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Analysis of the Effectiveness of Laparoscopic Appendectomy Compared to Laparotomy in the Treatment of Acute Appendicitis

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Abstract: *Objective*: To analyze the clinical effects of laparoscopic appendectomy compared to traditional laparotomy in treating acute appendicitis. *Methods:* 90 patients with acute appendicitis were selected as research subjects. They were divided into a control group and an observation group, with 45 cases in each group. The control group underwent traditional laparotomy, while the observation group underwent laparoscopic appendectomy. The intraoperative indicators, postoperative recovery indicators, postoperative stress indicators, and postoperative complications of the two groups were compared. *Results:* The operative time of the observation group was longer, but the incision length was shorter and the blood loss was lesser ($P < 0.05$); the observation group had shorter postoperative first gas-passing time, recovery of gastrointestinal function, ambulation time, and lower postoperative pain score. The observation group had lower postoperative stress index levels ($P < 0.05$); the observation group had a lower postoperative complication rate ($P < 0.05$). *Conclusion:* Aside from prolonging the operative time, laparoscopic appendectomy is more ideal than traditional laparotomy in all other indicators and has better therapeutic effects in treating acute appendicitis.

Keywords: Acute appendicitis; Traditional laparotomy; Laparoscopic appendectomy

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1. Introduction

Appendicitis is an acute abdominal disease, and its incidence gradually increases with age. Statistics show that the mortality rate of acute appendicitis in the elderly is eight times higher than that of non-elderly people [1], which may be related to the deterioration of physical functions in the elderly. It is related to many underlying diseases and other factors. The occurrence of appendicitis is related to a person's diet. Nowadays, most people eat processed foods every day. Processed foods have low fiber content, which will reduce the amount and the expansion of the distal intestinal cavity, leading to intestinal diverticula, which induces appendicitis [2]. The main clinical treatment for appendicitis is surgery. When medical equipment and technology were underdeveloped, laparotomy was mainly used to treat appendicitis. With the development of the medical field, more treatment options have been developed for appendicitis. These procedures are developed with the goal of being less invasive.

Laparoscopic appendectomy is the preferred option for treating appendicitis due to its benefits, including reduced trauma, quicker recovery, decreased patient pain, and an improved surgical experience. However, because it is a delicate surgery, it may take a longer time and cause some adverse effects on patients. Therefore, to further analyze the effects of laparoscopic surgery and laparotomy, 90 cases of acute appendicitis were included as research subjects and divided into two groups. The clinical data of the patients of the two groups were compared.

2. Materials and methods

2.1. Information

A total of 90 patients with acute appendicitis were selected as the subjects of this study (admission period: February 2022 to January 2023). They were divided into two groups according to different surgical treatment plans, with 45 cases in each group.

The control group consisted of 28 males and 17 females, aged 41 to 70 years old (62.26 ± 3.35 years old on average); the types of cases included 8 cases of simple appendicitis, 15 cases of gangrenous appendicitis, and 22 cases of suppurative appendicitis; the comorbidities of the patients in this group were 12 cases of high blood pressure, 10 cases of diabetes, 10 cases of coronary heart disease, and 5 cases of chronic bronchitis.

The observation group consisted of 29 males and 16 females, aged 40–72 years old (62.41 ± 3.18 years old on average); the types of cases included 10 cases of simple appendicitis, 14 cases of gangrenous appendicitis, 21 cases of suppurative appendicitis; the comorbidities of the patients in this group were 13 cases of high blood pressure, 11 cases of diabetes, 10 cases of coronary heart disease, and 4 cases of chronic bronchitis.

Inclusion criteria: (1) Diagnosed with acute appendicitis based on the "2015 Basic Clinical Practice Guidelines for Acute Abdomen Interpretation" [3]; (2) complaints of metastatic right lower quadrant pain upon admission, accompanied by Maxwell's point tenderness and reaction and throbbing pain; (3) abdominal effusion was found through B-ultrasound examination, and appendiceal enlargement and mass formation in the appendix area were also seen; (4) clear indications for surgery and postoperative pathological diagnosis; (5) complete clinical data.

Exclusion criteria: (1) Patients who have undergone abdominal surgery in the past or other major surgeries recently, (2) patients with contraindications to surgery, (3) patients in the acute infection stage, (4) patients with other serious illnesses or mental illnesses.

2.2. Methods

All 90 patients with appendicitis received symptomatic treatment upon diagnosis. Preoperative blood pressure and blood sugar levels were controlled within the surgical range, and water, electrolyte, and acid-base balance were corrected.

