



# Tubal restorative surgery for hydrosalpinges in women due to in vitro fertilization

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## Abstract

**Objective** The study was carried out to clarify the IVF outcome after laparoscopic neosalpingostomy for infertile patients affected by hydrosalpinx stage III. **Materials and Methods:** From January 2010 to June 2015, 91 subjects of hydrosalpinx stage III were treated in our center by laparoscopic surgery before IVF cycle. 43 underwent neosalpingostomy (group 1) and the remaining 48 underwent salpingectomy (group 2). We compared these patients and their IVF outcomes after two different surgical techniques.

**Results** There were no significant differences between the two groups, except a higher number of patients with bilateral hydrosalpinges was noted in the neosalpingostomy group (79.1% vs. 56.3%, respectively). 25 patients with neosalpingostomy and 29 with salpingectomy achieved pregnancy by IVF. The ongoing pregnancy rate per cycle in group 1 and group 2 was 51.1 and 47.2%, respectively. Two cases of ampullary ectopic pregnancies were noted in group 1 and one case of right tube interstitial pregnancy in group 2. No significant difference was observed in live birth rate between the groups (48.9% vs. 45.3%, respectively).

**Conclusions** The outcomes of IVF after neosalpingostomy were matchable with salpingectomy. For patients desire to preserve fallopian tubes, we recommend laparoscopic neosalpingostomy as an alternative choice to manage moderate hydrosalpinx before IVF.

**Keywords** Hydrosalpinx · Neosalpingostomy · Salpingectomy · IVF · Pregnancy

## Introduction

Hydrosalpinx refers to a pathologic condition in which distally obstructed salpinges are filled with fluid, forming a saccular structure. Approximately 25% of female fertility is caused by tubal factors and about 30% of tubal infertility is caused by hydrosalpinx [1]. Abundant evidence indicates that the presence of hydrosalpinx adversely affects pregnancy outcomes with in vitro fertilization-embryo transfer (IVF-ET), decreasing live birth rates by approximately 50% [2, 3]. Mechanical factors, embryo toxicity of the hydrosalpinx fluid, and a decrease in endometrial receptivity may explain detrimental effects [4, 5]. To reverse the harmful impact, two

main treatment options are available. The first approach is to remove it by salpingectomy, whereas the second is to restore tubal function which refers to neosalpingostomy [1, 6]. A Cochrane review in 2010 reported that laparoscopic surgery resection should be considered for all women with hydrosalpinges prior to IVF cycle [3]. In China, surgeons are usually prone to salpingectomy, an easy procedure. However, this treatment has its own drawbacks. Besides the psychological burden for the patients, salpingectomy could potentially exert a deleterious effect on ovarian blood flow as a result of transection of collateral vessels. Moreover, spontaneous pregnancies can eventually occur after 3 years following neosalpingostomy in some patients who had no pregnancy after recurrent IVF attempts [7]. These observations mean that after multiple unsuccessful IVF attempts, pregnancies are also possible as long as at least one fallopian tube is present. Yet, to date there have been no studies to investigate the effectiveness of tubal restorative surgery on patients with hydrosalpinges in subsequent IVF cycles.

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In addition, the decision to repair or remove of fallopian tubes before IVF should be based on the assessment of the extent of hydrosalpinges. Tubal stages have been reported and associated with the prognosis of subsequent intrauterine pregnancy [7]. Neosalpingostomy represents the suitable choice for tubal occlusion in stage I and II. In stage IV, with irreparable damage to the ciliated epithelium, salpingectomy followed by IVF should be served. However, in stage III, the choice of management is difficult. Whether the tubes could be preserved or not is less clear. The purpose of this study was to assess and compare the value of neosalpingostomy—the tubal preserving surgery for hydrosalpinx in stage III prior to IVF.

