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Characteristics and co-morbidities of pediatric patients requiring cholecystectomy

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Abstract

Cholelithiasis in children is an increasingly recognized condition, due to the rising prevalence of risk factors and advances in diagnostic techniques. This retrospective descriptive cohort analyzed the characteristics of patients who underwent surgery for cholelithiasis in two Italian centers. From 2013 to 2023, 53 pediatric patients were retrospectively analyzed. Data collected included surgical indications, predisposing factors, and perioperative management. When preoperative ultrasound detected stones in the common bile duct, Endoscopic Retrograde Cholangiopancreatography (ERCP) was performed, followed by Laparoscopic Cholecystectomy (LC) after two months. Postoperative clinical and ultrasonographic follow-up was conducted at 6 months and 1 year. The primary indication for surgery was symptomatic cholelithiasis in 38 patients (71.7%), followed by acute cholecystitis in 11 (20.7%) and persistent cholelithiasis in 4 (7.6%). Predisposing factors included hematological disorders in 14 cases (26.4%), a positive family history in 25 (47.2%), exposure to lithogenic substances in 9 (17.0%), and obesity in 9 (17.0%). ERCP was performed in 7 patients. Postoperative complications included one case of biliary fistula and one case of post-cholecystectomy syndrome. At follow-up, all patients were asymptomatic except for two who reported nonspecific abdominal pain. The most common risk factors for pediatric cholelithiasis in our cohort were a positive family history, hematological disorders, and obesity. LC remains the standard surgical treatment in children, with the primary aim of preventing complications.

Key words: cholecystectomy; cholelithiasis; laparoscopy; children.

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Introduction

Cholelithiasis is one of the most common disorders of the gastrointestinal system in adults. In children, the condition remains relatively uncommon compared with adults; however, its incidence has increased significantly in recent years.[1,2] According to the literature, prevalence among children has increased from 0.13% to 4.0%.[1] While traditional predisposing factors such as family history remain relevant, this increase appears to be related both to advances in diagnostic modalities, particularly abdominal ultrasonography, and to the growing prevalence of contributing factors such as obesity[3] and the use of lithogenic medications, including octreotide, diuretics, and antibiotic.[4,5]

Laparoscopic Cholecystectomy (LC) has become the standard of care in both adults and children.[6] Nevertheless, questions remain regarding the optimal indications for surgery in pediatric patients. In particular, the role of medical therapy, the management of asymptomatic cases, and the diagnostic workup required to exclude common bile duct involvement remain matters of ongoing discussion.[6,7] Furthermore, pediatric data are often limited to single-institution series with relatively small sample sizes, making it difficult to establish robust guidelines.

The purpose of the present study was to review an 11-year experience with laparoscopic cholecystectomy in children, analyzing demographic characteristics, predisposing factors, surgical indications, perioperative management, and outcomes in two Italian centers.

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Materials and Methods

A retrospective study was conducted at two pediatric surgery departments, including all patients who underwent cholecystectomy over an 11-year period, from January 2013 to December 2023. The study was based on the recorded clinical data of patients treated during the study period. The analysis included demographic characteristics (primary diagnosis, age, and sex), indications for cholecystec-

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tomy, and the presence of predisposing factors, including family history, hematological disorders, obesity, dietary habits (high-fat diet), and exposure to lithogenic substances. A high-fat diet was defined according to the daily intake of animal and vegetable fats (e.g., meat and butter). Obesity was assessed by calculating Body Mass Index (BMI) as weight (kg)/height (m²) and interpreting it according to age- and sex-specific percentiles. Obesity was defined as a BMI above the 97th percentile, while a BMI above the 99th percentile was considered severe obesity. To ensure a consistent clinical and surgical approach between the two centers, all patients were initially evaluated by the surgeon responsible for their care, while the surgeon from the other participating center independently reviewed the clinical and imaging data via email before the final treatment decision was made. Surgical treatment was recommended for patients with symptomatic cholelithiasis (recurrent biliary colic), for those with cholelithiasis who experienced one or more episodes of acute cholecystitis, and in cases of persistent cholelithiasis. Symptomatic cholelithiasis was diagnosed in patients presenting with diffuse abdominal pain and/or biliary colic, nausea, and vomiting in the absence of laboratory evidence of inflammation. Persistent cholelithiasis was defined as the presence of gallstones on ultrasound after at least six months of medical therapy with ursodeoxycholic acid (10 mg/kg twice daily).

