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Original Article

Infertility evaluation via laparoscopy and hysteroscopy after conservative treatment for tubal pregnancy

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Abstract: Objective: Evaluate the cause of infertility and impairment of tubal reproductive functions in infertility patients, who suffered tubal pregnancy after conservative treatment, using laparoscopy, hysteroscopic tubal catheterization, and hydrotubation. Methods: Seventy-five infertility patients treated for tubal pregnancies were divided into two groups based on past treatment methods of their tubal pregnancies, conservative-medical group and conservative-surgical group. The severity of pelvic adhesions, tubal morphology, tubal fimbria, and other infertility factors were observed via laparoscopy. Additionally, hysteroscopic tubal catheterization and hydrotubation was used to diagnose tubal patency and evaluate the intrauterine cavity. Results: There were one or more factors associated with infertility in the 75 patients, among which abnormal tubal was an absolutely important factor. In conservative-medical group, 92.11% (35/38) of the patients were with bilateral or unilateral oviduct exceptions, such as adhesion around or distorted tubal, closure or adhesion in umbrella end, lumen block. In conservative-surgical group, all of the patients were with bilateral or unilateral fallopian tube lesions. As two fallopian tubes per patient, 80.26% (61/76) of the tubes in conservative-medical group was damaged, 95.95% (71/74) in conservative-surgical group. The differences between the two groups was significant ($P < 0.05$). However, differences between these two groups in morphology of damaged tubes, anomaly of umbrella end and occlusion of lumen were not significant ($P > 0.05$). Incidence of pelvic adhesions in conservative-medical group was 76.32% (29/38), which was lower than 100% (37/37) of conservative-surgical group. The difference was significant ($P < 0.05$), which suggested that conservative-medical treatment was more effective than surgical treatment in preventing pelvic adhesion. Conclusion: Factors associated with tubal infertility affect patients who accepted conservative treatment for tubal pregnancy. In patients with a history of a tubal pregnancy, it may be less likely to compromise future reproductive function for conservative-medical treated patients than that for conservative-surgery treated patients.

Keywords: Female infertility, tubal pregnancy, laparoscopy, hysteroscopy, medical treatment, salpingostomy

Introduction

The incidence of fallopian tube pregnancies affecting women's health and future fecundity is approximately 2%, but may be increasing [1, 2]. With the development of techniques with which to diagnose tubal pregnancies early, tubal pregnancy-associated mortalities are declining, thus researchers and clinicians have begun to focus on preserving fertility. The three main methods for treating tubal pregnancies include conservative medical treatment, conservative surgical treatment, and radical salpingostomy. Two long-term complications of tubal pregnancies, repeat ectopic pregnancy and secondary infertility, will persist in future regardless of which treatment is chosen.

Most studies involving fecundity after tubal pregnancy are observational, population-based studies. However, reports that evaluate causes of infertility after tubal pregnancy, tubal morphology, and tubal function are limited. Mueller et al. reported that 92% of the causes of infertility after tubal pregnancy are due to tubal factors; however, none of the data was derived from evaluations and observations of fallopian tubes in patients with tubal infertility [3].

In this study, a pelvic examnination for patients after conservative tubal treatment was done by laparoscopy, hysteroscopic tubal catheterization and hydrotubation, in order to determine tubal patency, tubal morpholgy, severity of pelvic adhesions, causes of infertility, and tubal

Table 1. Characteristics of 75 patients with infertility after conservative tubal pregnancy treatment

Data Descriptions	Medical treatment n=38	Surgical treatment n=37	*P* value
Age ($\bar{x}$±s)	31.71±3.97	31.76±4.49	0.24
Number of pregnancies	2.37±1.22	2.19±1.17	0.95
Years of infertility ($\bar{x}$±s)	2.95±1.86	4.11±3.06	0.48
History of pelvic inflammation disease			0.67
Yes	12	10	
No	26	27	
History of intrauterine pregnancy			0.57
Yes	26	23	
No	12	14	
Location of tubal pregnancy			0.12
Left	19	12	
Right	19	25	
Surgical methods			
Laparotomy	/	25	
Laparoscopy	/	12	

function. Furthermore, the outcomes on fecundity in two treatment groups were compared.

Materials and methods

Patients

Seventy-five patients were included in this study. Thirty-eight (38) patients were treated using conservative medical methods and 37 patients were treated using conservative surgical methods.

