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SPECIAL ARTICLE

Tubal Infertility : Decision making on tubal reconstructive surgery versus in-vitro fertilization.

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Introduction

Tubal factor is a common cause of infertility. This condition includes patient with bilateral tubal occlusion and peritubal adhesion which interfere the process of ovum pick up and transport. The prevalence of tubal factor infertility varies widely among countries. Developing countries have higher rates of tubal infertility than those in the developed ones. As high as 40% prevalence rate of tubal infertility has been reported in some developing countries compared to about 10% in the developing world.[1] At Ramathibodi Hospital the prevalence of tubal infertility is about 30%. There is an increasing trend of this problem, mostly due to the spread of pelvic infection. Even in the developing country such as the United States the increasing incidence of pelvic inflammatory disease and other sexually transmitted disease has led to a rise in tubal factor infertility.[2]

The main etiologic causes of tubal infertility are pelvic infection, tubal sterilization, endometriosis and adhesion following pelvic surgery. The other less frequent conditions include tumor, salpingitis isthmica nodosa, and congenital anomaly of the fallopian tube. Common bacterial organisms cultured directly from tubal fluid included Neisseria gonorrhea, Chlamydia trachomatis, endogenous aerobic and anaerobic bacteria and genital Mycoplasma species.[3] Pelvic infection leads to tubal occlusion, hydrosalpinx and peritubal adhesion. Recently the incidence of tuberculosis is again increasing. Therefore, it is expected that cases of pelvic tuberculosis may also be increasing.[4] In almost all patients with pelvic tuberculosis both fallopian tubes are involved.[5] Infertility is one of the common clinical presenting symptoms of pelvic tuberculosis.[5] In recent report from India, 39% of women with tubal infertility had pelvic tuberculosis.[6] In patient with endometriosis bilateral tubal occlusion is less frequent except in severe cases. The disease usually causes tubo-ovarian adhesion which interfere tubal pick up of ovum. Female sterilization is a common contraceptive method in many countries including Thailand. Several methods of tubal occlusion have been employed such as Pomeroy's method, electric cauterization, clip or silastic ring. Pelvic and abdominal surgery also cause adhesion. In some case, leiomyoma may present near cornu and cause tubal occlusion.

There are several methods to investigate the fallopian tubes' pathology. Hysterosalpingography is the most common primary investigation. When complemented with laparoscopy valuable information about the uterine cavity, tubal patency and architecture, pelvic adhesion and other pelvic pathologies can be sought. The other methods are hysteroscopy, selective salpingography, salpingoscopy and falloposcopy.[7,8]

The pathological finding of tubal abnormality varies widely depended on the etiologic factors and extent of the disease. The common features are proximal and distal obstruction, hydrosalpinx, and tubo-ovarian adhesion. (Table 1)

Table 1 Causes of tubal occlusion

Location	Causes
Tubal-cornual region, interstitial part	Tubal spasm, mucous plug, synechiae, infection, polyp, endometriosis
Isthmus, ampulla	Sterilization, ectopic pregnancy, salpingitis isthmica nodosa, tuberculosis, endometriosis, endosalpingeal infection
Infundibulum, fimbria	Infection, adhesion
Periadnexal adhesion	PID, endometriosis, previous surgery

Treatment of tubal factor infertility

Unlike other causes of infertility, spontaneous pregnancy is very unlikely. When couple require fertility, specific treatment should be given. Before IVF era, the only therapeutic option for tubal infertility was reconstructive surgery. At that time the conventional surgery yielded disappointing success rate. Therefore when the successful IVF had been established some authorities speculated that it may be the end of tubal reconstructive surgery.[9,10] But that is not the case. While the success rate of IVF is increasing much progress have also been made in the field of reconstructive tubal surgery.

Advance in tubal reconstructive surgery

Reconstructive tubal surgery is effective in case with mild to moderate tubal damage.[11] The aim of reconstructive surgery is to restore tubal patency and anatomical relationship between ovaries and fallopian tubes. Several surgical technics including microsurgery by laparotomy or laparoscopy, transcervical balloon tuboplasty, hysteroscopic direct canulation, and falloscopic tuboplasty have been innovated.[12-14] These improvements result in an increase of pregnancy rate.

