

# The cost-effectiveness analysis of laparoscopic treatment of ectopic pregnancy: a single-center review of a five-year experience

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## Summary

**Purpose:** The aim of this study was to investigate the cost-effectiveness of laparoscopic treatment for ectopic pregnancy by comparing the medical expenses and time of hospitalization of laparoscopic and open surgery for ectopic pregnancy in partial area of Shanghai, China. **Materials and Methods:** Clinical data of 762 cases with ectopic pregnancy undergoing surgical treatment (307 cases for laparoscopic surgery and 455 cases for open surgery) were analyzed retrospectively. The clinical information including the medical expenses and time of hospitalization was compared. The patients were divided into three groups according to the treatments of different lesions (lesions resection, conservative laparotomy, and exploration group) and were analyzed. **Results:** The total hospitalization expenses and the top three single costs including surgery, exams, and medicine expenses were higher in laparoscopic group than in open surgery group. There was no significant difference between the two groups on the total time of hospitalization. The hospital days of preoperation were higher but the postoperative hospital days were lower in laparoscopic group than in open surgery group. Compared with the open surgery treatment, the hospitalization expenses of laparoscopic treatment for ectopic pregnancy increased. There was no significant difference on the total hospitalization days. **Conclusion:** The preoperative waiting period of inpatients increased and the post-operative hospital days reduced in laparoscopic group.

**Key words:** Cost; Ectopic pregnancy; Hospitalization days; Laparoscopy.

## Introduction

Laparoscopy is widely applied in the field of obstetrics and gynecology because of minor damage, less pain, rapid recovery, and other advantages. Main gynecological surgery such as salpingo-oophorectomy and hysterectomy can be performed by laparoscopically assisted surgery. In recent years, laparoscopy-assisted diagnosis and surgical treatment of gynaecological malignant tumors has been carried out. For example, laparoscopic surgery for cervical cancer (CC) study and treatment is one of the main achievements [1]. The impact and use of laparoscopy for benign adnexal tumours have markedly increased [2]. Diagnostic laparoscopy can also be used for evaluating patients with advanced ovarian cancer who qualify for primary cytoreduction [3]. Therefore, gynaecological open surgery has a great tendency to be gradually replaced by laparoscopically assisted surgery. With the clinical application and popularity of laparoscopy, its health economics has becoming the new research focus. Previous studies of laparoscopic gynecologic surgery on the reducing hospitalization days and expenses have been reported, so as to provide basis for its clinical application [4-6]. At present, laparoscopy has been applied widely in a variety of surgical interventions in China [7-9]. Compared with other countries, because of health system and different cultures, the laparoscopic technique in reducing length of hospitalization stay and expenses has had a certain difference in China.

In the present study, in order to investigate the health economics of laparoscopic treatment for ectopic pregnancy, retrospective research was conducted by comparing the medical expenses and time of hospitalization of laparoscopic and open surgery for ectopic pregnancy in the Sixth People's Hospital, Shanghai Jiaotong University, Shanghai, China. On this basis, the authors explored the value and strategy of laparoscopy on the rational utilization of health resources and reduction of hospitalization expenses, which can provide evidence for the ongoing health care reform.

## Materials and Methods

The data used in this study included the related hospital records of the present hospital information system (HIS) from January 2003 to December 2007. All diseases were classified according to the International Classification of Diseases 10<sup>th</sup> Revision (Clinical modification, ICD10-CM). The search codes included: abdominal pregnancy 000.001, tubal pregnancy 000.101, tubal abortion 000.102, ruptured tubal pregnancy 000.103, ovarian pregnancy 000.201, ruptured ovarian pregnancy 000.202, and ectopic pregnancy 000.901. The surgical records of cases were reviewed by professional doctor and the cases which met the diagnosis of ectopic pregnancy were included in this study. Exclusion criteria included: 1) Two special types of ectopic pregnancy: cornual pregnancy 000.801 and cervical pregnancy 000.802; 2) Cases with complications and/or complications of other diseases that underwent examination and treatment. 3) Patients with ectopic pregnancy that underwent conservative treatment. Information of all retrieved cases also included the patient's basic information, diagnosis, various fees, hospitalization days, and surgery date. The data were divided into two groups according to the treatment methods:

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laparoscopic surgery group and open surgery group. Their medical expenses and time of hospitalization were compared and analysed. The patients were divided into three groups according to the treatments of different lesions (lesions resection, conservative surgery, and exploration group) and were analyzed.