The inclusion criteria were as follows: 1) infertility patients with a history of fallopian tube pregnancies who were admitted to the Obstetrics & Gynecology Department of the Affiliated Hospital of The Chinese People's Armed Police Force Logistics College between December 2008 and October 2010 with regular menstrual cycles and a normal sex life with their husbands without contraception, but who did not conceive in > 1 y; 2) patients whose last pregnancy was their only tubal pregnancy and had been cured; and 3) patients with a history of tubal pregnancies who were treated with conservative medical treatment or surgical procedures (salpingostomy) without other peritoneal surgeries.

The exclusion criteria were as follows: 1) patients with ≥ 2 tubal pregnancies; 2) patients whose husbands had abnormal semen parameters; and 3) patients with a history of peritoneal surgery, tubal pregnancy after in vitro fertilization (IVF), and tubal pregnancies following other treatment methods.

Medical histories

All eligible patients were interviewed by trained investigators and surveyed using a standard questionnaire. The following information was elicited: general (age and occupation); menstrual cycle (regularity and cycle length); reproductive history (induced abortion, medical abortion, ectopic pregnancy, and miscarriage); medical history (pelvic inflammation, tuberculosis, and appendicitis); and history of pelvic-peritoneal surgery. Prior tubal pregnancies, including location of the tubal pregnancy, and treatment methods (medical treatment, laparotomy with salpingostomy, and laparoscopic salpingostomy) were recorded in detail. Data were entered into a Microsoft Office Access database, proofread, and sorted.

Laparoscopy, hysteroscopic tubal catheterization and hydrotubation was used for observation. All patients were examined via laparoscopy and hysteroscopy 3-7 days after menstrual bleeding stopped. Uterine size, bilateral fallopian tubal morphology, fimbrial structure, ovarian size and morphology, and the pelvic and upper peritoneal cavity findings were recorded. Hysteroscopic tubal catheterization and hydrotubation with methylene blue stain facilitated demonstration of tubal patency and uterine cavity abnormalities. Fallopian tube function and the causes of infertility were evaluated.

Pelvic adhesion scoring methods

The Pelvic Adhesion Scoring System was developed by the Canadian Adhesion Scoring Group in 1994 [4]. The following pelvic organ adhesion descriptors were added to the Pelvic Adhesion Scoring System based on laparoscopic findings: 0, no adhesions in the pelvis; I, loose pelvic adhesions and/or vascular adhesions; II, dense and/or vascular adhesions; III,

Table 2. Comparison of associated factors for infertility in conservative medical and surgical groups

Conservative-medical group (n=38)	Tube morphology	Frequency	Other infertility factors (Frequency)
	Bilaterally normal	3	Endometriosis (2)
			Polycystic ovary (1)
	Unilateral normal	9	No lesion (4)
			Endometriosis (2)
			Endometrial polyp (2)
			Polycystic ovary (1)
	Bilaterally abnormal	26	No lesion (20)
			Mesosalpinx cyst (1)
			Left accessory cyst (1)
			Unilateral ovarian cyst (2)
			Endometriosis (1)
			Proximalumbrella
			membrane vesicles (1)
Conservative-surgical group (n=37)	Bilaterally normal	0	
	Unilateral normal	3	Ipsilateral polycystic ovary (2)
			Endometriosis with unilateral polycystic ovary (1)
	Bilaterally abnormal	26	No lesion (18)
			Endometrial polyp (2)
			Endometriosis (2)
			Unilateral tube millet nodules (1)
			Unilateral ovarian cyst (3)

difficult to lyse dense and/or vascular adhesions; and IV, inoperable adhesions.

Statistical analysis

The Microsoft Office Access database was imported into statistical software (SPSS version 17.0; Chicago, IL, USA). A Chi-square test and Fisher's tests of 4-tables were used to analyze enumeration data. T-tests were used to analyze measurement data. The Wilcoxon rank sum test was used to analyze the severity of adhesions. Statistical analyses were 2-sided, and a $P < 0.05$ was considered to be statistically significant.

Results

General information

Seventy-five (75) women participated in this study. The range of ages was between 20 and 40 y (mean=31.74±4.24 y). The duration of infertility ranged between 1 and 14 y (mean =3.52±2.58 y; P_{25}-P_{75}=2-5 y). Of the subjects, 41.3% (31/75) had left tubal pregnancies and 58.7% (44/75) had right tubal pregnancies. Thirty-eight patients underwent medical treatment and 37 underwent conservative surgery (**Table 1**). Sixteen patients had histories of induced abortions (11 experienced 1 abortion, 4 experienced 2 abortions, and 1 experienced 3 abortions). Three patients had histories of vaginal births, 10 had medical abortions (6 had 1 abortion and 4 had 2 abortions). Three patients had miscarriages (2 had 1 miscarriage and 1 had 2 miscarriages). Ten women had histories of pelvic inflammatory disease.

