TRANSUMBILICAL LAPAROSCOPIC-ASSISTED VERSUS OPEN APPENDECTOMY IN CHILDREN: OUTCOMES IN AN ACADEMIC HOSPITAL

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ABSTRACT

Introduction: The best surgical approach to acute appendicitis is still a matter of debate in pediatric population.

Objectives: The aim of this study is to compare the outcomes between laparoscopic appendectomy and open appendectomy in children.

Methods: Between the January 2009 and December 2010, all pediatric patients submitted to appendectomy in a teaching hospital were retrospectively analyzed. Patients were classified in different groups: non-complicated appendicitis submitted to open appendectomy (NCA-OA), non-complicated appendicitis submitted to transumbilical laparoscopic-assisted appendectomy (NCA-LA), complicated appendicitis submitted to open appendectomy (CA-OA), complicated appendicitis submitted to transumbilical laparoscopic-assisted appendectomy (CA-LA), all open appendectomies (OA) and all transumbilical laparoscopic-assisted appendectomies (LA). Operative time, intra-operative complications, length of hospital stay, readmission rate, reoperation rate, major and minor complications were compared among the groups. Statistical analysis was performed with Two Way ANOVA for continuous variables and Chi-square test with Yates correction for categorical variables.

Results: A total of 691 appendectomies were performed (NCA-OA, n=397, NCA-LA, n=90; CA-OA, n=156, CA-LA, n=48). Operative time was longer in NCA-LA (57±22min) and CA-LA (75±34min) groups, as compared with NCA-OA (43±15min) and CA-OA (57±22min) groups, respectively. Length of hospital stay was shorter in NCA-LA (1.8±1.0days) as compared in NCA-OA group (3.3±1.2days), whereas was similar between CA-LA and CA-OA groups. There were no differences in readmission rates neither in major complications

between LA and OA groups. Regarding minor complications, NCA-LA and CA-LA groups had a higher number of suture granuloma, as compared with NCA-OA and CA-OA groups.

Conclusions: Transumbilical laparoscopic-assisted appendectomy is a valid option in both complicated and non-complicated appendicitis. The advantages of this technique included the better cosmetic result and shorter hospital stay in cases of non-complicated appendicitis.

Non-complicated appendicitis; Complicated appendicitis; Laparoscopic appendectomy; Open appendectomy; Pediatric population.

Since its introduction by McBurney in 1894, appendectomy has become the standard procedure for the treatment of acute appendicitis (Ingraham et al., 2010) and is the most common surgical procedure performed in emergencies worldwide (Addiss et al., 1990). With the introduction of laparoscopic appendectomy (LA) by Semm in 1983, a long controversy has begun (Kockerling et al., 2009). Several studies have been made comparing open appendectomy (OA) with LA. In a review of more than 30,000 appendectomies in patients older than 16 years old, Ingraham et al. (2010) demonstrate that laparoscopy was associated with a lower overall morbidity, lower serious morbidity, less surgical site infection and shorter postoperative stay.

Regarding the pediatric population, the best approach to acute appendicitis is a matter of debate since the majority of studies included small number of patients and had contradictory results (Vernon et al., 2004, Aziz et al., 2006). Some authors suggested a similar operative time (Oka et al., 2004, Vernon et al., 2004, York et al., 2006), length of hospital stay (Vernon et al., 2004, Faiz et al., 2008), readmission rates (Faiz et al., 2008) and intra-abdominal abscess (Meguerditchian et al., 2002, Aziz et al., 2006) between OA and LA. In contrast, others support that LA has a lower risk of wound infection (Aziz et al., 2006) and small bowel obstruction (Tsao et al., 2007, Kaselas et al., 2009), a shorter length of hospital stay (Meguerditchian et al., 2002, Ikeda et al., 2004, York et al., 2006, Rai et al., 2007) and a longer operative time (Meguerditchian et al., 2002, Ikeda et al., 2004, Rai et al., 2007). A meta-analysis by Aziz et al. (2006) suggests that the rate of wound infection and ileus is reduced in children submitted to LA, when compared with OA. Considering the division in patients with complicated (perforated) appendicitis and patients with non-complicated (non-perforated) appendicitis, some studies show that laparoscopic approach is safe in children

with complicated (perforated) appendicitis (Ikeda et al., 2004, Deepak et al., 2008, Taqi et al., 2008, Wang et al., 2009).

