



### Araştırma/Research

## Feasibility and outcomes of 3-port laparoscopic cholecystectomy in the pediatric population

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#### Abstract:

**Objective:** The objective of this retrospective study was to describe our experience with 3-port laparoscopic cholecystectomy in a total 20 pediatric patients.

**Method:** Data on patient demographics, indication for cholecystectomy, surgical technique, operative time (minutes), complications and length of hospital stay (LOS, day) were recorded.

**Result:** Mean (SD) operative time was 44.8 (9.5, range: 30.0-60.0) minutes and LOS was 2.1(1.2, range: 1.0-5.0) days. Surgery was successful in all patients without development of major complications. Apart from significantly shorter operative time in patients with cholelithiasis than those with other indications for laparoscopic cholecystectomy (median 42.2 vs. 55.0 min, p=0.001), no significant difference was noted in age, operative time and LOS with respect to gender or indications.

**Conclusion:** Our findings indicate safety and efficacy and feasibility of 3-port laparoscopic cholecystectomy in the pediatric population, regardless of indication or gender along with significant advantages regarding the operative time, complication rates and hospital stay.

**Keywords:** Laparoscopic cholecystectomy; pediatric population; cholelithiasis; hemolytic diseases; length of hospital stay, complications.

#### Yazışmadan Sorumlu Yazar

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## Pedriatrik popülasyonda 3 portlu laparoskopik kolesistektominin fizibilite ve sonuçları

### ÖZET

**Amaç:** Bu retrospektif çalışmanın amacı toplam 20 pedriatrik hastada 3 portlu laparoskopik kolesistektomi konusundaki tecrübemizi tanımlamaktır.

**Yöntem:** Hasta demografik verileri, kolesistektomi endikasyonu, cerrahi teknik, ameliyat süresi (dakika), komplikasyonlar ve hastanede kalış süresi (HKS, gün) verileri kaydedildi.

**Bulgular:** Ortalama (SD) ameliyat süresi 44.8 (9.5, aralık: 30.0-60.0) dakika ve HKS 2.1 (1.2, aralık: 1.0-5.0) gündü. Cerrahi, herhangi bir hastada majör komplikasyon görülmesizin başarılı olarak geçti. Kolelitiyazisi olan hastalarda laparoskopik kolesistektomi endikasyonları olanlardan (ortanca 42.2 ve 55.0 dk,  $p = 0.001$ ) anlamlı derecede daha kısa operasyon süresinin dışında, yaş, ameliyat süresi ve HKS'de cinsiyet veya endikasyonlar açısından anlamlı bir fark bulunmadı.

**Sonuç:** Bulgularımız, pedriatrik popülasyonda 3 port laparoskopik kolesistektominin, operasyon süresi, komplikasyon oranları ve hastanede kalış açısından önemli avantajların yanı sıra endikasyon veya cinsiyetten bağımsız olarak güvenlik ve etkinliğini ve uygulanabilirliğini göstermektedir.

**AnahtarKelimeler:** Laparoskopik kolesistektomi; pedriatrik popülasyon; safra taşı; hemolitik hastalıklar; hastanede kalış süresi, komplikasyonlar.

### Introduction

Gallbladder disease is a rare entity encountered in the pediatric population than in adults (1-5). However, with the use of ultrasonography it has become increasingly diagnosed in pediatric population in the last two decades (1-5).

Elective treatment of symptomatic cholelithiasis is cholecystectomy acknowledged today as the "gold standard". It is associated with lower risk of adhesion providing a thorough visualization of abdominal cavity and an earlier mobilization of the patient compared to the traditional open cholecystectomy (3,6).

However, in addition to scarcity of investigations addressing the epidemiology of gallbladder diseases in the pediatric population (5,7), laparoscopic cholecystectomy remains largely

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underreported in children due to limited experience with this approach in the management of pediatric gallbladder diseases (7,8)

Therefore, the aim of this study was to describe our experience with 3-port laparoscopic cholecystectomy in the pediatric population in terms of patient characteristics, indications, operative complications and outcomes.

