International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 4, April 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.4.2025.185

Original Research

Comparative Analysis of Laparoscopic Versus Open Surgical Management in Ectopic Pregnancy: Clinical and Fertility Outcomes

[1]Dr. Varun Pathak , [2]Dr. Prakriti Goswami

[1]Assistant Professor Dept of General Surgery, Santosh Medical College and Hospital, Ghaziabad
[2]Associate Professor, Dept of Obs and Gynae ,GS Medical College, Pilkhuwa

Corresponding Author
Dr. Prakriti Goswami
Associate Professor, Dept of Obs and Gynae ,GS Medical College, Pilkhuwa

Received date: 10 March 2025 Acceptance date: 25April 2025

ABSTRACT

Aim: To compare the clinical outcomes and fertility outcomes of laparoscopic versus open surgical management in patients with ectopic pregnancy.

Material and Methods: This hospital-based, prospective comparative study was conducted in the Department of Obstetrics and Gynecology at a tertiary care teaching hospital after obtaining ethical approval. A total of 110 hemodynamically stable women with tubal ectopic pregnancy were enrolled and divided into two groups: Group A (laparoscopic surgery, n=55) and Group B (open laparotomy, n=55). Intraoperative parameters, postoperative recovery indicators, and 12-month fertility outcomes were evaluated and compared between the groups. Statistical analysis was performed using SPSS version 25.0, with p-values <0.05 considered significant.

Results: Baseline demographic characteristics were comparable between the two groups. Laparoscopic surgery resulted in significantly shorter mean operative time (52.3 ± 10.4 minutes vs. 68.7 ± 12.1 minutes, p<0.001) and lower estimated blood loss (84.5 ± 20.7 mL vs. 142.3 ± 28.4 mL, p<0.001) compared to open surgery. Postoperative recovery was faster in the laparoscopic group with significantly lower pain scores, shorter hospital stays, and earlier resumption of daily activities. Although spontaneous intrauterine pregnancy rates were higher (60.00% vs. 47.27%) and recurrent ectopic pregnancy rates were lower (5.45% vs. 10.91%) in the laparoscopic group at 12 months, the differences were not statistically significant.

Conclusion: Laparoscopic management of ectopic pregnancy offers significant advantages in terms of operative time, blood loss, postoperative recovery, and reduced complications compared to open surgery. Although fertility outcomes were better with laparoscopy, the differences were not statistically significant. Laparoscopic surgery should be considered the preferred approach in hemodynamically stable patients.

Keywords: Ectopic pregnancy, Laparoscopy, Laparotomy, Fertility outcomes, Postoperative recovery

Introduction

Ectopic pregnancy represents a significant clinical challenge in modern gynecology, accounting for a notable proportion of early pregnancy morbidity and mortality. It occurs when a fertilized ovum implants outside the uterine cavity, most commonly within the fallopian tubes, though implantation can also occur in the ovary, cervix, abdomen, or within a cesarean scar. Prompt diagnosis and effective management are essential to prevent life-threatening complications such as tubal rupture, hemoperitoneum, and hemodynamic instability. Over the decades, advances in diagnostic modalities such as transvaginal ultrasonography and sensitive serum beta-hCG assays have facilitated earlier detection, allowing for the implementation of conservative, fertility-preserving treatments when appropriate.[1]

The management of ectopic pregnancy has evolved significantly, transitioning from primarily open surgical approaches toward minimally invasive laparoscopic techniques. Open surgery, typically involving laparotomy with salpingectomy or salpingostomy, was once the standard treatment modality. Although effective in controlling hemorrhage and removing ectopic tissue, open procedures are associated with longer hospital stays, increased postoperative pain, greater risk of adhesion formation, and extended recovery periods. These drawbacks, combined with the growing emphasis on fertility preservation, have spurred the adoption of laparoscopy as the preferred approach in hemodynamically stable patients.[2]

Laparoscopic surgery offers several advantages over open surgery. It is associated with reduced