In the present study, pediatric patients submitted to appendectomy in a tertiary Hospital were analyzed regarding to operative time, intra-operative complications, length of hospital stay, readmission rate, reoperation rate, major and minor complications.

Data acquisition

Between 1 January 2009 and 31 December 2010 all pediatric patients who underwent appendectomy were selected using the informatic database of Hospital São João, Porto, Portugal. Inclusion criteria were: i) diagnosis of acute appendicitis; ii) age less than 18 years old; iii) pediatric surgical teams from Hospital São João. Exclusion criteria: i) surgical teams from other Hospitals; ii) incidental appendectomy; iii) patients discharge against medical opinion. The information of each patient was collected assessing the clinical process in the software "SAM- Sistema de Apoio ao Médico" and "Manager Anesthesiology".

The indication for operation was the clinical diagnosis of appendicitis, as confirmed by examination by the pediatric surgeon and/or by abdominal ultrasonography. There were no selection criteria for the type of approach (OA or LA). The decision between open or laparoscopic approach was based on the surgeon's preference. Two patients were converted from laparoscopic to open surgery and were excluded from the analysis.

Complicated appendicitis (CA) was defined as acute appendicitis with appendix perforation, abscess and/or peritonitis and non-complicated appendicitis (NCA) was defined as acute appendicitis without any other intra-abdominal associated conditions. Patients were classified in different groups: non-complicated appendicitis submitted to open appendectomy (NCA-OA), non-complicated appendicitis submitted to transumbilical laparoscopic-assisted appendectomy (NCA-LA), complicated appendicitis submitted to open appendectomy (CA-OA), complicated appendicitis submitted to transumbilical laparoscopic-assisted appendectomy (CA-LA), all open appendectomies (OA) and all transumbilical laparoscopic-assisted appendectomies (LA).

Surgical technique

Transumbilical laparoscopic-assisted appendectomy

Laparoscopy was performed with one 10-mm trocar introduced under direct vision via umbilicus. A second trocar was introduced in the midline above the pubic symphysis after inspection of the abdominal cavity with a 10mm 0º-30º telescope. The patient was rotated to the left side. The inspection of the abdomen was complemented with a grasping forceps through the supra-pubic cannula. Then appendix was secured with the grasper and was removed through the umbilical incision. These same incision allows the delivered of appendiceal base. A conventional appendectomy was then performed extracorporeally. A final check for hemostasis and abdominal lavage was carried out. The umbilicus was closed using polyester or polyglactin with hook needle. In cases of acute appendicitis complicated with peritonitis, a peritoneal lavage using 3-5 liters of normal saline was performed. A third trocar was introduced in left lower quadrant in cases of difficult dissection of the appendix, bleeding from the appendicular mesentery and in cases of peritonitis where the mobilization of bowel was necessary to perform an adequate lavage.

Open appendectomy

Classic open appendectomy was performed using a transverse or oblique right lower quadrant muscle-splitting incision with exteriorization of the appendix. Mesenteric vessels were then ligated and the appendix was removed after stump ligation. The abdomen and pelvis were thoroughly irrigated in cases of appendicular abscess or peritonitis. Drains were rarely used.

Antibiotic administration

Routine preoperative antibiotic prophylaxis consisted of a single dose of cefoxitin at induction (25 mg/kg/dose). Patients with NCA completed 24h of cefoxitin (25 mg/kg/dose; 6-6h). Patients with peritonitis were treated with amoxicillin + clavulanic acid (30 mg/kg/dose;

8-8h) and metronidazole (7,5 mg/kg/dose; 8-8h) or imipenem (15 mg/kg/dose; 6-6h) for five to seven days. Patients started meals as soon as they were well waked up. Patients with peritonitis received liquids when signs of intestinal transit first appeared.

Definition of outcomes

The operative time was defined has the interval between the beginning and the end of the surgery counted in minutes. The length of hospital stay was calculated in days, considering the period between admission and discharge, irrespective of time of day. In cases of readmission, total days in hospital were also considered, defining the total length of hospital stay.

Complications were classified as major or minor. Major complications delay the discharge of the patient or need readmission or reoperation and include, between others, intra-abdominal abscess and small bowel obstruction. The minor complications evaluated were wound infection, suture granuloma and wound disruption. These complications were evaluated during hospital stay and follow-up outpatient during the first 6 months after surgery.

