

## Comparison of Laparoscopic and Open Appendectomy in Clinical Results and Cost: A Single Center Experience

### Laparoskopik ve Aık Apendektominin Klinik Sonuları ve Maliyet Aısından Karřılařtırılması: Tek Merkez Deneyimi

Özgün Arařtırma  
Research Article

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#### ABSTRACT

**Introduction:** Appendectomy is one of the most commonly performed emergency surgeries. As there is no consensus on the most appropriate technique, both open (OA) and laparoscopic (LA) methods have been used in appendectomy. This retrospective study aims to compare OA and LA in the treatment of acute appendicitis with regard to their effectiveness and cost analysis.

**Methods:** Data obtained from the records of patients who underwent appendectomy due to a diagnosis of acute appendicitis were retrospectively evaluated. The patients were divided into two groups as LA and OA. The two groups were compared with regard to age, gender, operative times, postoperative pain, complication rates, hospitalization times, return to daily activities, and cost.

**Results:** At our hospital, 4474 patients (2765 M, 1709 F) underwent appendectomy due to a diagnosis of acute appendicitis between September 2010-June 2017. Median age was 29.7 years (1-90 y). Of the patients, 806 underwent LA and 3668 OA. Median operative times were 43 min for the LA group and 39 min for the OA group ( $p>0.05$ ). As the post-operative complication, wound infection was detected in 102 patients in the AA group and in 21 cases in the LA group ( $p>0.05$ ). The total treatment cost was 37 USD higher for the LA group ( $p<0.05$ ).

**Conclusion:** Laparoscopic appendectomy is more advantageous than open appendectomy in terms of lesser need for postoperative analgesia and faster return to normal life. At the time being, the only disadvantage of laparoscopic appendectomy appears to be its cost.

**Keywords:** Appendectomy, laparoscopic, cost

#### ÖZ

**Ama:** Apendektomi en sık uygulanan acil cerrahi giriřimlerden birisidir. En uygun tekniđin hangisi olduđu konusunda tam bir fikir birliđi olmadıđı için apendektomide hem aık (AA) hem de laparoskopik (LA) yntem kullanılmaktadır. Bu retrospektif alıřmada, akut apandisit tedavisinde AA ve LA'nin etkinliklerinin ve maliyet analizlerinin karřılařtırılması amalanmıřtır.

**Yntem:** Akut apandisit tanısıyla apendektomi uygulanan hastanın dosya verileri retrospektif olarak incelendi. Hastalar LA ve aık AA olarak iki gruba ayrıldı. İki grup yař, cinsiyet, operasyon sresi, ameliyat sonrası ađrı, komplikasyon oranı, hastanede yatıř sresi, gnlk aktiviteye dnř ve maliyet aısından karřılařtırıldı.

**Bulgular:** Hastanemizde Eyll 2010-Haziran 2017 tarihleri arasında akut apandisit tanısıyla 4.474 hastaya (2765 E, 1709 K) apendektomi iřlemi uygulanmıřtır. Yař ortalaması 29,7 yıldır (1-90 y). Hastaların 806'sına LA, 3.668'ine AA uygulanmıřtır. Ortalama ameliyat sresi LA grubunda 43 dk., AA grubunda 39 dk. idi ( $p>0,05$ ). Ameliyat sonrası komplikasyon olarak AA grubunda 102 hastada yara yeri infeksiyonu saptanırken, LA grubunda 21 olguda gzlenmiřtir ( $p>0,05$ ). LA grubunda toplam tedavi maliyeti 37 USD daha yksekti ( $p<0,05$ ).

**Sonu:** Laparoskopik apendektomi, postoperatif analjezi gereksiniminin daha az olması ve gnlk aktiviteye erken dnř aısından aık apendektomiye gre daha avantajlıdır. Laparoskopik apendektominin řu an iin grnen tek dezavantajı maliyetinin yksekte olmasıdır.