DOI: 10.69605/ijlbpr_14.4.2025.185

intraoperative blood loss, shorter operative times, diminished postoperative pain, quicker mobilization, and earlier hospital discharge. Moreover, by minimizing peritoneal trauma and adhesion formation, laparoscopy may also contribute to better preservation of future fertility potential—a critical concern for many women affected by ectopic pregnancy, particularly those with pre-existing infertility or a desire for future conception. However, the success of laparoscopic management hinges on early diagnosis, surgical expertise, and the patient's hemodynamic status at presentation.[3]

Clinical outcomes following laparoscopic versus open surgery for ectopic pregnancy have been the subject of considerable investigation. Metrics such as operative time, estimated blood loss, length of hospital stay, analgesic requirement, complication rates, and time to return to normal activity are commonly analyzed. Evidence generally suggests that laparoscopy outperforms laparotomy on these measures, particularly in stable patients with unruptured ectopic pregnancies. Nonetheless, certain clinical scenarios—such as massive hemoperitoneum, extensive pelvic adhesions, or hemodynamic instability—may necessitate open surgical intervention. Thus, patient selection criteria play a pivotal role in determining the most appropriate surgical approach.[4,5]

Beyond immediate surgical outcomes, long-term reproductive performance remains a crucial consideration in assessing the efficacy of ectopic pregnancy treatments. Fertility outcomes are influenced by several factors, including the extent of tubal damage, type of surgical procedure (salpingectomy versus salpingostomy), presence of contralateral tubal pathology, and the patient's baseline reproductive health. Preservation of tubal anatomy through conservative surgery, often more feasible laparoscopically, is thought to favor subsequent intrauterine pregnancies while minimizing the risk of recurrent ectopic gestations. However, there remains some debate regarding whether conservative surgery indeed confers superior fertility outcomes compared to more radical approaches, and whether these benefits differ between laparoscopic and open techniques.[6,7]

The choice between salpingectomy (removal of the affected tube) and salpingostomy (incision and removal of the ectopic gestation with preservation of the tube) also bears significant implications for fertility. While salpingostomy is more conservative, it carries a risk of persistent trophoblastic tissue, requiring careful postoperative surveillance. Salpingectomy, while more definitive, eliminates the affected tube and may reduce overall tubal fertility, particularly if contralateral tubal disease exists. Both laparoscopic and open methods can be used to perform these procedures, but the minimally invasive nature of laparoscopy often facilitates tubal conservation in appropriate cases.[8]

Another aspect of interest in comparing laparoscopic and open management is the economic burden associated with each technique. Although laparoscopy may involve higher upfront costs related to equipment and surgical training, its association with shorter hospital stays and faster recoveries often translates into lower overall healthcare expenditures. Additionally, quicker return to work and normal activity after laparoscopy offers significant socioeconomic advantages, further tilting the balance in its favor from a healthcare systems perspective.[9]

In recent years, the expanding skill set of gynecologic surgeons, coupled with technological advances in laparoscopic instrumentation and imaging, has broadened the indications for minimally invasive management of ectopic pregnancy. Complex ectopic presentations that were previously considered contraindications to laparoscopy are now increasingly approached with minimally invasive strategies. Nevertheless, laparotomy retains a vital role in emergency situations where immediate surgical access and rapid hemostasis are paramount.[10,11]

In this context, a comparative analysis of laparoscopic versus open surgical management in ectopic pregnancy is essential to refine clinical guidelines, optimize patient outcomes, and inform counseling regarding fertility expectations. Understanding the relative benefits and limitations of each approach in terms of clinical outcomes, reproductive prognosis, perioperative safety, and patient satisfaction is crucial in tailoring individualized treatment strategies. As healthcare increasingly shifts toward patient-centered and minimally invasive models, such analyses help ensure that women with ectopic pregnancies receive evidence-based care that balances immediate medical needs with future reproductive aspirations.[12]

This study aims to bridge existing gaps in knowledge by systematically comparing the clinical and fertility outcomes associated with laparoscopic and open surgical management of ectopic pregnancies, thereby contributing valuable insights to both clinical practice and future research endeavors.

Material and Methods

This hospital-based, prospective comparative study was conducted in the Department of Obstetrics and Gynecology at a tertiary care teaching hospital, after obtaining approval from the Institutional Ethics Committee. Informed written consent was obtained from all participants prior to enrollment.

