Postprint: Meta-Analysis of Outcomes of Open versus Laparoscopic Surgery for Adrenal Tumors

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Abstract

Objective: To compare the efficacy and safety of open surgery versus laparoscopic surgery in the treatment of adrenal tumors through a systematic review. Methods: A computerized search was conducted on relevant databases including CNKI, PUBMED, SinoMed, EBSCO, Springerlink, Wanfang Medical Network, and VIP Database to comprehensively collect relevant literature published from 1999-2016. Articles were screened, evaluated, and relevant data were extracted. Meta-analysis was performed using RevMan5.2 software. Results: Twenty-five articles were included, totaling 2340 patients. Meta-analysis results showed that laparoscopic surgery was superior to open surgery in terms of postoperative intestinal function recovery time [OR=-0.96, 95%CI (-1.22, -0.70) P<0.00 001], hospital stay length [OR=-3.48, 95%CI (-4.13, -2.78) P<0.00 001], postoperative complications [OR=0.22, 95%CI (0.14, 0.35) P<0.00 001], and intraoperative blood loss (OR=-104.77, 95%CI (-138.95, -70.60) P<0.00 001) ; there was no statistically significant difference between the two groups in the comparison of operation time and surgical costs. Conclusion: Laparoscopic surgery is superior to open surgery in postoperative intestinal function recovery time, hospital stay length, postoperative complications, and intraoperative blood loss, but there is no significant difference in operation time and surgical expenses.

Full Text

Preamble

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Abstract

Objective: To systematically evaluate the efficacy and safety of open surgery versus laparoscopic surgery in the treatment of adrenal tumors. **Methods:** Computerized searches were conducted in CNKI, PUBMED, SinoMed, EBSCO, Springerlink, Wanfang Medical Network, VIP Database, and other relevant databases to comprehensively collect literature published from 1999 to 2016. Articles were screened, evaluated, and relevant data were extracted. Meta-analysis was performed using RevMan 5.2 software. **Results:** A total of 25 articles involving 2340 patients were included. Meta-analysis results showed that laparoscopic surgery was superior to open surgery in terms of postoperative intestinal function recovery time [OR=-0.96, 95%CI (-1.22, -0.70) P<0.00001], hospitalization time [OR=-3.48, 95%CI (-4.13, -2.78) P<0.00001], postoperative complications [OR=0.22, 95%CI (0.14, 0.35) P<0.00001], and intraoperative blood loss (OR=-104.77, 95%CI (-138.95, -70.60) P<0.00001). There was no statistically significant difference between the two groups in the comparison of operation time and surgical costs. **Conclusion:** Laparoscopic surgery is superior to open surgery in postoperative intestinal function recovery time, hospitalization time, postoperative complications, and intraoperative blood loss, but there is no significant difference in operation time and surgical costs.

Keywords: laparoscopic surgery; open surgery; adrenal tumor; meta-analysis

Introduction

Due to the high and deep location of adrenal tumors, traditional open surgery often requires long incisions and carries a risk of pleural injury. Moreover, functional adrenal tumors often have endocrine functions, and open surgery frequently encounters intraoperative hypertension and adrenal crisis, increasing surgical difficulty and risk [1]. After more than 20 years of development and promotion, laparoscopic technology has brought significant changes to the treatment of adrenal tumors. Many scholars [1, 4, 8] have reported its advantages in operation time, estimated intraoperative blood loss, complications, and postoperative hospitalization days. However, some scholars [5, 24] believe that obesity, tumor diameter, pheochromocytoma, and malignant tumors are the main limiting factors for retroperitoneal laparoscopic adrenal tumor surgery. Given that current studies on the two surgical approaches for adrenal tumor resection are mostly small-sample controlled studies lacking systematic comprehensive evaluation, this article conducts a Meta-analysis on the efficacy of open surgery versus laparoscopic surgery in adrenal tumor resection to compare the therapeutic effects and safety of the two methods.

Methods

1.1 Data Sources

Relevant databases including CNKI, PUBMED, SinoMed, EBSCO, Springerlink, Wanfang Medical Network, and VIP Database were searched for literature published from 1999 to 2016 using the Chinese keywords "open surgery," "laparoscopic surgery," and "adrenal tumor," and the English keywords "open operation," "laparoscopic operation," and "Adrenal tumor."