## Materials and methods

### Patients

This retrospective study was performed from January 2010 to June 2015. All infertile patients with regular menses surgically managed for hydrosalpinx and eligible for IVF attempts were included in the protocol. The presence hydrosalpinx suspected on hysterosalpingography (HSG) or ultrasound scan was confirmed by laparoscopy. All patients underwent surgery at the Reproductive Medicine institution of Peking University People's Hospital, Beijing, China. Only patients diagnosed with hydrosalpinges in stage III by laparoscopic surgery were analyzed in the study. Distal tubal scoring system was seen in Table 1. The definitive decision about which surgery to pursue should be based on the couple's wishes as well as the tubal status. According to whether the fallopian tubes were reserved or not, enrolled subjects were stratified into two groups. Group 1 consisted of women with neosalpingostomy before the subsequent IVF cycle. Group 2, as the control one, consisted of patients with salpingectomy before IVF treatment. Patients were excluded when bilateral hydrosalpinges was employed laparoscopic surgery

**Table 1** Tubal scoring system

Variable	Pathology	Score
Tubal blockage	Partial occlusion	2
	Total occlusion	5
Tubal mucosa (HSG)	Normal folds	0
	Decreased folds	5
	No fold	10
Tubal wall (laparoscopy)	Normal	0
	Thin	5
	Thick or rigid	10

Grade I, 2–5; grade II, 7–10; grade III, 12–15; grade IV,  $\geq 15$   
HSG hysterosalpingography

to remove one of her fallopian tubes and repair the other one. Participants were consented preoperatively for both of the two techniques and well-informed the possibilities of postoperative recurrence of hydrosalpinx which required a second surgery. Patients were followed up more than 2 years after the surgery and pregnancy outcomes in the subsequent IVF treatment were traced by phone. Four subjects from group 1 and 5 from group 2 were lost to follow-up. The study was approved by the local ethics committee. All patients were informed about this study and a signed consent was obtained.

### Tubal damage stage

The tubal damage stage takes into account the tubal blockage, the quality of the mucosa, and the tubal wall aspect during laparoscopy (normal, thin, or sclerotic) (Table 1) [8]. Scores were allocated prospectively for tubal damage based on findings at HSG and a systematic laparoscopic evaluation. The points for each factor were added to classify patients in one of four tubal stages assessed before surgery.

### Laparoscopic procedure

Laparoscopies in our infertility unit were performed by three senior reproductive laparoscopists, and every surgical procedure was video recorded. Laparoscopy was conducted under general endotracheal anesthesia. A systematic laparoscopic evaluation was firstly conducted in order to get a precise description of the tubal mucosa and wall. As mentioned previously, after precise evaluation, those with hydrosalpinges in stage III were focused. Depending on the location of the hydrosalpinx, the laparoscopic surgery was performed either unilaterally or bilaterally. Unaffected tubes were preserved. For laparoscopic neosalpingostomy, hydrosalpinx was opened by an atraumatic endoscopic forceps. Then, the fringes were opened completely by incisions followed by an everted suture of the fimbria with a 5-0 absorbable thread. Finally, diluted methylene blue was injected in order to access the tubal patency. For salpingectomy, total salpingectomy was performed by stepwise dissection of the mesosalpinx followed by cutting along the mesosalpinx using scissors. Finally, the layer underlying the incision was sutured using no 7-0 prolene.

### Outcome measures

In this study, intrauterine pregnancy was defined as the presence of an intrauterine gestational sac with a heartbeat on ultrasound, whereas ongoing pregnancy was defined as the presence of a viable embryo at 10 weeks of gestational age. The clinical pregnancy rate and ongoing pregnancy per IVF

cycle were calculated. Live birth was defined as a fetus exiting the maternal body and showing signs of life.

### Statistical analysis

All statistical analyses were performed using a windows-based SPSS version 19.0 (SPSS Inc., Chicago, IL, USA). Data were statistically described in terms of medians (range) or frequencies (percentage) when appropriate. Comparison of numerical variables was made by the *t* test. When comparing categorical data, Pearson's Chi Square test or Fisher's exact test was performed. Statistical significance was defined at an alpha value of  $P < 0.05$ .

### Results

Of the 91 subjects, 43 underwent laparoscopic neosalpingostomy and the remaining 48 underwent laparoscopic salpingectomy before IVF cycle. The characteristics of patients in the neosalpingostomy and salpingectomy groups are presented in Table 2. A higher number of patients with bilateral hydrosalpinges was noted in the neosalpingostomy group (79.1% vs 56.3%, respectively). There were no other significant differences between the two study groups with regard to the age and cause of infertility. The postoperative recurrence rate of hydrosalpinx is 6/43 (14%) when performing neosalpingostomy.

