seems that the chance in a complete-month pregnancy due to ovulation induction is 0.71% with low range of confidence interval. Ectopic in hydrosalpinx tends to be high with the number of relative risk of 1.43.

DISCUSSION

Infertility caused by fallopian tube phimosis, along with swelling or hydrosalpinx, has been confirmed to damage the embryo through embryotoxic effects and mechanical disruptions in the movement of cilia within the fallopian tube. This condition accounts for 20-30% of cases of female infertility. Laparoscopic neosalpingostomy is reported to be one of the factors causing ectopic pregnancy.^{10-12,21-25} This study finds that 4.1% of the total patient population, although confirmed one month after the procedure through HSG to have patent tubes, still experienced issues. Ectopic pregnancy is also influenced by adhesions that involve not only the fimbria but also other organs in the adnexa. Laparoscopic adhesiolysis is reported to be more effective than laparotomy for both moderate and severe adhesions. No statistically significant link was observed between maternal age over 35 years and pregnancy outcomes ($p > 0.05$). Although the relative risks suggest a higher tendency toward ectopic pregnancy in older women (RR 2.33), the wide confidence interval (0.42–12.91) indicates a lack of statistical precision. Similarly, within the ovulation induction group, there was no significant association with improved term pregnancy rates ($p = 1.00$). Corrective procedures such as peritubal adhesiolysis, fimbrioplasty, and neosalpingostomy performed via laparoscopy remain viable options for patients seeking pregnancy without assistance from assisted reproductive technologies IVF.²⁶⁻³⁰

Ovulation induction with clomiphene citrate, combined with estradiol valerate, may offer physiological benefits following tubal reconstructive surgery. Clomiphene citrate promotes follicular growth by selectively modulating estrogen receptors, which increases natural gonadotropin release and boosts ovulation frequency. Postoperatively, increased ovulatory events could increase the likelihood of gamete interaction within a newly reconstructed tubal lumen. Additionally, short-term estradiol supplementation might improve endometrial receptivity and support optimal regeneration of the tubal epithelium. Estrogen is important for maintaining ciliary activity and tubal motility, both crucial for transporting the ovum. After surgical trauma, hormonal support may aid mucosal healing and restore fimbrial architecture function. Therefore, although statistical significance was not proven, an 82.8% pregnancy success rate—whether natural or induced ovulation—is observed for up to 7 months following laparoscopic neosalpingostomy in patients with an average infertility duration of 8.2 years. The biological plausibility supports using controlled ovulation induction as an adjunct in selected patients after neosalpingostomy. Compared to previous studies where 60% of pregnancies occurred after fimbrioplasty, this surgical method can be a viable option for patients who desire pregnancy.^{10,11,15}

This study shows that laparoscopic neosalpingostomy in patients with stage III–IV hydrosalpinx results in a relatively high overall pregnancy rate within 7 months after surgery. Although there was no statistically significant difference between the natural conception and ovulation induction groups, a meaningful trend toward higher ongoing pregnancy rates was observed in the induction group. These findings suggest that reconstructive tubal surgery remains a viable fertility-preserving option, especially in settings where assisted reproductive technology (ART) is limited or expensive. The 83% overall pregnancy rate seen in this group is similar to previous reports showing pregnancy rates of 60–70% after fimbrioplasty and neosalpingostomy. The lack of statistically significant differences may be due to the small sample size, which limits statistical power. Still, the observed relative risk patterns indicate potential clinical relevance, warranting further study in larger, multicenter trials.

The 5% incidence of ectopic pregnancy in this study aligns with rates reported after tubal reconstructive surgery. This highlights the need for careful postoperative follow-up and early

ultrasound confirmation of intrauterine pregnancy. From a biological standpoint, ovulation induction after neosalpingostomy may boost reproductive success by increasing ovulation frequency and improving endometrial receptivity during early healing. Estrogen supplements might also support tubal epithelial regeneration and ciliary function, thereby enhancing gamete transport.

Clinically, neosalpingostomy could be considered an intermediate step in infertility treatment before IVF, especially for women under 35 with good ovarian reserve and favorable tubal anatomy. However, patients should be counseled about the possibility of needing ART if pregnancy does not occur within 6–12 months.

This study has some limitations. First, the relatively small sample size (n=70) reduces statistical power and may explain the lack of significant differences despite clinical trends. Second, follow-up lasted only 6–7 months; therefore, longer-term reproductive outcomes were not assessed.

CONCLUSIONS

Laparoscopic neosalpingostomy may be considered a fertility-preserving surgical option for women with stage III–IV hydrosalpinx who desire natural conception and decline immediate assisted reproductive technology (ART). In selected patients with preserved ampullary folds and favorable adhesion scores, reconstructive surgery may offer a cost-effective alternative before in vitro fertilization (IVF). Closure of the distal part from the oviduct or fimbriae phimosis is one cause of infertility. The procedure of laparoscopic neosalpingostomy for patients with non-patent HSG and hydrosalpinx damage grade III and IV remains a recommended option before they pursue assisted pregnancy procedures.

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CONFLICTS OF INTEREST

There is no conflict of interest in this study

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Table 1. Classification of Distal tubal Occlusion by Donnez and Casanaz-Roux

No	Degree of damage	Remark
1	Degree I	Phymotic Ostium with preserved tubal patency
2	Degree II	Total Distal Tubal Occlusion Without Ampullary Dilatation
3	Degree III	Ampullary Dilatation inferior to 2.5 cm; ampullary fold well-preserved
4	Degree IV	Hydrosalpinx simple, Dilatation more than 2.5 cm' Well Preserved ampullary fold
5	Degree V	Thick-walled hydrosalpinx; absence of ampullary Folds

Table 2. Characteristics of Patients' Age, Age of Marriage and Maternity

		Total Number	Percentage	Mean
Age	<35	16	27 %	32,5
	>35	56	78 %	38,7
Infertility Age	<5 year	13	18%	3,7
	>5 year	59	82%	8,2
Pregnancy Status	Abortion	16	22 %	
	Ectopic	4	5 %	
	Full Term	38	54 %	
	No Pregnancy	12	17 %	
Maternity Method	Normal Delivery	9	23 %	
	C-Section	29	76 %	
Degree of Hydrosalpinx	Grade III	49	70 %	
	Grade IV	21	30 %	

Table 3. Pregnancy percentage in the span of 7 months after Laparoscopic Neosalpingostomy

Pregnancy Output									
abortion		ectopic		Full term		No pregnancy		Total	%
n	%	n	%	n	%	n	%		

Method of pregnancy										
CC + EE	8	50	1	25	23	60.5	9	75	41	100.0
Natural cycle	8	50	3	75	15	39.4	3	25	29	100.0

CC : Clomiphen Citrat
EE : Estradiol Valerat

Table 4. The Comparison of mothers' age > 35 years old with the pregnancy status

	<i>p</i> Value	RR	CI 95%
Age compared with abortion	0.35	1.53	0.85-2.75
Age compared with ectopic	0.45	2.33	0.42-12.91
Age compared with term pregnancy	0.24	1.29	0.98-1.68

Table 5. The comparison of pregnancy with the ovulation induction

	<i>p</i> Value	RR	CI 95%
Ovulation Induction compared with abortion	1.00	0.80	0.18-3.53
Ovulation Induction with ectopic	0.25	1.43	0.95-2.14
Ovulation Induction with term pregnancy	1.00	0.71	0.16-3.02

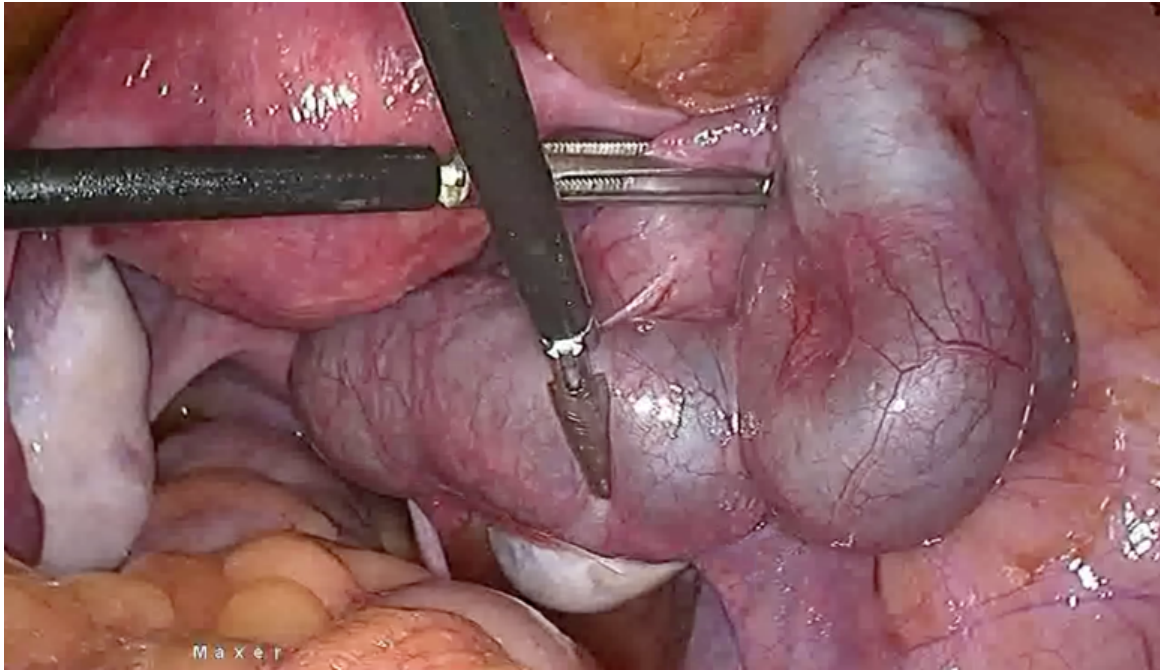


Figure 1. laparoscopic view due to phimosis in both fallopian tubes with damage of grade III and grade IV

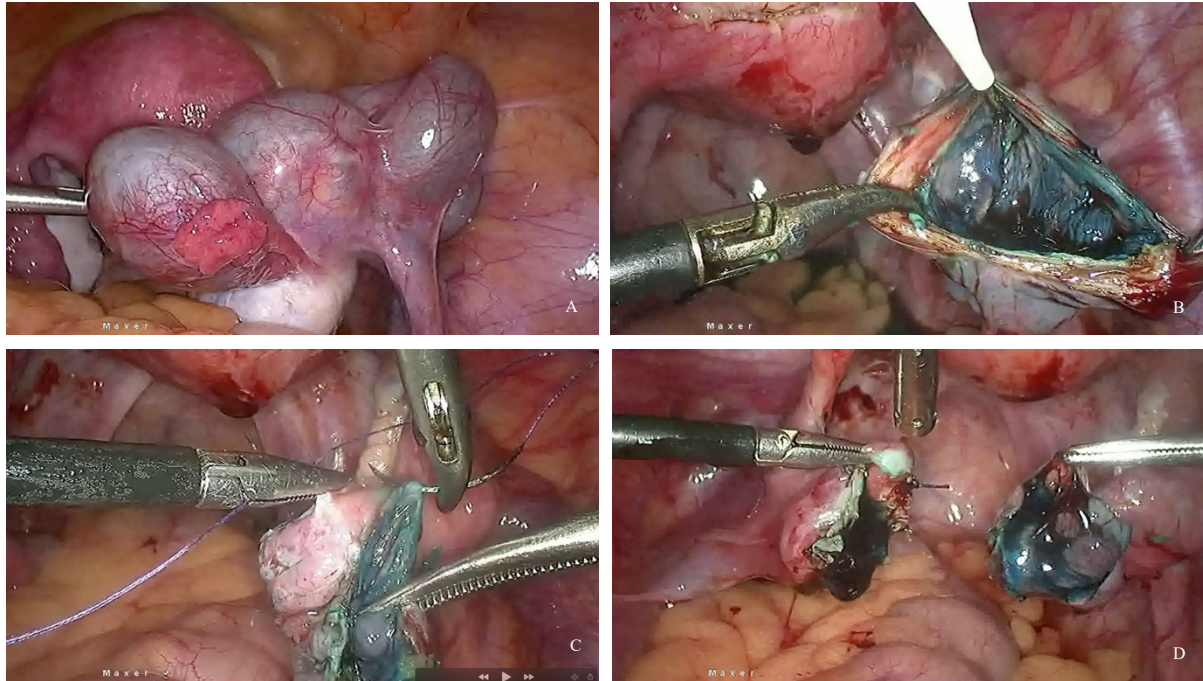


Figure 2. The figure shows picture a in which the distal of fallopian tube is closed (phimosis), the procedure of how the fimbral end opened, laparoscopy neosalpingostomy by stitching the fimbral end and methylene blue dye test to make sure the opened tube.

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 Unika Soegijapranata1

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A Comparison of the Incidence of Spontaneous Pregnancy Between Ovulation Induction and No Ovulation Induction in Patients After Post-Laparoscopic Neosalpingostomy with Stage III-IV Hydrosalpinx

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Abstract

Objective:

To compare pregnancy outcomes between natural conception and ovulation induction following laparoscopic neosalpingostomy in women with stage III–IV hydrosalpinx.

Methods:

A quasi-experimental study was conducted from 2014–2019 including 70 infertile women undergoing laparoscopic neosalpingostomy. Participants were divided into natural cycle and ovulation induction groups (clomiphene citrate plus estradiol valerate). Follow-up lasted six to seven months. Pregnancy outcomes were analyzed using chi-square and multivariate logistic regression, with $p < 0.05$ considered significant.

Results:

The overall pregnancy rate was 83% within seven months postoperatively. Forty-one pregnancies occurred without induction. No significant association was found between ovulation induction or maternal age > 35 years and term pregnancy ($p > 0.05$). Ectopic pregnancy occurred in 4–5% of cases. Multivariate analysis showed no independent predictors of term pregnancy.

Conclusion:

Laparoscopic neosalpingostomy remains a viable fertility-preserving option for women with advanced hydrosalpinx, with comparable outcomes between natural conception and ovulation induction.

Key words : Spontaneous pregnancy, hydrosalpinx, Laparoscopic Neosalpingostomy, Pregnancy outcomes

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INTRODUCTION

Infertility remains a health issue worldwide, including in Indonesia. Although it does not affect physical activity and is not life-threatening, it significantly impacts family life for many couples due to medical, economic, and psychological problems. Infertility is defined as the failure to conceive after 12 months of regular, unprotected sexual activity in the absence of reproductive pathology^{1,2}. Infertility can be caused by women, men, or both. However, among the many infertile couples, most cases are due to female factors. A woman may be infertile because of various risk factors. These factors include age, occupation, stress level, body mass

index related to nutritional status, and reproductive organ abnormalities, such as disorders of ovulation, tubal and pelvic issues, and uterine problems disorders.³⁻⁵

Factors related to abnormalities of female reproductive organs also contribute to infertility. According to the study's findings, women with reproductive organ disorders have a higher risk of infertility compared to those without such disorders. The issue of blocked fallopian tubes, often accompanied by swelling or hydrosalpinx, can lead to embryo damage through embryotoxic effects and mechanical disruption of ciliary hair movement within the fallopian tubes.⁶⁻¹² It is advised to perform corrections such as peritubal adhesiolysis, fimbrioplasty, and neosalpingostomy in cases of fallopian tube obstruction with hydrosalpinx, typically done laparoscopically. It is also recommended for patients who want to conceive naturally. Neosalpingostomy is a strategic alternative for those who are not willing to undergo salpingectomy but still desire a natural pregnancy without assisted technologies like IUI or IVF.¹³⁻¹⁵

The purpose of this study was to compare the pregnancy rates between patients who conceived naturally and those who successfully induced ovulation following laparoscopic neosalpingostomy for hydrosalpinx.

