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Fertility after laparoscopic management of gynecologic emergencies: the experience of a developing country

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Abstract The objectives of this study were to estimate the pregnancy rate after the surgical treatment of ectopic pregnancy (EP), adnexal torsion, ruptured ovarian cyst, and acute pelvic inflammatory disease (PID) within 1 year of operative laparoscopy (LAS) or laparotomy (LAP) and to define different factors that would affect this pregnancy rate in women desiring fertility. The study was based on a prospective longitudinal interventional non-randomized study and was set in a tertiary care university hospital. There was a total of 152 patients presenting with gynecologic emergencies. Transvaginal ultrasonography (TVS) was performed in all cases. The patients were divided into two groups. Diagnostic laparoscopy was performed to confirm the diagnosis in 77 cases (group A), which was followed by operative laparoscopic procedures accordingly. In 75 cases (group B), laparotomy was performed from the start. In both groups, the procedures were performed based on microsurgical principles and intraperitoneal drains were inserted. The main outcome measures were the rate of intrauterine or EP, or infertility within 1 year of the procedure. Positive TVS findings were seen in all cases. EP was diagnosed in 60 (78%) and 52 (69%) patients, while twisted adnexa was diagnosed in 7 (9%) and 12 (16%) patients in both groups, respectively. Ruptured ovarian cyst was diagnosed in 6 (7.8%) and 5 (6.7%) cases, whereas PID was diagnosed in 4 (5.2%) and 6 (8%) patients in both groups, respectively. On follow-up after 1 year, fertility was significantly higher in the LAS group (p=0.001), as 45 (58.4%) and 24 (32%) patients, respectively, fell pregnant. In patients desiring further fertility, both laparoscopy and laparotomy can achieve fertility preservation following basic microsurgical principles, with a significant superiority of the laparoscopic approach. High fertility is achieved in patients younger than 30 years of age, in multiparous women, if the contralateral tube is free, if concomitant adhesiolysis is performed, and after salpingotomy operation for treating EP.

Keywords Laparoscopy · Laparotomy · Fertility · Emergencies

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Introduction

Prompt diagnosis and effective treatment of gynecologic emergencies prevent complications and help preserve fertility [1]. Unfortunately, the poor patient's situation sometimes makes saving the patient's life the main goal of surgical intervention, with little attention paid to her future fertility. Future fertility in gynecologic emergencies is not compromised and, in some cases, may be improved with laparoscopic treatment [2]. Likewise, the pregnancy rate after open surgery in emergencies was reported to be of the same efficacy of laparoscopy [3]. This prospective study aims to estimate the pregnancy rate after the surgical treatment of ectopic pregnancy, adnexal torsion, ruptured ovarian cyst, and acute pelvic inflammatory disease (PID) within 1 year of operative laparoscopy or laparotomy in a developing country setup and to define different factors that would affect this pregnancy rate.

Patients and methods

This study comprised 152 patients presenting with gynecologic emergencies and was approved by the Ethics Committee of the Faculty of Medicine. A senior gynecologist clinically assessed patients, with emphasis on the general condition, and abdominal and vaginal examination. A quick pregnancy test was performed when ectopic pregnancy was suspected. Ultrasonography was performed in all cases using the apparatus ALOKA (Flexus 1100) with a vaginal probe at 5 MHz. A full pelvic and abdominal sonograms were performed, including careful description of the endometrial cavity and adnexa to detect adnexal masses, whether cystic or heterogenous, intrauterine or extrauterine gestational sac, fetal pole or free fluid in the pouch of Douglas or the peritoneal cavity. According to the approach of treatment, patients were divided into two groups.

Diagnostic laparoscopy (LAS) was performed under general anesthesia to confirm the diagnosis in 77 cases (group A), which was followed by operative laparoscopic procedures accordingly. All laparoscopic procedures were started by peritoneal washing of the blood or pus to allow better visualization and more precise microsurgical steps. Ectopic pregnancy was easily diagnosed by the presence of a gestational sac in the tube and some free blood in the peritoneal cavity. Laparoscopic microsurgical techniques began with the good exposure of the affected tube after proper lavage of any hemoperitoneum. If the ectopic sac was seen in the fimbrial end of the tube, gentle tubal milking was performed. When salpingotomy was needed, a non-traumatic blunt grasping forceps was gently applied just proximal to the ectopic sac. With a fine microneedle, linear salpingotomy was performed along the antimesentric surface of the tube just on the ectopic pregnancy. Subsequently, the sac that bulges through the incision could be easily extracted with another grasper. Meticulous exploration of the rest of the tubal lumen with fine instruments could be performed to ensure complete evacuation of the sac. Fine coagulation of the edges was sometimes required. The most important step was to ensure proper lavage of the hemoperitoneum with the aid of repeated suction irrigation and changing the patient's positions, which was followed by leaving a copious amount of lactated Ringer's solution intraperitoneally. Using a 10-mm suction cannula with a competent suction pump allowed the fast and effective removal of all clotted blood or even the ectopic sac. Laparoscopic salpingectomy was indicated if the tube was markedly damaged, uncontrollable bleeding was encountered, some cases of isthmic ectopic pregnancy, or if the patient had completed her family to minimize the risk of recurrent ectopic pregnancy. It was easily carried out using a bipolar forceps to safely coagulate the mesosalpinx, which was followed by excision of the tube