A database was built through transformation of HIS data into EXCEL format and a retrospective cohort study was conducted. SPSS Version 11.5 was used for data analysis. All values are expressed as means  $\pm$  SD. The significance of differences between two groups was determined by Student's t-test and one-way analysis of variance. Chi-square test of two frequencies with completely randomization was used to analyse three types of frequency distributions. A  $p$  value of  $< 0.05$  was considered as statistically significant.

## Results

There were 917 cases of ectopic pregnancy according to the diagnosis criteria of ICD10-CM, accounting for 6.94% of the total number of deliveries over the same period (917/13214). Among the 917 cases, the following cases were excluded in this study: three cases of cornual pregnancy, six cases of cervical pregnancy, 141 cases of patients examined or treated due to reasons other than ectopic pregnancy during hospitalization (including 33 cases of patients with complications of other organs requiring examination and treatment, 61 cases of patients complicated with ovarian or tubal disorders that underwent surgical treatment simultaneously, 32 cases of patients complicated with uterine diseases and that underwent surgical treatment simultaneously, 20 cases of patients with ectopic pregnancy that underwent conservative treatment).

The 762 cases included in this study were divided into two groups: 307 cases in the laparoscopic surgery group including 230 cases of laparoscopic lesions resection, 69 cases of laparoscopic conservative surgery, and eight cases of exploratory laparoscopy; 455 cases in the open surgery group including 384 cases of transabdominal surgery for focus resection, 66 cases of conservative laparotomy, and five cases of exploratory laparotomy. There was a difference in the treatments of lesions: the rate of transabdominal surgery for focus resection in the open surgery group was higher than that of laparoscopic lesions resection in the laparoscopic surgery group (Table 1).

Among the 762 cases, the incidence of emergency surgery was 44.75%. There were 105 cases of emergency laparoscopic surgery, accounting for 34.2% of laparoscopic surgery, which was significantly lower than that of open surgery (Table 2).

Rate of ectopic pregnancy diagnosed and treated by laparoscopy: during 2003-2007 the rate of ectopic pregnancy diagnosed and treated by laparoscopy was 36.2%-46.2% of the total cases. As shown in Figure 1, there was no rising tendency for application of laparoscopy on diagnosis and treatment of ectopic pregnancy in recent years.

Regarding the proportion of fees in two groups of treatment methods: as shown in Table 3, each of the fees had basically the same proportion. The top three fees (operation, inspection, and drug fees) were further compared. The results showed that the total and the top three fees in the

Table 1. — *Treatment methods of lesions in two groups.*

Treatment methods	Laparoscopic surgery group	Open surgery group	Total
Lesions resection	230	384	614
Conservative surgery	69	66	135
Exploration	8	5	13
Total	307	455	762

Pearson Chi-Square  $\chi^2 = 11.056$   $p = 0.004$ .

Table 2. — *Ways of seeking medical care in two groups.*

Ways of seeking medical care	Laparoscopic surgery group	Open surgery group	Total
Emergency surgery	105	236	341
Non-emergency surgery	202	219	421
Total	307	455	762

$\chi^2 = 23.16$   $p = 0.00$ .

Table 3. — *Proportion of fees in two groups of treatment methods (%).*

Fees	Laparoscopic surgery group	Open surgery group	Total
Operation cost	55	42	49
Inspection fee	18	21	20
Drug cost	10	11	10
Bed fee	3	5	4
Clinical cost	1	1	1
Nursing cost	1	2	1
Treatment cost	8	10	9
Blood transfusion cost	0	5	3
Other costs	4	3	3

Table 4. — *Comparison of fees in two groups.*

Fees (Currency: Yuan)	Laparoscopic surgery group (n = 307)	Open surgery group (n = 455)	t value	p value
Hospitalization cost	8850.94 $\pm$ 1100.46	5872.99 $\pm$ 1923.91	24.544	0.000
Operation cost	4807.72 $\pm$ 1071.03	2439.71 $\pm$ 1234.19	27.374	0.000
Inspection fee	1635.06 $\pm$ 814.16	1247.32 $\pm$ 504.61	7.436	0.000
Drug cost	864.46 $\pm$ 396.10	638.73 $\pm$ 358.00	8.017	0.000

Table 5 — *Fees comparison of treatment by lesions resection in two groups.*

Fees (Currency: Yuan)	Laparoscopic surgery group (n = 230)	Open surgery group (n = 384)	t value	p value
Hospitalization cost	8826.89 $\pm$ 998.13	5788.83 $\pm$ 1849.43	26.404	0.000
Operation cost	4723.99 $\pm$ 1074.95	2349.06 $\pm$ 1113.35	25.915	0.000
Inspection fee	1657.47 $\pm$ 790.70	1261.99 $\pm$ 522.82	6.753	0.000
Drug cost	845.16 $\pm$ 341.34	632.012 $\pm$ 354.52	7.311	0.000

laparoscopic surgery group were all higher than the open surgery group. The difference was statistically significant (Table 4). According to the lesions treatments, the fees of two groups were compared. The results showed that the total fees and the top three types of fees (operation, inspection, and drug fees) of treatments by laparoscopic lesions resection and laparoscopic conservative surgery in the laparoscopic surgery group were respectively higher than

Table 6 — Fees comparison of treatment by conservative surgery in two groups.