The observation group underwent laparoscopic appendectomy. The patients were laid in a supine position and were given general anesthesia and routinely sterilized draping. An arc incision (≈ 1cm) was made at the lower edge of the umbilicus, and the pneumoperitoneum needle was inserted. An artificial pneumoperitoneum was created, with an air pressure of between 12–14 mmHg, and the patients' positions were adjusted. A 10 mm trocar was inserted through the incision, and a 30° laparoscopic lens (5mm) was inserted to comprehensively explore the intracavity and exclude other lesions. The incision was expanded, and a single-hole multi-channel device was inserted, and two laparoscopic instruments and a 30° laparoscope were inserted through the single-hole multi-channel device to observe the condition of the appendix. Then the blind end of the appendix was lifted, the mesoappendix was double-clamped with a Hem-o-lok clip, and it was cut off using an

electrocoagulation hook, while simultaneously performing cauterization. The base of the appendix was further clamped, and the upper cover of the single-hole multi-channel device was opened. The pneumoperitoneum was deflated, and the resected appendix was extracted through the single-hole multi-channel device. Lastly, the device and the drainage tube were removed.

The control group underwent open appendectomy. In a supine position, under general anesthesia or combined spinal and epidural anesthesia, an oblique incision was made at one-third of the outside of the line between the umbilicus and the superior iliac spine. The appendix was found and removed, and the stump was closed using the purse-string suture, with the drainage tube removed.

2.3. Observation indicators

(1) Intraoperative indicators: incision length, intraoperative blood loss, and operative time.

(2) Postoperative recovery indicators: First gas-passing time, gastrointestinal function recovery time, ambulation time, and pain score. The pain score was evaluated using the visual analog scale (VAS) [4], ranging from 0–10 points. The higher the score, the higher the pain level.

(3) Postoperative stress indicators: Blood glucose levels, norepinephrine levels, and serum cortisol levels.

(4) Postoperative complications: Intestinal obstruction, surgical site infection, etc.

2.4. Statistical methods

SPSS 20.0 was used to perform statistical analysis. The count data were expressed as percentages and analyzed by a χ^2-test; while the measurement data were expressed as mean ± standard deviation and analyzed by a *t*-test, with $P < 0.05$ indicating statistical significance.

3. Results

3.1. Intraoperative indicators

The length of the incision was shorter and the intraoperative blood loss was lower in the observation group compared to the control group. However, the operative time of the observation group was longer than the control group ($P < 0.05$). Further details are shown in **Table 1**.

Table 1. Intraoperative indicators (mean ± standard deviation)

Group name	Number of cases	Incision length (cm)	Intraoperative blood loss (mL)	Operation time (min)
Control group	45	6.79 ± 2.14	73.52 ±**10.18**	54.15 ± 5.28
Observation group	45	1.08 ± 0.27	30.25 ± 4.15	73.63 ± 7.15
t	-	17.758	26.403	14.702
P	-	0.000	0.000	0.000

3.2. Postoperative recovery indicators

The first gas-passing time, gastrointestinal function recovery time, and ambulation time of the patients in the observation group were all shorter than those in the control group. The postoperative pain score of the patients in the observation group was also lower than that of the control group ($P < 0.05$). Further details are shown in **Table 2**.

Table 2. Postoperative recovery indicators (mean ± standard deviation)

Group	Number of cases	First gas-passing time (h)	Gastrointestinal function recovery time (h)	Ambulation time (h)	Pain score (points)
Control group	45	19.25 ± 3.16	34.52 ± 4.15	28.52 ± 7.23	4.20 ± 1.18
Observation group	45	15.20 ± 1.14	24.70 ± 2.29	16.34 ± 3.25	1.40 ± 0.58
t	-	8.087	13.898	10.307	14.285
P	-	0.000	0.000	0.000	0.000

3.3. Postoperative stress indicators

The postoperative blood sugar levels, norepinephrine levels, and serum cortisol levels of the patients in the observation group were lower than those of the control group ($P < 0.05$), as shown in **Table 3**.

Table 3. Postoperative stress indicators (mean ± standard deviation)

Group	Number of examples (n)	Blood sugar level (mmol/L)	Norepinephrine level (μg/L)	Serum cortisol level (μg/L)
Control group	45	8.59 ± 1.48	64.52 ± 5.28	125.36 ± 12.17
Observation group	45	6.45 ± 1.37	32.47 ± 2.29	55.14 ± 3.20
t	-	7.118	37.357	37.433
P	-	0.000	0.000	0.000

3.4. Postoperative complications

The incidence of postoperative complications in patients with appendicitis in the observation group was lower than that in the control group ($P < 0.05$), as shown in **Table 4**.