with hook scissors. The excised tube and the ectopic sac were extracted using claw forceps via a 10-mm auxiliary portal without the need for an endobag. One case of heterotopic pregnancy was treated by laparoscopic salpingostomy and vaginal evacuation of a definite intrauterine blighted sac.

Twisted adnexa were easily diagnosed laparoscopically. Adnexectomy was chosen if the adnexa was gangrenous and was performed using a bipolar forceps and hook scissors. Prior cyst aspiration was sometimes performed to facilitate adnexectomy procedure. However, detorsion of the adnexa was carried out if the tissues were healthy by untwisting the tube and the ovary until the normal anatomy was obtained. If ruptured ovarian cyst was diagnosed, ovarian cystectomy with spray coagulation of the bed was performed in most of the cases. Endosutures were rarely required if the ovarian defect was big using the intracorporeal suturing technique. Acute PID was diagnosed by the occurrence of pus in the pelvic peritoneum, with evidence of inflammatory process in the upper genital tract. Cautious peritoneal toilet and opening of pus locules were performed in such cases with minimal tissue manipulations.

In 75 cases (group B), laparotomy (LAP) was carried out from the start. The same laparoscopic procedures were performed via a transverse suprapubic incision using microsurgical instruments. Open microsurgical principles include proper illumination, gentle tissue handling, fine-caliber non-reactive sutures, and microsurgical instruments. Moreover, minimizing tissue trauma was enforced by using as atraumatic techniques as possible and meticulous hemostasis. In both groups, the procedures were carried out under potent broad spectrum antibiotics and were followed by the insertion of intraperitoneal tube drains for 24 h to allow any blood clots to be removed from the peritoneal cavity.

All patients were followed up for one year. When pregnancy was diagnosed, the exclusion of ectopic pregnancy was performed using transvaginal sonography (TVS). If ectopic pregnancy was diagnosed, it was laparoscopically treated, even in group B, to minimize the deleterious effect of repeated laparotomy on fertility. The data were collected and analyzed using SPSS software. Categorial variables were analyzed using Chi square tests and Fisher exact tests when appropriate. Paired t-tests were used for comparison between the data within the same group and comparison of the data between the two groups was carried out using the student t-test. The p value was considered significant if it was lower than 0.05.

Results

The patients' ages ranged from 18 to 36 years, with a mean of 26±2.43 years. Their mean parity was 2±1.35. Preoper-

atively, TVS could successfully diagnose abnormal findings in all cases as shown in Table 1. In 75 cases (group B), laparotomy was carried out due to hemodynamic instability in 33 (44%), inaccessible LAS in 25 (33%), impossible LAS in 7 (9%), or vague diagnosis in 10 (13%) patients. All patients in the LAS group (77 patients) were effectively treated without the need for laparotomy. EP was diagnosed in 60 (78%) and 52 (69%) patients in the LAS and LAP groups, respectively. The ampulla was the most common site in both groups, while the isthmus and the fimbria were the least common sites in both groups (Table 2). It was successfully treated by milking in 5 (8.3%) and 4 (7.7%), salpingotomy in 41 (68%) and 15 (29%), or salpingectomy in 14 (23%) and 33 (63.5%) patients in the LAS and LAP groups, respectively. Twisted adnexa was diagnosed in 7 (9%) and 12 (16%) patients, which was treated by adnexectomy in 5 (71%) and 9 (75%) or detorsion in 2 (29%) and 3 (25%) patients in the LAS and LAP groups, respectively. Ruptured ovarian cyst was diagnosed in 6 (7.8%) and 5 (6.7%) cases, which was treated with coagulation in 5 (83%) and 2 (40%) or suturing in 1 (17%) and 3 (60%) cases, respectively. PID was diagnosed in 4 (5.2%) and 6 (8%) patients in the LAS and LAP groups, respectively, and was treated with peritoneal toilet in all cases.