**Anahtar kelimeler:** Apendektomi, laparoskopik, maliyet

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## INTRODUCTION

Appendicitis, which is the most prevalent cause of an acute abdomen in all age groups, leads among diseases that most frequently require emergency surgical treatment <sup>(1,2)</sup>. Appendectomy can be performed with an open or laparoscopic method. Open appendectomy, which has been effectively and safely performed since the 19<sup>th</sup> century <sup>(3,4)</sup>, still prevails as the golden standard. As laparoscopic surgery becomes more common, which method to prefer in appendectomy has become a subject of discussion. While open appendectomy is the primary choice due to its shorter operative times, easy implementation, and lower complication rates <sup>(5,6)</sup>, laparoscopic appendectomy is preferred due to faster wound recovery, shorter hospitalization times, lesser postoperative pain, and better cosmetic results <sup>(2,7-9)</sup>.

In this study, we aimed to investigate the method which must be given priority in the treatment of acute appendicitis by comparing the laparoscopic and open methods with regard to their effectiveness, operative times, time to postoperative food intake, postoperative need for analgesia, complication rates, hospitalization times, return to daily activities, and cost.

## MATERIALS and METHODS

Data from patients operated at our clinic due to a diagnosis of an acute abdomen and diagnosed with acute appendicitis between September 2010-June 2017 were retrospectively evaluated. Time to surgery and incidental appendectomies were not included in the study. Also, patients diagnosed with perforated appendicitis were excluded from the study. The patients were divided into two groups as those who underwent laparoscopic appendectomy (LA) and open appendectomy (OA). The two groups were compared with regard to age, gender, operative times, intraoperative and postoperative complications, time of postoperative food intake, hospitaliza-

tion times, and cost.

Laparoscopic appendectomy was performed intracorporeally with the aid of three ports (umbilicus 10 mm, left lower quadrant 5 mm, suprapubic 5 mm). No staplers were used during the procedure, meso of the appendix was dissected using a monopolar cautery, then the appendiceal stump was ligated with 2-0 silk and cut with LigaSure™ (Covidien, Boulder, CO, USA). A sterile glove was used as an endobag. The inflamed appendix was extracted from the abdomen using a 10 mm-trocar, the operation was terminated after abdominal irrigation with physiological serum and aspiration.

In open appendectomy, the appendix was accessed through a transverse skin incision made on the right lower quadrant, meso of the appendix was dissected using a monopolar cautery, and the appendectomy procedure was performed. The appendiceal stump was not buried in most cases.

## RESULTS

At our hospital (Departments of Pediatric and General Surgery), 4474 patients (2765 M, 1709 F) underwent appendectomy due to a diagnosis of acute appendicitis between May 2001-June 2017. The median age for all patients was 29.7 years (1-90y). The median ages in the LA, and OA groups were 25.6 years and 30.6 years, respectively.

A total of 806 patients were enrolled to the laparoscopic, and 3668 patients to the open appendectomy group. Selection of the operative technique was made based on the availability of the required equipment for laparoscopic surgery and the assisting surgical team at the time of the surgery. All procedures initiated laparoscopically were terminated laparoscopically.

The two groups were compared with regard to their mean operative times, times to postoperative food

**Table 1. Demographic, clinical characteristic and postoperative data of the patient groups.**

	Laparoscopic Appendectomy	Open Appendectomy	p value
Number of patients	806	3668	
Female	347	1362	
Male	459	2306	
Age - Mean	25.6	30.6	
Mean Operative Time (min)	43	39	0.602
Time of Postoperative Food Intake Resumption/ Mean (days)	1.1	1.2	0.551
Number of Patients Requiring Pain Management After Surgery	41	103	0.001
Number of Postoperative Complications (n) (Clavien-Dindo grade I)	21	102	0.653
Hospitalization Time / Mean (days)	2.39 (SD±2.49)	2.33 (SD±2.12)	0.525
Return to Daily Activities / Mean (days)	5.3 (SD±3.2)	7.6 (SD±4.3)	0.010
Cost (USD) Mean / SD	223.12 (SD±196.78)	186.27 (SD±437.34)	0.015

intake, hospitalization times, need for analgesics during the postoperative periods, and cost of the procedure (Table 1). No significant differences were found between the groups in terms of the operative times and times to resumption of food intake ( $p>0.05$ ). No significant differences were found between the groups when hospitalization times was evaluated with regard to cost ( $p>0.05$ ).