Statistical analysis

Statistic analysis was performed with "Sigma Stat" program (version 3.5). Results are presented as mean±standard deviation. Significance was considered achieved at a P value <0.05. To compare OA vs LA groups a t-test was used. To compare NCA-LA, NCA-OA, CA-LA and CA-OA groups, a Two Way Analysis of Variance test was used for continuous variables. When the groups were significantly different, the Holm-Sidak test was used to perform multiple comparisons. A Chi-square test with Yates correction was used for categorical variables.

Demographic Data

A total of 691 appendectomies were included with 64% (443/691) boys and 36% (248/691) girls. In this study 80% of patients underwent OA and 20% underwent LA. 80% of NCA-LA and 81% of CA-LA patients was operated with 2 trocars. The other patients needed three or four trocars. In 6% of patients the final pathologic report was negative for appendicitis. The OA and LA groups have a similar mean age, 10±4 years old for OA group and 11±4 years old for LA group (mean ± standard deviation), and gender. The incidence of CA was 28% in OA group, against 35% in the LA group. In CA-OA and CA-LA groups the mean age of patients was lower when compared with NCA-OA and NCA-LA, respectively. No other differences were found between the different groups.

Outcomes

The results are presented in Table I, Table II and Table III. The different surgical procedures show some differences in outcomes. OA group reveals a longer length of hospital stay whereas LA group shows a longer operative time (16 minutes more) and a higher reoperation rate (Table I).

In patients with NCA there were some differences between the two surgical techniques. NCA-OA group had a longer length of hospital stay and total length of hospital stay, whereas NCA-LA group had a longer operative time (14 minutes more). There were no statically significant differences in readmission and reoperation rates between NCA-LA and NCA-OA groups (Table II).

There was a longer operative time (18 minutes more) in CA-LA group when compared with CA-OA group. There were no differences in length of hospital stay, total

length of hospital stay, and readmission or reoperation rates between CA-OA and CA-LA groups (Table II).

The CA-OA group had longer operative time, length of hospital stay, total length of hospital stay and a higher readmission rate as compared with NCA-OA group. The CA-LA group also had longer operative time, length of hospital stay, total length of hospital stay and a higher readmission rate as compared with NCA-LA group (Table III).

Table I. Operative time, length of hospital stay, readmission and reoperation rates (was compared OA with LA group).

	OA (n=553; 80%)	**LA** (n=138; 20%)	P value
Operative time (mean ± SD)	47 ± 18	63 ± 27	<0.001
Length of hospital stay (mean ± SD)	4.4 ± 2.4	3.6 ± 3.8	0.023
Total length of hospital stay (mean ± SD)	4.6 ± 3.1	4.1 ± 5.3	0.264
Readmission rate	12 (2.2%)	6 (4.3%)	0.241
Reoperation rate	6 (1.1%)	3 (2.2%)	0.014

OA – Open Appendectomy; LA – Laparoscopic Appendectomy; SD – Standard Deviation; Statistical significance for P<0.05

Table II. Operative time, length of hospital stay, readmission and reoperation rates (was compared NCA-OA with NCA-LA group and CA-OA with CA-LA group).

	NCA-OA (n = 397; 81.5%)	**NCA-LA** (n = 90; 18.5%)	P value	**CA-OA** (n = 156; 76.5%)	**CA-LA** (n = 48; 23.5%)	P value
Operative time (mean ± SD)	43 ± 15	57 ± 22	<0.001	57 ± 22	75 ± 34	<0.001
Length of hospital stay (mean ± SD)	3.3 ± 1.2	1.8 ± 1.0	<0.001	7.0 ± 2.7	6.9 ± 4.8	0.702
Total length of hospital stay (mean ± SD)	3.4 ± 1.4	2.0 ± 1.4	0.000	7.6 ± 4.1	8.0 ± 7.3	0.463
Readmission rate	3 (0.8%)	1 (1.1%)	0.757	9 (5.8%)	5 (10.4%)	0.431
Reoperation rate	3 (0.8%)	0 (0.0%)	0.935	3 (1.9%)	3 (6.3%)	0.288

NCA – Non-Complicated Appendicitis; OA – Open Appendectomy; LA – Laparoscopic Appendectomy; CA – Complicated Appendicitis; SD – Standard Deviation.
Statistical significance for P<0.05

Table III. Operative time, length of hospital stay, readmission and reoperation rates (was compared NCA-OA with CA-OA group and NCA-LA with CA-LA group).