The results of the IVF treatment in the two groups are summarized in Table 3. The outcomes of IVF after surgery were compared between the two groups. Patients underwent 47 cycles of IVF in group 1 and 53 cycles in group 2. No significant differences were observed in the clinical pregnancy or ongoing pregnancy rates between the two study groups. After laparoscopic surgery, patients in the neosalpingostomy

**Table 2** The characteristics of infertility patients receiving neosalpingostomy or salpingectomy

Variable	Group 1	Group 2	<i>P</i>
Number of patients	43	48	–
Age (year) (range)	31 (22–37)	32 (27–41)	NS
Infertility type ( <i>n</i> %)			
Primary	12 (27.9)	15 (31.3)	NS
Secondary	31 (72.1)	33 (68.7)	NS
History of previous surgery ( <i>n</i> %)	8 (18.6)	16 (33.3)	NS
Bilateral hydrosalpinx ( <i>n</i> %)	34 (79.1)	27 (56.3)	0.02
Recurrence of hydrosalpinx ( <i>n</i> %)	6 (14.0)	0	–
Time to recurrence (month) (range)	12.5 (6–21)	0	–

Values are presented as medians (range) or frequencies (percentage) when appropriate

NS not significant

**Table 3** The outcomes of IVF-ET treatment in the two groups

Variable	Group 1	Group 2	<i>P</i>
Number of patients	43	48	NS
Number of cycles	47	53	NS
Intrauterine pregnancy per cycle (%)	25 (53.2%)	29 (54.7%)	NS
Ectopic pregnancy per cycle (%)	2 (4.3%)	1 (1.9%)	NS
Ongoing pregnancy per cycle (%)	24 (51.1%)	25 (47.2%)	NS
Live birth rate per cycle (%)	23 (48.9%)	24 (45.3%)	NS

Values are presented as medians (range) or frequencies (percentage) when appropriate

NS not significant

group and 29 patients in the salpingectomy group achieved pregnancy by IVF-ET. The ongoing rate per cycle in group 1 and group 2 was 51.1 and 47.2%, respectively. Ectopic pregnancy rate was similar between the two surgical options. Two cases of ampullary ectopic pregnancies in group 1 and one case of right tube interstitial pregnancy was noted in group 2. There was also no significant difference in live birth rate between the groups (48.9% vs. 45.3%, respectively). During the follow-up period, a 26-year old patient in group 1 was noted that she conceived spontaneously after 3 years of the unilateral neosalpingostomy. And she had already delivered successfully after the first IVF treatment cycle.

### Discussion

As demonstrated in the current study, in accordance with accurate evaluation for hydrosalpinx, conservative surgery such as neosalpingostomy should be considered as an alternative choice (stage III) before IVF. We found that management of hydrosalpinx either by laparoscopic neosalpingostomy or salpingectomy yielded similar pregnancy outcomes in the subsequent IVF-ET procedure. Overall, the ongoing pregnancy and live birth rate for the neosalpingostomy group were 51.1 and 48.9%, compared to 47.2 and 45.3% for that of the salpingectomy group, and no significant difference in the rate of ectopic pregnancy.

### Impact of hydrosalpinx on IVF treatment

Hydrosalpinx is frequently the consequence of previous pelvic infections or post-operative adhesions. A growing body of research has shown that hydrosalpinx deleteriously affect IVF results, though the exact mechanism is not yet fully understood. The changes in the endometrial peristalsis by the fluid may wash-out or hinder implantation of the transferred embryo [4]. Hydrosalpinx fluid is proved to be embryo toxic, since removal of hydrosalpinx increases the endometrial receptivity factors (leukemia inhibitory factor,

and transcription factor *HOXA 10*) [9]. Since hydrosalpinx reduces the pregnancy rate for various reasons, it must be treated before IVF.

### Salpingectomy vs. Neosalpingostomy

Laparoscopic salpingectomy used to be thought as the rule to manage hydrosalpinx prior to IVF. Olivier et al. observed 45.8% pregnancy rate after bilateral salpingectomy and subsequent ART [7]. In this report, the ongoing pregnancy rate with salpingectomy was 47.2% which is in accordance with those reported in literature. After removing bilateral fallopian tubes, any possibility of conceiving spontaneously is removed permanently, and a single IVF treatment gives one chance only. To pull back one more level, even multiple times of IVF attempts could not guarantee the success of pregnancy. In addition, considering the patient preference and some religious belief, sometimes radical removal of fallopian tube is not acceptable, that is especially true in China.