1.2.1 Inclusion Criteria

(1) Studies included Chinese and English literature published from 1999 to 2016; (2) Laparoscopic surgery served as the experimental group and open surgery as the control group; (3) Patients were adrenal tumor patients without other serious diseases; (4) Study outcomes included postoperative intestinal function recovery time, hospitalization time, operation time, postoperative complications, intraoperative blood loss, and surgical costs.

1.2.2 Exclusion Criteria

(1) Review articles and duplicate reports of the same population data; (2) Literature with incomplete data or not meeting extraction criteria; (3) Patient populations that were special populations or had other serious diseases.

1.3 Data Extraction

According to the inclusion criteria, two researchers independently screened and extracted data. Any disagreements were resolved through discussion and adjudication by a third researcher. The extracted data mainly included the first author, publication date, basic patient information (age, gender, tumor location, etc.), postoperative intestinal function recovery time, hospitalization time, operation time, postoperative complications, intraoperative blood loss, and surgical costs.

1.4 Quality Assessment

The quality of included studies was assessed using the Jadad scale, which evaluates whether the study used randomization, whether blinding was employed, whether loss to follow-up and withdrawals were described, and whether baseline comparisons were consistent. The Jadad scale has a total score of 5 points (1-2 points indicating low quality, 3-5 points indicating high quality), with higher scores indicating better article quality (Table).

1.5 Statistical Analysis

Statistical analysis was performed using RevMan 5.2 software. Heterogeneity among studies was analyzed using the ^{2} test, with a heterogeneity test level of =0.1. If there was no statistical heterogeneity between studies (I2 50%), a fixed-effects model was used for Meta-analysis; if statistical heterogeneity existed (I2>50%), subgroup analysis was performed or a random-effects model was used for Meta-analysis. Dichotomous data used OR as the effect measure, while continuous data used mean difference (MD) as the effect measure, with a test level of =0.05.

Results

2.1 Literature Search Results

Initially, 356 articles were identified, and after screening according to the inclusion criteria, 25 articles were finally included, all published in full text. The basic characteristics of the included literature are shown in (Table).

2.2 Baseline Analysis

2.2.1 Age Analysis Among the 25 articles, 17 reported the standard deviation of age for both patient groups. Statistical analysis showed that the heterogeneity test (P<0.1, I2=82%) indicated heterogeneity, and a random-effects model was used for analysis (P=0.81). The results showed no statistically significant difference in patient age between study groups, with relatively consistent age baselines (Figure [Figure 1: see original paper]).

2.2.2 Gender Analysis Among the 25 articles, 21 reported the gender distribution for different groups. Statistical analysis showed that the heterogeneity test (P=0.99, I2=0%) indicated homogeneity, and a fixed-effects model was used for analysis (P=0.93). The results showed no statistically significant difference in patient gender between study groups, with relatively consistent gender baselines (Figure [Figure 2: see original paper]).

2.3 Outcome Measures

2.3.1 Postoperative Intestinal Function Recovery Time All 12 articles included the indicator of postoperative intestinal function recovery time. Statistical analysis showed that the heterogeneity test (P<0.1, I2=87%) indicated significant heterogeneity, and a random-effects model was used for analysis (P<0.00001). The results showed a statistically significant difference in postoperative intestinal function recovery time between study groups, with laparoscopic surgery demonstrating superior recovery time compared to open surgery (Figure [Figure 3: see original paper]).

2.3.2 Operation Time Among the 25 articles, 2 did not provide the standard deviation of age for both patient groups and could not be combined. The remaining 23 articles were included in statistical analysis. The heterogeneity test (P<0.1, I2=98%) indicated significant heterogeneity, and a random-effects model was used for analysis (P=0.21). The results showed no statistically significant difference in operation time between study groups (Figure [Figure 4: see original paper]).

2.3.3 Hospitalization Time Twenty-two articles provided information on hospitalization time for both patient groups. Statistical analysis showed that the heterogeneity test (P<0.1, I2=94%) indicated significant heterogeneity, and a random-effects model was used for analysis (P<0.00001). The results showed a statistically significant difference in hospitalization time between study groups, with laparoscopic surgery demonstrating superior hospitalization time compared to open surgery (Figure [Figure 5: see original paper]).