METHODS

This study employed a quasi-experimental design. It was conducted at Anugerah Women & Children Hospital in Semarang, Indonesia, from January 2014 to December 2019, and was approved by the Health Research Ethics Committee under the Ethical Clearance for Research No. 380/EC/KEPK.FK-UNDIP/X/2021. All patients provided written informed consent prior to participation in the study. Patients were informed about the surgical procedure, postoperative monitoring, potential risks including ectopic pregnancy, and the option of ovulation induction therapy. Consent for teleconsultation follow-up and data use for research purposes was also obtained. Data were analyzed using STATA statistical software. Descriptive statistics were used to summarize demographic and clinical characteristics. Continuous variables were presented as mean $\pm$ standard deviation, while categorical variables were expressed as frequencies and percentages. Bivariate analysis was performed using the Chi-square test or Fisher's exact test (when appropriate) to assess associations between categorical variables such as age group, ovulation induction status, and pregnancy outcomes. Relative risks (RR) with 95% confidence intervals (CI) were calculated to estimate the strength of association. A p-value less than 0.05 was considered statistically significant. The 6-month follow-up period was selected based on clinical evidence suggesting that most spontaneous or induced conceptions following tubal reconstructive surgery occur within the first 6–12 months postoperatively. Monitoring during this early period allows for the assessment of tubal patency before the risk of re-adhesion or tubal re-occlusion increases. Patients are divided into two groups based on hydrosalpinx. The first group comprises patients who decline ovulation induction, while the second group includes patients undergoing ovulation induction therapy with 10 mg of clomiphene citrate (Pinfetil 50 mg, Novell pharmaceutical laboratories), taking two tablets daily for five days from the 2nd to the 6th day of their cycle. Additionally, they receive 1 tablet of 2 mg estradiol valerate (Progynova, BAYER) daily for 5 days, from the 8th to the 12th day of the cycle.

Patients will be monitored over three cycles using the same therapy. Monitoring includes egg assessment via transvaginal ultrasound on day 12 to evaluate follicle size and endometrial thickness, followed by a three-month period without therapy. The total monitoring period spans six months from the beginning of the intervention. All patients undergo basal transvaginal ultrasonography (TVS) The General Electric Voluson S10 Expert[®] on day 2 of their menstrual cycle before starting treatment. Serial TVS begins on cycle day 8 to assess follicular growth (number and diameter of follicles) and endometrial thickness. This assessment continues every

1–3 days until the mean follicular diameter (average of two orthogonal measurements) reaches ≥ 18 mm. The inclusion criteria for this study are patients who have undergone laparoscopic neosalpingostomy surgery due to bilateral fallopian tube phimosis with damage classified as grade III or grade IV. They are monitored in two groups and are willing to participate in teleconsultation. In addition to the wives' factors, the husbands' factors—specifically, normal sperm according to WHO criteria—are also required. Exclusion criteria include patients who are unwilling to be monitored by the teleconsultation system. They prefer to directly undergo pregnancy therapy with assisted technology due to abnormal sperm factors. If more than six months pass after the intervention in both groups and group 2 still has not achieved pregnancy, these patients will be excluded and advised to try pregnancy with assisted technology. Multivariate logistic regression analysis was conducted to identify independent predictors of term pregnancy following laparoscopic neosalpingostomy. Variables in the regression model included maternal age (>35 vs. ≤ 35 years), duration of infertility (>5 vs. ≤ 5 years), degree of hydrosalpinx (grade III vs. IV), and ovulation induction status. Adjusted odds ratios (AOR) with 95% confidence intervals were calculated. Variables with $p < 0.25$ in bivariate analysis were included in the multivariate model.

The study population comprises all women who self-referred for infertility evaluation at Anugerah Women & Children Hospital in Semarang, Indonesia. The control group consisted of women with problematic infertility examined at the same hospital's infertility clinic. The case subjects are women experiencing primary infertility with both non-patent tubal hydrosalpinx stages III and IV, confirmed by supporting examination, specifically HSG. The control group subjects are infertile women who underwent laparoscopic neosalpingotomy by Erbe VIRON 1 Laparoscopy System[®] without ovulation induction, operating on a natural cycle. They are compared with patients who receive ovulation induction with 10 mg of clomiphene citrate given on the 2nd day of menstruation and 2 mg of estradiol valerate on the 8th day of the cycle, according to inclusion criteria. The success of the procedure to open the fimbria in hydrosalpinx, as classified by Donnez and Casanas-Roux, based on preoperative HSG examination [table 1], is influenced by the degree of adhesion, according to the American Fertility Society classification adhesion.¹⁶

Table 1 presents the classification of the degree of fimbrial closure in the fallopian tube according to Donnez and Casanas-Roux. In grade 1, the fimbrial ends are closed, but both tubes are open on a hysterosalpingography (HSG). At grade 2, both fimbriae are completely closed, and the HSG results show that both tubes are non-patent. Grades 3 and 4 are characterized by widening of the fallopian tubes. Meanwhile, in grade 5, there is thickening of the fallopian tube wall, leading to the loss of the folds in the entire ampulla of the fallopian tube.

In table 1, we can see the report during laparoscopic neosalpingostomy based on the American Fertility Society Classification of Adhesion, where the level of adhesion is higher. The closure of the distal part of the fimbria or phimosis of the fimbria, with or without hydrosalpinx, results from a chronic pelvic infection that causes adhesions. During laparoscopy, adhesiolysis is performed to free all parts of the fallopian tube from adhesions, followed by gently holding the distal part of the tube with phimosis. A tube is then opened with phimosis. This is done using a 40-watt Erbe VIO 3[®] monopolar needle set to “pure cut” mode, without coagulation, until the phimosis is opened. Cross-slices are made with a monopolar needle under laparoscopic guidance until the distal part of the tube is opened and the fimbriae are visible. This procedure is called a salpingostomy.^{10,17,18} To prevent re-closure of the phimosis, suturing is continued with 6-0 monofilament threads at four corners of the opened fimbria, a technique known as the Bruhat procedure or fimbrioplasty. This is why adhesion is divided into mild, moderate, and severe criteria. These procedures—the salpingostomy and fimbrioplasty—are referred to as a neosalpingostomy.^{19,20}

RESULTS

The entire study spans five years, during which participants are monitored via a teleconsultation system to track menstrual patterns and fertile period schedules until pregnancy occurs. A follow-up HSG examination is conducted one month after surgery to confirm that the laparoscopic neosalpingostomy was successful. Once the postoperative HSG confirms that the fallopian tubes are open, the patient is instructed to visit the infertility polyclinic during menstruation to consult with a doctor about a pregnancy plan. If a woman becomes pregnant, it is recorded whether the pregnancy happened naturally or through ovulation induction. Participants are also asked about the time between laparoscopy and pregnancy, gestational age, and pregnancy duration. They are invited to attend the hospital's antenatal care for pregnancy confirmation. Participants who do not become pregnant are encouraged to visit the polyclinic to discuss next steps, including options for pregnancy with assisted reproductive technology. The main outcome is that pregnancy occurs within six months after the HSG confirmation or within seven months following laparoscopic neosalpingostomy. Meanwhile, the live birth rate is the proportion of women who give birth to a live infant, and the ongoing pregnancy rate is the proportion of women with pregnancies extending beyond 24 weeks of gestation. The secondary result is the rate of clinical pregnancy, which is the proportion of women with an observed fetal heartbeat on ultrasound. Miscarriage is defined as the proportion of women who experience miscarriage before 20 weeks of pregnancy. Abnormal laparoscopic findings and surgery-related complications are also considered. The technique of data analysis involves using univariate, bivariate, and multivariate analysis. Univariate analysis aims to describe each characteristic data. Statistically, data is summarized in terms of standard deviation, or frequency (number of cases), and if necessary, the percentage. Bivariate analysis aims to examine the relationship between two variables in Stata using a chi-square test. Patients' characteristics that meet the proper criteria are outlined in Table 1 and Table 2. There are 72 patients included in the inclusion criteria, but two of them lost follow-up, so the total number of patients in the inclusion criteria is 70, all infertile patients who meet the proper criteria and are then analyzed. No statistically significant association was observed between maternal age >35 years and pregnancy outcomes ($p > 0.05$). Although relative risks suggested a higher trend toward ectopic pregnancy in older patients (RR 2.33), the wide confidence interval (0.42–12.91)

The pregnancy of the both group of patients with the high treatment is 83% happening in the span of 7 months after laparoscopic neosalpingostomy, in which 41 patients are successfully pregnant though without ovulation induction. However, there are only 38 patients who can continue the pregnancy completely, and there are 76% of them deliver the babies using cesarean section due to medical indication.

Similarly, ovulation induction was not significantly associated with improved term pregnancy rates ($p = 1.00$). Although there is no significant difference in table 4 ($p > 0.01$) from 70 patients with infertility due to hydrosalpinx on pregnancy, the relative ratio of age over 35 years old, compared with the ectopic pregnancy, is quite high with a wide range of confidence interval (CI). In multivariate logistic regression analysis, none of the evaluated variables reached statistical significance as independent predictors of term pregnancy ($p > 0.05$). However, maternal age >35 years showed a trend toward reduced likelihood of term pregnancy (AOR 0.74; 95% CI 0.41–1.68). Ovulation induction demonstrated a higher adjusted likelihood of term pregnancy, although not statistically significant (AOR 1.32; 95% CI 0.52–3.01).

Meanwhile, in table 5, it seems that the chance in a complete-month pregnancy due to ovulation induction is 0.71% with low range of confidence interval. Ectopic in hydrosalpinx tends to be high with the number of relative risk of 1.43.

DISCUSSION

Infertility caused by fallopian tube phimosis, along with swelling or hydrosalpinx, has been confirmed to damage the embryo through embryotoxic effects and mechanical disruptions in the movement of cilia within the fallopian tube. This condition accounts for 20-30% of cases of female infertility. Laparoscopic neosalpingostomy is reported to be one of the factors causing ectopic pregnancy.^{10-12,21-25} This study finds that 4.1% of the total patient population, although confirmed one month after the procedure through HSG to have patent tubes, still experienced issues. Ectopic pregnancy is also influenced by adhesions that involve not only the fimbria but also other organs in the adnexa. Laparoscopic adhesiolysis is reported to be more effective than laparotomy for both moderate and severe adhesions. No statistically significant link was observed between maternal age over 35 years and pregnancy outcomes ($p > 0.05$). Although the relative risks suggest a higher tendency toward ectopic pregnancy in older women (RR 2.33), the wide confidence interval (0.42–12.91) indicates a lack of statistical precision. Similarly, within the ovulation induction group, there was no significant association with improved term pregnancy rates ($p = 1.00$). Corrective procedures such as peritubal adhesiolysis, fimbrioplasty, and neosalpingostomy performed via laparoscopy remain viable options for patients seeking pregnancy without assistance from assisted reproductive technologies IVF.²⁶⁻³⁰

Ovulation induction with clomiphene citrate, combined with estradiol valerate, may offer physiological benefits following tubal reconstructive surgery. Clomiphene citrate promotes follicular growth by selectively modulating estrogen receptors, which increases natural gonadotropin release and boosts ovulation frequency. Postoperatively, increased ovulatory events could increase the likelihood of gamete interaction within a newly reconstructed tubal lumen. Additionally, short-term estradiol supplementation might improve endometrial receptivity and support optimal regeneration of the tubal epithelium. Estrogen is important for maintaining ciliary activity and tubal motility, both crucial for transporting the ovum. After surgical trauma, hormonal support may aid mucosal healing and restore fimbrial architecture function. Therefore, although statistical significance was not proven, an 82.8% pregnancy success rate—whether natural or induced ovulation—is observed for up to 7 months following laparoscopic neosalpingostomy in patients with an average infertility duration of 8.2 years. The biological plausibility supports using controlled ovulation induction as an adjunct in selected patients after neosalpingostomy. Compared to previous studies where 60% of pregnancies occurred after fimbrioplasty, this surgical method can be a viable option for patients who desire pregnancy.^{10,11,15}

This study shows that laparoscopic neosalpingostomy in patients with stage III–IV hydrosalpinx results in a relatively high overall pregnancy rate within 7 months after surgery. Although there was no statistically significant difference between the natural conception and ovulation induction groups, a meaningful trend toward higher ongoing pregnancy rates was observed in the induction group. These findings suggest that reconstructive tubal surgery remains a viable fertility-preserving option, especially in settings where assisted reproductive technology (ART) is limited or expensive. The 83% overall pregnancy rate seen in this group is similar to previous reports showing pregnancy rates of 60–70% after fimbrioplasty and neosalpingostomy. The lack of statistically significant differences may be due to the small sample size, which limits statistical power. Still, the observed relative risk patterns indicate potential clinical relevance, warranting further study in larger, multicenter trials.

The 5% incidence of ectopic pregnancy in this study aligns with rates reported after tubal reconstructive surgery. This highlights the need for careful postoperative follow-up and early

ultrasound confirmation of intrauterine pregnancy. From a biological standpoint, ovulation induction after neosalpingostomy may boost reproductive success by increasing ovulation frequency and improving endometrial receptivity during early healing. Estrogen supplements might also support tubal epithelial regeneration and ciliary function, thereby enhancing gamete transport.

Clinically, neosalpingostomy could be considered an intermediate step in infertility treatment before IVF, especially for women under 35 with good ovarian reserve and favorable tubal anatomy. However, patients should be counseled about the possibility of needing ART if pregnancy does not occur within 6–12 months.

This study has some limitations. First, the relatively small sample size (n=70) reduces statistical power and may explain the lack of significant differences despite clinical trends. Second, follow-up lasted only 6–7 months; therefore, longer-term reproductive outcomes were not assessed.

CONCLUSIONS

Laparoscopic neosalpingostomy may be considered a fertility-preserving surgical option for women with stage III–IV hydrosalpinx who desire natural conception and decline immediate assisted reproductive technology (ART). In selected patients with preserved ampullary folds and favorable adhesion scores, reconstructive surgery may offer a cost-effective alternative before in vitro fertilization (IVF). Closure of the distal part from the oviduct or fimbriae phimosis is one cause of infertility. The procedure of laparoscopic neosalpingostomy for patients with non-patent HSG and hydrosalpinx damage grade III and IV remains a recommended option before they pursue assisted pregnancy procedures.

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CONFLICTS OF INTEREST

There is no conflict of interest in this study

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Table 1. Classification of Distal tubal Occlusion by Donnez and Casanaz-Roux

No	Degree of damage	Remark
1	Degree I	Phymotic Ostium with preserved tubal patency
2	Degree II	Total Distal Tubal Occlusion Without Ampullary Dilatation
3	Degree III	Ampullary Dilatation inferior to 2.5 cm; ampullary fold well-preserved
4	Degree IV	Hydrosalpinx simple, Dilatation more than 2.5 cm' Well Preserved ampullary fold
5	Degree V	Thick-walled hydrosalpinx; absence of ampullary Folds

Table 2. Characteristics of Patients' Age, Age of Marriage and Maternity

		Total Number	Percentage	Mean
Age	<35	16	27 %	32,5
	>35	56	78 %	38,7
Infertility Age	<5 year	13	18%	3,7
	>5 year	59	82%	8,2
Pregnancy Status	Abortion	16	22 %	
	Ectopic	4	5 %	
	Full Term	38	54 %	
	No Pregnancy	12	17 %	
Maternity Method	Normal Delivery	9	23 %	
	C-Section	29	76 %	
Degree of Hydrosalpinx	Grade III	49	70 %	
	Grade IV	21	30 %	

Table 3. Pregnancy percentage in the span of 7 months after Laparoscopic Neosalpingostomy

		Pregnancy Output									
		abortion		ectopic		Full term		No pregnancy			
		n	%	n	%	n	%	n	%	Total	%
						</					

Method of pregnancy										
CC + EE	8	50	1	25	23	60.5	9	75	41	100.0
Natural cycle	8	50	3	75	15	39.4	3	25	29	100.0

CC : Clomiphen Citrat
EE : Estradiol Valerat

Table 4. The Comparison of mothers' age > 35 years old with the pregnancy status

	<i>p</i> Value	RR	CI 95%
Age compared with abortion	0.35	1.53	0.85-2.75
Age compared with ectopic	0.45	2.33	0.42-12.91
Age compared with term pregnancy	0.24	1.29	0.98-1.68

Table 5. The comparison of pregnancy with the ovulation induction

	<i>p</i> Value	RR	CI 95%
Ovulation Induction compared with abortion	1.00	0.80	0.18-3.53
Ovulation Induction with ectopic	0.25	1.43	0.95-2.14
Ovulation Induction with term pregnancy	1.00	0.71	0.16-3.02