Neither group demonstrated intraoperative complications. Postoperative complications were wound infection in 135 patients in the AA group and postoperative complications in 21 patients in the LA group. It is classified as grade I according to Clavien-Dindo classification. There were no statistically significant differences between the two groups in terms of postoperative complications ( $p>0.05$ ). The mean follow-up period was  $7\pm 5.4$  months (1-14 months). The total treatment cost in the LA group was 37 USD higher ( $p<0.05$ ).

## DISCUSSION

Appendectomy is the most prevalent emergency surgery in all groups as well as in children. As minimally invasive methods have gained a wider use in recent years, the use of laparoscopic appendectomy in the treatment of appendicitis has gradually increased.

LA was shown to be associated with longer operative

times than open appendectomy<sup>(10)</sup> which was connected to the process of the learning curve. Over time, with the wider use of laparoscopic surgery, the difference between the operative times of the two techniques has disappeared due to increased experience<sup>(11-13)</sup>. In our study, no significant differences were determined between the operative times associated with the two methods. We believe that this situation reflects the adequacy of our team's experience with LA.

Studies have compared the two methods in terms of risk of wound site infection and reported lower risk of wound site infection for LA. In a meta-analysis that included 2877 patients, the LA group manifested significantly fewer wound site infections<sup>(14)</sup>. Another study conducted by Rohr et al.<sup>(15)</sup> reported increased number of wound site infections in the LA group. Mantoglu et al.<sup>(16)</sup> determined that the wound site infection was localized at the trocar site where the appendix is extracted from the abdomen, and contamination of the skin by the appendectomy piece that is too large to fit inside the trocar, and suggested that risk of wound site infection could be minimized by placing the appendix inside a protective bag while extracting it from the abdomen in such cases. In our study, wound infection was defined as stage 1 according to Clavien-Dindo classification which was found in 21 patients in LA group, and 102 patients in OA group. However, there was no statistical intergroup difference ( $p>0.05$ ).

LA and OA show no differences with regard to time to postoperative resumption of food intake <sup>(17,18)</sup>. Accordingly, both groups in our study resumed food intake on the first postoperative day.

One study recorded linear analog pain scores of 135 patients and, after blind randomization to procedure, pain scores were determined to be lower in the LA group <sup>(19)</sup>. The main reason behind this difference could be that the length of dissected muscle in OA is much longer than that in LA, where the longest one was 10-mm trocar incision, with OA disrupting normal anatomy further. In our study, patients in the LA group manifested lesser pain and need for analgesia compared to patients in the OA group in the postoperative period.

In a multi-center prospective study, patients who underwent LA were shown to recover much more rapidly than patients who underwent OA <sup>(20)</sup>. Hong-Bo Wei et al. <sup>(21)</sup> reported that patients who had undergone LA returned to their daily lives much more quickly than patients who had undergone OA. In our study, mean time to return to daily life was much shorter for LA patients when compared to OA patients.

Certain studies reported that LA was costlier than OA, and that the higher cost of LA was linked to the hand tools used <sup>(22,23)</sup>. Certain techniques such as using a single trocar or two trocars <sup>(24)</sup> and ligating the appendix stump with the use of tools <sup>(25)</sup> have been attempted to reduce cost. The higher cost associated with LA was attempted to be reduced by preferring reusable endoscopic tools. Mantoglu et al. <sup>(16)</sup> succeeded in partially reducing the cost by using a special set comprised of reusable trocar and hand tools and knots they had prepared using 2.0 polyglycolic acid suture instead of utilizing preformed knots. In our study, the main cause of the difference in costs between the groups was the vessel closure and sealing device. According to the Communique on Healthcare Practices (Sağlık Uygulamaları Tebliği=

SUT) in our country, the package price of OA is 84 USD, whereas the package price of LA is 143 USD. When the cost of the vessel closure and sealing device is subtracted, LA appears more advantageous for health institutions in terms of cost.

In summary; between the two techniques which do not demonstrate any differences in terms of safety, effectiveness, and complication rates in the treatment of acute appendicitis, LA may become the primary choice as it offers faster return to normal life and lesser need for postoperative analgesia. In this study, laparoscopic appendectomy was found to be more costly compared to open appendectomy.

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