Selection of the surgical technic depends on the site and extent of tubal damage. In case with peritubal or tubo-ovarian adhesion, salpingoovariolysis should be performed, preferably via laparoscopy. In case with distal tubal obstruction, to choose between fimbrioplasty or salpingoneostomy depend on the extent of pathology. If the obstruction of fallopian tubes occur at isthmic ampulla region tubotubal anastomosis should be done. In proximal tubal occlusion several surgical technics may be considered, including tubocornual anastomosis, tubouterine implantation, transcervical tubal catheterization. Insertion of small catheter through the fallopian tube may be performed under tactile control, fluoroscopic, hysteroscopic or ultrasonic guidance.[13] Recently falloscopic tuboplasty has been suggested as a highly successful and less invasive treatment for tubal infertility.[14]

Advance in IVF

IVF originally was developed to treat infertile couple with irreversible tubal damage. At present although IVF is used in several conditions, tubal infertility remains the most common indication in most centers. There has been continuous improvement of IVF technology during the last two decades. Recent introduction of sperm retrieval methods and intracytoplasmic sperm injection (ICSI) have significantly increased the pregnancy rate in case with male factor infertility.[15-16] IVF successively replace other less effective treatment and is becoming a primary

treatment in many conditions.

Tubal reconstructive surgery versus IVF

In clinical practice when treating couples with tubal infertility decision should be made on whether tubal reconstructive surgery or IVF will be the primary treatment. Several factors have to be considered (Table 2)

Table 2. Factors affecting the decision making on reconstructive tubal surgery and IVF.

- **Efficacy of the treatment**
- **Associated infertility factors**
- **Expertise of surgeon**
- **Complications**
- **Couple thought**
- **Others**
- **Age of the patients**
- **Local availability**
- **Cost of treatment**
- **Previous surgery**
- **Subsequent pregnancy**

Efficacy of tubal reconstructive surgery

Tubal surgery increases pregnancy rate in some cases with tubal factor infertility. In general the success rate of tubal surgery varies from 10-80% with the average of about 50%.[11] The determining factors include cause and extent of tubal damage, site, age of the patient, surgical technic, expertise of surgeon, and associated infertility factors.[7,17] Tubal damage after pelvic infection is usually severe and the result of surgery is poor. Sterilization reversal generally has good result except the case done by cauterization of tubes.

The results of various tubal reconstructive surgeries are shown in Table 3. Salpingoovariolysis of tubo-ovarian adhesion yielded about 41-57% pregnancy rate with incidence of ectopic pregnancy of 5-8%.[7] In a controlled study the cumulative pregnancy rate in surgery group was about 3 times higher than that in the non treated group. (45% versus 16% after 24 months).[18] At present, laparoscopy is a method of choice, in the experience hand more than 60% of pregnancy rate was achieved.[19]

In case of fimbrial adhesion or phimosis, fimbrioplasty resulted in pregnancy in about 40-63% of cases with ectopic pregnancy rate of 2-12%.[7]

Table 3. Result of tubal reconstructive surgery

Type	Intrauterine PR (%)	Live birth rate (%)	Ectopic pregnancy rate (%)
Salpingoovariolysis	41 - 57	37 - 57	5 - 8
Fimbrioplasty	40 - 63	26 - 48	2 - 12
Salpingostomy			
laparotomy	25 - 40	20 - 36	0 - 18
laparoscopy	18 - 32	14 - 30	4 - 11
Tubocornual anastomosis	33 - 55	33 - 56	6 - 7
Tubotubal anastomosis	47 - 81	37 - 79	1 - 9

Data from Gomel V, 1997

Laparoscopy is also a preferred method.[20]

Distal tubal occlusion usually results in hydrosalpinx. In this case salpingostomy either by laparotomy or laparoscopy should be considered. The results of microsurgical salpingostomy vary widely. Compilation of several studies revealed average live birth rate of 14-36% and ectopic pregnancy rate was 4-18%.[7] Factors influencing the success of salpingostomy are the size and thickness of hydrosalpinx, fimbrial appearance, periovarian adhesion and tubal mucosal pattern.[21-23] Larger diameter of hydrosalpinx and absence of rugae pattern associate with poor result. Tubal mucosal pattern could be assessed by HSG or more directly by salpingoscope or falloposcopy. It has been found that pregnancy rate decrease significantly when >50% of the tubal mucosal surface was abnormal.[21]