Fees (Currency: Yuan)	Laparoscopic surgery group (n = 69)	Open surgery group (n = 66)	t value	p value
Hospitalization cost	8969.82 ± 1234.93	6425.14 ± 2260.62	8.066	0.000
Operation cost	5119.47 ± 897.88	2984.80 ± 1721.33	8.974	0.000
Inspection fee	1511.82 ± 855.06	1156.67 ± 376.00	3.099	0.002
Drug cost	930.45 ± 533.45	666.17 ± 350.35	3.386	0.001

Table 7 — Fees comparison of treatment by exploration in two groups.

Fees (Currency: Yuan)	Laparoscopic surgery group (n = 69)	Open surgery group (n = 66)	t value	p value
Hospitalization cost	8517.31 ± 2290.47	5047.68 ± 1732.48	2.892	0.015
Operation cost	4526.14 ± 1797.88	2206.95 ± 539.48	2.766	0.018
Inspection fee	2053.75 ± 1026.86	1317.00 ± 517.41	1.711	0.116
Drug cost	850.51 ± 476.58	792.33 ± 686.97	0.181	0.860

Table 8 — Comparison of hospitalization days between two groups.

Days	Laparoscopic surgery group (n = 308)	Open surgery group (n = 455)	t value	p value
Hospitalization	8.05 ± 3.39	8.21 ± 2.33	-0.787	0.431
Preoperation	1.64 ± 2.32	0.80 ± 1.70	5.448	0.000
Postoperation	6.41 ± 2.61	7.41 ± 1.82	-5.853	0.000

Table 9 — Comparison of preoperative hospital days of treatment by lesions resection between two groups.

Days	Laparoscopic surgery group (n = 230)	Open surgery group (n = 384)	t value	p value
Hospitalization	7.91 ± 3.38	8.03 ± 2.16	-0.548	0.584
Preoperation	1.59 ± 2.30	0.75 ± 1.64	4.829	0.000
Postoperation	6.32 ± 2.51	7.28 ± 1.73	-5.120	0.000

Table 10 — Comparison of preoperative hospital days of treatment by conservative surgery between two groups.

Days	Laparoscopic surgery group (n = 69)	Open surgery group (n = 66)	t value	p value
Hospitalization	8.30 ± 3.46	9.26 ± 2.95	-1.724	0.087
Preoperation	1.78 ± 2.27	1.09 ± 2.07	1.854	0.066
Postoperation	6.52 ± 2.79	8.17 ± 2.10	-3.880	0.000

Table 11 — Comparison of preoperative hospital days of treatment by exploration between two groups.

Days	Laparoscopic surgery group (n = 8)	Open surgery group (n = 5)	t value	p value
Hospitalization	9.75 ± 3.01	8.00 ± 2.55	1.122	0.289
Preoperation	1.88 ± 3.23	0.60 ± 0.55	1.093	0.308
Postoperation	7.88 ± 3.56	7.40 ± 2.70	0.272	0.791

those of treatments by transabdominal surgery for focus resection and conservative laparotomy in the open surgery group. The differences were statistically significant (Tables 5, 6). The fees of treatment by exploration including costs of hospitalization and operation in the laparoscopic surgery group were higher than the open surgery group (Table 7).

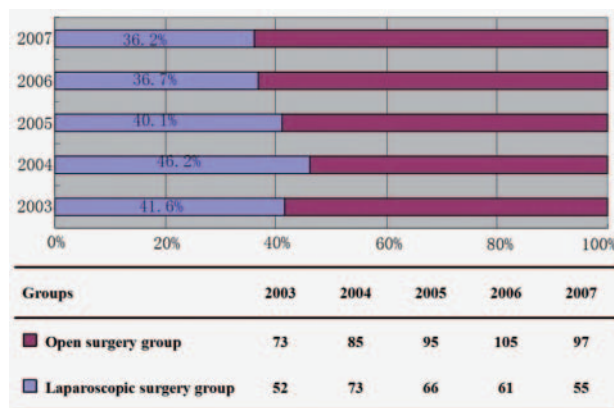


Figure 1. — Rate of ectopic pregnancy diagnosed and treated by laparoscopy.

