fortune Journals

Research Article

OBSTETRICS AND GYNECOLOGY RESEARCH

ISSN: 2637-4560

Comparative Analysis of Laparoscopic Versus Laparotomy Approaches in the Treatment of Ectopic Pregnancy

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Abstract

Background: Ectopic pregnancy (EP) is a significant risk to life and fertility, occurring when the blastocyst implants outside the uterine cavity and poses significant risks to maternal health. Laparoscopy, a minimally invasive technique, offers benefits like reduced recovery time and less postoperative pain. Conversely, laparotomy, a more invasive surgical method, may be necessary in complex cases.

Aim of the study: This study aimed to compare the outcome of laparoscopic surgery with laparotomy in the management of ectopic pregnancy.

Methods: This prospective observational study, conducted over one year at Prime Hospital in Dubai, UAE, examined surgical outcomes in 65 patients with ectopic pregnancies during five years from June 2019 to July 2024. Participants were divided into two groups based on surgical treatment: laparoscopic surgery (n=50) and laparotomy (n=15). Inclusion criteria ensured that participants were adult women with confirmed ectopic pregnancies and complete medical records. The primary technique used was linear salpingostomy under general anesthesia. Data on demographics, clinical parameters, diagnostics, and surgical details were collected via structured questionnaires. Statistical analyses were performed using SPSS (version 26), with significance set at $p \leq 0.05$.

Result: In a study comparing laparoscopic and laparotomy groups, the mean age was 27.8±5.7 years and 30.7±3.6 years, respectively. Parity was higher in the laparoscopy group (2.66±1.8 vs. 1.45±1.2). Both groups had similar beta-HCG levels and gestational ages. BMI was slightly higher in the laparoscopy group, but preoperative hemoglobin levels were lower. Previous surgeries were more common in the laparotomy group (46.67% vs. 20%), as was a history of ectopic pregnancy (46.67% vs. 8%). Operative outcomes showed significant differences: higher blood loss, transfusion rates, and operative time in the laparotomy group. The laparoscopy group had shorter hospital stays (1.32±0.7 days vs. 4.14±1.2 days) and lower complication rates.

Conclusion: Laparoscopic surgery offers superior outcomes for ectopic pregnancies, including less blood loss, shorter hospital stays, reduced analgesia use, faster recovery, fewer complications, and better fertility preservation. Despite its need for advanced expertise and equipment, laparoscopy is the preferred approach for improved patient outcomes and quicker recovery.

Keywords: Laparoscopic; Laparotomy and Ectopic Pregnancy

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Citation: Varsha Ojha, Vinod Kumar Singhal, Faris Dawood Alaswad, Nufra Senopher Mohamed Sarfraz. Comparative Analysis of Laparoscopic Versus Laparotomy Approaches in the Treatment of Ectopic Pregnancy. Obstetrics and Gynecology Research. 8 (2025): 72-78.

