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ORIGINAL ARTICLE

Fertility Promoting Laparoscopic Surgery: Our Experience

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ABSTRACT

Aim and objective: This study was to find out optimal laparoscopic surgical procedures for fertility promotion and to compare its pregnancy outcome with *in vitro* fertilization (IVF) procedure.

Design and setting: Laparoscopic surgical procedures were performed under one consultant in a tertiary fertility set-up.

Materials and methods: Between January 1994 and December 2008, 3,982 cases of fertility promoting laparoscopic surgery (FPLS) were performed in our center. The procedures were related to uterus and appendages and especially endometriosis.

Results: The pregnancy rate following the surgical correction of minor tubal defects, ovarian cyst and uterine fibroids was between 25 and 30%, major tubal defects (5.7%) and severe endometriosis 18.5%. But the assisted reproductive technology (ART) outcome for the former was 30% and for the latter too, was between 25 and 30%.

Conclusion: Laparoscopic surgical corrections for minor tubal defects yield comparable results to ART, but for other two conditions, the latter is superior to the former.

Keywords: Fertility promotion, Laparoscopic surgery, Minor tubal defects, IVF, Pregnancy outcome.

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INTRODUCTION

Surgery for correction of anatomical factors of infertility has long been a subject of discussion. With more and more use of laparoscopy, the surgical approach has become less invasive and more acceptable. Major procedures, like extensive adhesiolysis, tubal reconstruction, become rare due to availability of alternatives, like *in vitro* fertilization (IVF) and embryo transfer (ET). Fertility promoting laparoscopic surgery (FPLS) may be divided in the following groups: Surgeries on fallopian tubes, ovaries, uterus and recovery of the pouch of Douglas (POD). The surgery for endometriosis requires special mention, as often it becomes challenging.

FPLS is a separate entity, which can otherwise be called restorative surgery, which requires lot of patience, skill of surgeon, avoidance of widespread oozing and minimal diathermy use. Steps should be taken to prevent future adhesion formation. Liberal washing of tissues with physiological salt solution and other steps to minimize postoperative adhesion formation is necessary. Restoration of anatomical competence of reproductive organs at the cost of functional competence is mostly useless effort, so far promotion of fertility is concerned. So, too much of surgery, like extensive adhesiolysis or complete removal of very large ovarian cyst wall which may lead to vascular compromise and thereby loss of function of pelvic organs, should be avoided. FPLS requires a comprehensive assessment and careful approach to promote future fertility, and hence, it should be considered to be a separate subspecialty of gynecological laparoscopic surgery.

MATERIALS AND METHODS

Between January 1994 and December 2008, 3,982 cases of operative laparoscopies were performed for correction of pelvic pathology by single surgical team. These patients were aged between 26 and 37 years with infertility between 5 and 7 years duration. Pelvic assessment was performed primarily by manual pelvic examination, followed by transvaginal ultrasonography (TV-USG) performed by same observer. Emphasis was given to detect any pelvic mass and its origin. Possibility of presence of endometriosis was screened very meticulously.[1] Many had their tubal status assessed by Hysterosalpingography (HSG) or sonosalpingography (SSG) previously, and some of them had diagnostic laparoscopy too. Routine preoperative investigations, checkup and preparations for laparoscopy were undertaken. All procedures were performed under general anesthesia. Video laparoscopy was must. Usually triple puncture technique was used, but sometimes, four portals were also necessary. Tubal surgery may be for major or minor tubal defects. Major tubal defects were long segment tubal block, severe peritubal adhesion or puckering of tubes or major hydrosalpinx.

Minor tubal surgeries may be restoration of tubal length, recovery of tubal motility by correcting peritubal adhesions, restorations of tubo-ovarian relation (TOR) and freeing of the fimbriae.

The minor tubal defects noted at laparoscopy have been detailed by Chatterjee et al.[2] Following are the different types in our series; (1) tubal kinks due to serosa to serosal adhesion; (2) C-tube or pulled-up tubes toward respective iliac fossa due to shortening of infundibulopelvic (IP) ligaments; (3) fimbrial pathology, like fimbrial eversion, fimbrial agglutination or combination of both; (4) peritubal adhesion causing problem in tubal mobility and adhesions in the POD, causing hindrance to reservoir function and egg pick-up; (5) cornual or terminal tubal block developed in between previous HSG and present laparoscopy; and (6) pedunculated fimbrial cysts which can block the fimbrial opening of respective fallopian tube, like a ball valve, causing temporary tubal block. Combination of above pathologies was most common.