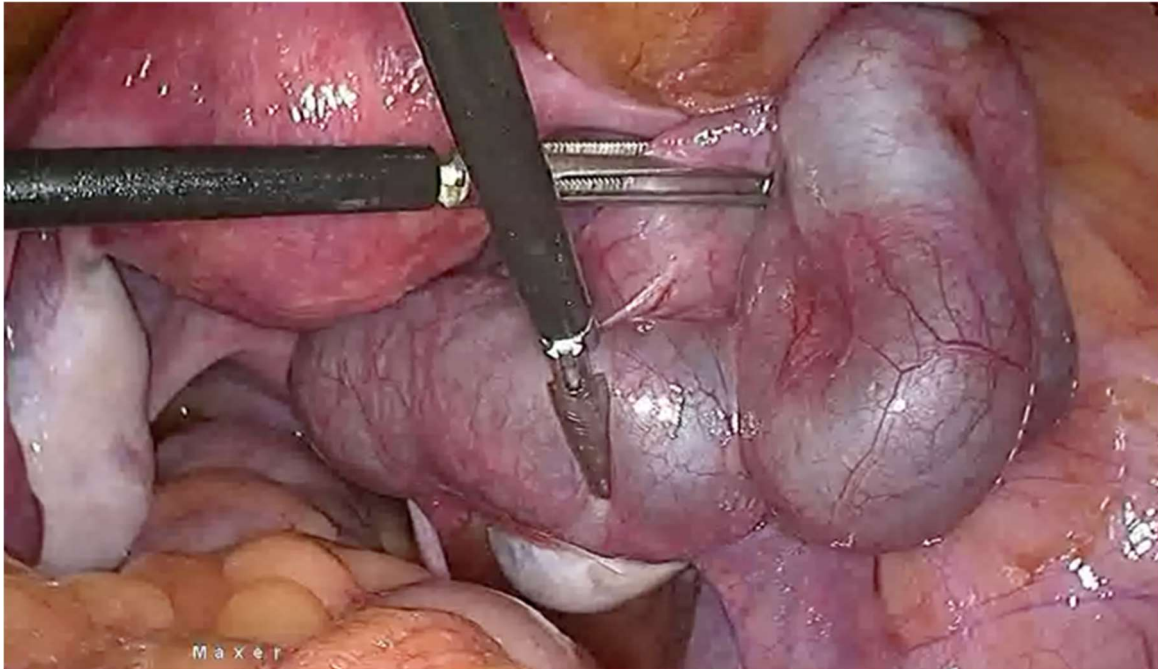


Figure 1. laparoscopic view due to phimosis in both fallopian tubes with damage of grade III and grade IV

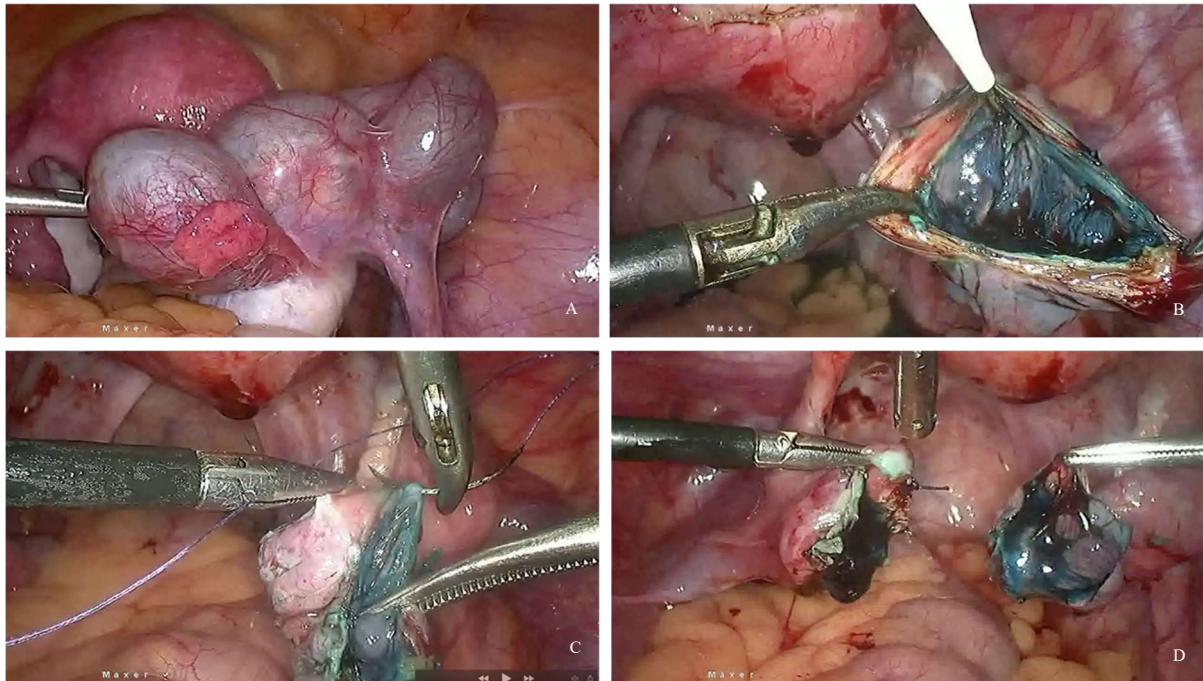


Figure 2. The figure shows picture a in which the distal of fallopian tube is closed (phimosis), the procedure of how the fimbral end opened, laparoscopy neosalpingostomy by stitching the fimbral end and methylene blue dye test to make sure the opened tube.



reviewer

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The following message is being delivered on behalf of Indonesian journal of obstetrics and gynecology



A Comparison of the Incidence of Spontaneous Pregnancy Between Ovulation Induction and No Ovulation Induction in Patients After Post-Laparoscopic Neosalpingostomy with Stage III-IV Hydrosalpinx

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Abstract

Objective:

To compare pregnancy outcomes between natural conception and ovulation induction following laparoscopic neosalpingostomy in women with stage III–IV hydrosalpinx.

Methods:

A quasi-experimental study was conducted from 2014–2019 including 70 infertile women undergoing laparoscopic neosalpingostomy. Participants were divided into natural cycle and ovulation induction groups (clomiphene citrate plus estradiol valerate). Follow-up lasted six to seven months. Pregnancy outcomes were analyzed using chi-square and multivariate logistic regression, with $p < 0.05$ considered significant.

Results:

The overall pregnancy rate was 83% within seven months postoperatively. Forty-one pregnancies occurred without induction. No significant association was found between ovulation induction or maternal age >35 years and term pregnancy ($p > 0.05$). Ectopic pregnancy occurred in 4–5% of cases. Multivariate analysis showed no independent predictors of term pregnancy.

Conclusion:

Laparoscopic neosalpingostomy remains a viable fertility-preserving option for women with advanced hydrosalpinx, with comparable outcomes between natural conception and ovulation induction.

Key words : Spontaneous pregnancy, hydrosalpinx, Laparoscopic Neosalpingostomy, Pregnancy outcomes

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INTRODUCTION

Infertility remains a health issue worldwide, including in Indonesia. Although it does not affect physical activity and is not life-threatening, it significantly impacts family life for many couples due to medical, economic, and psychological problems. Infertility is defined as the failure to conceive after 12 months of regular, unprotected sexual activity in the absence of reproductive pathology^{1,2}. Infertility can be caused by women, men, or both. However, among the many infertile couples, most cases are due to female factors. A woman may be infertile because of various risk factors. These factors include age, occupation, stress level, body mass

index related to nutritional status, and reproductive organ abnormalities, such as disorders of ovulation, tubal and pelvic issues, and uterine problems disorders.³⁻⁵

Factors related to abnormalities of female reproductive organs also contribute to infertility. According to the study's findings, women with reproductive organ disorders have a higher risk of infertility compared to those without such disorders. The issue of blocked fallopian tubes, often accompanied by swelling or hydrosalpinx, can lead to embryo damage through embryotoxic effects and mechanical disruption of ciliary hair movement within the fallopian tubes.⁶⁻¹² It is advised to perform corrections such as peritubal adhesiolysis, fimbrioplasty, and neosalpingostomy in cases of fallopian tube obstruction with hydrosalpinx, typically done laparoscopically. It is also recommended for patients who want to conceive naturally. Neosalpingostomy is a strategic alternative for those who are not willing to undergo salpingectomy but still desire a natural pregnancy without assisted technologies like IUI or IVF.¹³⁻¹⁵

The purpose of this study was to compare the pregnancy rates between patients who conceived naturally and those who successfully induced ovulation following laparoscopic neosalpingostomy for hydrosalpinx.

METHODS

This study employed a quasi-experimental design. It was conducted at Anugerah Women & Children Hospital in Semarang, Indonesia, from January 2014 to December 2019, and was approved by the Health Research Ethics Committee under the Ethical Clearance for Research No. 380/EC/KEPK.FK-UNDIP/X/2021. All patients provided written informed consent prior to participation in the study. Patients were informed about the surgical procedure, postoperative monitoring, potential risks including ectopic pregnancy, and the option of ovulation induction therapy. Consent for teleconsultation follow-up and data use for research purposes was also obtained. Data were analyzed using STATA statistical software. Descriptive statistics were used to summarize demographic and clinical characteristics. Continuous variables were presented as mean $\pm$ standard deviation, while categorical variables were expressed as frequencies and percentages. Bivariate analysis was performed using the Chi-square test or Fisher's exact test (when appropriate) to assess associations between categorical variables such as age group, ovulation induction status, and pregnancy outcomes. Relative risks (RR) with 95% confidence intervals (CI) were calculated to estimate the strength of association. A p-value less than 0.05 was considered statistically significant. The 6-month follow-up period was selected based on clinical evidence suggesting that most spontaneous or induced conceptions following tubal reconstructive surgery occur within the first 6–12 months postoperatively. Monitoring during this early period allows for the assessment of tubal patency before the risk of re-adhesion or tubal re-occlusion increases. Patients are divided into two groups based on hydrosalpinx. The first group comprises patients who decline ovulation induction, while the second group includes patients undergoing ovulation induction therapy with 10 mg of clomiphene citrate (Pinfetil 50 mg, Novell pharmaceutical laboratories), taking two tablets daily for five days from the 2nd to the 6th day of their cycle. Additionally, they receive 1 tablet of 2 mg estradiol valerate (Progynova, BAYER) daily for 5 days, from the 8th to the 12th day of the cycle.

Patients will be monitored over three cycles using the same therapy. Monitoring includes egg assessment via transvaginal ultrasound on day 12 to evaluate follicle size and endometrial thickness, followed by a three-month period without therapy. The total monitoring period spans six months from the beginning of the intervention. All patients undergo basal transvaginal ultrasonography (TVS) The General Electric Voluson S10 Expert® on day 2 of their menstrual cycle before starting treatment. Serial TVS begins on cycle day 8 to assess follicular growth (number and diameter of follicles) and endometrial thickness. This assessment continues every

1–3 days until the mean follicular diameter (average of two orthogonal measurements) reaches ≥ 18 mm. The inclusion criteria for this study are patients who have undergone laparoscopic neosalpingostomy surgery due to bilateral fallopian tube phimosis with damage classified as grade III or grade IV. They are monitored in two groups and are willing to participate in teleconsultation. In addition to the wives' factors, the husbands' factors—specifically, normal sperm according to WHO criteria—are also required. Exclusion criteria include patients who are unwilling to be monitored by the teleconsultation system. They prefer to directly undergo pregnancy therapy with assisted technology due to abnormal sperm factors. If more than six months pass after the intervention in both groups and group 2 still has not achieved pregnancy, these patients will be excluded and advised to try pregnancy with assisted technology. Multivariate logistic regression analysis was conducted to identify independent predictors of term pregnancy following laparoscopic neosalpingostomy. Variables in the regression model included maternal age (>35 vs. ≤ 35 years), duration of infertility (>5 vs. ≤ 5 years), degree of hydrosalpinx (grade III vs. IV), and ovulation induction status. Adjusted odds ratios (AOR) with 95% confidence intervals were calculated. Variables with $p < 0.25$ in bivariate analysis were included in the multivariate model.

The study population comprises all women who self-referred for infertility evaluation at Anugerah Women & Children Hospital in Semarang, Indonesia. The control group consisted of women with problematic infertility examined at the same hospital's infertility clinic. The case subjects are women experiencing primary infertility with both non-patent tubal hydrosalpinx stages III and IV, confirmed by supporting examination, specifically HSG. The control group subjects are infertile women who underwent laparoscopic neosalpingotomy by Erbe VIRON 1 Laparoscopy System[®] without ovulation induction, operating on a natural cycle. They are compared with patients who receive ovulation induction with 10 mg of clomiphene citrate given on the 2nd day of menstruation and 2 mg of estradiol valerate on the 8th day of the cycle, according to inclusion criteria. The success of the procedure to open the fimbria in hydrosalpinx, as classified by Donnez and Casanas-Roux, based on preoperative HSG examination [table 1], is influenced by the degree of adhesion, according to the American Fertility Society classification adhesion.¹⁶

Table 1 presents the classification of the degree of fimbrial closure in the fallopian tube according to Donnez and Casanaz-Roux. In grade 1, the fimbrial ends are closed, but both tubes are open on a hysterosalpingography (HSG). At grade 2, both fimbriae are completely closed, and the HSG results show that both tubes are non-patent. Grades 3 and 4 are characterized by widening of the fallopian tubes. Meanwhile, in grade 5, there is thickening of the fallopian tube wall, leading to the loss of the folds in the entire ampulla of the fallopian tube.

In table 1, we can see the report during laparoscopic neosalpingostomy based on the American Fertility Society Classification of Adhesion, where the level of adhesion is higher. The closure of the distal part of the fimbria or phimosis of the fimbria, with or without hydrosalpinx, results from a chronic pelvic infection that causes adhesions. During laparoscopy, adhesiolysis is performed to free all parts of the fallopian tube from adhesions, followed by gently holding the distal part of the tube with phimosis. A tube is then opened with phimosis. This is done using a 40-watt Erbe VIO 3[®] monopolar needle set to “pure cut” mode, without coagulation, until the phimosis is opened. Cross-slices are made with a monopolar needle under laparoscopic guidance until the distal part of the tube is opened and the fimbriae are visible. This procedure is called a salpingostomy.^{10,17,18} To prevent re-closure of the phimosis, suturing is continued with 6-0 monofilament threads at four corners of the opened fimbria, a technique known as the Bruhat procedure or fimbrioplasty. This is why adhesion is divided into mild, moderate, and severe criteria. These procedures—the salpingostomy and fimbrioplasty—are referred to as a neosalpingostomy.^{19,20}

RESULTS

The entire study spans five years, during which participants are monitored via a teleconsultation system to track menstrual patterns and fertile period schedules until pregnancy occurs. A follow-up HSG examination is conducted one month after surgery to confirm that the laparoscopic neosalpingostomy was successful. Once the postoperative HSG confirms that the fallopian tubes are open, the patient is instructed to visit the infertility polyclinic during menstruation to consult with a doctor about a pregnancy plan. If a woman becomes pregnant, it is recorded whether the pregnancy happened naturally or through ovulation induction. Participants are also asked about the time between laparoscopy and pregnancy, gestational age, and pregnancy duration. They are invited to attend the hospital's antenatal care for pregnancy confirmation. Participants who do not become pregnant are encouraged to visit the polyclinic to discuss next steps, including options for pregnancy with assisted reproductive technology. The main outcome is that pregnancy occurs within six months after the HSG confirmation or within seven months following laparoscopic neosalpingostomy. Meanwhile, the live birth rate is the proportion of women who give birth to a live infant, and the ongoing pregnancy rate is the proportion of women with pregnancies extending beyond 24 weeks of gestation. The secondary result is the rate of clinical pregnancy, which is the proportion of women with an observed fetal heartbeat on ultrasound. Miscarriage is defined as the proportion of women who experience miscarriage before 20 weeks of pregnancy. Abnormal laparoscopic findings and surgery-related complications are also considered. The technique of data analysis involves using univariate, bivariate, and multivariate analysis. Univariate analysis aims to describe each characteristic data. Statistically, data is summarized in terms of standard deviation, or frequency (number of cases), and if necessary, the percentage. Bivariate analysis aims to examine the relationship between two variables in Stata using a chi-square test. Patients' characteristics that meet the proper criteria are outlined in Table 1 and Table 2. There are 72 patients included in the inclusion criteria, but two of them lost follow-up, so the total number of patients in the inclusion criteria is 70, all infertile patients who meet the proper criteria and are then analyzed. **No statistically significant association was observed between maternal age >35 years and pregnancy outcomes ($p > 0.05$). Although relative risks suggested a higher trend toward ectopic pregnancy in older patients (RR 2.33), the wide confidence interval (0.42–12.91)**

The pregnancy of the both group of patients with the high treatment is 83% happening in the span of 7 months after laparoscopic neosalpingostomy, in which 41 patients are successfully pregnant though without ovulation induction. However, there are only 38 patients who can continue the pregnancy completely, and there are 76% of them deliver the babies using cesarean section due to medical indication.