Study Population

A total of **110 patients** diagnosed with ectopic pregnancy requiring surgical intervention were enrolled consecutively based on predefined inclusion and exclusion criteria. Patients were divided into two groups based on the type of surgical management performed:

- **Group A (Laparoscopic Group)**: 55 patients underwent laparoscopic surgery.

DOI: 10.69605/ijlbpr_14.4.2025.185

- **Group B (Open Surgery Group)**: 55 patients underwent open laparotomy.

Inclusion Criteria

- Hemodynamically stable women diagnosed with tubal ectopic pregnancy.
- Age between 18–40 years.
- Willingness to preserve fertility.
- Consent for participation in the study and follow-up.

Exclusion Criteria

- Hemodynamically unstable patients requiring emergency laparotomy.
- Non-tubal ectopic pregnancies (e.g., cervical, interstitial, ovarian).
- Known history of infertility before the ectopic pregnancy.
- Previous bilateral salpingectomy.
- Severe cardiopulmonary comorbidities contraindicating laparoscopy.

Study Procedure

After a detailed clinical assessment and confirmation of ectopic pregnancy through transvaginal ultrasonography and serum β-hCG levels, eligible patients were allocated into either the laparoscopic surgery group or the open surgery group based on clinical condition, surgeon expertise, patient preference, and resource availability. All surgical procedures were performed under general anesthesia by experienced surgeons adhering to standard operative protocols. Intraoperative parameters such as operative time, estimated blood loss, and occurrence of intraoperative complications were meticulously recorded during each procedure.

Postoperative outcomes were systematically evaluated, including assessment of pain using the Visual Analogue Scale (VAS), duration of hospital stay, time taken to resume normal daily activities, and the incidence of postoperative complications such as surgical site infections or the requirement for blood transfusion. All patients were followed up for a period of 12 months post-surgery to assess fertility-related outcomes, particularly focusing on the occurrence of subsequent intrauterine pregnancies and recurrence of ectopic pregnancy.

The primary outcomes evaluated in this study were operative time, estimated intraoperative blood loss, and parameters related to postoperative recovery including pain scores and hospital stay duration. The secondary outcomes were related to fertility prognosis, namely spontaneous conception rates and the incidence of recurrent ectopic pregnancies during the follow-up period.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 25.0. Continuous variables were expressed as mean ± standard deviation (SD) and compared using Student's t-test. Categorical variables were expressed as percentages and compared using the Chi-square test or Fisher's exact test as appropriate.A p-value <0.05 was considered statistically significant.

Results

Table 1: Baseline Demographic Characteristics

The baseline demographic characteristics of patients between the two groups were comparable with no statistically significant differences. The mean age in the laparoscopic group (Group A) was 28.7 ± 4.2 years, while in the open surgery group (Group B) it was 29.3 ± 4.7 years (p = 0.42). Similarly, the mean gravidity was nearly identical between Group A (2.1 ± 0.8) and Group B (2.0 ± 0.9) with no significant difference (p = 0.55). A history of previous ectopic pregnancy was present in 9.09% of patients in Group A and 10.91% in Group B (p = 0.74), indicating a balanced distribution. The side of ectopic pregnancy (right versus left) was also evenly distributed between groups (32/23 in Group A vs 34/21 in Group B; p = 0.67). The mean serum β-hCG levels at the time of diagnosis were comparable, measured at 2460 ± 510 IU/L in Group A and 2510 ± 530 IU/L in Group B (p = 0.58). These findings suggest that the two groups were well-matched at baseline, allowing fair comparison of surgical outcomes.

Table 2: Intraoperative Outcomes

A significant difference was observed in intraoperative outcomes between the two surgical groups. The mean operative time was considerably shorter in the laparoscopic group (52.3 ± 10.4 minutes) compared to the open surgery group (68.7 ± 12.1 minutes), and this difference was highly statistically significant (p < 0.001). Similarly, the estimated blood loss was significantly lower in the laparoscopic group, averaging 84.5 ± 20.7 mL versus 142.3 ± 28.4 mL in the open surgery group (p < 0.001). Although intraoperative complications were slightly less frequent in Group A (3.64%) compared to Group B (9.09%), the difference did not reach statistical significance (p = 0.24). These findings indicate that laparoscopic surgery was associated with shorter operative times and reduced blood loss without an increased risk of intraoperative complications.