There was no statistical difference in age, duration of infertility, history of pelvic inflammation, history of intrauterine pregnancy, and location of tubal pregnancy between the two groups.

Of the patients treated by conservative surgery for their tubal pregnancies, 67.6% (25/37) were laparotomies and 32.4% (12/37) were laparoscopic procedures.

Observations via laparoscopy and hysteroscopy

The causes of infertility of the 75 patients were evaluated by laparoscopy and hysteroscopy observation. One or more of the following infertility factors were observed in 96% of the patients: abnormal tubal morphology; peritubal adhesions; fimbrial occlusion; and tubal obstruction. Each patient had two fallopian tubes. Among the fallopian tubes, abnormal tubal

Table 3. Comparison of severity of damaged fallopian tubes in the two groups

Ltem	Group		X^2	*P*
	Conservative-medical group	Conservative-surgical group		
	Frequency (percentage)	Frequency (percentage)		
Number of damaged fallopian tubes	61 (80.26%)	71 (95.95%)	8.73	0.005
Abnormal morphology	51 (83.61%)	61 (85.92%)	0.14	0.81
Abnormal umbrella	36 (59.02%)	48 (67.61%)	1.05	0.37
Lumen occlusion	58 (95.82%)	70 (98.59%)	1.38	0.34

Table 4. Comparison of severity of pelvic adhesion in the two treatment groups

Severity of pelvic adhesions	Group		Z	*P*
	Medical conservation (n=38)	Conservative surgery (n=37)		
0	9	4	-1.82	0.07
I	5	8		
II	20	12		
III	4	13		

morphology, abnormal fimbrial morphology, and obstruction were observed in 46.7% (70/150), 43.3% (65/150), and 73.3% (110/150), respectively. Only 3 patients (4%) had normal pelvic findings, bilateral fallopian tube patency, and none of the above physical factors associated with tubal infertility. One of three patients had an endometrial polyp, one had bilateral ovarian chocolate cysts, and one had bilateral ovarian polycystic changes and a thin endometrium. The incidence of pelvic adhesions was 82.7%, among which 17.3%, 42.7%, and 22.7% of the patients had I, II, and III adhesion severity scores, respectively.

Of the 75 women, 48% (36/75) had abnormal tubal morphology, 38.7% (29/75) had abnormal fimbrial morphology, and 70.7% (53/75) had obstructed fallopian tubes. Among the medical treatment group, 47.4% (18/38) had abnormal tubal morphology, 31.6% (12/38) had abnormal fimbrial morphology, and 65.8% (25/38) had occluded hydrosalpinges. Of the 37 patients in the conservative surgical treatment group, 48.6% (18/37) had abnormal tubal morphology, 45.9% (17/37) had abnormal fimbrial morphology, and 75.7% (28/37) had occluded hydrosalpinges. There was no statistical difference between the two groups (**Table 2**).

The incidence of pelvic adhesions in the conservative medical treatment group was 76.3% (29/38), which was less than the 89.2% (33/37) in the conservative surgical group. There was no statistical difference between the incidences in the two treatment groups. The average incidence of adhesions in the two groups was 82.7%. Based on the Wilcoxon rank sum test, there was no statistical difference in the incidence and severity of adhesions between the two groups (**Table 3**).

Other pelvic factors that might affect fertility, such as endometriosis, ovarian polycystic changes, and ovarian teratomas, occurred in 24.0% (18/75) of the patients. Uterine factors, such as endometrial polyps and thin endometria, occurred in 17.3% (13/75) of the patients. There were no statistical differences between the two groups (**Table 4**).

Discussion

The present study analysed many factors affecting fertility in infertility patients after conservative treatments for tubal pregnancies. The most important factors were shown to be tubal structural and functional damage. The second most common factor affecting fertility was pelvic adhesions, among which adhesion severity scores II and III were most common. Abnormal tubal morphology, peritubal adhesions, fimbrial occlusion, and tubal obstruction were also notable infertility factors. Fallopian tube obstruction was the most common tubal factor, occurring in 73.3% of the patients. Abnormal tubal morphology existed in 46.7% of the patients, with or without a history of a unilateral tubal pregnancy. Fimbrial occlusion was the most serious morphologic abnormality.