Similarly, ovulation induction was not significantly associated with improved term pregnancy rates ($p = 1.00$). Although there is no significant difference in table 4 ($p > 0.01$) from 70 patients with infertility due to hydrosalpinx on pregnancy, the relative ratio of age over 35 years old, compared with the ectopic pregnancy, is quite high with a wide range of confidence interval (CI). In multivariate logistic regression analysis, none of the evaluated variables reached statistical significance as independent predictors of term pregnancy ($p > 0.05$). However, maternal age >35 years showed a trend toward reduced likelihood of term pregnancy (AOR 0.74; 95% CI 0.41–1.68). Ovulation induction demonstrated a higher adjusted likelihood of term pregnancy, although not statistically significant (AOR 1.32; 95% CI 0.52–3.01).

Meanwhile, in table 5, it seems that the chance in a complete-month pregnancy due to ovulation induction is 0.71% with low range of confidence interval. Ectopic in hydrosalpinx tends to be high with the number of relative risk of 1.43.

DISCUSSION

Infertility caused by fallopian tube phimosis, along with swelling or hydrosalpinx, has been confirmed to damage the embryo through embryotoxic effects and mechanical disruptions in the movement of cilia within the fallopian tube. This condition accounts for 20-30% of cases of female infertility. Laparoscopic neosalpingostomy is reported to be one of the factors causing ectopic pregnancy.^{10-12,21-25} This study finds that 4.1% of the total patient population, although confirmed one month after the procedure through HSG to have patent tubes, still experienced issues. Ectopic pregnancy is also influenced by adhesions that involve not only the fimbria but also other organs in the adnexa. Laparoscopic adhesiolysis is reported to be more effective than laparotomy for both moderate and severe adhesions. No statistically significant link was observed between maternal age over 35 years and pregnancy outcomes ($p > 0.05$). Although the relative risks suggest a higher tendency toward ectopic pregnancy in older women (RR 2.33), the wide confidence interval (0.42–12.91) indicates a lack of statistical precision. Similarly, within the ovulation induction group, there was no significant association with improved term pregnancy rates ($p = 1.00$). Corrective procedures such as peritubal adhesiolysis, fimbrioplasty, and neosalpingostomy performed via laparoscopy remain viable options for patients seeking pregnancy without assistance from assisted reproductive technologies IVF.²⁶⁻³⁰

Ovulation induction with clomiphene citrate, combined with estradiol valerate, may offer physiological benefits following tubal reconstructive surgery. Clomiphene citrate promotes follicular growth by selectively modulating estrogen receptors, which increases natural gonadotropin release and boosts ovulation frequency. Postoperatively, increased ovulatory events could increase the likelihood of gamete interaction within a newly reconstructed tubal lumen. Additionally, short-term estradiol supplementation might improve endometrial receptivity and support optimal regeneration of the tubal epithelium. Estrogen is important for maintaining ciliary activity and tubal motility, both crucial for transporting the ovum. After surgical trauma, hormonal support may aid mucosal healing and restore fimbrial architecture function. Therefore, although statistical significance was not proven, an 82.8% pregnancy success rate—whether natural or induced ovulation—is observed for up to 7 months following laparoscopic neosalpingostomy in patients with an average infertility duration of 8.2 years. The biological plausibility supports using controlled ovulation induction as an adjunct in selected patients after neosalpingostomy. Compared to previous studies where 60% of pregnancies occurred after fimbrioplasty, this surgical method can be a viable option for patients who desire pregnancy.^{10,11,15}

This study shows that laparoscopic neosalpingostomy in patients with stage III–IV hydrosalpinx results in a relatively high overall pregnancy rate within 7 months after surgery. Although there was no statistically significant difference between the natural conception and ovulation induction groups, a meaningful trend toward higher ongoing pregnancy rates was observed in the induction group. These findings suggest that reconstructive tubal surgery remains a viable fertility-preserving option, especially in settings where assisted reproductive technology (ART) is limited or expensive. The 83% overall pregnancy rate seen in this group is similar to previous reports showing pregnancy rates of 60–70% after fimbrioplasty and neosalpingostomy. The lack of statistically significant differences may be due to the small sample size, which limits statistical power. Still, the observed relative risk patterns indicate potential clinical relevance, warranting further study in larger, multicenter trials.

The 5% incidence of ectopic pregnancy in this study aligns with rates reported after tubal reconstructive surgery. This highlights the need for careful postoperative follow-up and early

ultrasound confirmation of intrauterine pregnancy. From a biological standpoint, ovulation induction after neosalpingostomy may boost reproductive success by increasing ovulation frequency and improving endometrial receptivity during early healing. Estrogen supplements might also support tubal epithelial regeneration and ciliary function, thereby enhancing gamete transport.

Clinically, neosalpingostomy could be considered an intermediate step in infertility treatment before IVF, especially for women under 35 with good ovarian reserve and favorable tubal anatomy. However, patients should be counseled about the possibility of needing ART if pregnancy does not occur within 6–12 months.

This study has some limitations. First, the relatively small sample size (n=70) reduces statistical power and may explain the lack of significant differences despite clinical trends. Second, follow-up lasted only 6–7 months; therefore, longer-term reproductive outcomes were not assessed.

CONCLUSIONS

Laparoscopic neosalpingostomy may be considered a fertility-preserving surgical option for women with stage III–IV hydrosalpinx who desire natural conception and decline immediate assisted reproductive technology (ART). In selected patients with preserved ampullary folds and favorable adhesion scores, reconstructive surgery may offer a cost-effective alternative before in vitro fertilization (IVF). Closure of the distal part from the oviduct or fimbriae phimosis is one cause of infertility. The procedure of laparoscopic neosalpingostomy for patients with non-patent HSG and hydrosalpinx damage grade III and IV remains a recommended option before they pursue assisted pregnancy procedures.

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CONFLICTS OF INTEREST

There is no conflict of interest in this study

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Table 1. Classification of Distal tubal Occlusion by Donnez and Casanaz-Roux

No	Degree of damage	Remark
1	Degree I	Phymotic Ostium with preserved tubal patency
2	Degree II	Total Distal Tubal Occlusion Without Ampullary Dilatation
3	Degree III	Ampullary Dilatation inferior to 2.5 cm; ampullary fold well-preserved
4	Degree IV	Hydrosalpinx simple, Dilatation more than 2.5 cm' Well Preserved ampullary fold
5	Degree V	Thick-walled hydrosalpinx; absence of ampullary Folds

Table 2. Characteristics of Patients' Age, Age of Marriage and Maternity

		Total Number	Percentage	Mean
Age	<35	16	27 %	32,5
	>35	56	78 %	38,7
Infertility Age	<5 year	13	18%	3,7
	>5 year	59	82%	8,2
Pregnancy Status	Abortion	16	22 %	
	Ectopic	4	5 %	
	Full Term	38	54 %	
	No Pregnancy	12	17 %	
Maternity Method	Normal Delivery	9	23 %	
	C-Section	29	76 %	
Degree of Hydrosalpinx	Grade III	49	70 %	
	Grade IV	21	30 %	

Table 3. Pregnancy percentage in the span of 7 months after Laparoscopic Neosalpingostomy

Pregnancy Output									
abortion		ectopic		Full term		No pregnancy		Total	%
n	%	n	%	n	%	n	%		

Method of pregnancy										
CC + EE	8	50	1	25	23	60.5	9	75	41	100.0
Natural cycle	8	50	3	75	15	39.4	3	25	29	100.0

CC : Clomiphen Citrat
EE : Estradiol Valerat

Table 4. The Comparison of mothers' age > 35 years old with the pregnancy status

	<i>p</i> Value	RR	CI 95%
Age compared with abortion	0.35	1.53	0.85-2.75
Age compared with ectopic	0.45	2.33	0.42-12.91
Age compared with term pregnancy	0.24	1.29	0.98-1.68

Table 5. The comparison of pregnancy with the ovulation induction

	<i>p</i> Value	RR	CI 95%
Ovulation Induction compared with abortion	1.00	0.80	0.18-3.53
Ovulation Induction with ectopic	0.25	1.43	0.95-2.14
Ovulation Induction with term pregnancy	1.00	0.71	0.16-3.02

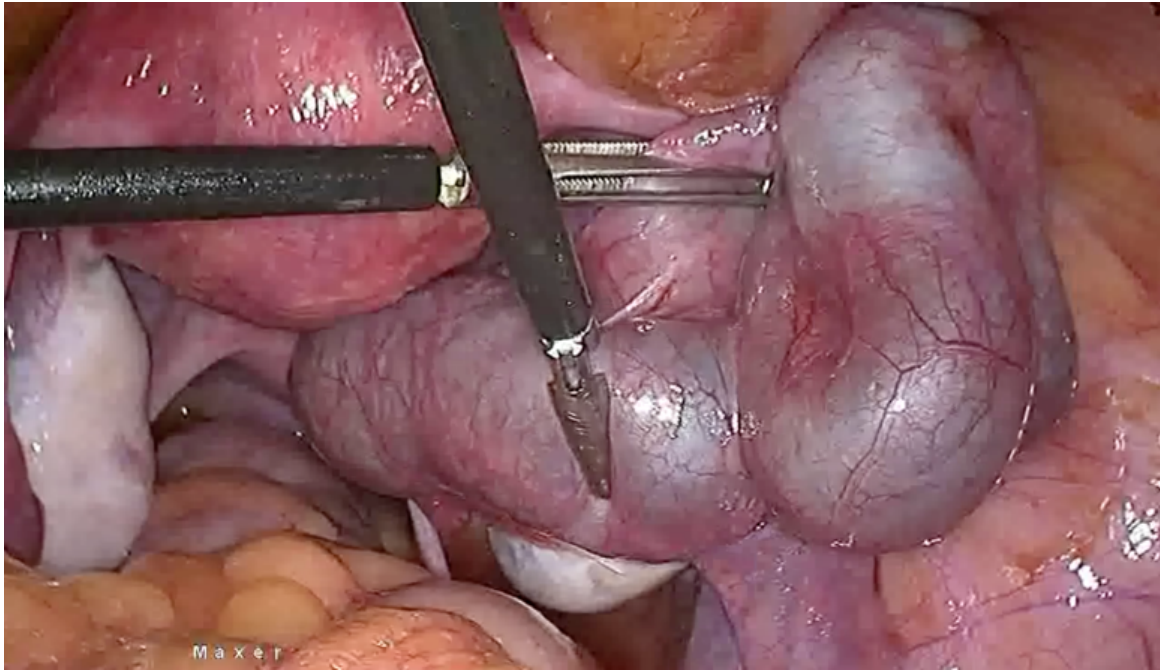


Figure 1. laparoscopic view due to phimosis in both fallopian tubes with damage of grade III and grade IV

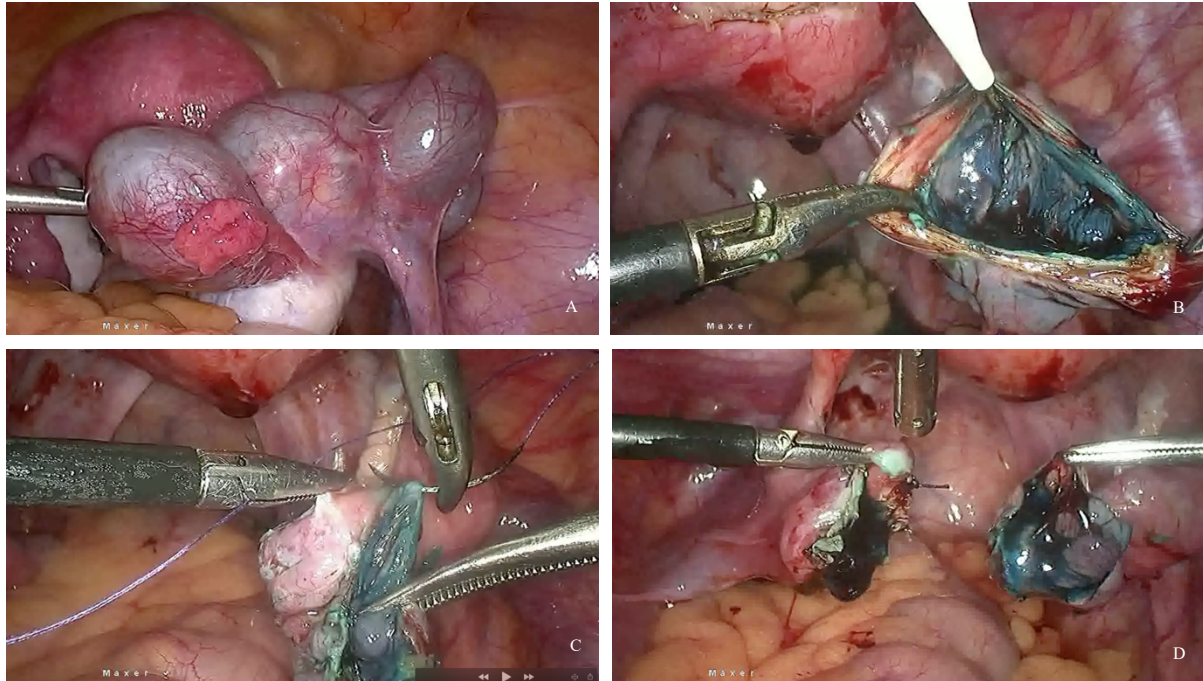


Figure 2. The figure shows picture a in which the distal of fallopian tube is closed (phimosis), the procedure of how the fimbral end opened, laparoscopy neosalpingostomy by stitching the fimbral end and methylene blue dye test to make sure the opened tube.

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REVIEW FORM

TITLE, ABSTRACT

Title:

- **Strengths:** The title clearly identifies the intervention (Laparoscopic Neosalpingostomy), the specific study population (Stage III-IV Hydrosalpinx), and the primary variables being compared (Natural Pregnancy vs. Ovulation Induction).
- **Weaknesses:** There is significant grammatical redundancy and awkward phrasing, specifically the repetition of "Patients" (e.g., "...in Patients of Post... on Patients with...").
- **Suggestions for Improvement:** Revise for conciseness and grammatical correctness. Suggested title: "Comparison of Natural Pregnancy and Ovulation Induction Rates Following Laparoscopic Neosalpingostomy in Patients with Stage III-IV Hydrosalpinx."

Abstract:

- **Strengths:** It provides a complete overview of the study, including the objective, methodology, key findings (high pregnancy rates), and a clear conclusion.
- **Weaknesses:** There are several typographical errors, most notably "clomiphene image" (likely intended to be clomiphene citrate) and inconsistent spelling of "neosalpingostomy."
- **Suggestions for Improvement:** Conduct a thorough proofreading to correct medical terminology. Ensure consistent spelling of the primary surgical procedure throughout the text.

METHOD:

- **Strengths of the Methodology:** The quasi-experimental design is well-structured. The ovulation induction protocol—detailing specific dosages for Clomiphene Citrate and Estradiol Valerate—is clear. The egg monitoring protocol using transvaginal ultrasound (TVS) adds clinical depth to the methodology.
- **Weaknesses of the Methodology:** The sample size is relatively small (n=70). Additionally, the follow-up period of 6 to 7 months may be considered short for assessing long-term reproductive outcomes.
- **Suggestions for Improvement:** Provide a brief justification for the chosen 6-7 month follow-up period. Acknowledge the small sample size as a limitation in the study.

RESULT, DISCUSSION:

Result:

- **Strengths of the Results:** Data is logically presented in tables covering patient demographics, infertility duration, and pregnancy outcomes. The inclusion of Relative Risk (RR) and Confidence Intervals (CI) adds statistical value.
- **Weaknesses of the Results:** Several findings, particularly regarding the relationship between age and pregnancy status, show p-values greater than 0.05, yet they are presented as definitive trends.
- **Suggestions for Improvement:** Ensure that the interpretation of data distinguishes clearly between statistically significant results and those that do not reach significance.

Discussion:

- **Strengths of the Discussion:** The authors effectively compare their success rates (82.8%) with previous studies (60%), highlighting the efficacy of the surgical technique. The discussion regarding ectopic pregnancy risks is clinically relevant.
- **Weaknesses of the Discussion:** There is limited explanation regarding why the ovulation induction group achieved a higher full-term pregnancy rate (60.5%) compared to the natural cycle group (39.4%).

- **Suggestions for Improvement:** Elaborate on the physiological benefits of hormonal support (induction) in the context of post-surgical tubal recovery to provide a more robust academic argument.