Table 3: Postoperative Recovery Outcomes

Postoperative recovery parameters showed a significant advantage for patients undergoing laparoscopic surgery. The mean pain score at 6 hours postoperatively was significantly lower in Group A (3.5 ± 1.1) compared to Group B (6.2 ± 1.4), with a p-value of <0.001. The duration of hospital stay was also significantly shorter for laparoscopic patients, with a mean stay of 2.8 ± 0.7 days versus 5.3 ± 1.1 days in the open surgery group (p < 0.001). Furthermore, patients in the laparoscopic group

DOI: 10.69605/ijlbpr_14.4.2025.185

resumed normal activities earlier (10.4 ± 2.3 days) compared to the open surgery group (17.8 ± 3.5 days), which was again highly statistically significant ($p < 0.001$). The incidence of postoperative infections was lower in Group A (1.82%) than in Group B (10.91%), reaching borderline statistical significance ($p = 0.05$). Although the need for blood transfusion was lower in Group A (1.82%) compared to Group B (7.27%), the difference was not statistically significant ($p = 0.17$). Overall, laparoscopic surgery resulted in better postoperative recovery profiles.

Table 4: Fertility Outcomes at 12-Month Follow-up

At the 12-month follow-up, fertility outcomes favored the laparoscopic group, although the differences were not statistically significant. Spontaneous intrauterine pregnancy occurred in 60.00% of patients in Group A compared to 47.27% in Group B ($p = 0.16$). The recurrence of ectopic pregnancy was lower in the laparoscopic group (5.45%) than in the open surgery group (10.91%), but this difference was not statistically significant ($p = 0.29$). Additionally, the proportion of patients who did not achieve pregnancy within 12 months was slightly lower in Group A (34.55%) compared to Group B (41.82%), with a p-value of 0.42. These results suggest that laparoscopic management of ectopic pregnancy may be associated with better fertility preservation, although the differences were not statistically conclusive.

Table 1: Baseline Demographic Characteristics of Patients (n = 110)

Parameter	Group A (Laparoscopic, n=55)	Group B (Open Surgery, n=55)	p-value
Mean Age (years)	28.7 ± 4.2	29.3 ± 4.7	0.42
Gravidity (mean)	2.1 ± 0.8	2.0 ± 0.9	0.55
Previous Ectopic Pregnancy (%)	9.09% (5/55)	10.91% (6/55)	0.74
Site of Ectopic (Right/Left)	32/23	34/21	0.67
Mean Serum β-hCG (IU/L)	2460 ± 510	2510 ± 530	0.58

Table 2: Intraoperative Outcomes

Parameter	Group A (Laparoscopic, n=55)	Group B (Open Surgery, n=55)	p-value
Mean Operative Time (minutes)	52.3 ± 10.4	68.7 ± 12.1	<0.001
Estimated Blood Loss (mL)	84.5 ± 20.7	142.3 ± 28.4	<0.001
Intraoperative Complications (%)	3.64% (2/55)	9.09% (5/55)	0.24

Table 3: Postoperative Recovery Outcomes

Parameter	Group A (Laparoscopic, n=55)	Group B (Open Surgery, n=55)	p-value
Mean Pain Score (VAS at 6h)	3.5 ± 1.1	6.2 ± 1.4	<0.001
Mean Hospital Stay (days)	2.8 ± 0.7	5.3 ± 1.1	<0.001
Time to Resume Normal Activity (days)	10.4 ± 2.3	17.8 ± 3.5	<0.001
Postoperative Infection (%)	1.82% (1/55)	10.91% (6/55)	0.05
Blood Transfusion Required (%)	1.82% (1/55)	7.27% (4/55)	0.17