## **Materials and Methods**

### *Study population*

A total of 20 pediatric patients who underwent 3-port laparoscopic cholecystectomy at our clinic between January 2014 and December 2017 were included in this retrospective study. Patients with symptomatic cholelithiasis, acute calculous/acalculous cholecystitis, gallbladder dyskinesia and structural anomalies of gallbladder were included in the study.

The study was conducted in full accordance with local Good Clinical Practice (GCP) guideline and current legislations, while the permission was obtained from our institutional ethics committee for the use of patient data for publication purposes.

### *Study parameters*

Data on patient demographics (age, gender), indication for cholecystectomy, surgical technique, operative time (min), intraoperative and postoperative complications and length of hospital stay (LOS, day) were recorded. Patient age, operative time and LOS were also analyzed with respect to gender and laparoscopic cholecystectomy indications.

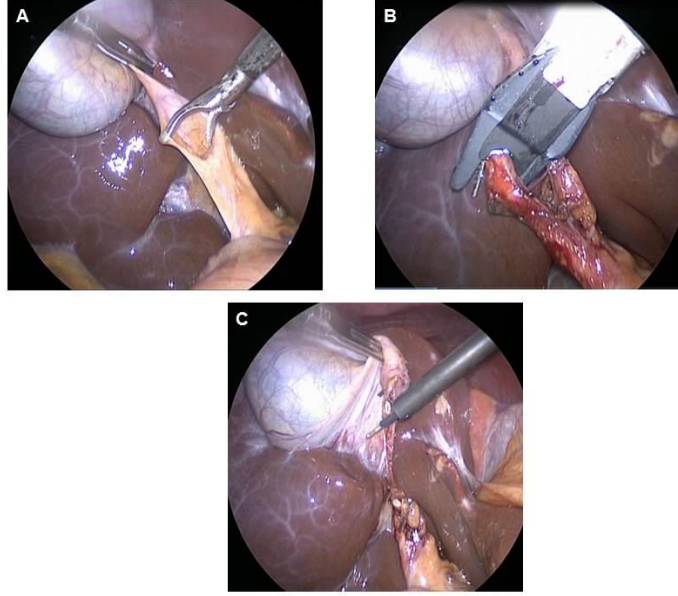
### *Surgery*

For the 3-port laparoscopic cholecystectomy, a 5-mm infra-umbilical port, a 5-mm subxyphoidpost (left to the upper 1/3 of the distance between the umbilicus and xyphoid), and a 5-mm subcostal port (right lower quadrant at midclavicular line) ports were used, similar to locations in 4-port approach. The umbilical port was used for the camera, the subxyphoidport was used for the dissector, and the third port was inserted in the right lower quadrant for the grasping clamp and the extraction of the gallbladder (Fig 1). An operating telescope was inserted into the umbilical port. Retraction of the gallbladder was achieved by the grasping forceps inserted from the right hypochondrium through the 5-mm subcostal port, until the

identification of the Calot triangle, whereas dissection of cystic duct and cystic artery was accomplished through the 5-mm subxyphoid port. The gallbladder was retrieved for dissection through the umbilical port after the position of the operating telescope was changed. Removal of the dissected gallbladder was performed through the subxyphoid port and drains were placed through the right hypochondrial port to enable bleeding control when necessary (Fig 2). Endo-bag was used if required. While 1 patient with postoperative incision site infection received post operative antibiotics, all patients had similar prophylactic antibiotic regimen preoperatively, none of the patients received antibiotics in the postoperative period.



**Fig 1.** Location of ports in 3-port laparoscopic cholecystectomy, a 5-mm infra-umbilical port, a 5-mm subxyphoid post and a 5-mm subcostal port (right lower quadrant at midclavicular line)



**Fig 2.** Operative procedure. (A- Dissection of bile duct and cystic artery, B- Endoclipping of bile duct, C- Dissection of bile gallbladder)

### *Statistical Analysis*

Statistical analysis was made using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY). Mann-Whitney U test (Monte Carlo) was used for analysis of numerical variables. Data were expressed as “mean (standard deviation, SD)” median (minimum-maximum) and percent (%) where appropriate.  $p < 0.05$  was considered statistically significant.

### **Results**

Demographic and clinical characteristics of individual cases are provided in Table 1. Overall, mean(SD) age of patients was 11.6(3.3) years and 55.0% of patients were boys.