On follow-up after one year, fertility was significantly higher in the laparoscopy group ($p=0.001$) as 45 (58.4%) and 24 (32%) patients fell pregnant, of which, EP was diagnosed in 5 (11%) and 9 (37.5%) patients in the LAS and LAP groups, respectively ($p=0.01$). Different factors that were suspected to affect the fertility after the surgical management of gynecologic emergencies are demonstrated in Tables 3 and 4. Second-look laparoscopy was carried out for all the recurrent cases, which revealed some pathologic lesions that would explain the recurrence of ectopic pregnancy (Table 5).

Discussion

Transvaginal ultrasonography (TVS) could diagnose one or more pelvic abnormalities in all cases of this study prior to

Table 1 Preoperative sonographic findings

	Laparoscopy (77 patients)		Laparotomy (75 patients)		p value
	No	%	No	%	
Extrauterine gestational sac	14	18	34	45	0.01
Intrauterine gestational sac	1	1.3	0	–	–
Extrauterine fetal pole	5	6.5	25	33	0.0001
Adnexal mass	50	65	35	47	0.03
Free fluid	41	53	54	72	0.03

Table 2 Anatomic sites of ectopic tubal pregnancy

	Laparoscopy (60)		Laparotomy (52)		p value
	No	%	No	%	
Fimbrial (20)	14	23.3	6	11.5	0.02
Ampullary (71)	39	65	32	61.5	0.37
Isthmic (19)	5	8.3	14	27	0.02
Heterotopic (1)	1	1.7	–	–	–
Bilateral ampullary (1)	1	1.7	–	–	–

surgery. These findings highlight the central role of TVS in gynecologic emergency units day and night, with the availability of an experienced sonographer to help residents and young staff reach a reliable diagnosis [4]. Ultrasonography allows the identification of ovarian torsion and has both diagnostic and therapeutic capabilities in patients with PID through the guidance of abscess drainage via the transvaginal route [5]. Furthermore, it has a definite role in treating ovarian cysts, even during first and second trimesters of pregnancy using aspiration needles [6].

Laparotomy for treating gynecologic emergencies was the gold standard for a long time. Nevertheless, skillful laparoscopists consider laparoscopy to be an ideal approach to assess and treat gynecologic emergencies. It is as safe and effective as laparotomy for the treatment of ectopic pregnancy, ovarian cysts, dermoid cysts, and adnexal torsion [2]. It considerably reduces costs [7]. Other well-known advantages of laparoscopy include less operative time [8], shorter hospital stay [9], less intraoperative blood loss, lower narcotic requirements [3], rapid convalescence, and less postoperative adhesions formation [10]. These advantages are more valuable in developing countries with limited resources. In this study, no case planned for laparoscopic management was switched to laparotomy, unlike others [11], who performed laparotomy for 3 out of 49 cases with gynecologic emergencies.

Laparoscopic microsurgical salpingotomy for undisturbed tubal ectopic pregnancy is a universally accepted line of treatment. Since first described in 1977 [12], laparoscopic surgery is considered to be the cornerstone of treatment in the majority of tubal pregnancy in hemodynamically stable patients desiring further fertility. Unfortunately, it may be impossible to use laparoscopy in many centers, due to the bad general condition of the patient or the unavailability of a competent laparoscopy setup or a well-trained surgeon. Whether to carry out salpingectomy or try to preserve the fallopian tube whenever possible is controversial. The proposed advantages of preserving the tube are to increase the chances of subsequent pregnancy by leaving a healthy tube and to improve the psychic state of the patient postoperatively. On the other hand, salpingectomy will definitely decrease the

Table 3 Surgical techniques affecting fertility

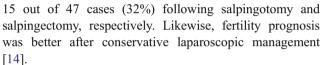| Technique	Laparoscopy group		Laparotomy group		Total	
	No. (77)	Preg 45 (58%)	No. (75)	Preg 24 (32%)	No. (152)	Preg 69 (45%)
Milking	5	2 (40%)	4	1 (25%)[ad]	9	3 (33.3%)[g]
Salpingotomy	41	28 (68.3%)[a]	15	12 (80%)[d]	56	40 (71.4%)[h]
Salpingectomy	14	9 (64.3%)[a]	33	6 (18.2%)	47	15 (32%)[h]
Detorsion	2	2 (100%)	3	1 (33.3%)[d]	5	3 (60%)
Adnexectomy	5	2 (40%)	9	1 (11%)[d]	14	3 (21.4%)[h]
Ovarian coagulation	5	1 (20%)[b]	2	1 (50%)	7	2 (28.6%)[g]
Ovarian suturing	1	0	3	1 (33.3%)	4	1 (25%)[i]
Peritoneal toilet	4	1 (25%)[a]	6	1 (16.7%)	10	2 (20%)[i]