Table 4: Fertility Outcomes at 12-Month Follow-up

Parameter	Group A (Laparoscopic, n=55)	Group B (Open Surgery, n=55)	p-value
Spontaneous Intrauterine Pregnancy (%)	60.00% (33/55)	47.27% (26/55)	0.16
Recurrent Ectopic Pregnancy (%)	5.45% (3/55)	10.91% (6/55)	0.29
No Pregnancy Achieved (%)	34.55% (19/55)	41.82% (23/55)	0.42

DOI: 10.69605/ijlbpr_14.4.2025.185

Discussion

In the present study, the baseline demographic characteristics such as mean age, gravidity, history of previous ectopic pregnancy, laterality of ectopic site, and mean serum β-hCG levels were comparable between the laparoscopic and open surgery groups, with no statistically significant differences. This ensured that the comparison of surgical outcomes between the groups was fair and unbiased. Similar observations were made by Bouyer et al (2002), who in their multicenter study reported no significant baseline demographic differences between patients undergoing different surgical modalities for ectopic pregnancy, reinforcing the validity of group comparisons in ectopic pregnancy management.[13]

The intraoperative outcomes in our study demonstrated that laparoscopic surgery significantly reduced operative time and estimated blood loss compared to open laparotomy, with mean operative times of 52.3 ± 10.4 minutes versus 68.7 ± 12.1 minutes, and blood loss of 84.5 ± 20.7 mL versus 142.3 ± 28.4 mL, respectively ($p < 0.001$). Although intraoperative complications were slightly lower in the laparoscopic group (3.64% vs. 9.09%), the difference was not statistically significant. These findings are consistent with the results of Hajenius et al (2007), who found that laparoscopy for ectopic pregnancy was associated with shorter surgery duration and lower intraoperative morbidity compared to open surgery.[14]

Postoperative recovery parameters clearly favored the laparoscopic group in our study. Patients in the laparoscopic group had significantly lower pain scores (3.5 ± 1.1 vs. 6.2 ± 1.4, $p < 0.001$), shorter hospital stays (2.8 ± 0.7 days vs. 5.3 ± 1.1 days, $p < 0.001$), and faster return to normal activities (10.4 ± 2.3 days vs. 17.8 ± 3.5 days, $p < 0.001$). Additionally, postoperative infection rates were notably lower in Group A (1.82%) compared to Group B (10.91%). These outcomes are similar to findings by Tulandi et al (1998), who reported that laparoscopic surgery for ectopic pregnancy significantly improved postoperative recovery times and reduced wound complications compared to laparotomy.[15]

Regarding postoperative infection rates and need for blood transfusion, our study observed a trend toward better outcomes in the laparoscopic group, although not all differences reached statistical significance. Only 1.82% of patients in Group A required blood transfusion compared to 7.27% in Group B. This trend aligns with findings from Silva et al (2010), who in their retrospective analysis noted lower postoperative infection and transfusion rates in patients managed laparoscopically for ectopic pregnancy compared to those managed by laparotomy.[16]

Fertility outcomes at the 12-month follow-up showed that 60.00% of women in the laparoscopic group achieved spontaneous intrauterine pregnancy compared to 47.27% in the open surgery group, although the difference was not statistically significant ($p = 0.16$). Recurrence of ectopic pregnancy was also lower in the laparoscopic group (5.45% vs. 10.91%). These results are in agreement with the findings of Kirk et al (1997), who demonstrated higher subsequent intrauterine pregnancy rates and lower recurrence rates in women undergoing laparoscopic salpingostomy compared to open procedures.[17]

Conclusion

In this study, laparoscopic management of ectopic pregnancy was associated with significantly shorter operative times, reduced blood loss, faster postoperative recovery, and lower complication rates compared to open surgery. Although fertility outcomes favored laparoscopy, the differences were not statistically significant. Overall, laparoscopic surgery proved to be a safer and more effective alternative, supporting its use as the preferred surgical approach in hemodynamically stable patients.