Different from salpingectomy, conservative surgery such as laparoscopic neosalpingostomy represents a significantly less invasive approach while eliminating retrograde flow of the hydrosalpinx fluid into the cavity. Overall clinical pregnancy rates following restorative surgery for the treatment of hydrosalpinx have been reported to range from 5 to 43.5% [10–13]. Some degree of clinical heterogeneity is due to the selection of patients and various approaches to the surgical procedures. The lowest clinical pregnancy rate (5%) was reported by Bayrak et al. [10] in 2006. But the samples were too small that we cannot draw strong conclusions. The clinical pregnancy rate reported by us was 53.2% per IVF cycle, comparable with the result of salpingectomy. Following reasons could explain the impressive results. Firstly, surgeons performing the procedure in our center have extensive training in tubal microsurgery and also have adequate clinical experience. Secondly, microsurgery and IVF procedure are complementary therapies for the treatment of hydrosalpinx. The postoperative IVF therapy could make some contributions. In consistent with our result, study by Chanelles et al. [7] also showed that chance of achieving clinical pregnancy after neosalpingotomy is as high as 62.5%, in women who underwent subsequent IVF treatment. This may suggest that women with neosalpingostomy and following IVF treatment have a more favorable outcome.

Our study showed a 4.3% rate of ectopic pregnancy in tubal preserving group, and this was not significantly different from that of resection group. In the past, bilateral salpingectomy was generally considered to eliminate the risk of ectopic pregnancy. However, studies shown that transection of the tube too close to the cornua may also increase the risk of an interstitial pregnancy after embryo transfer, a devastating complication [14, 15]. In our study, despite undergoing salpingectomy, a case in group 2 had an interstitial

pregnancy which was in accordance with the published case report. It seems that even bilateral salpingectomy does not prevent from the risk of ectopic pregnancy and the potential for ectopic pregnancy should be considered.

### Which therapy for which patient

A prospective study by Vasques et al. [16] found that among the different lesions of hydrosalpinges the mucosal adhesions are the key influential factor in fertility outcome. The distal tubal occlusion classification was proposed in 1986 and is still used in China and other countries [8, 11]. Based on this scoring system, it is significant to identify the health of the tubal mucosa which determines the results. Lack of the mucosa folds in the distal tubes is indicative of irreversible damage to the ciliated epithelium. In that case, removal the tube would be more appropriate. Microsurgery of the fallopian tubes to restore functioning in the case of tubal disease has been progressed within the recent decades. The birth rate and ongoing pregnancy rate of the study, all favoring the efficacy of conservative surgery to hydrosalpinx in stage. Thus, to assess the degree of damage to the tubal epithelium may allow more effective triage of patients to suitable management.

Our study has some limitations as a result of its retrospective nature with the inherent biases that are associated with such design and its sample size, which may limit its generalizability. In addition, ovarian response was not addressed in the current study. However, since all of the tubal damage was in stage III, the size of hydrosalpinx, the degree of tubal mucosal damage and peritubal adhesions were comparable in this study. Nevertheless, a larger multicenter prospective study on this topic is warranted to confirm the present results.

It has been reported that a spontaneous pregnancy can eventually occur after several years following neosalpingostomy for hydrosalpinx [17]. In the current study, we also observed spontaneous pregnancy at 3 years after surgery in a patient who had obtained a baby after the first IVF treatment. These observations support that the diseased tubes should not be blindly removed.

### Conclusion

Performing neosalpingostomy prior to IVF in women with hydrosalpinx in stage III may improve the outcome of subsequent IVF, while offering the potential for spontaneous conception. Surgery that restoring the damaged tubes is a delicate technique, and performed by a highly skilled professional would enhance the efficacy as well as reduce recurrence. As the demand of restorative surgery on damaged tubes has increased at our center, training infertility

specialists in minimally invasive surgery is necessary and emergency.

**Authors' contribution** Xiaoming Yu and He Cai contributed equally to this writing of initial manuscript and should be considered as co-first authors. Jing Guan. contributed to study concept. Xingbang Zheng and Junyan Feng contributed to literature review. Jing Guan and Xiaoming Yu contributed to substantial manuscript revisions. All authors approved the final manuscript version.

### Compliance with ethical standards

**Conflicts of interest** None of the authors have any conflict of interest associated with the study.

**Ethical approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was approved by the local ethics committee of Peking University People's hospital.

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