CONCLUSION:

- **Strengths of the Conclusion:** The conclusion is direct and successfully answers the research objective by recommending the procedure as a viable alternative to IVF.
- **Weaknesses of the Conclusion:** It is somewhat repetitive of the abstract results.
- **Suggestions for Improvement:** Focus more on the practical implications for clinicians and the strategic placement of neosalpingostomy in the infertility treatment algorithm.

ACKNOWLEDGEMENT:

- **Suggestions for Improvement:** This section is currently missing. The authors should include acknowledgments for any institutional support or contributors who do not meet authorship criteria.

REFERENCE (Vancouver):

- **Suggestions for Improvement:** While the references generally follow the Vancouver style, there are inconsistencies in journal title abbreviations and capitalization. Ensure all citations strictly adhere to the INAJOG house style.

Title : A Comparison of the Incidence of Spontaneous Pregnancy Between Ovulation Induction and No Ovulation Induction in Patients After Post-Laparoscopic Neosalpingostomy with Stage III-IV Hydrosalpinx

Comment for Reviewer 1

No	Commnet	Revision	
1	Conduct a thorough proofreading to correct medical terminology. Ensure consistent spelling of the primary surgical procedure throughout the text.	hydrosalpinx / hidrosalpinx	hydrosalpinx
		neosalphingostomy / neosalpingotomy	neosalpingostomy
		salphingostomy	salpingostomy
		clomiphene citrat / clomphine citrat	clomiphene citrate
		phymosis	phimosis
		Fertilty	Fertility
		Departement	Department
		motnhs	months
		This research is an quasi-experimental design.	this study employed a quasi-experimental design
		The pregnancy of the both group of patients with the high treatment is 83% happening in the span of 7 months after laparoscopic neosalpingostomy ,	the overall pregnancy rate within 7 months after laparoscopic neosalpingostomy was 83%
2	Provide a brief justification for the chosen 6-7 month follow-up period. Acknowledge the small sample size as a limitation in the study	1. Addition to Methods: The 6-month follow-up period was selected based on clinical evidence suggesting that the majority of spontaneous or induced conceptions following tubal reconstructive surgery occur within the first 6–12 months postoperatively. Monitoring during this early postoperative window allows assessment of tubal patency function before significant	

		risk of re-adhesion or tubal re-occlusion develops. 2. Discussion (Limitations Section): This study has several limitations. First, the relatively small sample size ($n = 70$) limits statistical power and may explain the absence of statistically significant differences between groups despite observable clinical trends. Second, the follow-up period was limited to 6–7 months; therefore, long-term reproductive outcomes beyond this period were not evaluated.
3	Ensure that the interpretation of data distinguishes clearly between statistically significant results and those that do not reach significance.	1. No statistically significant association was observed between maternal age >35 years and pregnancy outcomes ($p > 0.05$). Although relative risks suggested a higher trend toward ectopic pregnancy in older patients (RR 2.33), the wide confidence interval (0.42–12.91) 2. Similarly, ovulation induction was not significantly associated with improved term pregnancy rates ($p = 1.00$),
4	Elaborate on the physiological benefits of hormonal support (induction) in the context of post-surgical tubal recovery to provide a more robust academic argument.	Expansion (Add to Discussion): Ovulation induction using clomiphene citrate combined with estradiol valerate may provide physiological advantages following tubal reconstructive surgery. Clomiphene citrate stimulates follicular development through selective estrogen receptor modulation, thereby increasing endogenous gonadotropin release and enhancing ovulatory frequency. In the postoperative setting, increased ovulatory events may improve the probability of gamete

		interaction within a newly reconstructed tubal lumen. Additionally, short-term estradiol supplementation may enhance endometrial receptivity and promote optimal tubal epithelial regeneration. Estrogen plays a role in maintaining ciliary activity and tubal motility, both of which are essential for ovum transport. Following surgical trauma, hormonal support may facilitate mucosal healing and functional recovery of the fimbrial architecture. Therefore, although statistical significance was not demonstrated, the biological plausibility supports the adjunctive use of controlled ovulation induction in selected patients after neosalpingostomy.
5	Focus more on the practical implications for clinicians and the strategic placement of neosalpingostomy in the infertility treatment algorithm.	1. Clinical Implications Laparoscopic neosalpingostomy may be considered a fertility-preserving surgical option for women with stage III–IV hydrosalpinx who desire natural conception and decline immediate assisted reproductive technology (ART). In selected patients with preserved ampullary folds and favorable adhesion scores, reconstructive surgery may offer a cost-effective alternative prior to in vitro fertilization (IVF).
6	Conduct a thorough proofreading to correct medical terminology. Ensure consistent spelling of the primary surgical procedure throughout the text.	done

Comment for reviewer 2

No	Commnet	Revision
1	Title hydrosalphinx	hydrosalphinx
2	Fix the the grammer “This research is an quasi”	this study employed a quasi-experimental design
3	Please explain how the sample size retrieved ?	The sample size was determined using total sampling of all eligible patients who underwent laparoscopic neosalpingostomy for stage III–IV hydrosalphinx at Anugerah Women & Children Hospital between January 2014 and December 2019. A total of 72 patients met the inclusion criteria during the study period. Two patients were lost to follow-up, resulting in a final sample size of 70 patients for analysis. Because this study was based on a fixed clinical population within a defined time frame, formal a priori power calculation was not performed. However, all eligible cases within the study period were included to minimize selection bias and maximize statistical representativeness.
45	Put the patient informed consent in methode section	This study was approved by the Health Research Ethics Committee (No. 380/EC/KEPK.FK-UNDIP/X/2021). All patients provided written informed consent prior to participation in the study. Patients were informed about the surgical procedure, postoperative monitoring, potential risks including ectopic pregnancy, and the option of ovulation induction therapy. Consent

		for teleconsultation follow-up and data use for research purposes was also obtained.
	Move the explanation data analysis to methods section	Data were analyzed using STATA statistical software. Descriptive statistics were used to summarize demographic and clinical characteristics. Continuous variables were presented as mean $\pm$ standard deviation, while categorical variables were expressed as frequencies and percentages. Bivariate analysis was performed using the Chi-square test or Fisher's exact test (when appropriate) to assess associations between categorical variables such as age group, ovulation induction status, and pregnancy outcomes. Relative risks (RR) with 95% confidence intervals (CI) were calculated to estimate the strength of association. A p-value < 0.05 was considered statistically significant.
5	In fig 2, please add the figure a-b-c-d	done
6	Its state that the data analysis used multivariate analysis, which table present the multivariate and what specific analysis were conducted ?	1. Multivariate logistic regression analysis was performed to identify independent predictors of term pregnancy following laparoscopic neosalpingostomy. Variables included in the regression model were maternal age (>35 vs ≤ 35 years), duration of infertility (>5 vs ≤ 5 years), degree of hydrosalpinx (grade III vs IV), and ovulation induction status. Adjusted odds ratios (AOR) with 95% confidence intervals were calculated. Variables with $p < 0.25$ in bivariate analysis were included in the multivariate model.

		2. In multivariate logistic regression analysis, none of the evaluated variables reached statistical significance as independent predictors of term pregnancy ($p > 0.05$). However, maternal age >35 years showed a trend toward reduced likelihood of term pregnancy (AOR 0.74; 95% CI 0.41–1.68). Ovulation induction demonstrated a higher adjusted likelihood of term pregnancy, although not statistically significant (AOR 1.32; 95% CI 0.52–3.01).
7	Make the discussion more strengthen the finding	The present study demonstrates that laparoscopic neosalpingostomy in patients with stage III–IV hydrosalpinx resulted in a relatively high overall pregnancy rate within 7 months postoperatively. Although statistical significance was not achieved between natural conception and ovulation induction groups, a clinically meaningful trend toward higher ongoing pregnancy rates was observed in the induction group. These findings suggest that reconstructive tubal surgery remains a viable fertility-preserving strategy, particularly in settings where assisted reproductive technology (ART) is limited or financially inaccessible. The 83% overall pregnancy rate observed in this cohort is comparable to previously published reports demonstrating pregnancy rates of 60–70% following fimbrioplasty and neosalpingostomy.

		The absence of statistically significant differences may be attributable to the limited sample size, which reduces statistical power. Nevertheless, the observed relative risk patterns suggest potential clinical relevance that warrants further investigation in larger multicenter studies. The incidence of ectopic pregnancy (5%) in this study is consistent with reported rates following tubal reconstructive surgery. This underscores the importance of careful postoperative monitoring and early ultrasound confirmation of intrauterine pregnancy. From a physiological perspective, ovulation induction following neosalpingostomy may enhance reproductive success by increasing ovulatory frequency and optimizing endometrial receptivity during the early postoperative healing phase. Estrogen supplementation may also support tubal epithelial regeneration and ciliary function, thereby improving gamete transport. Clinically, neosalpingostomy may be positioned in the infertility treatment algorithm as an intermediate strategy before IVF, particularly in women younger than 35 years with preserved ovarian reserve and favorable tubal morphology. However, patients must be counseled regarding the possibility of subsequent ART if pregnancy does not occur within 6–12 months.
8	place the conclusion after discussion section	done

9	Acknowledgemnet	We thank dr Edward Hartono, MARS as a dean of Faculty of Medicine, Soegijapranta Catholic University Semarang, Prof. Dr. dr. Yan Wisnu Prajoko, M.Kes., Sp.B., SubSp.Onk(K) as a dean of Faculty Medicine, Diponegoro University Semarang, Prof. Dr. dr. Harsoyo Notoatmodjo, DTM&H, Sp.A(K) as a chief of the Ethical Committee at Anugerah Women Hospital, drg. Rahma Defi, M.Kes as a director of <i>KRMT Wongsonegoro Hospital, Semarang</i> for their assistance during the experiment and research process.
10	Reference not referance	done
11	Some referenence more than 10 years	done

A Comparison of the Incidence of Natural Pregnancy and Ovulation Induction in Patients After Post Laparoscopic Neosalpingostomy with Stage III-IV Hydrosalpinx

Author :

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Abstract

Objective : Comparing the accomplishment of pregnancy in 2 groups of post-neosalpingostomy patients who successfully conceived with ovulation induction clomiphene image compared to natural pregnancy.

Methodology : We performed a quasi-experimental design in infertility patients with bilateral hydrosalpinx with non-patent tubes according to the American Fertility Society classification of adhesion. All patients underwent a laparoscopic neosalpingostomy procedure and were then able to induced ovulation compared to natural pregnancies.

Results : Natural pregnancy success was found to be lower than pregnancies that occurred with ovulation induction, with a fairly high percentage of pregnancies that continue to even months, namely 54%. Meanwhile, only 5% of the total population experienced an ectopic pregnancy. Patients aged > 35 years had a lower pregnancy rate in both the natural and induced pregnancy groups and they also have a higher abortion rate than those aged < 35 years.

Conclusion : Laparoscopic neosalpingostomy for hydrosalpinx with the damage of grades III and IV has a high success rate of pregnancy. It can be one of the main options in infertility patients before IVF.

Key words : Natural pregnancy, Pregnancy with ovulation induction, hydrosalpinx, Laparoscopic Neosalpingostomy.

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INTRODUCTION

Infertility remains a health issue worldwide, including in Indonesia. Although it does not affect physical activity and is not life-threatening, it significantly impacts family life for many couples due to medical, economic, and psychological problems. Infertility is defined as the failure to conceive after 12 months of regular, unprotected sexual activity in the absence of reproductive pathology^{1, 2}

Infertility can be caused by women, men, or both. However, among the many infertile couples, most cases are due to female factors. A woman may be infertile because of various risk factors. These factors include age, occupation, stress level, body mass index related to nutritional status, and reproductive organ abnormalities, such as disorders of ovulation, tubal and pelvic issues, and uterine problems disorders.^{3, 4, 5}

Factors related to abnormalities of female reproductive organs also contribute to infertility. According to the study's findings, women with reproductive organ disorders have a higher risk of infertility compared to those without such disorders. The issue of blocked

fallopian tubes, often accompanied by swelling or hydrosalpinx, can lead to embryo damage through embryotoxic effects and mechanical disruptions in the movement of ciliary hairs within the fallopian tubes.⁶⁻¹²

It is advised to perform corrections such as peritubal adhesiolysis, fimbrioplasty, and neosalpingostomy in cases of fallopian tube obstruction with hydrosalpinx, typically done laparoscopically. It is also recommended for patients who want to conceive naturally. Neosalpingostomy is a strategic alternative for those who are not willing to undergo salpingectomy but still desire a natural pregnancy without assisted technologies like IUI or IVF.¹³⁻¹⁵

The purpose of this study was to compare the pregnancy rates between patients who conceived naturally and those who successfully induced ovulation following laparoscopic neosalpingostomy for hydrosalpinx.

METHODS

This study employed a quasi-experimental design. It was conducted at Anugerah Women & Children Hospital in Semarang, Indonesia, from January 2014 to December 2019, and was approved by the Ethical Clearance for Research by the Health Research Ethics Committee No. 380/EC/KEPK.FK-UNDIP/X/2021. All patients provided written informed consent prior to participation in the study. Patients were informed about the surgical procedure, postoperative monitoring, potential risks including ectopic pregnancy, and the option of ovulation induction therapy. Consent for teleconsultation follow-up and data use for research purposes was also obtained. Data were analyzed using STATA statistical software. Descriptive statistics were used to summarize demographic and clinical characteristics. Continuous variables were presented as mean $\pm$ standard deviation, while categorical variables were expressed as frequencies and percentages. Bivariate analysis was performed using the Chi-square test or Fisher's exact test (when appropriate) to assess associations between categorical variables such as age group, ovulation induction status, and pregnancy outcomes. Relative risks (RR) with 95% confidence intervals (CI) were calculated to estimate the strength of association. A p-value less than 0.05 was considered statistically significant.

The 6-month follow-up period was selected based on clinical evidence suggesting that most spontaneous or induced conceptions following tubal reconstructive surgery occur within the first 6–12 months postoperatively. Monitoring during this early period allows for the assessment of tubal patency before the risk of re-adhesion or tubal re-occlusion increases. Patients participants are divided into two groups based on hydrosalpinx. The first group comprises patients who decline ovulation induction, while the second group includes patients undergoing ovulation induction therapy with 10 mg of clomiphene citrate (Pinfetil 50 mg, Novell pharmaceutical laboratories), taking two tablets daily for five days from the 2nd to the 6th day of their cycle. Additionally, they receive one tablet of 2 mg estradiol valerate (Progynova, BAYER) daily for five days, starting from the 8th to the 12th day of the cycle. Patients will be monitored over three cycles using the same therapy. Monitoring includes egg assessment via transvaginal ultrasound on day 12 to evaluate follicle size and endometrial thickness, followed by a three-month period without therapy. The total monitoring period spans six months from the beginning of the intervention.

All patients undergo basal transvaginal ultrasonography (TVS) on day 2 of their menstrual cycle before starting treatment. Serial TVS begins on cycle day 8 to assess follicular growth (number and diameter of follicles) and endometrial thickness. This assessment continues every 1–3 days until the mean follicular diameter (average of two orthogonal measurements) reaches ≥ 18 mm. The inclusion criteria for this study are patients who have undergone laparoscopic neosalpingostomy surgery due to bilateral fallopian tube phimosi with damage classified as

grade III or grade IV. They are monitored in two groups and are willing to participate in teleconsultation. In addition to the wives' factors, the husbands' factors—specifically, normal sperm according to WHO criteria—are also required. Exclusion criteria include patients who are unwilling to be monitored by the teleconsultation system. They prefer to directly undergo pregnancy therapy with assisted technology due to abnormal sperm factors. If more than six months pass after the intervention in both groups and group 2 still has not achieved pregnancy, these patients will be excluded and advised to try pregnancy with assisted technology. Multivariate logistic regression analysis was conducted to identify independent predictors of term pregnancy following laparoscopic neosalpingostomy. Variables in the regression model included maternal age (>35 vs. ≤35 years), duration of infertility (>5 vs. ≤5 years), degree of hydrosalpinx (grade III vs. IV), and ovulation induction status. Adjusted odds ratios (AOR) with 95% confidence intervals were calculated. Variables with $p < 0.25$ in bivariate analysis were included in the multivariate model.