2.3.4 Postoperative Complications Eleven articles were included. The heterogeneity test (P=0.11, I2=36%) indicated no significant heterogeneity, and a fixed-effects model was used for analysis (P<0.0001). The results showed a statistically significant difference in postoperative complications between study groups, with laparoscopic surgery having fewer complications than open surgery (Figure [Figure 6: see original paper]).

2.3.5 Intraoperative Blood Loss A total of 21 articles were included. The heterogeneity test (P<0.0001, I2=99%) indicated significant heterogeneity, and a random-effects model was used for analysis (P<0.00001). The results showed that intraoperative blood loss was less in laparoscopic surgery than in open surgery (Figure [Figure 7: see original paper]).

2.3.6 Surgical Costs Four articles were included. The heterogeneity test (P<0.1, I2=99%) indicated significant heterogeneity, and a random-effects model was used for analysis (P=0.13). The results showed no statistically significant difference in surgical costs between the two procedures (Figure [Figure 8: see original paper]).

Discussion

This study conducted a Meta-analysis comparing the effectiveness and safety of open surgery versus laparoscopic surgery for adrenal tumors by analyzing indicators such as postoperative intestinal function recovery time, hospitalization time, operation time, postoperative complications, intraoperative blood loss, and surgical costs. Baseline analysis of the 25 included articles involving 2340 patients showed no differences in age and gender, demonstrating good consistency. Statistical analysis of the main outcome indicators showed that laparoscopic surgery was superior to open surgery in postoperative intestinal

function recovery time, hospitalization time, postoperative complications, and intraoperative blood loss, but there was no significant difference between the two surgical approaches in operation time and surgical costs.

Since Gagner first reported laparoscopic adrenalectomy in 1992, laparoscopic surgery has been increasingly applied in the clinical treatment of adrenal diseases [3]. In 1999, Smith even compared laparoscopic adrenalectomy to transurethral resection of the prostate, considering it the gold standard for adrenal surgery [23]. Laparoscopic adrenalectomy is divided into retroperitoneal and transperitoneal approaches based on the surgical route [2]. Foreign surgeons mostly prefer the transperitoneal approach, characterized by easily identifiable anatomical structures and large operating space, which is particularly advantageous for robot-assisted surgery. In China, the retroperitoneal approach is mostly adopted, with advantages including easy exposure of the adrenal gland, minimal interference with abdominal organs, reduced postoperative abdominal infection and adhesion, and faster recovery. The disadvantages are that anatomical structures are not easily identified and the operating space is small [19]. Data analysis showed that laparoscopic surgery is superior to open surgery in treating adrenal tumors, with characteristics including less interference with the abdominal cavity, minimal trauma, rapid recovery, and avoidance of infection caused by stimulation and contamination of the abdominal cavity by bacteria from air and skin surface.

Although the analysis results showed that laparoscopic surgery is superior to open surgery for adrenal tumors, there are still domestic reports of blood pressure surge and cardiac arrest due to unskilled operation and tumor rupture during dissection [24]. Additionally, due to bleeding, uncertain establishment of the retroperitoneal operating space after peritoneal rupture, or patient obesity, some patients require conversion to open surgery during the procedure [24]. This demonstrates that while laparoscopic surgery has significant advantages, it also has certain limitations. The artificial retroperitoneal space has unclear anatomical landmarks, surgical instruments easily interfere with each other, and it requires proficient laparoscopic skills, limiting its application. Furthermore, laparoscopic equipment is expensive and the operation is relatively complex, requiring retraining in laparoscopic surgery and high technical demands on surgeons [25]. The operation time for laparoscopic surgery is difficult to predict before surgery, and complex cases often require considerably more time. Although statistical analysis showed that overall laparoscopic surgery duration was better than open surgery, a small portion of procedures took significantly longer than open surgery.

The main limitations of this study include: in the comparison of surgical costs, the lack of statistically significant difference between the two groups may be due to insufficient data, as only 2 of the 25 articles discussed surgical costs, resulting in incomplete data and potential bias in the study results. Additionally, the included studies lacked RCTs. Although baseline analysis showed no differences in patient age and gender with good consistency, the included literature

spanned from 1999 to 2016, a relatively long time period that may have heterogeneity in medical standards and technology, potentially causing bias in the Meta-analysis. Therefore, when using the results of this study as a reference, appropriate and reasonable clinical decisions should be made in combination with actual circumstances.

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Note: Figure translations are in progress. See original paper for figures.