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GAVIN PUBLISHERS

Archives of Pediatrics

Tanaka N, et al. Arch Pediatr 3: JPED-147.

Research Article

DOI: 10.29011/2575-825X.100047

# Single Port Laparoscopic Appendectomy for Chronic Right Lower Quadrant Pain in Children

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**Citation:** Tanaka N, Sasaki T, Matsuda I, Zenitani M, Hirota S, et al. (2018) Single Port Laparoscopic Appendectomy for Chronic Right Lower Quadrant Pain in Children. Arch Pediatr 3: 147. DOI: 10.29011/2575-825X.100047

**Received Date:** 12 March, 2018; **Accepted Date:** 15 March, 2018; **Published Date:** 26 March, 2018

## Abstract

**Purpose:** Chronic Right Lower Quadrant Pain (CRLQP) is a common clinical problem. It remains a diagnostic and therapeutic challenge. We have performed Trans Umbilical Laparoscopic-Assisted Appendectomy (TULA) for CRLQP in children. The aim of this study was to clarify the benefits of TULA in children with CRLQP.

**Methods:** The medical records of 12 consecutive patients who underwent TULA for CRLQP and were followed for at least one year were reviewed. Long-term results were determined by telephone survey.

**Results:** Median age at surgery was 11.8 years (range, 9.3-14.7). Median duration of symptoms was 3 months (range, 1-48). Preoperative laboratory data were within normal limits in all patients. Imaging studies showed mild swelling of the appendix in one patient and appendicolith in two patients. Intraoperatively, mild inflammatory changes of the appendix were detected in six patients (50%). However, histopathological examination revealed mild acute appendicitis only in two patients; the remaining ten had normal appendices. All patients were discharged within four days of surgery without complications. Ten patients (83%) reported complete resolution of CRLQP at one month after surgery, of whom 90% reported pain resolution lasted for a median of 35 months. All patients were satisfied with their operative scar hidden in the umbilicus.

**Conclusions:** TULA is feasible and safe. It has a high cure rate for CRLQP. It has a high cure rate for CRLQP even though the removed appendices show only weak or no acute inflammation.

**Keywords:** Chronic Right Lower Quadrant Pain; Children; Trans Umbilical Laparoscopic Appendectomy

## Introduction

Chronic Right Lower Quadrant Pain (CRLQP) is a common clinical problem that remains a diagnostic and therapeutic challenge. Especially in the pediatric population, CRLQP is associated with missing school and distress, resulting in social and economic loss. Although elective appendectomy has been reported as an effective treatment for this condition, the effect of the operative scar has not been emphasized. It is a long-lasting reminder of surgery for patients and their parents. We have performed Trans Umbilical Laparoscopic-Assisted Appendectomy (TULA) for CRLQP since June 2009. The aim of this study was to clarify the benefit of TULA for CRLQP in children.

## Materials and Methods

### Patients Characteristics

This retrospective observational study has been approved by the research ethics committee of the Hyogo College of Medicine. Patients who underwent TULA for CRLQP at our hospital between April 2010 and March 2016 were included. Previous reports have described CRLQP as pain in the right lower abdominal quadrant lasting from ≥1 month to 12 months for which routine investigations do not reveal any pathology [1-5]. Patients' medical records were reviewed to gather information such as symptom duration before surgery, preoperative physical examination findings, intraoperative findings, histology results, and short-term outcomes after appendectomy.