For proximal tubal occlusion tubocornual anastomosis or cornual implantation of the fallopian tube have been treatment of choice.[7,24] However due to the high rate of false positive rate of HSG and in vasiveness of surgery, transcervical fallopian tube catheterization has been advocated to overcoming the problem of tubal spasm, mucous plug and cornual synechiae.[8,12,25-27] Today transcervical tubal catheterization is considered to be the standard treatment of proximal tubal occlusion.[28] For tubocornual anastomosis the live births rate was 33-56% with 6% of ectopic pregnancy.[7]

Recently falloscopic tuboplasty has been used successfully to treat both proximal and distal tubal occlusions (not include hydrosalpinx). Almost 80% of patency rate is obtained.[14] The result of this new method is convincing but more studies are needed to prove its efficacy.

Microsurgical tubal reanastomosis after sterilization yields high chance of pregnancy. About 47-81% of pregnancy rates and 1-9% of ectopic pregnancy rate were reported.[7] The prognostic factors were length of each tube, type and location of tubal occlusion, age of the patient and the associated pathology.[29-30] Tubal length after surgery should be more than 4 cm. Isthmo-isthmic anatomosis was the most successful. Tubal occlusion by clip or ring gave better result than by electric cautery. Recently high pregnancy rate of over 90% has been reported.[31] They believe that the high pregnancy rate in this study results from experienced surgeons, careful patient selection, better exposure of the operative field by newer instruments, continuous irrigation with heparinized solution during the operation, minimization of tissue injury with avoidance of unnecessary hemostasis and postoperative adhesion preventive measure. Recently laparoscopic microsurgical tubal anastomosis has been introduced. The result is very convincing. This advancement will further strengthen the role of surgery for sterilization reversal.[32,33]

Efficacy of IVF

IVF success rate varies widely among centers around the world. Report from the Reproductive Biology Committee of the Asia and Oceanic Federation of Obstetrics and Gynecology on the outcomes of IVF in 1993 revealed about 20% of pregnancy per embryo transfer (Table 4).[34] At Ramathibodi Hospital the live birth rate of the first 100 IVF cycles was 22%.[35]

Unlike tubal surgery, in IVF there is a single chance of pregnancy per treatment cycle. Therefore multiple treatment cycles may be needed to obtained the optimal success. Time specific conception rate gives more meaningful. The cumulative conception and livebirth rates related to age and cause of infertility provide the most useful estimate of success after IVF.[36,37]

Using life-table approach, log-rank test and logistic regression model, Tan et al found that in cases with tubal damage above 50% will become pregnant and 38% will have a live birth within five IVF treatment cycles (Table 5).[37] Recent study reported that more than 70% of women with tubal factor infertility achieved live birth within four cycles of IVF treatment.[38] However these figures appear to be the best outcomes which may not be applicable to all centers. Therefore local success rate should be considered in decision making.

Table 4. Outcomes of IVF-ET in Asia-Oceania, 1993.

Total cycles	24571
Oocyte retrieval	21653
Embryo transfer	18915
Pregnancies	4093 (21.6% of ET)
Spontaneous abortion	577 (14.1%)
Ectopic pregnancies	239 (5.8%)
Delivery	3277 (80%)
Multiple pregnancies	768 (18.7%)
Malformation	52 (1.3%)

Current status of ART in Asia-Oceania Report, 1995.

Table 5. Cumulative conception and live birth rates in women with tubal damage treated by IVF (n=1161)

Treatment cycle (n)	**% cumulative conception (95% CI)**	**% cumulative live birth (95% CI)**
1	14.7 (12.8, 16.9)	9.6 (8.0, 11.4)
3	37.0 (32.9, 41.4)	26.6 (23.0, 30.7)
5	51.5 (44.8, 58.7)	38.2 (32.2, 45.0)

Tan et al. Lancet 1992;339:1390-4.

The outcome of IVF depends on many factors.[39] It is difficult to determine the prognosis by separate evaluation of each factor due to the complex relationships between these prognostic factors. The success rate of IVF is usually reported as a range or an average pregnancy rate of all patients. Since individual success rates can vary greatly according to the patient characteristics it is clinical useful to study the factors affecting the outcome of IVF treatment. These factors can be used to predict the success of treatment in individual cases. Templeton et al, in a large series found that age duration of infertility, previous pregnancy and previous unsuccessful IVF attempts each significantly affect the likelihood of IVF outcome.[39] They used these parameter to calculate the predicted probability of a live birth of an individual patient. This figure could be used to compare with the result by other treatment. However further studies are needed to validate their hypothetical idea.