Cholelithiasis was the indication in 80.0% (alone: 65.0%, with thalassemia/hereditary spherocytosis in 10.0% and with acute cholecystitis in 5.0%) of patients, while other indications were noted in 20.0% (gallbladder disease in 15.0% and acute acalculous cholecystitis in 5.0%) of patients (Table 2).

All patients underwent laparoscopic cholecystectomy, while 2 patients with accompanying thalassemia or hereditary spherocytosis underwent splenectomy along with cholecystectomy. Mean (SD) operative time was 44.8(9.5, range: 30.0-60.0) min and LOS was 2.1(1.2, range: 1.0-5.0) days (Table 2). Surgery was successful in all patients without development of major complications such as bile fistula, bile leak or bile duct injury, or mortality.

Table 1. Demographic and clinical characteristics of individual cases

No	Gender	Age (year)	Operative time (min)	Length of hospital stay (day)	Indication	Surgery
1	Female	11	40	2	Cholelithiasis	LC
2	Female	16	55	2	Gallbladder disease*	LC
3	Male	12	30	2	Cholelithiasis	LC
4	Female	9	50	2	Cholelithiasis	LC
5	Male	13	35	2	Cholelithiasis	LC
6	Male	10	45	3	Cholelithiasis	LC
7	Female	15	30	2	Cholelithiasis	LC
8	Male	6	45	1	Cholelithiasis	LC
9	Male	15	40	1	Cholelithiasis	LC
10	Male	14	50	1	Gallbladder disease*	LC
11	Male	9	60	5	Cholelithiasis, HS	LC + SPL
12	Female	12	40	2	Cholelithiasis, AC	LC
13	Female	12	55	1	Acute acalculous cholecystitis	LC
14	Female	6	50	2	Gallbladder disease*	LC
15	Female	14	50	1	Cholelithiasis	LC
16	Male	16	35	2	Cholelithiasis	LC
17	Male	11	40	2	Cholelithiasis	LC
18	Male	5	65	5	Cholelithiasis, TH	LC + SPL
19	Female	15	30	1	Cholelithiasis	LC
20	Male	11	45	2	Cholelithiasis	LC

AC: Acute cholecystitis, LC: laparoscopic cholecystectomy, SPL: splenectomy, HS: hereditary spherocytosis, TH: thalassemia \*Gallbladder dyskinesia and structural anomalies of gallbladder

Table 2. Patient demographics and study parameters in the overall study population

<b>Age (year)</b>	Mean(SD)	11.6 (3.3)
	Median (min-max)	12.0 (5.0-16.0)
<b>Gender, n(%)</b>		
Girl		9 (45.0)
Boy		11 (55.0)
<b>Indication, n(%)</b>		
	Total	16 (80.0)
Cholelithiasis	<i>alone</i>	13 (65.0)
	+ <i>thalassemia/hereditary spherocytosis</i>	2 (10.0)
	+ <i>acute cholecystitis</i>	1 (5.0)
Other	Total	4 (20.0)
	<i>gallbladder disease*</i>	3 (15.0)
	<i>acute acalculous cholecystitis</i>	1 (5.0)
<b>Surgery, n(%)</b>		
	Total	20 (100.0)
<b>Laparoscopic cholecystectomy</b>	<i>alone</i>	18 (90.0)
	+ <i>splenectomy</i>	2 (10.0)
	Mean(SD)	44.8 (9.5)
<b>Operative time (min)</b>	Median (min-max)	45.0 (30.0-60.0)
	Mean(SD)	2.1 (1.2)
<b>Length of hospital stay (day)</b>	Median (min-max)	2.0 (1.0-5.0)

\*Gallbladder dyskinesia and structural anomalies of gallbladder

Apart from significantly shorter operative time in patients with cholelithiasis than those with other indications for laparoscopic cholecystectomy (median 42.2 vs. 55.0 min,  $p=0.001$ ), no significant difference was noted in age, operative time and LOS with respect to gender or indications of laparoscopic cholecystectomy (Table 3).