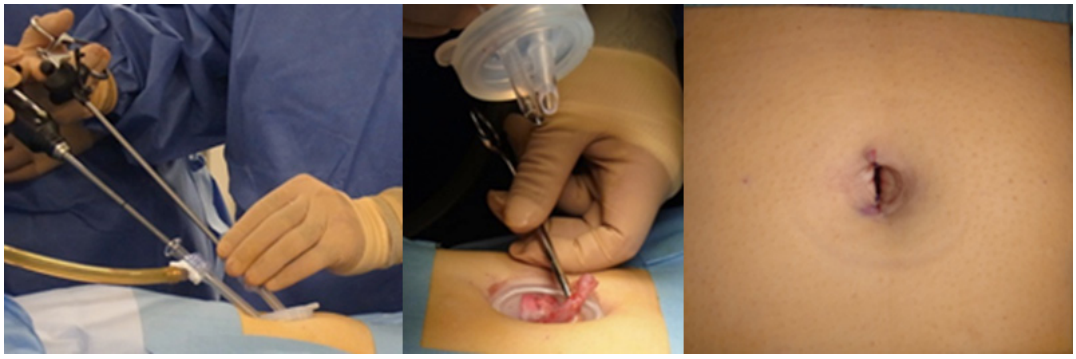
## Operative Procedures

The TULA procedure has already been described by others [6]. Briefly, the patient was placed in the standard supine position under general anesthesia. Laparotomy was made through a small longitudinal skin incision inside the umbilical ring. A LAP PROTECTOR (Figure 1A) and an EZ ACCESS (Hakko Co. Ltd., Nagano, Japan) (Figure 1B) were applied and a $CO_2$ pneumoperitoneum was made. Using a 5-mm flexible laparoscope (Olympus Co, Tokyo, Japan) and atraumatic forceps (Figure 2A), the appendix was identified and grasped. After some dissection and mobilization, if necessary, the appendix was exteriorized through the umbilicus and resected extra corporeally using the same technique as in open appendectomy (Figure 2B). After the removal of the appendix, the pneumoperitoneum was re-initiated by re-attaching the EZ ACCESS. The lower abdominal cavity, including the ileum and the internal genital organs, was inspected laparoscopically to rule out other etiologies of right lower quadrant pain.

A B

**Figures 1(A-B):** A LAP PROTECTOR(A) and an EZ ACCESS (Hakko Co. Ltd., Nagano, Japan) (B) were inserted through the umbilical incision. One to three 5-mm ports were placed through the EZ ACCESS.

A B C



**Figures 2(A-C):** Photograph of surgical findings. A) Laparoscopic settings. B) The appendix was removed through the trans umbilical incision. C) The postoperative scar was hidden in the umbilicus.

## Assessment of Pain and Satisfaction

The degree of CRLQP was evaluated at one month after surgery in the outpatient clinic. Pain was scored as follows: 1, unchanged (or even worse); 2, remarkable reduction of pain (but not completely pain-free); and 3, completely pain-free. Long-term follow-up of pain and satisfaction with the cosmetic outcome of patients and their parents were also assessed by telephone survey.

## Histopathology

A pathologist blinded to the patients' clinical information performed histopathological examination of the excised appendices. Hematoxylin-eosin stained slides from the specimens were examined to assess for the presence of wall integrity as well as acute inflammation based on intraluminal hemorrhage, congestion in the muscularis propria, and intramural infiltration of neutrophils. Intraluminal contents, if any, were examined as well. The diagnosis of acute appendicitis was based on the presence of intraluminal or intramural neutrophil infiltration.

# Results

## Clinical Characteristics of the Patients

During the six-year study period, 12 consecutive patients underwent TULA for CRLQP (Table 1). They consisted of five girls and seven boys. Median age at surgery was 11.8 years (range, 9.3-14.7 years). The median duration of symptoms was 4.5 months (range, 1-9 months). None of the patients had any relevant underlying medical conditions.