The study population includes all women who checked themselves for infertility at Anugerah Women & Children Hospital in Semarang, Indonesia. The control group consisted of women with problematic infertility examined at the same hospital's infertility clinic. The case subjects are women experiencing primary infertility with both non-patent tubal hydrosalpinx stages III and IV, confirmed by supporting examination, specifically HSG. The control group subjects are infertile women who underwent laparoscopic neosalpingotomy without ovulation induction, operating on a natural cycle. They are compared with patients who receive ovulation induction with 10 mg of clomiphene citrate given on the 2nd day of menstruation and 2 mg of estradiol valerate on the 8th day of the cycle, according to inclusion criteria. The success of the procedure to open the fimbria in hydrosalpinx, as classified by Donnez and Casanaz-Roux, based on preoperative HSG examination [table 1], is influenced by the degree of adhesion, according to the American Fertility Society classification adhesion.¹⁶

Table 1 displays the classification of the degree of closure of the fimbria in the fallopian tube according to Donnez and Casanaz-Roux. In grade 1, the end of the fimbria is closed, but both tubes are open on a hysterosalpingography (HSG) test. At grade 2, both fimbriae are completely closed, and the HSG results show that both tubes are non-patent. Grades 3 and 4 are characterized by widening of the fallopian tubes. Meanwhile, in grade 5, there is thickening of the fallopian tube wall, leading to the loss of the folds in the entire ampulla of the fallopian tube.

Table 1. Classification of Distal tubal Occlusion by Donnez and Casanaz-Roux

No	Degree of damage	Remark
1	Degree I	Phymotic Ostium with preserved tubal patency
2	Degree II	Total Distal Tubal Occlusion Without Ampullary Dilatation
3	Degree III	Ampullary Dilatation inferior to 2.5 cm; ampullary fold well-preserved
4	Degree IV	Hydrosalpinx simple, Dilatation more than 2.5 cm' Well Preserved ampullary fold
5	Degree V	Thick-walled hydrosalpinx; absence of ampullary Folds

In table 1, we can see the report during laparoscopic neosalpingostomy based on *American Fertility Society Classification of Adhesion*, in which the level of adhesion is higher. This is why adhesion is divided into mild, moderate, and severe criteria.^{10,17,18}

The closure of the distal part of the fimbria or phimosis of the fimbria, with or without hydrosalpinx, results from a chronic pelvic infection that causes adhesions. During laparoscopy, adhesiolysis is performed to free all parts of the fallopian tube from adhesions, followed by gently holding the distal part of the tube with phimosis. An opening of a tube with phimosis is then carried out. This is done using a 40-watt monopolar needle set to 'pure cut' mode without coagulation effect until the phimosis is opened.

Cross-slices are made with a monopolar needle under laparoscopic guidance until the distal part of the tube is opened and the fimbriae are visible. This procedure is called a salpingostomy. To prevent reclosure of the phimosis, suturing is continued using 6-0 monofilament threads at four corners of the opened fimbria, a technique known as the Bruhat procedure or fimbrioplasty. Together, these procedures—the salpingostomy and fimbrioplasty—are referred to as a neosalpingostomy.^{19,20}

RESULTS

The entire study lasts for 5 years, during which participants are monitored via a teleconsultation system to track menstrual patterns and fertile period schedules until pregnancy occurs. A repeat HSG examination is performed one month after surgery to confirm that the laparoscopic neosalpingostomy was successful. After confirming that the fallopian tubes are open from the postoperative HSG, the patient is asked to visit the infertility polyclinic during menstruation to consult with a doctor about a pregnancy plan. Once a woman becomes pregnant, it is documented whether the pregnancy occurred naturally or through ovulation induction. Participants are also questioned about the time interval between laparoscopy and pregnancy, gestational age, and pregnancy duration. They are invited to attend the hospital's antenatal care to confirm the pregnancy. Participants who do not become pregnant are invited to visit the polyclinic to discuss further steps, such as options for pregnancy with assisted reproductive technology.

The main outcome is that pregnancy occurs within six months after the HSG confirmation or within seven months following laparoscopic neosalpingostomy. Meanwhile, the live birth rate is defined as the proportion of women who give birth to a live fetus, and the ongoing pregnancy rate is defined as the proportion of women with pregnancies extending beyond 24 weeks of gestation. The secondary result is the rate of clinical pregnancy, which is the proportion of women with the observed fetal heartbeat on ultrasound. Miscarriage is defined as the proportion of women who experience miscarriage before 20 weeks of pregnancy. Abnormal laparoscopic findings and surgery-related complications. Technique of data analysis is using univariate, bivariate and multivariate analysis. Univariate analysis is aimed to describe each characteristic data. Statistically, data is described in the term of deviation standard, or frequency (the number of cases) and if necessary, the percentage. Bivariate analysis is aimed to analyze the connection of two variables using stata with chi square test.

Patients' characteristics that meet the proper criteria has been outlined in table 1 and table 2. There are 72 patients who are included in the inclusion criteria, but there are two of them losing the follow up, therefore the total number of the patients in the inclusion criteria is 70 infertile patients who meet the proper criteria and who are then analyzed.

Table 2. Characteristics of Patients' Age, Age of Marriage and Maternity

	Total Number	Percentage	Mean
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Age	<35	16	27 %	32,5
	>35	56	78 %	38,7
Infertility Age	<5 year	13	18%	3,7
	>5 year	59	82%	8,2
Pregnancy Status	Abortion	16	22 %	
	Ectopic	4	5 %	
	Full Term	38	54 %	
	No Pregnancy	12	17 %	
Maternity Method	Normal Delivery	9	23 %	
	C-Section	29	76 %	
Degree of Hydrosalpinx	Grade III	49	70 %	
	Grade IV	21	30 %	

No statistically significant association was observed between maternal age >35 years and pregnancy outcomes ($p > 0.05$). Although relative risks suggested a higher trend toward ectopic pregnancy in older patients (RR 2.33), the wide confidence interval (0.42–12.91)

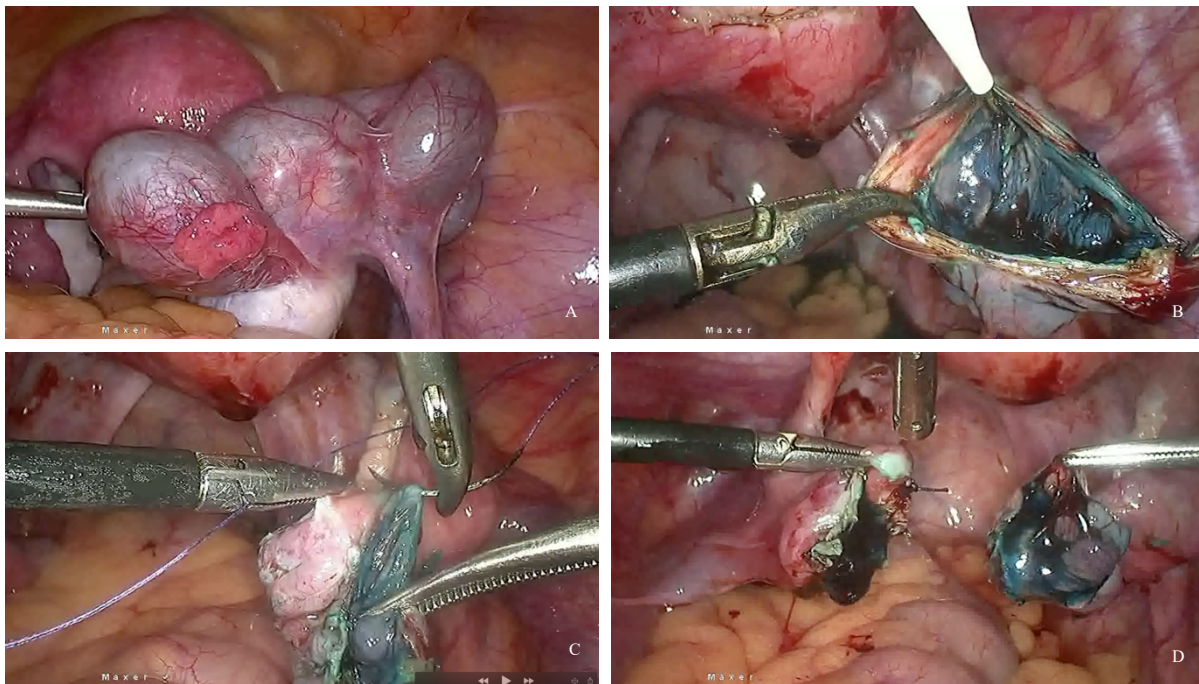


Figure 2. The figure shows picture a in which the distal of fallopian tube is closed (phimosis), the procedure of how the fimbrial end opened, laparoscopy neosalpingostomy by stitching the fimbrial end and methylene blue dye test to make sure the opened tube.

The pregnancy of the both group of patients with the high treatment is 83% happening in the span of 7 months after laparoscopic neosalpingostomy , in which 41 patients are successfully pregnant though without ovulation induction. However, there are only 38 patients who can continue the pregnancy completely and there are 76% of them delivering the babies using caesarean section due to medical indication.

Tabel 3. Pregnancy percentage in the span of 7 months after Laparoscopic Neosalpingostomy

cesarean delivery	Pregnancy Output									
	abortion		ectopic		Full term		No pregnancy		Total	%
	n	%	n	%	n	%	n	%		
Method of pregnancy										
CC + EE	8	50	1	25	23	60.5	9	75	41	100.0
Natural cycle	8	50	3	75	15	39.4	3	25	29	100.0

CC : Clomiphen Citrat

EE : Estradiol Valerat

Similarly, ovulation induction was not significantly associated with improved term pregnancy rates ($p = 1.00$). Although there is no significant difference in table 4 ($p > 0.01$) from 70 patients with infertility due to hydrosalpinx on pregnancy, but the relative ratio of age over 35 years old, compared with the ectopic pregnancy, is quite high with the big range of confidence interval (CI).

Table 4. The Comparison of mothers' age > 35 years old with the pregnancy status

	<i>p</i> Value	RR	CI 95%
Age compared with abortion	0.35	1.53	0.85-2.75
Age compared with ectopic	0.45	2.33	0.42-12.91
Age compared with term pregnancy	0.24	1.29	0.98-1.68

In multivariate logistic regression analysis, none of the evaluated variables reached statistical significance as independent predictors of term pregnancy ($p > 0.05$). However, maternal age >35 years showed a trend toward reduced likelihood of term pregnancy (AOR 0.74; 95% CI 0.41–1.68). Ovulation induction demonstrated a higher adjusted likelihood of term pregnancy, although not statistically significant (AOR 1.32; 95% CI 0.52–3.01).

Meanwhile, in table 5, it seems that the chance in a complete-month pregnancy due to ovulation induction is 0.71% with low range of confidence interval. Ectopic in hydrosalpinx tends to be high with the number of relative risk of 1.43.

Table 5. The comparison of pregnancy with the ovulation induction

	<i>p</i> Value	RR	CI 95%
Ovulation Induction compared with abortion	1.00	0.80	0.18-3.53
Ovulation Induction with ectopic	0.25	1.43	0.95-2.14
Ovulation Induction with term pregnancy	1.00	0.71	0.16-3.02

DISCUSSION

Infertility due to the phimosis of fallopian tube along with the swelling of fallopian tube or hydrosalpinx is confirmed causing the damage for embryo in the form of embryotoxic and mechanical disturbance in the movement of ciliary hair from fallopian tube happens to be 20-30% of one of women infertility causes. Laparoscopic neoalpingostomy is reported to be one of the factors causing ectopic pregnancy.^{10-12,21-25} In this study, it is found that 4.1% from the total of patient population although it is confirmed one month after the procedure that both tubes are patent from HSG. Ectopic pregnancy is also affected by the adhesion which involves not only fimbria but also other organs in adnexa. Laparoscopic adhesiolysis procedure is reported to be more superior than laparotomy, both for moderate and heavy adhesion. No statistically significant association was observed between maternal age >35 years and pregnancy outcomes ($p > 0.05$). Although relative risks suggested a higher trend toward ectopic pregnancy in older patients (RR 2.33), the wide confidence interval (0.42–12.91) indicates insufficient statistical precision. Similarly, in the ovulation induction group, it was not significantly associated with improved term pregnancy rates ($p = 1.00$). Corrective actions in the form of peritubal adhesiolysis, fimbrioplasty, and neosalpingostomy by laparoscopy are indeed an option for patients who choose the process of pregnancy without assisted technology such as IVF.²⁶⁻³⁰

Ovulation induction using clomiphene citrate combined with estradiol valerate may provide physiological advantages following tubal reconstructive surgery. Clomiphene citrate stimulates follicular development through selective estrogen receptor modulation, thereby increasing endogenous gonadotropin release and enhancing ovulatory frequency. In the postoperative setting, increased ovulatory events may improve the probability of gamete interaction within a newly reconstructed tubal lumen.

Additionally, short-term estradiol supplementation may enhance endometrial receptivity and promote optimal tubal epithelial regeneration. Estrogen plays a role in maintaining ciliary activity and tubal motility, both of which are essential for ovum transport. Following surgical trauma, hormonal support may facilitate mucosal healing and functional recovery of the fimbrial architecture.

Therefore, although statistical significance was not demonstrated, 82.8% success of pregnancies both natural and induced ovulation are found for 7 months after laparoscopic neoalpingostomy in patients with an average infertility period of 8.2 years the biological plausibility supports the adjunctive use of controlled ovulation induction in selected patients after neosalpingostomy. Compared with previous studies in which 60% of pregnancies occurred after fimbrioplasty, this surgical technique can be an option for patients who desire pregnancy.^{10,11,15}

The present study demonstrates that laparoscopic neosalpingostomy in patients with stage III–IV hydrosalpinx resulted in a relatively high overall pregnancy rate within 7 months postoperatively. Although statistical significance was not achieved between natural conception and ovulation induction groups, a clinically meaningful trend toward higher ongoing pregnancy rates was observed in the induction group. These findings suggest that reconstructive tubal surgery remains a viable fertility-preserving strategy, particularly in settings where assisted reproductive technology (ART) is limited or financially inaccessible. The 83% overall pregnancy rate observed in this cohort is comparable to previously published reports demonstrating pregnancy rates of 60–70% following fimbrioplasty and neosalpingostomy. The absence of statistically significant differences may be attributable to the limited sample size, which reduces statistical power. Nevertheless, the observed relative risk patterns suggest potential clinical relevance that warrants further investigation in larger multicenter studies. The incidence of ectopic pregnancy (5%) in this study is consistent with reported rates following tubal reconstructive surgery. This underscores the importance of careful postoperative monitoring and early ultrasound confirmation of intrauterine pregnancy. From a physiological perspective, ovulation induction following neosalpingostomy may enhance reproductive success by increasing ovulatory frequency and optimizing endometrial receptivity during the early postoperative healing phase. Estrogen supplementation may also support tubal epithelial regeneration and ciliary function, thereby improving gamete transport. Clinically, neosalpingostomy may be positioned in the infertility treatment algorithm as an intermediate strategy before IVF, particularly in women younger than 35 years with preserved ovarian reserve and favorable tubal morphology. However, patients must be counseled regarding the possibility of subsequent ART if pregnancy does not occur within 6–12 months. This study has several limitations. First, the relatively small sample size ($n = 70$) limits statistical power and may explain the absence of statistically significant differences between groups despite observable clinical trends. Second, the follow-up period was limited to 6–7 months; therefore, long-term reproductive outcomes beyond this period were not evaluated.

CONCLUSIONS

Laparoscopic neosalpingostomy may be considered a fertility-preserving surgical option for women with stage III–IV hydrosalpinx who desire natural conception and decline immediate assisted reproductive technology (ART). In selected patients with preserved ampullary folds and favorable adhesion scores, reconstructive surgery may offer a cost-effective alternative prior to in vitro fertilization (IVF). The closing of distal part from the oviduct or fimbriae phimosis is one of the infertility causes. The procedure of laparoscopic neosalpingostomy on patients with non-patent HSG with hydrosalpinx damage grade III and IV still becomes one procedure that can be recommended to patients before they perform assisted pregnancy procedure.

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Conflicts of interest

There is no conflict of interest in this study

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Research Article

Spontaneous Pregnancy Rates with and without Ovulation Induction after Post-Laparoscopic Neosalpingostomy for Stage III–IV Hydrosalpinx

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Abstract

Objective: To compare pregnancy outcomes between natural conception and ovulation induction following laparoscopic neosalpingostomy in women with stage III–IV hydrosalpinx.

Methods: A quasi-experimental study was conducted between 2014 and 2019 involving 70 infertile women who underwent laparoscopic neosalpingostomy. Participants were assigned to either a natural conception group or an ovulation induction group receiving clomiphene citrate and estradiol valerate. Patients were followed for six to seven months postoperatively. Pregnancy outcomes were analyzed using the chi-square test and multivariate logistic regression, with statistical significance set at $p < 0.05$.