Received: January 08, 2025
Accepted: January 17, 2025
Published: April 11, 2025

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DOI:10.26502/ogr0181

Introduction

Ectopic pregnancy (EP) poses a serious risk to both life and fertility [1]. An ectopic pregnancy occurs when the blastocyst implants outside the endometrial lining of the uterine cavity [2]. It is the leading cause of maternal deaths during the first trimester, accounting for 9–14% of cases and 5–10% of all pregnancy-related fatalities [3]. The exact cause of ectopic pregnancy is still unclear, though several risk factors have been recognized [2]. Women who experience an ectopic pregnancy have a higher risk of future ectopic pregnancies and potential infertility [4]. The significant risk associated with previous ectopic pregnancy, prior tubal surgery, known tubal pathology, or in-utero DES exposure supports the consideration of a screening policy for ectopic pregnancy in these women [5]. Factors that increase the likelihood of ectopic pregnancy include damaged fallopian tubes due to previous pelvic infections or tubal surgery, smoking, and conception through assisted reproductive techniques. However, EP can also occur in women with no identified risk factors [5]. With the advancement of high-resolution transvaginal ultrasonography and beta-hCG testing, EP can now be accurately diagnosed at an early stage. In developing countries, however, late diagnosis remains a major contributor to severe complications and the need for emergency surgical intervention, which significantly increases fatality rates among women with ectopic pregnancy [6]. EP can be managed through various approaches, including expectant management, medical treatment, and surgical intervention, depending on the patient's clinical presentation, hemodynamic stability, β-hCG levels, ultrasound findings, and the surgeon's expertise. However, surgery continues to be the primary treatment method [7]. Surgical treatments may be radical (salpingectomy) or conservative (milking, salpingostomy), and they may be performed by laparoscopy or laparotomy [8]. Laparotomy is a surgical procedure that involves making a large incision in the abdominal wall to gain access to the abdominal cavity. Laparoscopy is a minimally invasive surgical technique that uses small incisions (usually 0.5 to 1.5 cm) to access the abdominal cavity [9,10]. Laparotomy offers better visualization of tissue and allows for increased confidence in controlling haemostasis, making it a preferred choice in specific cases [11]. However, with the growing emphasis on fertility preservation, minimally invasive surgical techniques, particularly laparoscopy, have become the preferred approach [12]. Operative laparoscopy offers several advantages over laparotomy for managing ectopic pregnancy, including shorter surgery duration, reduced intraoperative blood loss, a shorter hospital stay, lower need for pain relief, significantly fewer adhesions, and reduced costs [13-16]. Laparoscopic management, despite its advantages, poses certain challenges. It is not always applicable universally, as factors such as the site of implantation (e.g., cornual or ovarian locations) and the hemodynamic stability of the patient play crucial roles in determining the feasibility of laparoscopic procedures. While non-tubal EPs are rare (approximately 5% of all EP cases), they often present later and carry a higher risk of rupture, which increases the likelihood of laparotomy being required. Additionally, such cases demand higher levels of surgical expertise, as the limited surgical field and indirect visualization during laparoscopy can hinder prompt management of complications, thus necessitating experienced surgeons and specialized equipment [17]. This study aims to compare the laparoscopic and laparotomy approaches in the treatment of ectopic pregnancy, evaluating factors such as operative time, blood loss, hospital stay, recovery time, complication rates, and overall patient outcomes to determine the more effective and patient-friendly surgical method.

Methodology & Materials

This meticulously conducted prospective observational study was executed in the Department of Obstetrics and Gynecology at Prime Hospital, Dubai, UAE. Spanning five years, from June 2019 to July 2024, the study systematically investigated the surgical outcomes of patients with confirmed ectopic pregnancies. Employing a purposive sampling strategy, a total of 65 patients admitted through either emergency services or the outpatient department were enrolled to form a well-defined study cohort. The inclusion of participants adhered to rigorously established criteria, ensuring the reliability and clinical relevance of the research findings. Participants were carefully allocated into two distinct groups based on the surgical approach:

Laparoscopy (n=50): Patients who underwent laparoscopic surgery.

Laparotomy (n=15): Patients who underwent laparotomy surgery.

Inclusion Criteria:

1. Women diagnosed with ectopic pregnancy.
2. Women who underwent either laparoscopic or laparotomy surgery.
3. Patients aged 18 years and above.
4. Patients with complete medical records available.

Exclusion Criteria:

1. Patients treated medically or expectantly for ectopic pregnancy.
2. Incomplete medical records.
3. Patients with contraindications for either surgical approach.

Surgical Approach

The primary surgical technique employed in both groups was linear salpingostomy, a procedure designed to preserve

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DOI:10.26502/ogr0181

reproductive function. All surgeries were performed under general anesthesia with endotracheal intubation. Postoperative analgesia was administered based on patient demand, with options including pethidine (1.5 mg/kg I/M every eight hours) or diclofenac sodium (100 mg). Specimens from all procedures were sent for histopathological examination to confirm the diagnosis.