	NCA-OA (n = 397; 71.8%)	**CA-OA** (n = 156; 28.2%)	P value	**NCA-LA** (n = 90; 65.2%)	**CA-LA** (n = 48; 34.8%)	P value
Operative time (mean ± SD)	43 ± 15	57 ± 22	<0.001	57 ± 22	75 ± 34	<0.001
Length of hospital stay (mean ± SD)	3.3 ± 1.2	7.0 ± 2.7	<0.001	1.8 ± 1.0	6.9 ± 4.8	<0.001
Total length of hospital stay (mean ± SD)	3.4 ± 1.4	7.6 ± 4.1	0.000	2.0 ± 1.4	8.0 ± 7.3	0.000
Readmission rate	3 (0.8%)	9 (5.8%)	<0.001	1 (1.1%)	5 (10.4%)	0.034
Reoperation rate	3 (0.8%)	3 (1.9%)	0.461	0 (0.0%)	3 (6.3%)	0.074

NCA – Non-Complicated Appendicitis; OA – Open Appendectomy; CA – Complicated Appendicitis; LA – Laparoscopic Appendectomy; SD – Standard Deviation.
Statistical significance for P<0.05

Surgical data

From the 140 patients operated by laparoscopic technique two had the surgery converted to an open procedure and were excluded from the analysis. The conversion rate was 1,43 % (2/140). Both cases occurred in patients with perforated appendicitis. The necessity to convert the technique was, in one patient, due to impossibility of identify the appendix and in the other patient because of the presence of massive fecal content in the abdominal cavity.

The LA and OA groups revealed no differences in intra-operative complications (Table IV). When the severity of appendicitis is considered, NCA-LA group shows a higher incidence of appendicular bleeding (Table V). Regarding the two cases of appendicular artery bleeding in NCA-LA group, one patient needed a third trocar (5mm) and in both cases the bleeding was controlled with monopolar energy. These two patients were discharged in the day after and no further complications were reported. There were two cases of bowel perforation during the surgery, one patient on NCA-OA group and the other one on CA-OA group. These cases had a longer hospital stay (6 days) but no post-operative complications were reported.

Complications Data

The LA and OA groups showed some differences as a higher rate of suture granuloma in LA patients and higher rate of wound disruption on OA patients. The rate of intra-abdominal abscess was similar between the two techniques (Table IV).

In NCA-LA group, there was a higher rate of suture granuloma when compared with NCA-OA group. The comparison among these groups regarding intra-abdominal abscess, small bowel obstruction, wound infection and wound disruption had a power below the desired (Table V).

In CA-LA group, the incidence of suture granuloma was higher when compared with CA-OA group. Analysis of small bowel obstruction data presented a power below the desired. There were no other differences, including in the rate of intra-abdominal abscess (Table V).

The CA-OA group present higher rates of intra-abdominal abscess and wound infection as compared with NCA-OA group. The same results were found for CA-LA group, a higher rate of intra-abdominal abscess and wound infection as compared with NCA-LA group (Table VI).

Table IV. Surgical complications (was compared OA with LA group).

	OA (n=553; 80%)	**LA** (n=138; 20%)	P value
Intra-operative complications			
Appendicular bleeding	0 (0.0%)	2 (1.4%)	0.158
Bowel perforation	2 (0.4%)	0 (0.0%)	0.157
Major complications			
Intra-abdominal abscess	17 (3.1%)	7 (5.1%)	0.322
Small bowel obstruction	7 (1.3%)	3 (2.2%)	0.497
Minor complications			
Suture granuloma	1 (0.2%)	8 (5.8%)	0.006
Wound infection	22 (4.0%)	6 (4.3%)	0.848
Wound disruption	4 (0.7%)	0 (0.0%)	0.045

OA – Open Appendectomy; LA – Laparoscopic Appendectomy.
Statistical Significance for P<0.05.

Table V. Surgical complications (was compared NCA-OA with NCA-LA group and CA-OA with CA-LA group).