Results: The overall pregnancy rate was 83% within seven months after surgery. Forty-one pregnancies occurred in the natural conception group. No significant association was found between ovulation induction or maternal age >35 years and term pregnancy ($p > 0.05$). Ectopic pregnancy occurred in 4–5% of cases. Multivariate logistic regression analysis identified no independent predictors of term pregnancy.

Conclusion: Laparoscopic neosalpingostomy remains a viable fertility-preserving treatment option for women with advanced hydrosalpinx. Pregnancy outcomes were comparable between women who conceived naturally and those who received ovulation induction therapy.

Keywords: hydrosalpinx, laparoscopic neosalpingostomy, pregnancy outcomes, spontaneous pregnancy.

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INTRODUCTION

Infertility remains a significant health issue worldwide, including in Indonesia. Although it does not impair physical functioning and is not life-threatening, infertility can substantially affect the quality of life of couples by causing medical, economic, and psychological burdens. Infertility is defined as the inability to achieve pregnancy after 12 months of regular, unprotected sexual intercourse in the absence of known reproductive pathology.^{1,2}

Infertility may result from female factors, male factors, or a combination of both. However, a substantial proportion of infertility cases are attributed to female factors. Various risk factors contribute to female infertility, including advanced maternal age, occupation, stress, Body Mass Index (BMI), and abnormalities of the reproductive organs. These abnormalities may involve ovulatory dysfunction, tubal and pelvic disorders, and uterine abnormalities.^{3–5}

Disorders of the female reproductive organs, particularly tubal pathology, are important

contributors to infertility. Studies have shown that women with reproductive tract abnormalities are at a higher risk of infertility than those without such conditions. Fallopian tube obstruction, frequently accompanied by hydrosalpinx, may impair fertility through embryotoxic effects and disruption of normal ciliary function and embryo transport within the fallopian tubes.^{6–12}

For women with distal tubal obstruction and hydrosalpinx, corrective surgical procedures such as peritubal adhesiolysis, fimbrioplasty, and neosalpingostomy are recommended and are commonly performed laparoscopically. These procedures may be considered for patients who wish to preserve their fertility and achieve spontaneous pregnancy. Laparoscopic neosalpingostomy represents a fertility-preserving alternative for women who prefer to avoid salpingectomy and assisted reproductive technologies such as Intrauterine Insemination (IUI) or in Vitro Fertilization (IVF).^{13–15}

The present study aimed to compare pregnancy outcomes between women who conceived naturally and those who underwent ovulation induction following laparoscopic neosalpingostomy for stage III–IV hydrosalpinx.

METHODS

This quasi-experimental study was conducted at Anugerah Women & Children Hospital, Semarang, Indonesia, between January 2014 and December 2019. Ethical approval was obtained from the Health Research Ethics Committee of the Faculty of Medicine, Universitas Diponegoro (No. 380/EC/KEPK.FK-UNDIP/X/2021). Written informed consent was obtained from all participants, including consent for surgery, postoperative monitoring, teleconsultation follow-up, and the use of clinical data for research purposes.

Women with primary infertility who underwent laparoscopic neosalpingostomy for bilateral stage III–IV hydrosalpinx were eligible for inclusion. Diagnosis was confirmed by hysterosalpingography (HSG). Additional inclusion criteria included normal semen parameters according to WHO criteria and willingness to participate in teleconsultation follow-up. Patients who preferred immediate Assisted Reproductive Technology (ART), had abnormal sperm factors, or declined follow-up were excluded.

Participants were allocated into two groups: a natural conception group and an ovulation induction group. Patients in the ovulation induction group received clomiphene citrate 100 mg daily (two 50-mg tablets) from cycle days 2–6 and estradiol valerate 2 mg daily from cycle days 8–12. Treatment was administered for three consecutive cycles, followed by three months of observation without medication.

All patients underwent baseline Transvaginal Ultrasonography (TVS) on cycle day 2 before treatment initiation. Serial TVS examinations were performed from cycle day 8 and repeated every 1–3 days to monitor follicular development and endometrial thickness until at least one follicle reached a mean diameter of ≥ 18 mm. Patients were followed for six months after intervention. This follow-up period was selected because most spontaneous or treatment-assisted conceptions after tubal reconstructive surgery occur within the first 6–12 months postoperatively.

The laparoscopic procedure was performed using the Erbe VIRON 1 Laparoscopy System®. Hydrosalpinx severity was classified according to the Donnez and Casanas-Roux classification based on preoperative HSG findings. Grade I was defined as a phymotic ostium with preserved tubal patency, grade II as complete distal tubal occlusion without ampullary dilatation, grade III as ampullary dilatation < 2.5 cm with preserved ampullary folds, grade IV as hydrosalpinx with ampullary dilatation > 2.5 cm and preserved ampullary folds, and grade V as thick-walled hydrosalpinx with loss of ampullary folds. Only patients with grade III and IV hydrosalpinx were included in this study. Pelvic adhesions were graded according to the American Fertility Society classification.¹⁶ Representative laparoscopic findings of bilateral fimbrial phimosis with stage III–IV hydrosalpinx are shown in Figure 1.



Figure 1. Laparoscopic appearance of bilateral distal tubal occlusion (fimbrial phimosis) associated with stage III–IV hydrosalpinx before neosalpingostomy

Distal tubal obstruction caused by fimbrial phimosis, with or without hydrosalpinx, was treated by adhesiolysis followed by salpingostomy. The distal fimbrial end was opened using a monopolar needle (40 W, pure-cut mode) under laparoscopic guidance until the fimbriae became visible.^{10,17,18} To prevent re-occlusion, fimbrioplasty (Bruhat procedure) was performed using 6-0 monofilament sutures placed at four corners of the opened fimbria. Together, salpingostomy and fimbrioplasty constituted the neosalpingostomy procedure.^{19,20} The main surgical steps are illustrated in Figure 2.

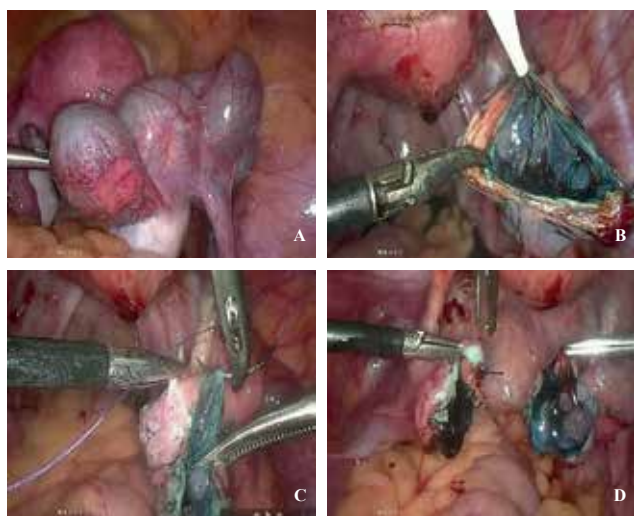


Figure 2. Surgical steps of laparoscopic neosalpingostomy. (A) Fimbrial phimosis with hydrosalpinx. (B) Creation of salpingostomy. (C) Fimbrioplasty with suturing of the fimbrial edges. (D) Final reconstructed fimbrial ostium after neosalpingostomy.

Pregnancy outcomes, including term pregnancy and ectopic pregnancy, were recorded during follow-up. Data were analyzed using STATA software. Continuous variables were expressed as mean $\pm$ standard deviation, whereas categorical variables were presented as frequencies and percentages. Associations between clinical variables and pregnancy outcomes were assessed using the Chi-square test or Fisher's exact test, as appropriate. Relative risks (RRs) with 95% confidence intervals (CIs) were calculated. Multivariate logistic regression analysis was performed to identify independent predictors of term pregnancy, including maternal age (>35 vs. ≤ 35 years), duration of infertility (>5 vs. ≤ 5 years), hydrosalpinx grade (III vs. IV), and ovulation induction status. Adjusted odds ratios (AORs) with 95% CIs were reported. Variables with $p < 0.25$ in bivariate analysis were included

in the multivariate model. Statistical significance was defined as $p < 0.05$.

RESULTS

A total of 72 women met the eligibility criteria and were enrolled in the study. Two patients were lost to follow-up, resulting in 70 women included in the final outcome analysis.

Baseline characteristics of the enrolled participants are presented in Table 1. Most women were older than 35 years (77.8%), with a mean age of 38.7 years. The majority had experienced infertility for more than five years (81.9%), with a mean infertility duration of 8.2 years.

Table 1. Baseline Characteristics of Enrolled Participants (N = 72)

Variable	n (%)	Mean
Maternal age (years)		
≤ 35	16 (22.2)	32.5
> 35	56 (77.8)	38.7
Duration of infertility (years)		
≤ 5	13 (18.1)	3.7
> 5	59 (81.9)	8.2

Among the 70 women included in the final analysis, 41 underwent ovulation induction using clomiphene citrate and estradiol valerate (CC+EE), whereas 29 attempted natural conception. Overall, 58 women (82.9%) achieved pregnancy within seven months after laparoscopic neosalpingostomy, while 12 women (17.1%) did not conceive.

Clinical outcomes and hydrosalpinx characteristics are summarized in Table 2. Term pregnancy was achieved in 38 women (54.3%), while 16 women (22.9%) experienced miscarriage and four women (5.7%) developed ectopic pregnancy. Among women who delivered, 29 (76.3%) underwent cesarean section because of obstetric indications. Stage III hydrosalpinx was more common than stage IV hydrosalpinx (70.0% vs. 30.0%).

Table 2. Clinical Outcomes and Hydrosalpinx Characteristics (N = 70)

Variable	n (%)
Pregnancy outcome	
Miscarriage	16 (22.9)
Ectopic pregnancy	4 (5.7)
Term pregnancy	38 (54.3)
No pregnancy	12 (17.1)
Mode of delivery (n=38)	
Vaginal delivery	9 (23.7)
Cesarean section	29 (76.3)
Hydrosalpinx grade	
Grade III	49 (70.0)
Grade IV	21 (30.0)

Pregnancy outcomes according to treatment group are presented in Table 3. Term pregnancy occurred in 23 women (56.1%) in the ovulation induction group and 15 women (51.7%) in the natural conception group. Ectopic pregnancy occurred in one woman (2.4%) in the ovulation induction group and three women (10.3%) in the natural conception group. Miscarriage occurred in eight women in each group.

Table 3. Pregnancy Outcomes According to Treatment Group (N = 70)

Outcome	Ovulation Induction (CC+EE) n=41	Natural Cycle n=29
Miscarriage	8 (19.5)	8 (27.6)
Ectopic pregnancy	1 (2.4)	3 (10.3)
Term pregnancy	23 (56.1)	15 (51.7)
No pregnancy	9 (22.0)	3 (10.3)
Total	41 (100)	29 (100)

Abbreviations: CC = Clomiphene Citrate; EE = Estradiol Valerate.

No statistically significant association was observed between maternal age >35 years and pregnancy outcomes ($p > 0.05$). Although older women demonstrated a higher relative risk of ectopic pregnancy (RR 2.33; 95% CI 0.42–12.91), the association was not statistically significant because of the wide confidence interval.

Similarly, ovulation induction was not significantly associated with improved term pregnancy rates compared with natural conception ($p > 0.05$). Although the proportion of term pregnancies was slightly higher in the ovulation induction group, the difference did not reach statistical significance.

Multivariate logistic regression analysis demonstrated that none of the evaluated variables, including maternal age (>35 vs. ≤35 years), duration of infertility (>5 vs. ≤5 years), hydrosalpinx grade (III vs. IV), and ovulation

induction status, were independent predictors of term pregnancy (all $p > 0.05$). Maternal age >35 years showed a trend toward a lower likelihood of term pregnancy (AOR 0.74; 95% CI 0.41–1.68), whereas ovulation induction showed a non-significant trend toward a higher likelihood of term pregnancy (AOR 1.32; 95% CI 0.52–3.01).

DISCUSSION

Tubal factor infertility caused by distal tubal occlusion and hydrosalpinx is responsible for approximately 20–30% of female infertility cases. Hydrosalpinx may impair fertility through embryotoxic effects and disruption of normal tubal ciliary function, thereby reducing the likelihood of successful fertilization and embryo transport.^{6–12} In women who wish to conceive naturally and avoid immediate Assisted Reproductive Technology (ART), reconstructive tubal surgery remains a potential treatment option.^{10,11,14,15}

In the present study, laparoscopic neosalpingostomy resulted in an overall pregnancy rate of 82.9% within seven months after surgery. Although no statistically significant difference was observed between women who conceived naturally and those who underwent ovulation induction, both groups achieved favorable reproductive outcomes. These findings support previous studies reporting pregnancy rates of approximately 60–70% following fimbrioplasty and neosalpingostomy in selected patients with hydrosalpinx.^{10,11,15}

Ectopic pregnancy remains a recognized complication following tubal reconstructive surgery.^{21–25} In this study, ectopic pregnancy occurred in 5.7% of patients despite postoperative HSG confirmation of tubal patency. This finding is consistent with previous reports and may be explained by residual tubal dysfunction, impaired ciliary activity, or persistent peri-adnexal adhesions that affect ovum transport.^{21–25}

The severity of pelvic adhesions is an important determinant of reproductive outcomes after tubal surgery. Distal tubal occlusion associated with chronic pelvic inflammation frequently results in peri-adnexal adhesions involving the fimbriae and surrounding structures. Previous studies have shown that laparoscopic adhesiolysis is more effective than laparotomy in restoring pelvic anatomy and preserving reproductive function, particularly in patients with moderate-to-severe adhesions.^{16,18–20}

Maternal age greater than 35 years was not significantly associated with pregnancy outcomes. Although older women showed a higher relative risk of ectopic pregnancy (RR 2.33; 95% CI 0.42–12.91), the wide confidence interval suggests limited statistical precision, likely related to the relatively small sample size. Likewise, ovulation induction was not significantly associated with an increased likelihood of term pregnancy.

From a biological perspective, ovulation induction using clomiphene citrate and estradiol valerate may provide additional reproductive benefits after tubal reconstructive surgery. Clomiphene citrate stimulates follicular development through modulation of estrogen receptors and increased endogenous gonadotropin secretion, thereby enhancing ovulation frequency. Estradiol supplementation may support endometrial receptivity, tubal epithelial regeneration, ciliary activity, and tubal motility during postoperative healing. Although these physiological mechanisms are plausible, the present study did not demonstrate a statistically significant advantage of ovulation induction over natural conception.

The findings of this study suggest that laparoscopic neosalpingostomy remains a viable fertility-preserving option for women with stage III–IV hydrosalpinx, particularly in settings where ART is unavailable, inaccessible, or financially burdensome. Recent studies have also demonstrated favorable reproductive outcomes following neosalpingostomy in selected patients with hydrosalpinx, supporting its role as a fertility-preserving procedure before IVF.^{26–30} Patients should nevertheless be counseled regarding the risk of ectopic pregnancy and the possibility of requiring ART if conception does not occur within 6–12 months following surgery.

This study has several limitations. First, the relatively small sample size ($n = 70$) may have limited the statistical power to detect significant differences between groups. Second, the follow-up period was limited to 6–7 months; therefore, long-term reproductive outcomes and cumulative live birth rates could not be evaluated. Larger multicenter studies with longer follow-up periods are warranted to further clarify the role of ovulation induction after laparoscopic neosalpingostomy.

CONCLUSIONS

Laparoscopic neosalpingostomy may be considered a fertility-preserving surgical option for women with stage III–IV hydrosalpinx who desire natural conception and prefer to defer assisted reproductive technology (ART). In selected patients with preserved tubal morphology and favorable adhesion characteristics, neosalpingostomy may provide a cost-effective alternative before in vitro fertilization (IVF). Although ovulation induction did not significantly improve pregnancy outcomes compared with natural conception, both approaches achieved favorable pregnancy rates following surgery. Therefore, laparoscopic neosalpingostomy remains a reasonable treatment option for women with advanced hydrosalpinx before proceeding to ART.

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CONFLICTS of INTEREST

There is no conflict of interest in this study

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Research Article

Spontaneous Pregnancy Rates with and without Ovulation Induction after Post-Laparoscopic Neosalpingostomy for Stage III–IV Hydrosalpinx

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Abstract

Objective: To compare pregnancy outcomes between natural conception and ovulation induction following laparoscopic neosalpingostomy in women with stage III–IV hydrosalpinx.