Laparoscopic Procedure

In the laparoscopic group, a minimally invasive three-port technique was employed. The pneumoperitoneum was established using CO_2, and a 10 mm laparoscope was introduced through an 11 mm cannula via an intra-umbilical incision. Once the ectopic pregnancy was confirmed, 5 mm ports were inserted into the left and right lower quadrants under direct visualization. A linear salpingostomy was performed by creating an incision along the antimesenteric border of the affected fallopian tube using monopolar diathermy. The ectopic tissue was removed with forceps, and the tube was thoroughly irrigated with Ringer's solution. Hemostasis was achieved using bipolar diathermy, and the incision was left to heal by secondary intention. For cases requiring total laparoscopic salpingectomy, the fallopian tube was coagulated and excised incrementally, starting at the fimbrial end and progressing to the isthmic region. In instances of fimbrial ectopic pregnancy, the ectopic tissue was extracted through a 10 mm port, ensuring safe removal.

Laparotomy Procedure

Patients in the laparotomy group underwent surgery via a Pfannenstiel incision in the lower abdomen. Standard open surgical techniques were followed meticulously to manage the ectopic pregnancy.

Data Collection

Data were systematically collected using a structured and validated questionnaire. Key variables included Demographics and Baseline Clinical Parameters: Age, parity, body mass index (BMI), and gestational age of the ectopic pregnancy; Diagnostic Parameters: Quantitative beta-hCG levels, preoperative hemoglobin levels, and transvaginal ultrasonography findings, Risk Factors for Adhesion Formation: Prior surgeries, history of pelvic inflammatory disease, previous ectopic pregnancies, and endometriosis. The diagnosis of ectopic pregnancy was based on a combination of patient history, clinical presentation, physical examination, serum beta-hCG levels, and transvaginal ultrasonography findings. Operative details, including estimated blood loss, operative time, surgical complications, type of procedure performed, and length of hospital stay, were meticulously recorded. Data were collected after obtaining consent forms from every participant and ethical approval was obtained from the ethics committee of the institution.

Statistical Analysis

Statistical analyses were conducted using SPSS software (version 26). Continuous variables were summarized as mean±standard deviation (SD). Categorical variables were presented as frequencies and percentages. To compare quantitative variables, an unpaired t-test was applied, while the chi-square test was utilized for categorical variables. A p-value ≤ 0.05 was considered statistically significant, providing a robust framework for identifying meaningful differences between the two groups.

Result

In this study of 65 patients, 50 underwent laparoscopy, and 15 had laparotomy. The mean age in the laparoscopy group was 27.8±5.7 years, slightly lower than the 30.7±3.6 years in the laparotomy group. Parity was higher in the laparoscopy group, with an average of 2.66±1.8, compared to 1.45±1.2 in the laparotomy group. Both groups had similar beta-HCG levels and gestational ages, averaging around 653.87 and 751.56, and 6.0±2.7 and 6.5±1.5 weeks, respectively. BMI was slightly higher in the laparoscopy group, while preoperative hemoglobin levels were lower compared to the laparotomy group, though these differences were not statistically significant (Table 1). Regarding prior medical history, 20% of laparoscopy patients had previous surgeries compared to 46.67% in the laparotomy group. A history of ectopic pregnancy was noted in 8% of the laparoscopy group and 46.67% in the laparotomy group. Both groups had comparable rates of previous PID and endometriosis, and none of these differences reached statistical significance (Table 2). Operative outcomes showed significant contrasts between the two groups. Estimated blood loss was considerably higher in the laparotomy group (468.5±140.2 mL) compared to the laparoscopy group (178.72±97.8 mL). Blood transfusions were required by 73.33% of the laparotomy patients but only 4% of the laparoscopy group. The operative time was higher in the laparotomy group, averaging a score of 85.4±29.2 compared to 54.4±15.3 in the laparoscopy group with a significant difference. Linear salpingostomy was performed in 82% of the laparoscopy group and 60% of the laparotomy group. Salpingectomy was more frequent in the laparotomy group, while milking was performed at similar rates in both groups. Hospital stay was significantly shorter in the laparoscopy group, averaging 1.32±0.7 days, while the laparotomy group required 4.14±1.2 days. Additionally, 72% of laparoscopy patients needed no analgesia, contrasting with universal analgesia use in the laparotomy group (Table 3). Figure 1 shows that the laparoscopy group had significantly lower complication rates across all categories compared to the laparotomy group. Specifically, infections occurred in 4.00% of the laparoscopy group versus 20.00% of the laparotomy group, hemorrhage occurred in 6.00% versus 13.33%, and no other complications occurred in the laparoscopic group where 6.67% have occurred in the laparotomy group.