Age of the patients

Female age is a significant prognostic factor. By

40 years of age the conception and live birth rates declined rapidly in all patients treated either with surgery of IVF.[2,28,36-39] For sterilization reversal there was a study in women aged over 40 years. Surprising high pregnancy rate of 33% with mean duration of 5.5 months was achieved.[40] In IVF, pregnancy rate in women over 40 years old was less than 10%.[2] Many authors stated that in older women IVF should be preferred because the successful pregnancy is more immediate.[2]

The associated infertility factors

Many couples have multiple causes of infertility. This certainly will reduce the success rate. Case with male factor infertility usually has low pregnancy rate. Patients with male factor infertility who underwent successful tubal surgery therefore may not become pregnant. In IVF treatment, male infertility reduced the chance of pregnancy. Tan et al reported cumulative conception rate and live birth rate of 28% and 17.8% in male infertility compared with 51% and 38% in cases with tubal infertility.[37] Today, however the poor result of male factor infertility has been overcome by ICSI[16,41] up to 40% of pregnancy rate per cycle has been reported by many centers.[15-16]

Local availability

In developed countries the availability of treatment may not be problematic. Most reproductive centers have facilities in both tubal reconstructive surgery and IVF. In some developing countries IVF services may not be available. Long waiting list is also problem especially in women with high age group.

Expertise of surgeon

Tubal reconstructive surgery requires an expertised surgeon to obtained good result. Disappointing result was reported in non-specialist centers. Microsurgical technic is a delicated work. The training usually takes time and effort. IVF is a teamwork procedure involving gynecologist, embryologist, nurse and other personels. Gynecologist usually takes part in clinical aspects and surgical procedures. The technics of oocyte retrieval and embryo transfer are easy to learn and practices. Most gynecologists at present play their attention more on IVF practice than microsurgical training. Therefore less expertise in microsurgery is expected. This will decrease the success rate of surgery. It is noticed that there is an increasing reliance on IVF as the sole treatment option for tubal infertility. Expertised surgeon is being severely deficient.

Cost of treatment

It is difficult to compare the real cost of tubal recontructive surgery with IVF. Important determining factors include health care system, insurance, private or service cases. The calculated cost per live birth in one study was US $ 17000 for tubal surgery, compared with US $ 12000 after IVF treatment.[10] On the contrary, some reports on the cost-effectiveness of microsurgery show equal efficacy between surgery and IVF.[42,43] In Thailand, the estimated cost of an IVF cycle could compare favorably with microsurgery. However multiple IVF cycles may be required to obtain an optimal success rate. It is therefore apparent that IVF is more expensive.

In addition the cost of treatment of the possible complications during pregnancy, delivery and neonatal care should be taken into account. IVF pregnancies result in high abortion rate. Multiple pregnancies were reported in about 20%.[34] Prematurity is common and intensive neonatal care is usually prolonged. This part will further make IVF treatment much more expensive than tubal reconstructive surgery.

Complication of treatment

Complications of reconstructive surgery include surgical and anesthetic complications. The more prolonged and extensive reconstructive surgery prone the patient to complications more than does IVF. The serious complication of IVF is ovarian hyperstimulation syndrome and high ordered multiple pregnancies. Ectopic pregnancy rate is higher than normal both in cases with reconstructive surgery and IVF.

Couples' opinion

Couples should be informed all the data available. They should play a final role deciding what to

do. However most couples usually ask the doctor to judge for them. The practising gynecologist should use all evidences available to choose the best treatment option.

Previous surgery

In a patient who failed tubal surgery, is it worth to try a second attempt? Poor result of repeated surgery has been reported.[44] Therefore if available patient who fails previous surgery should proceed to IVF.

Subsequent pregnancy

After first pregnancy patient will have chance of successive pregnancy without intervention. Gillett et al found that in 68% of women who choose to conceive after their first pregnancy had a second normal conception.[45] This high recurrent pregnancy rate emphasizes the value of tubal reconstructive surgery.