The co-existence of pelvic adhesions, abnormal tubal fimbrial structure, and obstruction com-

plicated infertility factors with respect to diagnosis and treatment. Mueller investigated risk factors for infertility after tubal pregnancy and found that nearly one-fifth of patients with tubal pregnancy had abnormal fallopian tubes [3]. Of the high-risk factors for infertility, 92% were fallopian tubal factors, which was 12.5-fold greater than other high-risk factors, such as age, pregnancy, and income. The study was based on face-to-face interviews and the diagnosis of a physician, not empirical observations. The results from this study were based on surgical observations during laparoscopy and hysteroscopy. The comparative results of the two studies are similar and merit discussion.

The treatment method for tubal pregnancies has an impact on future fertility. If the condition of the patient allows, conservative medical treatment or salpingotomy is considered first-line treatment for tubal pregnancies. This study showed that there was no statistical difference in results between the medical and surgical treatment groups in women with a history of a unilateral tubal pregnancy associated with tubal morphology, fimbrial occlusion, and tubal obstruction. Thus, the ipsilateral tube had no effect on fertility in patients after medical or conservative surgical treatment.

With respect to unilateral tubes without a history of pregnancy, the incidence of normal tubal morphology and tubal patency was higher after medical treatment than conservative surgery, indicating that both medical and surgical treatment can damage the ipsilateral fallopian tube by pregnancy. However, medical treatment afforded some protection to the unilateral tube without a history of pregnancy.

Fecundity after an ectopic pregnancy is a focus for researchers and clinicians. An important cause of tubal pregnancy is damage to fallopian tube structure and function. Tubal damage is the likely cause of ectopic pregnancy [5]. Tubal pregnancies exacerbate damage to the fallopian tube. Although ectopic pregnancy lesions are conservatively cleared by medical treatment or salpingostomy, fallopian tube function may not be restored, resulting in decreased fecundity, secondary infertility, and repeat tubal pregnancies [6].

Kuroda reported that the pregnancy rates are lower after tubal pregnancies than after miscarriages. The incidence of repeated ectopic pregnancies also increased significantly to 7.7% [7]. Bennetot reported that the intrauterine pregnancy rate within 2 years of medical treatment was 76%, 67% after conservative surgery, and 67% after radical salpingostomy; the corresponding repeated ectopic pregnancy rate was 25.5%, 18.5%, and 18.5%, respectively [8].

In the current study, there was no difference in spontaneous intrauterine pregnancy rates after tubal pregnancies between the conservative medical and surgery treatment groups with respect to fecundity after tubal pregnancy. It was also shown that when infertility occurred, the extent of damage to the fallopian tube in patients who had no previous pregnancies was less following conservative medical treatment than conservative surgical treatment. Thus, for those patients with histories of tubal pregnancies and desired fertility, medical treatment methods are recommended if not contraindicated.

Age is a factor that affects pregnancy. Natural pregnancy rates of patients with a history of tubal pregnancy or tubal disease declines after 35 years of age [9]. In the current study, the average duration of infertility after a tubal pregnancy was nearly 4 years, with a interval of 14 years. Of the patients, 56% were pregnant again within 1 year of a tubal pregnancy; the pregnancy rate was 67% within 2 years [10].

The time for patients to conceive following a tubal pregnancy is limited, thus long-term infertility treatment methods may not be effective [11]. Patients with desired fertility should be treated within 1 year and assisted reproductive methods should be encouraged.

Non-invasive methods, such as laparoscopy, are safe and effective treatments for ectopic pregnancies. Some studies have reported laparoscopic surgery would decrease ectopic pregnancy rates [12], which is minimally invasive and associated with shorter hospital stays compared to laparotomies [13]; however, the number of patients who underwent laparoscopic surgery in this study outnumbered the patients who had laparotomies. We could not determine if patients who had laparotomies had a higher incidence of infertility than patients who underwent laparoscopic surgery

because the duration of infertility after tubal pregnancy is long. This was a limitation of our study.

Infertility caused by fallopian tubal factors may be best diagnosed using laparoscopy. Compared with hysterosalpingography, hysteroscopic tubal catheterization, and hydrotubation, laparoscopy has no radiologic exposure and observations based on the accurate and real-time detection of methylene blue chromopertubation from the fimbria [14]. A future study will include investigating the efficacy of laparoscopy combined with hysteroscopy in infertility patients after conservative treatment of tubal pregnancy with long-term follow-up.

The small sample size was another limitation in this study, and a lager size of samples were more convictive to the result.

In conclusion, there were still several factors resulting in infertility for patients with a history of tubal pregnancy, although they accepted conservative treatments. Among these factors, fallopian tube was an absolutely main one. Compared with surgical treatment, conservative-medical treatment was more effective in preventing pelvic adhesion and caused lower incidence of abnormal fallopian tubes.

Disclosure of conflict of interest

None.

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