The surgical procedures are summarized by Chatterjee et al.[2] To recapitulate, the kinked tubes are corrected by SMH technique to regain their normal lengths. The stretching of IP ligament to correct the C-tube is not always successful. Fimbrial pathologies were corrected by fimbriolysis and fimbrial combing. Everted fimbriae were released by combing with palpating rod against the lateral pelvic wall or by cutting thick membranous adhesions. Sometimes, ostial dilatation by endoscopic forceps (Merryland) was necessary. Peritubal adhesions and bands or membranes were separated either by blunt or sharp dissection, taking precaution not to injure intestines. Bleeding may be controlled by saline wash or bipolar cautery. In case of cornual block, cornual massage with palpating rod or squeezing with special forceps aided by push-and-pull technique might be successful. Pedunculated fimbrial cysts were easily excised, using diathermy or scissors. Tubo-ovarian relation is very important for conception to occur. It is observed that TOR might remain disturbed, causing infertility. Chatterjee et al[2] have detailed about TOR in their study. TOR was divided into four categories. TOR 4 position was most favorable position for pregnancy to occur.

The surgery for endometriosis is a controversial subject, required to alleviate pain or to treat infertility. In advanced endometriosis, the aim of surgery is to bring the pelvic structures back to normal anatomically. The extent of adhesiolysis is always controversial. Too much of release of adhesions may impair vascularity of vital organs and requires the use of diathermy, impairing blood supply further. Extensive raw area and depritonization may invite reformation of adhesions. During the era of assisted reproductive technology (ART), functional integrity of pelvic organs is more important than structural normalcy. Surgery on the ovaries in endometriosis may lead to diminution of ovarian function or folliculogenesis. Surgical adhesions are more avascular than endometriotic adhesions. Hence, paucity of blood supply resulting in less availability of stimulating hormones leads to improper folliculogenesis. So, it is of utmost importance to perform surgery in endometriosis with great care. It should be peritoneal, sparing minimal adhesiolysis, to bring back effective TOR. If adhesions are extensive, IVF and ET are better choice. The use of medical treatment as an adjuvant has long been denied, as it does not promote fertility during its use.[3,4] Many centers use post-operative medical treatment for few months to delay recurrence and to increase the chance of conception during recurrence free period.[5,6] Preoperative medical treatment helps in effective adhesiolysis due to diminished vascularity or neovascularity of the pelvic organs and less use of diathermy. Another advantage of GnRH—a use preoperatively is if the pelvic adhesions indicate the requirement of ART procedure, controlled ovarian hyperstimulation (COH) can be undertaken in immediate postoperative period, as the patient is already down-regulated. This procedure may be of choice, when complex chocolate cysts are removed before IVF. Operations on the chocolate cysts also have become subject of controversy. We take the cyst wall out, if the dissection is easy. In some occasions, it is difficult to find the plane between cyst wall and healthy ovarian tissue, when cyst wall is removed as much as possible and superficial diathermy is applied on the remaining cyst wall. If the cyst is more than 10 cm in diameter, removal of the cyst wall may lead to destruction of large amount of healthy ovarian tissue, hence deroofing,[7] followed by immediate initiation of COH for IVF and ET treatment is helpful.[8]

Uterine fibroids, if cause infertility or produce symptoms should be removed. We consider uterine fibroid in infertile women according to the following points: (1) Whether the tubes are patent; if not, whether fibroid is responsible, (2) length of the uterine cavity if it is more than 10 to 12 cm, implantation of embryo becomes difficult, (3) whether the fibroid is distorting the uterine cavity and (4) huge size of fibroid causing cosmetic problem or pressure symptom. So, also during pregnancy, that can cause respiratory embarrassment or further pressure symptoms. If difficulty in oocyte recovery for IVF program is anticipated due to fibroid, it is removed before hand. Moreover, large fibroid is better removed before ART procedure, as those can impair vascular supply to uterus and developing embryo. Laparoscopic or open myomectomy is to be decided according to situation. Large fibroids, as we feel, are better removed by open procedure, as repair of uterus can be performed more accurately than laparoscopic procedure. In case of moderate to large fibroid, even if it is removed laparoscopically, sometimes repair is performed by small laparotomy opening for better repair. Dubuisson et al[9] reported a three times higher conversion rate, when fibroids measured more than 8 cm, or located anteriorly. Conversion to a laparotomy is actually a prudent judgment on the part of the surgeon. The similar accurate multilayered repair of the uterine wound can be performed by robotic laparoscopic surgery,[10] about which we do not have any experience. The incision line may be covered by adhesion-preventing barriers to prevent postoperative adhesions[11] with debatable benefit.[12] We use omental patch for cost-saving. Laparoscopic myomectomy is a preferred procedure for fibroids less than 5 cm diameter, though larger fibroids are excised in similar way. Though multilayered suture is preferred,[13] successful single-layered laparoscopic suturing following removal of large fibroids have already been presented in literature.[14] Out of 136 cases of uterine fibroid, 45 cases of laparoscopic myomectomy were performed. Among the rest 91 cases, 80 cases needed suturing of uterine cavity by small laparotomy wound, for proper repair in layers. 11 cases were converted to total abdominal myomectomy. In small fibroid, less than 4 cm, single-layered suturing was sufficient.