| Patient | Age (Years) | Sex | Symptom Duration (Months) | Imaging Findings of Appendix | | Blood Test Results | |
|---|---|---|---|---|---|---|---|
| | | | | Swelling | Fecalith | WBC count (x$10^3$) | CRP (mg/dl) |
| 1 | 10.7 | F | 12 | - | - | 4410 | 0 |
| 2 | 12.8 | F | 48 | - | - | 6200 | 0 |
| 3 | 14.7 | F | 12 | - | - | 5300 | 0 |
| 4 | 14.2 | M | 9.5 | - | - | 7890 | 0 |
| 5 | 10 | M | 1 | - | - | 3610 | 0 |
| 6 | 14 | M | 1 | - | - | 6250 | 0 |
| 7 | 10.7 | M | 1 | - | - | 4390 | 0.2 |
| 8 | 9.5 | M | 7 | slight | - | 7830 | 0 |
| 9 | 10.2 | F | 3 | - | - | 9290 | 0.08 |
| 10 | 9.3 | M | 6 | - | + | 6330 | 0.05 |
| 11 | 13.7 | F | 1 | - | - | 3860 | 0.01 |
| 12 | 14.5 | M | 3 | - | + | 3770 | 0.18 |
| M: Male, F: Female, WBC: white blood cell, CRP: C-reactive protein | | | | | | | |

**Table 1:** Clinical Characteristics of the Patients.

## Blood Test and Imaging Findings

All patients underwent blood tests, including complete blood count and general biochemical tests. They also received screening imaging studies such as ultrasonography, Computed Tomography (CT), or both. In all patients, the laboratory data was within normal limits. None had an elevated white blood cell count or C-reactive protein level. Imaging studies revealed slight swelling of the appendix in one patient and an appendicolith in two patients.

## Intraoperative Findings and Postoperative Courses

The operative findings are summarized in Table 2. Median operative time was 58 minutes (range, 48-73 minutes). For seven patients, the appendix was described as showing some abnormalities, such as 'slightly hyperemic' or 'Long and Tortuous'. No other pelvic or abdominal abnormalities were found in all patients during exploratory laparoscopy after appendectomy. No postoperative complications occurred. The median time from surgery to discharge was 2.5 days (range, 2-4 days). The postoperative scar was hidden in the umbilicus (Figure 2C).

| Patient | Operative time (min) | Discharge (POD) | Surgical findings of appendix | pain score | | Timing of telephone survey (months) * | Complications |
|---|---|---|---|---|---|---|---|
| | | | | 1 month | telephone survey | | |
| 1 | 61 | 2 | hyperemic | 3 | 3 | 86 | - |
| 2 | 37 | 2 | hyperemic | 3 | 3 | 69 | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | 70 | 4 | normal | 3 | 3 | 64 | - |
| 4 | 59 | 2 | normal | 1 | 1 | 58 | - |
| 5 | 73 | 3 | swollen | 3 | 3 | 47 | - |
| 6 | 57 | 2 | long and hyperemic | 2 | 2 | 39 | - |
| 7 | 69 | 3 | normal | 3 | 3 | 30 | - |
| 8 | 48 | 3 | hyperemic | 3 | 3 | 28 | - |
| 9 | 68 | 3 | attached to the abdominal wall | 3 | 3 | 17 | - |
| 10 | 48 | 3 | normal | 3 | 2 | 16 | - |
| 11 | 48 | 2 | normal | 3 | 3 | 15 | - |
| 12 | 53 | 2 | curved like a shrimp and hyperemic | 3 | 3 | 15 | - |

POD: postoperative day

*Duration between appendectomy and telephone survey

**Table 2:** Surgical Findings and Outcomes.

## Histopathological Findings

Histopathological findings are summarized in Table 3. All of the cases showed intact wall integrity of the resected appendices. Ten of 12 patients did not have either intraluminal or intramural neutrophil infiltration, although they did have some evidence of chronic inflammation. Only two patients were diagnosed as appendicitis, although the degree of neutrophil infiltration was not remarkable.