	NCA-OA (n = 397; 81.5%)	**NCA-LA** (n = 90; 18.5%)	P value	**CA-OA** (n = 156; 76.5%)	**CA-LA** (n = 48; 23.5%)	P value
Intra-operative complications						
Appendicular bleeding	0 (0.0%)	2 (2.2%)	0.039	0 (0.0%)	0 (0.0%)	

Bowel perforation	1 (0.3%)	0 (0.0%)	0.416	1 (0.6%)	0 (0.0%)	0.532
Major complications						
Intra-abdominal abscess	0 (0.0%)	1 (1.1%)	0.416 #	17 (10.9%)	6 (12.5%)	0.963
Small bowel obstruction	3 (0.8%)	0 (0.0%)	0.935 #	4 (2.6%)	3 (6.3%)	0.439 #
Minor complications						
Suture granuloma	1 (0.3%)	3 (3.3%)	0.023	0 (0.0%)	5 (10.4%)	<0.001
Wound infection	4 (1.0%)	0 (0.0%)	0.965 #	18 (11.5%)	6 (12.5%)	0.940
Wound disruption	1 (0.3%)	0 (0.0%)	0.416 #	3 (1.9%)	0 (0.0%)	0.778

NCA – Non-Complicated Appendicitis; OA – Open Appendectomy; LA – Laparoscopic Appendectomy; CA – Complicated Appendicitis
Statistical significance for P<0.05
the power of the performed test is below the desired power.

Table VI. Surgical complications (was compared NCA-OA with CA-OA group and NCA-LA with CA-LA group).

	NCA-OA (n = 397; 71.8%)	**CA-OA** (n = 156; 28.2%)	P value	**NCA-LA** (n = 90; 65.2%)	**CA-LA** (n = 48; 34.8%)	P value
Intra-operative complications						
Appendicular bleeding	0 (0.0%)	0 (0.0%)	0.920 #	2 (2.2%)	0 (0.0%)	0.770
Bowel perforation	1 (0.3%)	1 (0.6%)		0 (0.0%)	0 (0.0%)	
Major complications						
Intra-abdominal abscess	0 (0.0%)	17 (10.9%)	<0.001	1 (1.1%)	6 (12.5%)	0.013
Small bowel obstruction	3 (0.8%)	4 (2.6%)	0.197	0 (0.0%)	3 (6.3%)	0.074
Minor complications						
Suture granuloma	1 (0.3%)	0 (0.0%)	0.628	3 (3.3%)	5 (10.4%)	0.189
Wound infection	4 (1.0%)	18 (11.5%)	<0.001	0 (0.0%)	6 (12.5%)	0.003
Wound disruption	1 (0.3%)	3 (1.9%)	0.126	0 (0.0%)	0 (0.0%)	

NCA – Non-Complicated Appendicitis; OA – Open Appendectomy; CA – Complicated Appendicitis; LA – Laparoscopic Appendectomy.
Statistical significance for P<0.05
the power of the performed test is below the desired power.

The present study compared the outcomes of transumbilical laparoscopic-assisted appendectomy with open appendectomy within patients with NCA and CA in a tertiary teaching hospital. The study shows that laparoscopic and open appendectomies are techniques equally safe and acceptable in both NCA and CA in children. Laparoscopic approach allowed an early discharge of one and a half days in patients with a non-complicated appendicitis. The operative time was longer in LA group, both in NCA and CA patients.

Length of the hospital stay is an important outcome. In this study, a shorter length of hospital stay for NCA-LA group was demonstrated. This result is in agreement with other studies (Ikeda et al., 2004, Aziz et al., 2006, York et al., 2006). A shorter length of stay has several benefits for patient, namely, a faster return to normal activities like school and exercise practice, minimizing potential psychological damage for the child and family, as well as for the hospital, namely reduced bed occupancy (Meguerditchian et al., 2002, Aziz et al., 2006, Faiz et al., 2008). However, other studies failed to show this advantage (Oka et al., 2004, Faiz et al., 2008). Nevertheless, when comparing length of hospital stay between CA-LA and CA-OA groups, there were no differences. These results are in accordance to other studies (Ikeda et al., 2004, Taqi et al., 2008). This shows that not only the technique influences the outcomes but also the severity of the disease.