Laparoscopic management of ovarian cysts has been controversial.[15] It has gone through tremendous scrutiny and evaluation with the trend now moving toward increasing acceptance.[16,17] Ovarian cysts were simple serous cysts, dermoid cysts, chocolate cysts, rarely mucinous cystadenoma and very rarely hemorrhagic corpus luteal or serosal cysts. The commonest ovarian cysts in infertile women were chocolate cysts, the management of which is mentioned previously. Care should be taken to avoid spillage of cyst material of dermoid

cyst in the abdominal cavity during cyst removal to prevent severe adhesion formation. For large dermoid cysts, laparoscopy-assisted open ovarian cystectomy may be performed,[17] either abdominally or through colpotomy wound. Posterior colpotomy was not associated with significant post-operative adhesion.[18] Small or average sized cysts, after removal, may be brought out in a specially prepared plastic bag, otherwise called a lapsac or endobag. Large ovarian cyst may displace the fallopian tube and, thereby, can impair oocyte pick-up. They may be silent at times. Ovarian cystectomy is always the operation of choice, because the removed cyst wall can be subjected to histopathological examination, and subsequent recurrence is lessened.[8] Other procedures may be drainage or thermoablation.

Large hydrosalpinx needs surgical management, even before IVF procedure is undertaken. Neosalpingostomy yields little success. Excision of hydrosalpinx, drainage, clipping of cornual end or discontinuation of cornual end of fallopian tube may be procedures of choice before IVF. There is controversy about the management of hydrosalpinx, but it is agreed that hydrosalpingeal fluid has antifertility effect even in IVF at different levels, like COH, folliculogenesis as well as implantation.

Availability of free POD is a prerequisite for non-ART pregnancy. POD acts as a reservoir for egg, and so also a place for tubal fimbrial play. Adhesion in POD, either infective or endometriotic, hinders the above functions, either by seduction of eggs on, by affecting oocyte pick-up. Infective adhesions can be separated by diathermy hook or forceps, if they are vascular. Scissors dissection is performed when they are avascular. Endometriotic pseudomembranes are better excised, as they reform quickly. Sometimes through and through, adhesion in the lower part of POD, particularly in deep pelvis, may be left alone, as the upper part can provide the function of POD successfully and does not impair fertility.

Laparoscopic ovarian drilling (LOD) is a widely discussed procedure and has not been included in this study.

The pregnancy outcome following surgical corrections was compared to IVF procedural outcome in three different groups: (1) Minor tubal defects, ovarian cyst and uterine fibroids (2) major tubal defects, and (3) severe endometriosis.

OBSERVATION

A total of 3,982 cases of laparoscopic surgeries performed in infertile women were presented with different pathologies. These pathologies along with the incidences are presented in Table 1.

It was observed that minor tubal defects in this series were premier indication for FPLS (49.6%); ovarian pathologies and endometriosis were distant followers (19.2 and 14.5% respectively). Among tubal pathologies, minor tubal defects were major component (1,405 cases). Incidence of different types of minor tubal defects is presented in Table 2. TOR is another important factor for the promotion of non-ART pregnancy, and the results after correction are mentioned in Table 3. Maximum number of cases was in TOR 2 and TOR 3 positions. The aim of surgical correction was to bring the relation to TOR 4 position, if possible. After correction, TOR 1 position could be taken maximally to TOR 2 and TOR 3 positions; from TOR 2 to TOR 3 with not much of difficulty; and from TOR 3, easily to TOR 4 position.

RESULTS

During the last 14 years, 3,982 cases of operative laparoscopic procedures were performed. The pregnancy outcomes are mentioned in Tables 1 and 2. It is observed that the pregnancy rate after laparoscopic surgery remained between 25 and 30% except advanced endometriosis, where the pregnancy rate in our series is about 18.5%. This incidence is less than what is reported in literature. This is because of associated adenomyosis, which is a common accompaniment in advanced endometriosis in Eastern India. In minor tubal defects, the pregnancy outcome following laparoscopic correction or ART procedures is comparable ($p < 0.01$). It is worth-mentioning that in major tubal defects or severe endometriosis, ART procedures produce better (above 25%) than laparoscopic surgery (5.7% for major tubal defect and 18% for advanced endometriosis) pregnancy outcome ($p < 0.05$) (Table 3).