| Patient | intraluminal hemorrhage | intraluminal neutrophils | congestion in the muscularis propria | inflammatory infiltrate in the muscularis propria | intramural neutrophils | Pathological diagnosis |
|---|---|---|---|---|---|---|
| 1 | + | - | + | - | - | normal |
| 2 | + | + | - | - | - | appendicitis, mild |
| 3 | + | - | - | - | - | normal |
| 4 | + | - | + | + | - | normal |
| 5 | + | - | - | - | - | normal |
| 6 | + | + | - | - | - | appendicitis, mild |
| 7 | + | - | + | - | - | normal |
| 8 | - | - | + | + | - | normal |
| 9 | + | - | + | + | - | normal |
| 10 | - | - | - | - | - | normal |
| 11 | + | - | + | - | - | normal |
| 12 | - | - | + | - | - | normal |

**Table 3:** Histopathological Findings.

## Pain Score and Satisfaction

Evaluation of short-term symptoms was performed in the outpatient clinic at one month after surgery. Of 12 patients, 10 had complete resolution of symptoms (pain score of 3). In the remaining two patients, right lower quadrant pain was at least not worse (Table 2).

Long-term results were assessed by telephone survey, with a median of 35 months (range, 15-86 months) after surgery. Nine patients reported that they remained pain-free. Histopathological records of these nine patients revealed that only one patient had mild appendicitis. The remaining eight patients had normal histology of the appendix. The two patients who had a pain scale score of <2 at short-term follow-up reported that their pain score remained unchanged. All patients were satisfied with the cosmetic results of the surgery.

## Discussion

CRLQP has been a challenging problem in pediatric populations [4]. The usefulness of appendectomy for CRLQP remains controversial. Many previous reports have described that removal of the appendix was effective in 70%-100% of patients with CRLQP [1-4,7,8]. On the other hand, Popović et al found no differences in overall satisfaction between patients who underwent diagnostic laparoscopy with or without appendectomy [9]. Our present retrospective study revealed that the pain was completely relieved after TULA in 75% of patients and did not worsen in the remaining 25%. This result is consistent with those in previous positive reports.

Although the clinical data on CRLQP resolution after TULA is convincing, the histopathological presence of acute inflammation in these patients is not remarkable. Of the nine patients who became RLQ pain-free after TULA, eight did not have apparent neutrophil infiltration in their appendectomy specimens, which is inconsistent with their symptomatology. Krone and Sperke reported that of the 1718 prophylactic appendectomies performed during gynecological operations, 8% of resected specimens had microscopic acute appendicitis and only 21% were normal [10]. This dissociation between histopathology and clinical pain was hypothesized to be due to the presence of a non-inflammatory pain pathway [1]. The term "Neurogenic Appendicopathy" has been used for patients who underwent appendectomy for acute appendicitis but their appendices lacked signs of acute inflammation [11].

Previous reports have recommended that a normal appendix found during diagnostic laparoscopy should not be removed [12,13]. However, in this study, four of five patients with a normal intraoperative macroscopic diagnosis stated that their pain was relieved or resolved after appendectomy. This result might demonstrate that appendectomy is an effective and acceptable option for CRLQP even if the appendix appears normal intraoperatively.

Cosmetic outcomes of the surgery are also important, particularly for children. The operative scar is a long-lasting reminder of surgery for children and their parents. Chandler et al reported that Single-Incision Laparoscopic Appendectomy (SILA) or multiport laparoscopic appendectomy was associated with significantly increased cosmetic satisfaction in pediatric patients and their families when compared with open appendectomy [14]. It is needless to say that the top priority should always be the safety of the operation. Boo et al reported that TULA is preferable to SILA for treating pediatric appendicitis because it is technically easier, results in better surgical outcomes, and provides the same excellent cosmetic results [15].

Previous papers on appendectomy for CRLQP have reported that postoperative complications occur in 10%-15% of patients [1,3,9]. Most of them were superficial wound infections. There were no surgical complications observed in this study.

In conclusion, TULA can resolve CLRQP in pediatric patients. This procedure was safe and provided excellent cosmetic results. This study was small, retrospective, and observational, so the generalizability of the results is limited. Further investigation is needed.

## Disclosure Statement

No competing financial interests exist.

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