Methods: A quasi-experimental study was conducted between 2014 and 2019 involving 70 infertile women who underwent laparoscopic neosalpingostomy. Participants were assigned to either a natural conception group or an ovulation induction group receiving clomiphene citrate and estradiol valerate. Patients were followed for six to seven months postoperatively. Pregnancy outcomes were analyzed using the chi-square test and multivariate logistic regression, with statistical significance set at $p < 0.05$.

Results: The overall pregnancy rate was 83% within seven months after surgery. Forty-one pregnancies occurred in the natural conception group. No significant association was found between ovulation induction or maternal age >35 years and term pregnancy ($p > 0.05$). Ectopic pregnancy occurred in 4–5% of cases. Multivariate logistic regression analysis identified no independent predictors of term pregnancy.

Conclusion: Laparoscopic neosalpingostomy remains a viable fertility-preserving treatment option for women with advanced hydrosalpinx. Pregnancy outcomes were comparable between women who conceived naturally and those who received ovulation induction therapy.

Keywords: hydrosalpinx, laparoscopic neosalpingostomy, pregnancy outcomes, spontaneous pregnancy.

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INTRODUCTION

Infertility remains a significant health issue worldwide, including in Indonesia. Although it does not impair physical functioning and is not life-threatening, infertility can substantially affect the quality of life of couples by causing medical, economic, and psychological burdens. Infertility is defined as the inability to achieve pregnancy after 12 months of regular, unprotected sexual intercourse in the absence of known reproductive pathology.^{1,2}

Infertility may result from female factors, male factors, or a combination of both. However, a substantial proportion of infertility cases are attributed to female factors. Various risk factors contribute to female infertility, including advanced maternal age, occupation, stress, Body Mass Index (BMI), and abnormalities of the reproductive organs. These abnormalities may involve ovulatory dysfunction, tubal and pelvic disorders, and uterine abnormalities.^{3–5}

Disorders of the female reproductive organs, particularly tubal pathology, are important

contributors to infertility. Studies have shown that women with reproductive tract abnormalities are at a higher risk of infertility than those without such conditions. Fallopian tube obstruction, frequently accompanied by hydrosalpinx, may impair fertility through embryotoxic effects and disruption of normal ciliary function and embryo transport within the fallopian tubes.^{6–12}

For women with distal tubal obstruction and hydrosalpinx, corrective surgical procedures such as peritubal adhesiolysis, fimbrioplasty, and neosalpingostomy are recommended and are commonly performed laparoscopically. These procedures may be considered for patients who wish to preserve their fertility and achieve spontaneous pregnancy. Laparoscopic neosalpingostomy represents a fertility-preserving alternative for women who prefer to avoid salpingectomy and assisted reproductive technologies such as Intrauterine Insemination (IUI) or in Vitro Fertilization (IVF).^{13–15}

The present study aimed to compare pregnancy outcomes between women who conceived naturally and those who underwent ovulation induction following laparoscopic neosalpingostomy for stage III–IV hydrosalpinx.

METHODS

This quasi-experimental study was conducted at Anugerah Women & Children Hospital, Semarang, Indonesia, between January 2014 and December 2019. Ethical approval was obtained from the Health Research Ethics Committee of the Faculty of Medicine, Universitas Diponegoro (No. 380/EC/KEPK.FK-UNDIP/X/2021). Written informed consent was obtained from all participants, including consent for surgery, postoperative monitoring, teleconsultation follow-up, and the use of clinical data for research purposes.

Women with primary infertility who underwent laparoscopic neosalpingostomy for bilateral stage III–IV hydrosalpinx were eligible for inclusion. Diagnosis was confirmed by hysterosalpingography (HSG). Additional inclusion criteria included normal semen parameters according to WHO criteria and willingness to participate in teleconsultation follow-up. Patients who preferred immediate Assisted Reproductive Technology (ART), had abnormal sperm factors, or declined follow-up were excluded.

Participants were allocated into two groups: a natural conception group and an ovulation induction group. Patients in the ovulation induction group received clomiphene citrate 100 mg daily (two 50-mg tablets) from cycle days 2–6 and estradiol valerate 2 mg daily from cycle days 8–12. Treatment was administered for three consecutive cycles, followed by three months of observation without medication.

All patients underwent baseline Transvaginal Ultrasonography (TVS) on cycle day 2 before treatment initiation. Serial TVS examinations were performed from cycle day 8 and repeated every 1–3 days to monitor follicular development and endometrial thickness until at least one follicle reached a mean diameter of ≥ 18 mm. Patients were followed for six months after intervention. This follow-up period was selected because most spontaneous or treatment-assisted conceptions after tubal reconstructive surgery occur within the first 6–12 months postoperatively.

The laparoscopic procedure was performed using the Erbe VIRON 1 Laparoscopy System®. Hydrosalpinx severity was classified according to the Donnez and Casanas-Roux classification based on preoperative HSG findings. Grade I was defined as a phymotic ostium with preserved tubal patency, grade II as complete distal tubal occlusion without ampullary dilatation, grade III as ampullary dilatation < 2.5 cm with preserved ampullary folds, grade IV as hydrosalpinx with ampullary dilatation > 2.5 cm and preserved ampullary folds, and grade V as thick-walled hydrosalpinx with loss of ampullary folds. Only patients with grade III and IV hydrosalpinx were included in this study. Pelvic adhesions were graded according to the American Fertility Society classification.¹⁶ Representative laparoscopic findings of bilateral fimbrial phimosis with stage III–IV hydrosalpinx are shown in Figure 1.



Figure 1. Laparoscopic appearance of bilateral distal tubal occlusion (fimbrial phimosis) associated with stage III–IV hydrosalpinx before neosalpingostomy

Distal tubal obstruction caused by fimbrial phimosis, with or without hydrosalpinx, was treated by adhesiolysis followed by salpingostomy. The distal fimbrial end was opened using a monopolar needle (40 W, pure-cut mode) under laparoscopic guidance until the fimbriae became visible.^{10,17,18} To prevent re-occlusion, fimbrioplasty (Bruhat procedure) was performed using 6-0 monofilament sutures placed at four corners of the opened fimbria. Together, salpingostomy and fimbrioplasty constituted the neosalpingostomy procedure.^{19,20} The main surgical steps are illustrated in Figure 2.

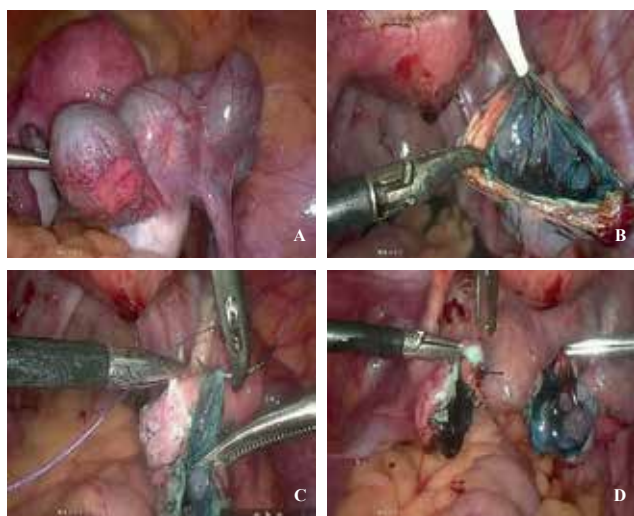


Figure 2. Surgical steps of laparoscopic neosalpingostomy. (A) Fimbrial phimosis with hydrosalpinx. (B) Creation of salpingostomy. (C) Fimbrioplasty with suturing of the fimbrial edges. (D) Final reconstructed fimbrial ostium after neosalpingostomy.

Pregnancy outcomes, including term pregnancy and ectopic pregnancy, were recorded during follow-up. Data were analyzed using STATA software. Continuous variables were expressed as mean $\pm$ standard deviation, whereas categorical variables were presented as frequencies and percentages. Associations between clinical variables and pregnancy outcomes were assessed using the Chi-square test or Fisher's exact test, as appropriate. Relative risks (RRs) with 95% confidence intervals (CIs) were calculated. Multivariate logistic regression analysis was performed to identify independent predictors of term pregnancy, including maternal age (>35 vs. ≤ 35 years), duration of infertility (>5 vs. ≤ 5 years), hydrosalpinx grade (III vs. IV), and ovulation induction status. Adjusted odds ratios (AORs) with 95% CIs were reported. Variables with $p < 0.25$ in bivariate analysis were included

in the multivariate model. Statistical significance was defined as $p < 0.05$.

RESULTS

A total of 72 women met the eligibility criteria and were enrolled in the study. Two patients were lost to follow-up, resulting in 70 women included in the final outcome analysis.

Baseline characteristics of the enrolled participants are presented in Table 1. Most women were older than 35 years (77.8%), with a mean age of 38.7 years. The majority had experienced infertility for more than five years (81.9%), with a mean infertility duration of 8.2 years.

Table 1. Baseline Characteristics of Enrolled Participants (N = 72)

Variable	n (%)	Mean
Maternal age (years)		
≤ 35	16 (22.2)	32.5
> 35	56 (77.8)	38.7
Duration of infertility (years)		
≤ 5	13 (18.1)	3.7
> 5	59 (81.9)	8.2

Among the 70 women included in the final analysis, 41 underwent ovulation induction using clomiphene citrate and estradiol valerate (CC+EE), whereas 29 attempted natural conception. Overall, 58 women (82.9%) achieved pregnancy within seven months after laparoscopic neosalpingostomy, while 12 women (17.1%) did not conceive.

Clinical outcomes and hydrosalpinx characteristics are summarized in Table 2. Term pregnancy was achieved in 38 women (54.3%), while 16 women (22.9%) experienced miscarriage and four women (5.7%) developed ectopic pregnancy. Among women who delivered, 29 (76.3%) underwent cesarean section because of obstetric indications. Stage III hydrosalpinx was more common than stage IV hydrosalpinx (70.0% vs. 30.0%).

Table 2. Clinical Outcomes and Hydrosalpinx Characteristics (N = 70)

Variable	n (%)
Pregnancy outcome	
Miscarriage	16 (22.9)
Ectopic pregnancy	4 (5.7)
Term pregnancy	38 (54.3)
No pregnancy	12 (17.1)
Mode of delivery (n=38)	
Vaginal delivery	9 (23.7)
Cesarean section	29 (76.3)
Hydrosalpinx grade	
Grade III	49 (70.0)
Grade IV	21 (30.0)

Pregnancy outcomes according to treatment group are presented in Table 3. Term pregnancy occurred in 23 women (56.1%) in the ovulation induction group and 15 women (51.7%) in the natural conception group. Ectopic pregnancy occurred in one woman (2.4%) in the ovulation induction group and three women (10.3%) in the natural conception group. Miscarriage occurred in eight women in each group.

Table 3. Pregnancy Outcomes According to Treatment Group (N = 70)

Outcome	Ovulation Induction (CC+EE) n=41	Natural Cycle n=29
Miscarriage	8 (19.5)	8 (27.6)
Ectopic pregnancy	1 (2.4)	3 (10.3)
Term pregnancy	23 (56.1)	15 (51.7)
No pregnancy	9 (22.0)	3 (10.3)
Total	41 (100)	29 (100)

Abbreviations: CC = Clomiphene Citrate; EE = Estradiol Valerate.

No statistically significant association was observed between maternal age >35 years and pregnancy outcomes ($p > 0.05$). Although older women demonstrated a higher relative risk of ectopic pregnancy (RR 2.33; 95% CI 0.42–12.91), the association was not statistically significant because of the wide confidence interval.

Similarly, ovulation induction was not significantly associated with improved term pregnancy rates compared with natural conception ($p > 0.05$). Although the proportion of term pregnancies was slightly higher in the ovulation induction group, the difference did not reach statistical significance.

Multivariate logistic regression analysis demonstrated that none of the evaluated variables, including maternal age (>35 vs. ≤35 years), duration of infertility (>5 vs. ≤5 years), hydrosalpinx grade (III vs. IV), and ovulation

induction status, were independent predictors of term pregnancy (all $p > 0.05$). Maternal age >35 years showed a trend toward a lower likelihood of term pregnancy (AOR 0.74; 95% CI 0.41–1.68), whereas ovulation induction showed a non-significant trend toward a higher likelihood of term pregnancy (AOR 1.32; 95% CI 0.52–3.01).

DISCUSSION

Tubal factor infertility caused by distal tubal occlusion and hydrosalpinx is responsible for approximately 20–30% of female infertility cases. Hydrosalpinx may impair fertility through embryotoxic effects and disruption of normal tubal ciliary function, thereby reducing the likelihood of successful fertilization and embryo transport.^{6–12} In women who wish to conceive naturally and avoid immediate Assisted Reproductive Technology (ART), reconstructive tubal surgery remains a potential treatment option.^{10,11,14,15}

In the present study, laparoscopic neosalpingostomy resulted in an overall pregnancy rate of 82.9% within seven months after surgery. Although no statistically significant difference was observed between women who conceived naturally and those who underwent ovulation induction, both groups achieved favorable reproductive outcomes. These findings support previous studies reporting pregnancy rates of approximately 60–70% following fimbrioplasty and neosalpingostomy in selected patients with hydrosalpinx.^{10,11,15}

Ectopic pregnancy remains a recognized complication following tubal reconstructive surgery.^{21–25} In this study, ectopic pregnancy occurred in 5.7% of patients despite postoperative HSG confirmation of tubal patency. This finding is consistent with previous reports and may be explained by residual tubal dysfunction, impaired ciliary activity, or persistent peri-adnexal adhesions that affect ovum transport.^{21–25}

The severity of pelvic adhesions is an important determinant of reproductive outcomes after tubal surgery. Distal tubal occlusion associated with chronic pelvic inflammation frequently results in peri-adnexal adhesions involving the fimbriae and surrounding structures. Previous studies have shown that laparoscopic adhesiolysis is more effective than laparotomy in restoring pelvic anatomy and preserving reproductive function, particularly in patients with moderate-to-severe adhesions.^{16,18–20}

Maternal age greater than 35 years was not significantly associated with pregnancy outcomes. Although older women showed a higher relative risk of ectopic pregnancy (RR 2.33; 95% CI 0.42–12.91), the wide confidence interval suggests limited statistical precision, likely related to the relatively small sample size. Likewise, ovulation induction was not significantly associated with an increased likelihood of term pregnancy.

From a biological perspective, ovulation induction using clomiphene citrate and estradiol valerate may provide additional reproductive benefits after tubal reconstructive surgery. Clomiphene citrate stimulates follicular development through modulation of estrogen receptors and increased endogenous gonadotropin secretion, thereby enhancing ovulation frequency. Estradiol supplementation may support endometrial receptivity, tubal epithelial regeneration, ciliary activity, and tubal motility during postoperative healing. Although these physiological mechanisms are plausible, the present study did not demonstrate a statistically significant advantage of ovulation induction over natural conception.

The findings of this study suggest that laparoscopic neosalpingostomy remains a viable fertility-preserving option for women with stage III–IV hydrosalpinx, particularly in settings where ART is unavailable, inaccessible, or financially burdensome. Recent studies have also demonstrated favorable reproductive outcomes following neosalpingostomy in selected patients with hydrosalpinx, supporting its role as a fertility-preserving procedure before IVF.^{26–30} Patients should nevertheless be counseled regarding the risk of ectopic pregnancy and the possibility of requiring ART if conception does not occur within 6–12 months following surgery.

This study has several limitations. First, the relatively small sample size ($n = 70$) may have limited the statistical power to detect significant differences between groups. Second, the follow-up period was limited to 6–7 months; therefore, long-term reproductive outcomes and cumulative live birth rates could not be evaluated. Larger multicenter studies with longer follow-up periods are warranted to further clarify the role of ovulation induction after laparoscopic neosalpingostomy.

CONCLUSIONS

Laparoscopic neosalpingostomy may be considered a fertility-preserving surgical option for women with stage III–IV hydrosalpinx who desire natural conception and prefer to defer assisted reproductive technology (ART). In selected patients with preserved tubal morphology and favorable adhesion characteristics, neosalpingostomy may provide a cost-effective alternative before in vitro fertilization (IVF). Although ovulation induction did not significantly improve pregnancy outcomes compared with natural conception, both approaches achieved favorable pregnancy rates following surgery. Therefore, laparoscopic neosalpingostomy remains a reasonable treatment option for women with advanced hydrosalpinx before proceeding to ART.

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CONFLICTS of INTEREST

There is no conflict of interest in this study

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