There were no significant differences in the costs of inspection and drugs between the two groups. Because of the small number of cases, the difference of cost between the two treatment methods require further analysis.

The results showed that there was no significant difference on the total hospitalization days between the two groups. However, the hospital days of preoperation were higher but the postoperative hospital days were lower in the laparoscopic group than in the open surgery group (Table 8). Among the cases of lesions resection, the hospital days of preoperation were higher in the laparoscopic group than in the open surgery group. There were no difference on the hospital days of preoperation between the two groups of conservative surgery, but the postoperative hospital days of conservative surgery in the laparoscopic group were lower than that in the open surgery group. There was no difference in hospitalization days between two exploratory groups (Tables 9, 10, 11).

## Discussion

Operative laparoscopy as the mainstay in management of ectopic pregnancy is the safest and most effective method [10-13]. However, the degree of popularity of operative laparoscopy in management of ectopic pregnancy can be affected by health policy, medical technology, and other factors in different countries. The primary reason of using open surgery for treatment of ectopic pregnancy is no experience in management of ectopic pregnancy by laparoscopy [12]. In addition, one of the reasons for the application of laparoscopic technique is more likely due to the use of open abdominal surgery in emergency. The use of laparoscopy increased with the improvement of early diagnosis of ectopic pregnancy and decrease of requirement for an emergency open surgery intervention in emergency [13]. The percentage of laparoscopic approach for ectopic pregnancy between 2000 and 2006 in Romania has grown from 23.5 to 58.6% [14]. In France, only open surgery is required unless there are contraindications in the use of laparoscopic treatment [15]. The percentage of laparoscopic treatment of ectopic pregnancy in America is up to 70% [16]. Laparoscopy has been



applied in all surgical areas in China at a higher rate after laparoscopy due to the impact and promotion of the international community since the eighties-nineties of last century [17, 18]. Currently, laparoscopic technique has been mastered by Chinese doctors, especially by those in larger institutions, but its application is not completely universal. In the present study, application of laparoscopic treatment of ectopic pregnancy in a large hospital in Shanghai, China was analyzed. The data indicated that application rate of laparoscopic treatment of ectopic pregnancy during 2003-2007 was 36.2-46.2%. The highest rate was in 2004 and it shows a downward trend in recent years. The main reason may be related to the introduction and promotion of the new technology by the former doctors. With mastery of technology, doctors no longer require promotions and ectopic pregnancy may be diagnosed and treated by lower-seniority doctors. Therefore, open surgery was usually chosen for treatment of by lower-seniority doctors due to lack of experience in laparoscopic diagnosis and treatment, hence leading to a decreasing trend in the number of laparoscopic treatments.

Compared with open surgery, there were different reports on laparoscopy regarding reducing healthcare costs in the management of patients with ectopic pregnancy. Some believe that the total cost can be reduced [18]. It also believed in some reports that there was no difference in costs between laparoscopic surgery and traditional open surgery, and that it could be even higher than open surgery [6, 19, 20]. The reason may be related to different healthcare systems and to varying costs in different countries. In the present study, the data from Shanghai, China showed that the main costs in the management of patients with ectopic pregnancy were fees related to surgery, inspection, and medication. The percentage of hospitalization costs was only three to five percent of the total costs. The cost was higher than that of traditional open surgery and the reason was mainly related to the economic level at the times when charging standards of new technology were established by the Chinese government. Increase of inspection fees may be related to the preparation before laparoscopic surgery. Therefore, because of these factors the total medical fees of laparoscopic surgery in the management of patients with ectopic pregnancy is increased. Because laparoscopy is less painful and does not increase intra- or postoperative complications, it has a shorter length of hospital stay and quicker return to work than traditional open surgery [5]. Due to different cultural backgrounds, the patients in China are willing to stay in the hospital until fully recovery, so the hospital stay is often longer than many developed countries. The results in this study indicated that compared with traditional open surgery, there was no significant improvement of the total hospitalization days in diagnosis and treatment of ectopic pregnancy by laparoscopy. Because laparoscopy is usually used for non-emergency surgery, the preoperative hospital days were longer in the laparoscopic group than in the open surgery group and the postoperative length of hospital stay is improved due to faster recovery, especially in the cases of ectopic pregnancy by lesions resection. In conclusion, it is feasible to reduce hospital stay of laparoscopic treatment of ectopic pregnancy in China but its effect on reducing costs is not significant.

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