Acute cholecystitis was diagnosed in patients presenting with right upper quadrant pain, fever, leukocytosis, and elevated C-reactive protein levels. All patients scheduled for surgery underwent abdominal ultrasonography within 48 hours before the procedure to assess for Common Bile Duct (CBD) stones. When ductal stones were suspected, Magnetic Resonance Imaging (MRI) was performed to confirm the diagnosis. Patients with CBD stones identified on MRI underwent Endoscopic Retrograde Cholangiopancreatography (ERCP) with sphincterotomy of the papilla of Vater and endoscopic stone removal. Following ERCP, patients were discharged and scheduled for laparoscopic cholecystectomy at least two months later.

Laparoscopic cholecystectomy was performed in both centers using the same standard technique. Open transumbilical access with a 5-mm Hasson trocar was employed, supplemented by two additional 5-mm working trocars positioned along the right and left paraumbilical lines and a 5-mm accessory trocar in the high epigastric region (Figure 1). After identification and isolation of the relevant structures, the cystic duct and cystic artery were secured with titanium clips and divided. The gallbladder was then dissected from the liver, placed in an endobag, and extracted through the umbilical access, which was slightly enlarged if necessary to facilitate removal.

In the postoperative period, patients remained *nil per os* for 24 hours, after which they gradually commenced a fat-free diet for one week, followed by a low-fat diet for one month. All patients underwent clinical and ultrasonographic follow-up at 6 months and 1 year after surgery. Follow-up aimed to assess recovery, dietary adaptation, and the occurrence of postoperative complications.

Results

During the 11-year study period at the two pediatric surgery centers, a total of 53 pediatric patients underwent laparoscopic cholecystectomy, comprising 31 females and 22 males. The mean age at surgery was 11.6 ± 2.1 years (range, 3–16 years). Regarding surgical indications, 38 patients (71.7%) had symptomatic cholelithiasis (recurrent biliary colic). In 11 patients (20.7%), the indication for surgery was acute cholecystitis associated with cholelithiasis, while 4 patients (7.6%) underwent surgery because of persistent cholelithiasis detected on ultrasound after six months of medical treatment with ursodeoxycholic acid. Cholecystectomy was performed in a 3-year-old boy who had received Total Parenteral Nutrition (TPN) for 12 months because of short bowel syndrome and developed an episode of cholecystitis despite medical treatment.

Analysis of associated conditions revealed that 14 patients (26.4%) had hematological disorders. Detailed review identified thalassemia major in 3 children, hereditary spherocytosis in 6 patients (3 with an affected sibling and 3 with an affected cousin), and sickle cell anemia in 5 cases. One patient had a history of Wilms tumor, with multiple previous hospitalizations and surgeries. A family history of cholelithiasis was reported in 25 patients (47.2%): in 15 cases, cholelithiasis was present in the father, and in 10 cases, it was present in the mother. Exposure to lithogenic substances was documented in 9 patients (17.0%): six had received lithogenic antibiotics for an average of 2 months (five of whom had received ceftriaxone), and three had undergone total parenteral nutrition. Obesity, defined as a BMI above the 97th percentile, was observed in 9 children (17.0%); 2 were severely obese. All obese patients also had inadequate dietary fiber intake. A high-fat, low-fiber diet was present in all obese patients and in 10 additional patients with a positive family history of cholelithiasis. These results are summarized in Table 1.

All patients undergoing laparoscopic cholecystectomy underwent preoperative ultrasonography within 48 hours before surgery, with an average interval of 36 hours (range, 24–48 hours). In seven patients, gallstones were suspected in the common bile duct and subsequently confirmed by abdominal MRI. These seven patients underwent ERCP with sphincterotomy for treatment of choledocholithiasis, followed by laparoscopic cholecystectomy at least two months later.

All patients underwent laparoscopic cholecystectomy (Figure 2), with no conversions to open surgery in either center. No intraoperative complications were recorded. The mean operative time was 92 minutes (range, 55–160 minutes) at one center and 89 minutes (range, 50–150 minutes) at the other. Subhepatic drainage was