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Table 1: Demographic and clinical data of the study groups

Parameter	Laparoscopy (n=50)	Laparotomy (n=15)	P-value
	Mean±SD	Mean±SD	
Age (years)	27.8±5.7	30.7±3.6	NS
Parity	2.66±1.8	1.45±1.2	NS
beta-HCG	653.87	751.56	NS
Gestational age (week)	6.0±2.7	6.5±1.5	NS
BMI	24.2±3.5	20.8±5.4	NS
Preoperative haemoglobin levels (mg/dl)	8.05±3.7	10.5±1.1	NS

Table 2: Predisposing factors of the two study groups.

Characteristics	Laparoscopy (n=50)		Laparotomy (n=15)		P-value
	n	%	n	%	
Previous surgery	10	20	7	46.67	NS
Previous ectopic pregnancy	4	8	7	46.67	NS
Previous PID	3	6	1	6.67	NS
History of endometriosis	1	2	1	6.67	NS

Table 3: Operative outcome in the laparoscopy and laparotomy groups

Parameter	Laparoscopy (N=50)		Laparotomy (N=15)		P value
	n	%	n	%	
	Mean±SD		Mean±SD		
Estimated blood loss (ml)	178.72 ± 97.8		468.5±140.2		S
Blood transfusion (%)	2	4	11	73.33	S
Operative time (min)	54.4 ± 15.3		85.4 ± 29.2		S
Procedure performed					
Linear salpingostomy	41	82	9	60	NS
Salpingectomy	6	12	5	33.33	NS
Milking	3	6	1	6.67	NS
Hospital stay (days)	1.32±0.7		4.14±1.2		S
No need for analgesia	36	72	0	0	S

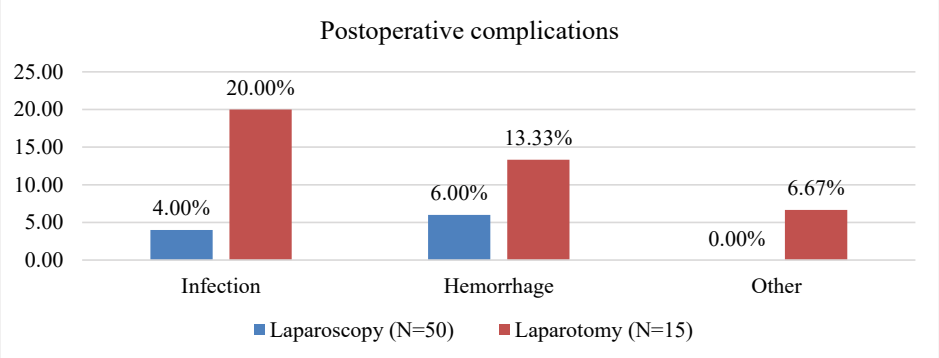

Figure 1: Distribution of postoperative complications among the study groups.