[a] $p<0.05$, [b] $p<0.01$, [c] $p<0.001$ vs. pregnants and non-pregnants in each group
[d] $p<0.05$, [e] $p<0.01$, [f] $p<0.001$ pregnant vs. non-pregnant in LAS vs. LAP groups
[g] $p<0.05$, [h] $p<0.01$, [i] $p<0.001$ vs. pregnants and non-pregnants in the total patients

chance of ectopic pregnancy at this side and will minimize the risk of postoperative oozing from the site of the gestational sac and, hence, postoperative adhesions. Failure of complete trophoblast evacuation or recognition of underlying tubal disease and the possibility of trophoblast seeding in the peritoneal cavity are real risks of conservative management [13]. In this study, we conceived the concept of conservative management whenever possible, since the patients in developing countries have access to limited resources, which hinder assisted reproductive techniques that are not covered by the health care system. Our results significantly supported this concept, where pregnancy was achieved in 40 out of 56 cases (71.4%) and

15 out of 47 cases (32%) following salpingotomy and salpingectomy, respectively. Likewise, fertility prognosis was better after conservative laparoscopic management [14].

Adnexal torsion is a serious condition [15] that may lead to severe acute pain and even sudden death [16]. However, it is most commonly associated with a benign process. A more conservative approach to the treatment of torsion is becoming increasingly common, as seems warranted in light of the low incidence of malignancy [17, 18]. Laparoscopic detorsion, rather than adnexectomy, seems to be an effective adnexa-sparing approach [18]. However, adnexectomy is indicated in cases of gangrenous adnexa, neoplastic ovarian cyst, or unusual ovarian attachment [19]. In this study, adnexectomy was performed for 14 patients (73.7%), due to extensive gangrenous changes, while detorsion was carried out for only 5 (26.3%) cases. Late presentation and delayed diagnosis of adnexal torsion were the leading causes of this radical approach. Many of these cases were admitted to other departments with unclear diagnosis for many days before their referral to the gynecology department. Extended awareness of all concerned specialties may lead to early diagnosis and,

Table 4 Miscellaneous factors affecting pregnancy

	Group A (77)	Group B (75)	Total (152)	p value
Age				0.001[c]
<30 years	38 (84%)	20 (83%)	58 (84%)	
>30 years	7 (16%)	4 (17%)	11 (16%)	
Parity				0.04[a]
Multipara	25 (56%)	19 (79%)[d]	44 (64%)	
Nullipara	20 (44%)	5 (21%)[d]	25 (3%)	
Timing				0.03[a]
<6 months	31 (69%)	17 (71%)	48 (70%)	
>6 months	14 (31%)	7 (29%)	21 (30%)	
Contralateral tube				0.001[c]
Normal	34 (76%)	20 (83%)[d]	54 (78%)	
Pathologic	11 (24%)	4 (17%)[d]	15 (22%)	
Concomitant procedure				0.04[a]
Adhesiolysis	37 (82%)	15 (62.5%)[d]	42 (42%)	
No	8 (18%)	9 (37.5%)[d]	27 (39%)	

[a] $p<0.05$, [b] $p<0.01$, [c] $p<0.001$ vs. pregnants and non-pregnants in all patients
[d] $p<0.05$, [e] $p<0.01$, [f] $p<0.001$ vs. pregnants and non-pregnants in both groups

Table 5 Second-look laparoscopy of recurrent ectopic pregnancy in both groups (14 patients*)

Laparoscopic findings	No.	%
Peritubal adhesions	5	35
Paratubal cyst	3	21
Pathologic tube	3	21
Bilateral ampullary EP	1	7
Non-specific (? intratubal)	2	14

*One case of recurrent ampullary EP three times

hence, more conservative management, particularly in infertile women. One-hundred and two women with twisted black-bluish ischemic adnexa were safely treated with detorsion rather than adnexectomy in a previous study [20]. They reported smooth postoperative course, good follicular development, and normal anatomy in most cases. Since leaving dead tissues in the abdomen is a serious decision, we think that adding Doppler ultrasonography to the preoperative diagnostic work-up in suspected cases of adnexal torsion would differentiate healthy from devitalized tissue to determine the appropriate surgical technique. Instead, intraoperative laparoscopic ultrasonography can properly evaluate the adnexa and the blood vessels [21]. In this study, in the LAS group, cases of large adnexal gangrenous cysts were treated by preliminary aspiration, which was very helpful to have an easy access to the mesosalpinx during adnexectomy. This simple step has made adnexectomy feasible in all cases without the need for laparotomy. Gorkemli et al. [22] performed laparotomy for one case out of nine occurrences of detorsion due to the large size of the ovary. In this study, no case of recurrence of adnexal torsion was encountered and we were not obliged to fix the adnexa by sutures in any case. Ovarian bivalving after detorsion was recently described to decrease intracapsular pressure, increase arterial perfusion, and to facilitate adnexal reperfusion and recovery [23].