Regarding to the operative time, the present study showed a longer time in both NCA-LA and CA-LA patients similarly to other studies (Ikeda et al., 2004, York et al., 2006, Rai et al., 2007, Taqi et al., 2008, Wang et al., 2009). An increase in operative time by laparoscopic approach is superimposed by several advantages of LA, like the improved aesthetic results, the superior ability to explore the abdomen and pelvis, and the faster return to normal activity decreasing hospital stay (Meguerditchian et al., 2002, Ikeda et al., 2004, York et al., 2006,

Kaselas et al., 2009). On the contrary, there are studies that show similar operative times between the two techniques (Oka et al., 2004, Aziz et al., 2006, York et al., 2006), which may reflect the surgeon experience or the type of hospital (teaching vs non-teaching).

The readmission and reoperation rates are parameters rarely studied. When the LA and OA groups are compared, the LA group reveals a higher reoperation rate but when the severity of appendicitis is considered this parameter is similar between the two techniques. The readmission rate was similar in both NCA and CA patients and is in agreement with Faiz et al. (2008). Meguerditchian et al. (2002) shows a similar rate of reoperation between the two techniques, showing that laparoscopic approach could be as safe as the open approach.

Although appendectomy is considered a safe operation, a potential for complications always exists. Therefore, is fundamental to evaluate intra-operative, major and minor complications. In the present study, a very low incidence of intra-operative complications was found with an incidence of appendicular bleeding of 1.4% in LA group and bowel perforation of 0.4% in OA group reinforcing the security of this kind of surgery. It is also important to highlight that these patients had no other post-operative complications, showing that intra-operative complications do not increase post-operative morbidity.

Especially in adult population the differences in the incidence of intra-abdominal abscess between the two surgical techniques is a matter of worry. A meta-analysis by Bennet et al. (2007) shows a higher risk of intra-abdominal abscess for laparoscopic approach. In the pediatric population some studies don't find any difference in the incidence of intra-abdominal abscess between the two techniques (Meguerditchian et al., 2002, Ikeda et al., 2004).

In the present study, regarding to major complications, like intra-abdominal abscess and small bowel obstruction, weren't found any differences between the two techniques. The power of the results was below the desired, which indicates a less likelihood to detect

differences. Therefore, only studies with bigger samples could clarify this issue. For small bowel obstruction some authors find a lower rate for laparoscopic technique (Aziz et al., 2006, Tsao et al., 2007, Kaselas et al., 2009) and others find a similar rate for the two techniques, as in this study (Ikeda et al., 2004). The expected result considering the well-documented advantages of laparoscopic procedure should be a lower rate of major complications. The laparoscopic approach is associated with less trauma of the abdominal wall, fewer introductions of foreign bodies, a better visualization of the abdominal cavity and allows a better lavage of the abdominal cavity. These advantages will allow a better recovery with less adhesion formation and so an earlier postoperative return of bowel motility (Kaselas et al., 2009).

In regard to minor complications, the OA group shows a higher rate of wound disruption and LA group a higher rate of suture granuloma. These study demonstrated a higher incidence of suture granuloma in both NCA-LA and CA-LA groups, whereas other complications, like wound infection and wound disruption, was similar between the two techniques. The type of suture used to close umbilical port could explain the higher rate of suture granuloma in LA patients. After this analysis, was changed from polyester to polyglactin. Some studies showed a similar rate of wound infection between the two techniques (Meguerditchian et al., 2002, Ikeda et al., 2004) but Aziz et al. (2006) showed a lower rate of wound infection for the LA group.

The study realized by Patrick (2006) shows a longer operative time, longer length of hospital stay and a higher rate of intra-abdominal abscess in patients with complicated appendicitis when compared with patients with simple appendicitis, both groups submitted to laparoscopic appendectomy. These results were also found in the present study.

This study has some limitations. It is a retrospective analysis without randomization. Other aspect to improve is the information provided in patient clinical process, which

sometimes was incomplete, as usual in the retrospective studies. In this study the cases of conversion to open approach were excluded from the analysis but, as many authors do actually, they can be included in the initial group.

CONCLUSION

In conclusion, the present study demonstrated that both open and laparoscopic-assisted appendectomies are safe options either in NCA or CA. Laparoscopic procedures resulted in a shorter hospital stay in the NCA cases. In both NCA and CA patients, laparoscopy had longer operative time than open approach. Regarding these results, transumbilical laparoscopic-assisted appendectomy is a valid option in both complicated and non-complicated cases of appendicitis. The advantages of this technique included the better cosmetic result and shorter hospital stay in cases of non-complicated appendicitis.

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