References

1. Sivalingam VN, Duncan WC, Kirk E, et al. Diagnosis and management of ectopic pregnancy. J Fam PlannReprod Health Care. 2011;37(4):231-40.
2. Houser M, Kandalaft N, Khati NJ. Ectopic pregnancy: a resident's guide to imaging findings and diagnostic pitfalls. Emerg Radiol. 2022;1-2.
3. Petrini A, Spandorfer S. Recurrent ectopic pregnancy: current perspectives. Int J Womens Health. 2020;4:597-600.
4. Chen S, Zhu Y, Xie M. Comparison of laparoscopic and open approach in the treatment of heterotopic pregnancy following embryo transfer. Front Surg. 2022 Nov 1;9:1006194. doi:10.3389/fsurg.2022.1006194. PMID: 36386500; PMCID: PMC9663481.
5. Marchand G, Taher Masoud A, Sainz K, Azadi A, Ware K, Vallejo J, et al. A systematic review and meta-analysis of laparotomy compared with laparoscopic management of interstitial pregnancy. Facts Views Vis Obgyn. 2021 Jan 8;12(4):299-308. PMID: 33575679; PMCID: PMC7863690.
6. Xiao S, Mo M, Hu X, Zhang H, Xu S, Wang Z, et al. Study on the incidence and influences on heterotopic pregnancy from embryo transfer of fresh cycles and frozen-thawed cycles. J Assist Reprod Genet. 2018;35(4):677-81. doi:10.1007/s10815-017-1109-x. PMID: 29318464; PMCID: PMC5891943.
7. Fernandez H, Gervaise A. Ectopic pregnancies after infertility treatment: modern diagnosis and therapeutic strategy. Hum Reprod Update. 2004;10(6):503-13. doi:10.1093/humupd/dmh043. PMID: 15358731.
8. Clayton HB, Schieve LA, Peterson HB, Jamieson DJ, Reynolds MA, Wright VC. A comparison of heterotopic and intrauterine-only pregnancy outcomes after assisted reproductive technologies in the United States from 1999 to 2002. Fertil Steril. 2007;87(2):303-9. doi:10.1016/j.fertnstert.2006.06.037. PMID: 17162141.
9. Barrenetxea G, Barinaga-Rementeria L, Lopez de Larruzea A, Agirregoikoa JA, Mandiola M, Carbonero K. Heterotopic pregnancy: two cases and a

DOI: 10.69605/ijlbpr_14.4.2025.185

comparative review. Fertil Steril. 2007;87(2):417.e9-15. doi:10.1016/j.fertnstert.2006.05.085. PMID: 16996602.

10. Wu Z, Zhang X, Xu P, Huang X. Clinical analysis of 50 patients with heterotopic pregnancy after ovulation induction or embryo transfer. Eur J Med Res. 2018;23(1):17. doi:10.1186/s40001-018-0316-y. PMID: 29699418; PMCID: PMC5910374.
11. Guan Y, Ma C. Clinical outcomes of patients with heterotopic pregnancy after surgical treatment. J Minim Invasive Gynecol. 2017;24(7):1111-5. doi:10.1016/j.jmig.2017.03.003. PMID: 28336495.
12. Solangon SA, Otify M, Gaughran J, Holland T, Ross J, Jurkovic D. The risk of miscarriage following surgical treatment of heterotopic extrauterine pregnancies. Hum Reprod Open. 2022;2022(1):hoab046. doi:10.1093/hropen/hoab046. PMID: 35253368; PMCID: PMC8896396.
13. Bouyer J, Coste J, Fernandez H, Pouly JL, Job-Spira N. Sites of ectopic pregnancy: a 10 year population-based study of 1800 cases. Hum Reprod. 2002;17(12):3224-30.
14. Hajenius PJ, Mol F, Mol BW, Bossuyt PM, Ankum WM, Van der Veen F. Interventions for tubal ectopic pregnancy. Cochrane Database Syst Rev. 2007;(1):CD000324.
15. Tulandi T, Saleh A. Surgical management of ectopic pregnancy. Fertil Steril. 1998;70(5):865-9.
16. Silva PD, Schaper AM, Rooney CM. Laparoscopic management of ectopic pregnancy: a review of 245 cases. SurgEndosc. 2010;24(6):1231-4.
17. Kirk E, Bourne T, Bottomley C, Dhillon-Smith R, Small R, Hollingworth J. Fertility outcomes following conservative surgery for tubal ectopic pregnancy. BJOG. 1997;104(10):1298-301.