Acute PID, in addition to antibiotic therapy, may benefit from surgical or laparoscopic intervention. The old concept that surgery during acute pelvic infection results in greater injury than waiting for the infection to subside has been recently challenged. It is much easier to operate on acute adhesions than on the dense adhesions that obliterate the normal anatomic relationships and develop neovasularization. Laparoscopic drainage of a pelvic abscess followed by lysis of all peritoneal cavity adhesions and excision of necrotic inflammatory exudate allows host defenses to effectively control the infection [24]. Rapid subjective improvement of the general status, the absence of early PID complications, and the absence of recurrence were noticed when laparoscopy was carried out to supplement the medical treatment of PID [25]. Many cases of acute PID are examined in the emergency units, simulating acute appendicitis or due to unclear diagnosis. These laparotomies could be avoided, if laparoscopy of those patients was considered.

In this study, fertility after the surgical treatment of gynecologic emergencies was achieved in 45 (58.4%) and 24 (32%) patients within one year in both groups, respectively. The pregnancy rate was significantly higher in the LAS group, which can be explained by having patients with early ectopic pregnancies, minimal tubal damage, less salpingectomy operations, less isthmic and more fimbrial ectopic pregnancies, and, above all, the well-documented advantages of LAS over LAP. On the other hand, despite the fact that postoperative conceptions were significantly lower in the laparotomy group, one third of patients in this group fell pregnant within 12 months of the procedure. This can be explained by the advantage of following microsurgical principles. Moreover, these patients were young and 112 of those patients were already pregnant (ectopic) at the beginning of the study. Fertility could be higher if the follow-up period was more than one year like other studies [26], who followed patients for up to 24 months. Nevertheless, the total fertility figure in this study (69 patients, 45%) seems reasonable as compared to a large-sample-sized study of 1,451 patients [27], which reported 52% intrauterine and 14% extrauterine pregnancy rates following laparoscopy or laparotomic salpingotomy for treating ectopic pregnancy. Our study addressed the fertility rate following emergencies other than ectopic pregnancy because those patients are usually subjected to the same situation.

Fertility following LAS vs. LAP for treating ectopic pregnancy is variable. Live birth rates are similar, but the recurrent ectopic pregnancy rate, surprisingly, tends to be lower in the LAS group for reasons that are unclear in one study [28]. In this study, the lower rate of recurrent ectopic pregnancy [5 (11%) and 9(37.5%) patients in the LAS and LAP groups, respectively] can be explained by minimal laparoscopic trauma to the tubal lumen and less liability to adhesions formation. Pregnancy rates following radical and conservative surgery were 50% and 56% and recurrent pregnancy rates were 11% compared to 8% in both groups, respectively, in a recent study [29]. Likewise, there was no fertility difference between radical and conservative surgery treatment in a study of 138 patients [26]. In 167 patients with absent or occluded contralateral tube, the conception rate after salpingotomy was 75%. Of those, 55% were intrauterine and 20% had recurrent EP [30]. The choice of surgical treatment was not found to influence the posttreatment fertility and a prior history of infertility was associated with a marked reduction in fertility [31]. In our study, high fertility rate was achieved in patients younger than 30 years, in multiparous women, if the contralateral tube was free, if concomitant adhesiolysis was performed, and after salpingotomy operation for treating ectopic pregnancy. We think that discussion of these variables, which significantly affect fertility, with patients postoperatively would provide a reliable idea about the prognosis of the surgery. In 14 recurrent EP cases, obvious pathologic lesions could explain the recurrence in 12 of them. These findings highlight the importance of concomitant procedures that would improve fertility or minimize the risk of recurrent ectopic pregnancy. In a previous study, we recommended routine removal of paratubal or paraovarian cysts during laparoscopy in all patients. One of the objectives was to minimize the possibility of subsequent EP [32].

From this study, we conclude that, in patients desiring further fertility, both laparoscopy and laparotomy can achieve fertility preservation following basic microsurgical principles. Better results could be significantly achieved following laparoscopic surgery. High fertility is seen in patients younger than 30 years, in multiparous women, if the contralateral tube is free, if concomitant adhesiolysis is performed, and after salpingotomy operation for treating EP.

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