Table 4. Postoperative complications [*n* (%)]

Group	Number of cases	Intestinal obstruction	Incision infection	Abdominal abscess	Total
Control group	45	3	4	3	10 (22.22)
Observation group	45	1	0	1	2 (4.44)
χ^2	-	-	-	-	6.154
P	-	-	-	-	0.013

4. Discussion

Appendicitis is related to many factors, such as daily diet, living habits, etc. The most common type of appendicitis is purulent appendicitis, which has an acute onset and rapid progression. Appendicitis comes with symptoms such as metastatic right lower quadrant pain, tenderness, and rebound tenderness and requires prompt treatment, otherwise, it might be life-threatening. There are currently many surgical options available for the treatment of appendicitis, with one of them being laparoscopic appendectomy. This method requires a small incision, which can avoid the exposure of the organs to air, thereby reducing negative effects. Laparoscopic surgery is a minimally invasive surgery and is less painful. A wide field of view and accurate positioning are conducive to the recovery of intestinal function after surgery. Since the incision is small, the scar would be less visible. In short, laparoscopic surgery can reduce trauma and is more beneficial for the patient.

Acute appendicitis can also be treated by appendectomy, which involves directly removing the

inflammatory lesions and cutting off the path of invasion, thereby preventing recurrence. Traditional laparotomy requires a large incision and causes a large amount of blood loss. Besides, prolonged exposure of abdominal organs to the air will increase the risk of abdominal abscess and infection [5].

Furthermore, the instruments employed during the surgery can potentially cause significant irritation to the intestinal tract, increasing the risk of intestinal adhesion and obstruction. Additionally, the operation's effectiveness may be compromised if the appendix cannot be located due to the constraints of the surgical incision and the variability in the appendix's position. Laparoscopic surgery opens the way for minimally invasive techniques. It not only has many advantages such as less trauma, less pain, and faster recovery, but is also more in line with modern people's needs for aesthetics. Laparoscopic appendectomy combines diagnosis and treatment, involving pre-surgery exploration of the abdominal cavity with a laparoscope. This approach helps in confirming the diagnosis, identifying the appendix's location, and screening for any additional abnormalities. If other issues like gastric perforation are identified, only one or two additional puncture holes may be necessary [6,7], without needing another surgery. In addition, the intra-abdominal organs are not exposed during the surgery, which can reduce gastrointestinal irritation and facilitate the recovery of gastrointestinal function post-surgery. **Table 2** shows that the recovery time of various indicators such as the first gas-passing time in the observation group was shorter, and the pain score was lower, indicating that laparoscopic surgery is more conducive to postoperative recovery. This surgical incision is small and can be covered by using just a band-aid, so the chances of infection are very low. In cases of appendiceal perforation, pus may accumulate in the abdominal cavity. Traditional laparotomy is constrained by a limited field of view, making it difficult to completely remove the pus [8]. However, laparoscopic surgery can effectively irrigate and remove the accumulated pus within the abdominal cavity, reducing the risk of postoperative complications such as intestinal obstruction and abdominal abscess, as indicated in the data presented in **Table 4**. The incidence of postoperative complications in the observation group was lower, which further shows that laparoscopic surgery can reduce complications. **Table 1** shows that the observation group had smaller incision length and smaller blood loss, but the operative time was longer, which may be related to the presence of appendiceal perforation, cecal edema, or other, which increased the difficulty of the surgery [9,10]. Moreover, it was found that the observation group had lower levels of postoperative stress indicators, indicating that laparoscopic surgery can reduce postoperative stress response. Studies have found that pneumoperitoneum created in laparoscopic surgery can cause high abdominal pressure and induce stress hyperglycemia [11]. But surgery has little impact on blood sugar, C-peptide, insulin, etc., so the occurrence of stress hyperglycemia is unlikely [12]. The lower blood sugar levels observed in the study group support this perspective.

5. Conclusion

In summary, acute appendicitis has a very high incidence rate in clinical practice. Although laparoscopic appendectomy for acute appendicitis takes a longer time compared to traditional laparotomy, but it results in less trauma, faster postoperative recovery, and less pain for the patient. It also has a lower complication rate, which makes it a more ideal option for the patient.

Disclosure statement

The author declares no conflict of interest.

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