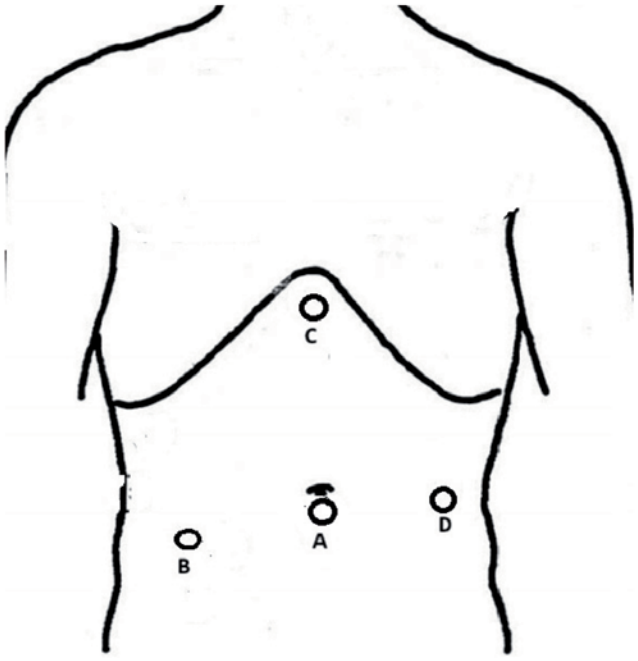


Figure 1. Schematic representation of port placement. Trocar A is infraumbilical.

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placed in 12 patients (22.6%) because of adhesions (11 of whom had cholecystitis) and was left in place for a mean of 2.5 days (range, 2–5 days). All 11 patients who presented with cholecystitis before surgery initially received medical therapy with ursodeoxycholic acid; however, three underwent surgery before the planned two-month interval because of a lack of clinical improvement. Intraoperative assessment revealed anatomical variations in both centers: three patients had an hourglass-shaped gallbladder (narrowing of the central portion of the organ), and five patients, all of whom had a history of cholecystitis, exhibited significant pericholecystic adhesions. Regarding the characteristics of the stones, crystalline cholesterol deposits were found in 29 children, bilirubin polymers in 14 cases, and other bile components in 10. The mean stone size reported by the pathologist was 1.2 cm (range, 0.9–1.3 cm).

The average postoperative hospital stay was 3 days (range, 2–4 days) at both centers. Postoperative complications occurred in 2 patients (3.8%): one male patient developed a biliary fistula, with bile leakage through the drain for 4 days, requiring reoperation with laparoscopic closure of the cystic remnant using clips. This patient had a history of cholecystitis initially managed with medical therapy (antibiotics, hydration, and fasting) without improvement, necessitating surgical intervention. Another patient experienced post-cholecystectomy syndrome, characterized by nausea and diarrhea, which resolved after one month of medical management and dietary modification. At 6-month follow-up, all patients were asymptomatic. At 12 months, two patients reported persistent nonspecific abdominal pain.

Ultrasound follow-up one year after surgery was performed in 52 patients (96.0%); one patient declined the examination. No abdominal collections or other pathological findings in the hepatic region were detected.

Table 1. Distribution of predisposing factors and associated comorbidities among the 53 pediatric patients who underwent laparoscopic cholecystectomy between 2013 and 2023.

Predisposing factors	Cases
Familiarity	25 (47.2)
With high-fat diet	10 (18.0)
Normal diet	15 (28.3)
Hemolytic anemias	14 (26.4)
Thalassemia major	3 (5.7)
Hereditary spherocytosis	6 (11.3)
Sickle cell disease	5 (9.4)
Obesity	9 (17.0)
Litogenic substances	9 (17.0)
Antibiotics	6 (11.3)
Total parenteral nutrition	3 (5.7)
Wilms tumor	1 (1.9)

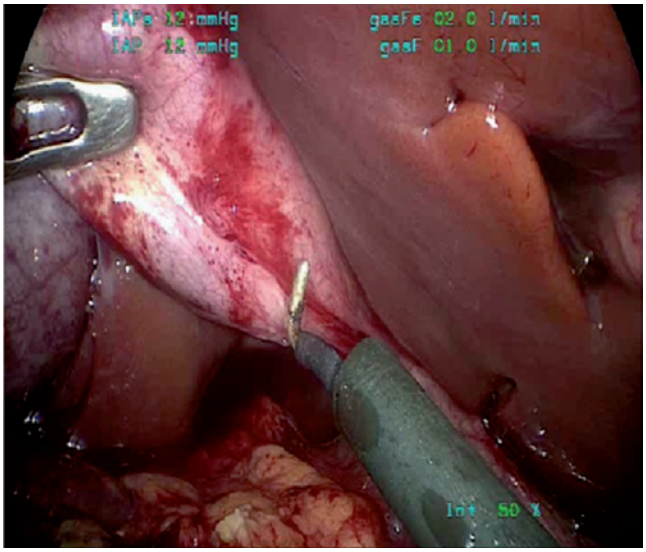


Figure 2. Laparoscopic cholecystectomy image: use of a monopolar instrument to perform adhesiolysis.