The correction of ovarian pathology or fibroids yields similar success rates (30% as compared to 30.8%). This rate is not high, as other factors of infertility might interfere. The recovery of POD gives better success (40% or more). Relation

Table 1: Common pathologies for FPLS

Nature of pathologies	*No.*	*%*
Tubal defects	1754	49.6
Major	249	
Minor	1405	36
Ovarian	768	19.2
Uterine fibroid	136	3.4
Endometriosis III/IV	574	14.5
Adhesion in POD	209	5
Others	395	Nil

Table 2: Pregnancy outcome following laparoscopic surgery

Laparoscopic surgery		*Non-ART pregnancy outcome*	
Operation	*No.*	*Pregnancy (non-ART)*	*%*
Tubal			
Major	349	19	5.7
Minor	1405	383	27.4
Ovarian	768	230	30
Fibroid	136	42	30.8
Endometriosis	574	117	21
Recovery of POD	209	84	40

Table 3: Comparison of FPLS and ART pregnancy

Treatment	*Laparoscopic surgery*			*ART*		
Cases	*No.*	*Pregnancy*	*%*	*No.*	*Pregnancy*	*%*
Major tubal	349	19	5.7	240	67	28.1
Advanced endometriosis	308	51	16	377	99	26

between the pregnancy rate and TOR is not considered here, because it was not possible to find out what was the TOR at the time of conception.

The statistical analysis of the pregnancy outcome indicates that there is not much of difference between the success rates, when IVF and ART are compared for minor tubal defects ($p < 0.01$). But, ART procedure yields much better results compared to surgery ($p < 0.05$) for advanced pelvic pathology.

DISCUSSION

Operative laparoscopy is an important procedure to achieve pregnancy in infertile women. It is mostly required for the anatomical correction of pelvic organs to remove any mass from pelvis, hindering fertility. Correction of minor tubal defects and ovarian pathology gives good success rate. Unnoticed minor tubal defects are often stamped as unexplained infertility and subjected to IVF program. The fallopian tube has multiple functions[2] in achieving pregnancy. The surgical approach should be directed to get all the tubal functions back in a damaged or diseased tube. It has been observed from the present study that certain simple measures can alleviate tubal pathology to great extent and restore most of the functions. Minor tubal defect may be the result of subclinical or silent inflammation, introduced by *Chlamydia trachomatis*[19] or *E. coli*. *Chlamydia trachomatis*, for reasons unknown, may exist in nonreplicating state for prolonged latent period without any symptoms.[20] On many occasions, tubal kinks and thereby shortening of the effective tubal length can happen due to minimal or mild endometriosis, a proinflammatory state, causing adhesive disease, leading to subfertility.[21] Sometimes, tubal defects are results of postabortal or puerperal infections, as it happens in secondary infertility. Fimbrial pathology is also a cause of concern. If the fimbriae are not inspected properly in video monitor under magnified view, the defects pass unnoticed. Lyses are also very important to get back mobility of the fallopian tubes. After adhesiolysis, bleeding from tubal serosa should be dealt with caution. In most of the cases, bleeding stops on pressure or on its own. If diathermy is necessary, bipolar is a better choice, as there is minimal scattering of coagulated current. Any blood clot or carbon particle produced as a result should be washed out carefully to prevent readhesion.

In pelvic adhesion, as it happens in endometriosis mapping of the disease, is very important. Assessment should be made whether adhesiolysis can bring TOR back to normal with functioning POD. If that is difficult, not much of dissection should be made. All attempts should be made to preserve vascular supply to vital pelvic organs, for their functional competence. Fibroids do not mean myomectomy always for infertile women. Indicated cases need myomectomy, while repair may be performed by open procedure. Ovarian cysts, particularly chocolate cysts, should be dealt carefully. Preservation of ovarian function as much as possible is the aim. Combined tubo-ovarian (TO) as well as uterine mass should be dealt with reasonably and preferably at the same sitting.

In recent years, laparoscopy has gained a role for fertility prevention in patients undergoing chemotherapy or radiotherapy. Laparoscopic ovarian transposition in patients undergoing radiotherapy for genital malignancies helps to keep away the ovaries from radiation injuries, thereby preserving their fertility potential. The collection of ovarian tissue laparoscopically and thereby preserving them, creates the opportunity of future ovarian tissue transplantation in same patient to induce fertility function.[22,23]

CONCLUSION

Present study shows that operative laparoscopy in our center is done in maximum number of cases of tubal defects, the major component of it being minor tubal defects which passes unnoticed, if not observed with great care during diagnostic laparoscopy. Laparoscopic surgery for endometriosis is the second common indication which requires great expertise, proper assessment and so also anticipation. In case of severe pelvic adhesion, the dilemma remains whether to proceed for extensive adhesiolysis or ART procedure. The latter shows better success rate in such situations. The main objective of laparoscopic surgery is to bring the proper anatomical position of the pelvic organs back, preserving their functional competence. The pregnancy outcome following fruitful laparoscopic surgery is comparable to IVF and ET results, particularly in minor tubal defects.

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