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Discussion

Ectopic pregnancy is a potentially life-threatening condition. Timely and effective management is critical to prevent complications that can arise if the condition remains untreated. Traditionally, ectopic pregnancies have been managed surgically, with laparotomy being the standard approach. However, advances in minimally invasive techniques have introduced laparoscopy as a viable alternative. The choice between laparoscopic management and laparotomy depends on multiple factors, including the patient's clinical presentation, the surgeon's expertise, and available resources. This comparative study aims to analyze the outcomes and benefits of both laparoscopic and laparotomy approaches in treating ectopic pregnancy. The mean age of patients in the laparoscopic group was 27.8 years, compared to 30.7 years in the laparotomy group, indicating that both groups consisted of relatively young women within the typical reproductive age range affected by ectopic pregnancies. This result is comparable with the findings of Singh et al. [18]. Although slightly higher in the laparoscopic group (2.66) than in the laparotomy group (1.45), a difference that was not statistically significant. Body Mass Index (BMI) differed slightly, with the laparoscopy group having a higher average BMI (24.2) than the laparotomy group (20.8). The parity and BMI were comparable with another study [19]. The mean beta-HCG levels, a critical marker in diagnosing ectopic pregnancies, were also statistically similar between the groups, with levels of 653.87 mIU/mL in the laparoscopy group and 751.56 mIU/mL in the laparotomy group. Additionally, the gestational age at diagnosis was comparable between the two groups (6.0 weeks in the laparoscopy group vs. 6.5 weeks in the laparotomy group), suggesting that both techniques were applicable across similar early pregnancy stages. Singh et al. also found similar results [20]. Preoperative hemoglobin levels were somewhat lower in the laparoscopy group (8.05 mg/dL) than in the laparotomy group (10.5 mg/dL) in this study. Singh et al. [18] reported similar results. A greater percentage of patients in the laparotomy group had a history of previous surgery (46.67%) and last ectopic pregnancies (46.67%) in comparison to those in the laparoscopy group (20% and 8%, respectively). The occurrence of previous pelvic inflammatory disease (PID) and endometriosis was similar across both groups. The predisposing factors that have been demonstrated in the present study were almost comparable with those found in previous studies [21,22]. In the laparoscopic group, there was a significant reduction in total blood loss ($P<0.0001$), number of patients who needed blood transfusion ($P<0.001$), total days required for hospital stay ($P<0.0001$) and the need for postoperative analgesia in the laparoscopic group versus laparotomy group ($P<0.0001$). These findings were in agreement with previous studies [23,24]. Women who underwent laparoscopy do not do worse than those who underwent laparotomy, and even those who required ICU admission still benefit from the advantages of operative laparoscopy [17]. In the present study, laparoscopic techniques (salpingostomy or salpingectomy) do not increase the operating time. It saves time, as during a laparotomy, opening and closing the abdomen just to gain access to the affected tube consumes precious operating time. Previous comparative studies support this [23]. In another study, the groups differed concerning total operation time (73 min for the laparoscopy group vs. 88 min for the laparotomy group), hospital stay (2.2 vs. 5.4 days), and convalescence period (11 vs. 24 days) [25]. In the present study, we have demonstrated that EPs can be managed successfully via minimal access surgery, and laparoscopic management offers several advantages over conventional treatment via laparotomy. It not only results in reduced hospital stay with associated financial savings but also reduced patient morbidity, enabling women to return to their normal activities much sooner [23,26]. In our study, the postoperative elimination of HCG was similar in both the laparoscopy and laparotomy-treated patients, whether treated by conservative salpingostomy or radical salpingectomy. The study also found a notable difference in conception rates post-surgery, with 68% of laparoscopy patients achieving conception compared to only 4% in the laparotomy group. According to our study, the majority of tubal ectopic pregnancies can be managed laparoscopically. Operative laparoscopy is currently the best treatment for EP [27]. The benefits to patients are self-evident, and our findings are supported in the literature [28,29].

Limitations of the study: This study has several limitations. The study did not account for long-term follow-up of fertility outcomes and recurrence rates, which are important factors in evaluating the overall effectiveness of the surgical approaches. Also, the expertise of the surgeons and the availability of advanced laparoscopic equipment may not be uniformly accessible in all healthcare facilities, potentially affecting the reproducibility of the results.

Conclusion

In conclusion, this comparative study highlights the superior outcomes of laparoscopic surgery over laparotomy for treating ectopic pregnancies. Patients undergoing laparoscopy experienced significantly lower intraoperative blood loss, shorter hospital stays, reduced need for postoperative analgesia, and quicker recovery times. Additionally, laparoscopy demonstrated fewer complications and better preservation of fertility, with higher conception rates post-surgery compared to laparotomy. Despite requiring advanced surgical expertise and equipment, the benefits of minimally invasive laparoscopy make it the preferred approach for managing ectopic pregnancies, promoting better patient outcomes and quicker return to normal activities.

Funding: No funding sources

Conflict of interest: None declared

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Ethical approval: The study was approved by the Institutional Ethics Committee.

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