Table 3. Comparison of age, operative time and hospital stay according to gender and indication

	Age (year)		Operative time (min)		Length of hospital stay (day)	
	Mean(SD)	Median (min-max)	Mean(SD)	Median (min-max)	Mean(SD)	Median (min-max)
<b>Gender</b>						
Girl (n=9)	12.2(3.2)	12.0(6.0-16.0)	46.1(11.4)	50.0(30.0-60.0)	1.7(0.5)	2.0(1.0-2.0)
Boy (n=11)	11.1(3.5)	11.0(5.0-16.0)	43.6(8.1)	45.0(30.0-55.0)	2.2(1.4)	2.0(1.0-5.0)
p value	0.462		0.592		0.157	
<b>Indication</b>						
Cholelithiasis (n=16)	11.5(3.2)	11.5(5.0-16.0)	42.2(8.8)	42.5(30.0-55.0)	2.2(1.2)	2.0(1.0-5.0)
Other (n=4) <sup>a</sup>	12.0(4.3)	13.0(6.0-16.0)	55.0(4.1)	55.0(50.0-60.0)	1.5(0.6)	1.5(1.0-2.0)
p value	0.839		<b>0.001</b>		0.131	

<sup>a</sup>Patients with gallbladder disease (n=3) and acute acalculous cholecystitis (n=1)  
Mann-Whitney U test (Monte Carlo)

## Discussion

Our findings in a retrospective cohort of pediatric patients who underwent 3-port laparoscopic cholecystectomy revealed successful surgical and clinical outcome with median of 45 minutes operative time and 2.0 days of LOS along with no major complications or mortality observed in any of patients. No significant gender influence was noted on mean operative time and LOS and no significant impact of diagnosed indication was noted on LOS, while operative time was significantly shorter in patients with cholelithiasis than those with other indications for laparoscopic cholecystectomy.

Our findings revealed that cholelithiasis (80.0%) was the leading indication for laparoscopic cholecystectomy, as followed by other indications (i.e. gallbladder dyskinesia, structural anomalies of gallbladder, and calculous and acalculous cholecystitis). Thalassemia and hereditary spherocytosis were evident in two patients leading to indication for splenectomy in these patients. 3-port laparoscopic cholecystectomy was technically and clinically successful in all patients, regardless of the indication with identification of no major complications including bile fistula, bile leak or bile duct injury, or mortality.

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Similarly, in a retrospective analysis of 6-year experience with laparoscopic cholecystectomy in 224 children (mean age: 12.9 years, range, 0-21), authors reported symptomatic gallstones (n=166) and biliary dyskinesia (n=35) as the most common indications alongside indication for splenectomy in 6 cases and presence of calculous/ acalculous cholecystitis in 6 cases (8). Authors reported no conversions, ductal injuries, bile leaks or mortality after laparoscopic cholecystectomy, while the mean operative time (excluding patients with concomitant operations) was reported to be 77 minutes (range, 30-285) (8).

In another retrospective study of 202 pediatric patients with laparoscopic cholecystectomy, symptomatic cholelithiasis was reported to be the primary (46%) indication with concomitant splenectomy in 7.9% of patients.<sup>9</sup> Authors reported no common bile duct injuries, whereas spillage of bile in 5.9% and wound infection, retained stones, abdominal abscess, and biloma in 4.5% of patients (9). The median operative time and postoperative LOS were reported to be 117.5 minutes and 1 day, respectively (9).

Notably, the mean operative time in our series during 3-port laparoscopic cholecystectomy seems to be shorter (44.8 min, range 30.0-60.0). Moreover, there was a significant difference in operative time with respect to indications in our cohort with 42.2 min (range 30.0-50.0) duration of operation for cholelithiasis vs. 55.0 min (range, 50.0-60.0) for gallbladder dyskinesia, structural anomalies of gallbladder and acalculous cholecystitis. Association of 3-port laparoscopic cholecystectomy with short operative time in our pediatric patients with cholelithiasis seems also notable given that single incision laparoscopy, as a technique considered likely to replace the multi-port laparoscopic paradigm (10,11), was reported to be associated with favorable safety and efficacy whereas with a longer operative time that ranges from 90 to 100 min when used for cholecystectomy in pediatric patients (10,12).