Other factors

Some other limiting factors for surgery or IVF may occur in some group of patient. Some religious may not allow the couple to receive the IVF treatment. In place which few IVF centers are available a long waiting list may be problematic especially in cases with advanced aged.

Decision making

It is difficult to compare the efficacy of tubal reconstructive surgery to IVF due to marked variation in success rates and multiple affecting factors.[11] Individual consideration therefore should be made. All prognostic factors available for each couple should be taken into account. For practical purposes case with mild pathology should be primarily treated with surgery. In this case the expected pregnancy rate should be more than 40-50%. After successful surgery if pregnancy does not occur with in 1-2 years the couple should also be proceeded to IVF. In case with moderate to severe tubal pathology IVF should be selected due to the poor result of surgery. We could devide the couples with tubal factor infertility into 4 groups as follow

1. absolute indication for IVF
2. primary treatment by tubal surgery
3. primary treatment by IVF
4. either tubal surgery or IVF could be used primarily

Absolute indication for IVF

This group consists of patients with congenital absence of fallopian tubes, irreparable tubes and tubal damage by tuberculosis. The result of surgery in case with tubal pathology caused by tuberculosis is very poor. Term pregnancy is rarely occurred and the chance of ectopic pregnancy is high.[5] Although today the effective anti-tuberculous drugs are available, the fallopian tubes in patient with pelvic tuberculosis are mostly irreparable due to the difficulty of making early diagnosis. Therefore IVF should be the treatment of choice in infertile women caused by pelvic tuberculosis.[46] In place where no successful IVF service is available, the couples should be referred to the established IVF center.

Primary treatment by reconstructive tubal surgery

The patients should have mild tubal damage. The expected chance of pregnancy after surgery is more than 50%. Tubal pathology in this group include sterilization reversal, mild to moderate peritubal adhesion, proximal tubal occlusion, hydrosalpinx with thin walled, normal mucosal fold and without adhesion. In these patients, tubal surgery appears to be more cost-effective. The surgical correction of damage tubes, however, should be performed by the expertised surgeon.

Primary treatment by IVF

IVF should be considered as a primary treatment in cases with tubal factor infertility who has poor chance of pregnancy after surgery, patients with associated male infertility and in cases with advanced age. Case with thick-walled hydrosalpinx with fibrosis and mucosal adhesion is unlikely to achieve pregnancy after surgery.[21-23] IVF should be offerred to this

patient. The accumulating data in recent years have shown the adverse effect of hydrosalpinx on IVF outcomes and surgical excision of hydrosalpinx before IVF has been advocated.[21-23,47,48] Apart from increase of pregnancy rate, surgical removal of hydrosalpinx will decrease the chance of ectopic pregnancy.

Either surgery or IVF

This group consists of patient with moderate tubal damage who will have equal chance after IVF or surgery. The availability of IVF and expertise of surgeon with local success rate will be the important determining factors. Others factors such as cost and complication of treatment should be considered as well.

Current trend

During the last decade there is a wide spread of IVF throughout the world. A continue improvement of IVF success rate and its availability result in an increasing reliance on IVF as the sole treatment of tubal infertility. Microsurgical tubal surgery although yields good result in considerable number of case but need expertise of surgeon. Besides the establishment of IVF laboratory the training in IVF surgical procedures is much easier than in microsurgery. Tubal surgery is a delicated work and time consuming. As more cases of tubal infertility are moving towards IVF, less competent surgeon in microsurgery is expected. Results of surgery will be decreased and reconstructive tubal surgery may be abandoned. The urgent need is to establish the criteria of patient selection. This matter has been tried for many years but without success.[49,50]

Preventive measure

Since the most common cause of tubal factor infertility is infection. This problem could therefore be preventable. However there is an increasing trend of sexually transmitted diseases. Tubal factor infertility will be a major concern for decades. The priority of research should be made on the preventive measures i.e. control of sexually transmitted diseases.

Conclusion

From this review it appears that tubal reconstructive surgery and IVF is not competitive but complementary. In mild to moderate tubal pathology surgical correction should be primary treatment. In severe case or failure to surgical treatment IVF treatment should be offered. However this decision making may be modified by other factors including local availability, expertise of gynecologist, and financial aspects. Couples should have a major role in the decision making process.

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