Nonetheless, it should also be noted that in a retrospective analysis 54 children (mean 7.6 years, range, 14 months to 15 years) who underwent laparoscopic cholecystectomy (conventional 4-port technique in 17 patients and 3-port approach in 37 patients) over a 5-year period, authors reported the duration of hospitalization varied from 1 to 4 days (mean: 2.7 days) and no significant impact of 3-port approach (umbilical, subxyphoid region and right lower quadrant ports) on the duration of the procedure (13). Authors concluded that the reduction of the number of ports in children enables an easier and safe approach without affecting the perioperative time (13).



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In another retrospective study in 110 pediatric patients who underwent laparoscopic cholecystectomy (107 with 4-port approach, 3 with 5-port approach) over a 5-year period, all patients were reported to have symptomatic cholelithiasis, while co-morbid hemolytic diseases were noted in 27 patients including sickle cell disease in 17 patients, hereditary spherocytosis in 7 patients and thalassemia in three patients (14). Authors noted median duration of operation to be 45 min (range, 25–75) and median hospital stay was 2 days (range, 1 to 10) and complications in 17 (15.5%) patients including gallbladder perforation during dissection, a fall of stones into the abdominal cavity during extraction, and a trocar orifice infection (14).

In a retrospective case series of 95 children (age 6–18 y) treated with laparoscopic cholecystectomies (3 port approach in 76 cases, 4-port approach in 19 cases), symptomatic cholelithiasis was reported to be the leading indication for laparoscopic cholecystectomy (6). The port locations for 3-port approach were similar to our technique, including an umbilical port for the camera, a subxyphoid port for the dissector, and a third one in the right lower quadrant for the grasping clamp and the extraction of the gallbladder.<sup>6</sup> Authors considered the 3-port approach to be mostly sufficient for cholecystectomy with a need for conversion to open cholecystectomy in 3 patients and postoperative complications due to failure of bile drainage in 3 patients (6).

Accordingly, our findings are consistent with findings from published series of pediatric patients indicating efficacy and safety of laparoscopic cholecystectomy that results in short postoperative hospital stay and low complication rates (6-9,14). Our findings also support the higher prevalence of idiopathic cholelithiasis as well as the association of cholelithiasis, particularly pigment stones containing bilirubin salts, with hemolytic disorders in the pediatric population (7,8,14-17) and the safety of laparoscopic cholecystectomy in the case of symptomatic cholelithiasis in pediatric patients with hemolytic disorders (5,18). Likewise, in a study with 223 pediatric cholelithiasis patients with comorbid hemolytic disorders in 139 patients (62.3%), laparoscopic cholecystectomy (applied in 204 patients) was reported to be associated with limited postoperative complications in children with gallstones with no injuries to the hepatic artery or common bile duct (19).

Thus, our findings emphasize the favorable surgical and clinical outcome via 3-port laparoscopic cholecystectomy in pediatric patients regardless of the indication for laparoscopic cholecystectomy and gender.

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Notably, in an analysis of national database involving 5,046 pediatric patients (75.0% female; median age 13.7 years) who underwent cholecystectomy due to cholelithiasis (69.6%), cholecystitis (16.3%), biliary dyskinesia (12.3%), and pancreatitis (1.8%), authors reported that same-day discharge occurred in 1,061 patients (21.0%) and overall rate of re-admission was 3.6% with no increase in re-admission rates compared to those discharged on the same day (2.1%) as compared with those discharged on postoperative day 1 or 2 (3.9%).<sup>17</sup> While lower same-day discharge rates with median 2 days (range 1-5) of LOS in our cohort seems notable in this regard, it should be noted that longer LOS was noted in our two patients with concomitant splenectomy operation (5 days for each).

In conclusion, our findings indicate safety and efficacy of 3-port laparoscopic cholecystectomy in pediatric population, regardless of the idiopathic or hemolytic etiology of cholelithiasis or gender of patients. Our findings support the feasibility of 3-port laparoscopic cholecystectomy in pediatric population and emphasize the likelihood of this approach to be considered as a first-choice surgical treatment of gallbladder diseases in pediatric population, with significant advantages regarding the operative time, intra and post-operative complication rates and hospital stay.

### **Conflict of Interest**

The authors declare no competing interest.

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