Discussion

In recent decades, the incidence of gallbladder disease in the pediatric population has increased significantly, with an estimated fourfold rise.[8,9] This trend likely reflects both an epidemiological shift in risk factors—particularly the rising prevalence of childhood obesity—and the broader use of noninvasive imaging techniques such as abdominal ultrasonography.[10]

In our study of 53 pediatric patients who underwent LC, the most frequently observed predisposing factor was a positive family history of cholelithiasis, present in 47.2% of cases. These observational findings support the hypothesis of a strong genetic component, consistent with studies identifying variants in genes such as ABCG8 and ABCB4, which increase biliary cholesterol secretion and are associated with a fivefold higher risk of gallstone formation in first-degree relatives.[11]

Hematological disorders were the second most common risk factor in our cohort, affecting 26.4% of patients. These included hereditary spherocytosis, thalassemia major, and sickle cell anemia, all characterized by chronic hemolysis that increases unconjugated bilirubin levels in bile, thereby promoting pigment stone formation. Our findings are consistent with the existing literature,[12-13] which recommends prophylactic cholecystectomy—often in combination with splenectomy—in selected symptomatic patients with hemolytic diseases.

Obesity, defined as a BMI above the 97th percentile, was present in 17.0% of our patients. Although this percentage appears lower than that reported in some contemporary series,[14] it is worth noting that the high proportion of patients with hematological disorders in our study may have obscured the full impact of obesity. According to Frybova *et al.*, obesity is emerging as a major contributor to pediatric cholelithiasis through mechanisms such as cholesterol hypersecretion, bile supersaturation, reduced gallbladder motility, and low-grade systemic inflammation.[15]

Exposure to lithogenic medications was observed in 17.0% of cases. In patients receiving TPN without enteral feeding, levels of hormones such as gastrin, motilin, gastric inhibitory polypeptide, and glucagon are reduced. This may result in decreased gallbladder contractility, intestinal stasis, bacterial overgrowth, bacterial translocation, and sepsis, all of which may exacerbate cholestasis in infants.[16] Ceftriaxone is well documented to induce biliary pseudolithiasis by forming calcium–ceftriaxone complexes that can mimic true gallstones; these typically resolve within 10–15 days of drug discontinuation.[17,18]

Anatomical anomalies such as an hourglass-shaped gallbladder were identified in three cases, suggesting a possible role for congenital anomalies in symptom persistence or biliary stasis.[19] Biliary dyskinesia is also emerging as a surgical indication; in patients presenting with this condition, abnormal gallbladder motility may lead

to recurrent upper abdominal pain. LC has a reported success rate of approximately 67.0% in this population.[20-22]

As reported in the literature, our data confirm that the incidence of cholelithiasis increases with age and is rare in newborns.[23,24] More than half of gallstone cases in newborns resolve spontaneously with postnatal monitoring; therefore, surgical intervention or symptomatic treatment is required only in selected cases.[23]

Our data also show a higher incidence of cholelithiasis in girls than in boys.[22,25,26] This difference may be influenced by puberty and hormonal factors, particularly estrogen production.

Clinically, the most common indication for surgery was symptomatic cholelithiasis (71.7%), followed by acute cholecystitis (20.7%). Persistent, asymptomatic stones refractory to medical therapy accounted for 7.6% of cases. These findings underscore the limited efficacy of medical management in pediatric cholelithiasis. Spontaneous resolution has been reported in only about 17% of asymptomatic cases.[27-30] Moreover, 30–50% of initially asymptomatic patients eventually develop symptoms, supporting the rationale for prophylactic cholecystectomy in selected patients to prevent complications such as acute cholecystitis and choledocholithiasis, which may be associated with increased morbidity and mortality.[31,32]

Regarding treatment, many studies describe laparoscopic cholecystectomy as the gold standard for managing cholelithiasis.[33] In our series, the procedure proved safe and well tolerated, with no conversions to open surgery and a low postoperative complication rate (3.8%), consistent with rates reported in both pediatric and adult populations.[34] The only major complication, a biliary fistula requiring reoperation, occurred in a patient with cholecystitis who had not improved with initial medical treatment, underscoring the importance of timely surgical intervention in unresponsive cases.

In adults, bile duct injury occurs in approximately 0.85% of cases, but no comparable rate has been established for children and adolescents. In both populations, acute or chronic gallbladder inflammation, obesity, anatomical variations, and bleeding-related events represent recognized intraoperative risks.[35,36]

Determining the optimal timing of cholecystectomy is crucial in the management of pediatric cholelithiasis. In clinically stable patients with acute cholecystitis, an initial conservative approach with antibiotics, hydration, and fasting may be adopted to allow the inflammatory process to subside. However, lack of clinical improvement should prompt earlier intervention. According to Balanescu *et al.*,[37] deferred surgery may provide outcomes comparable to elective procedures in selected patients. In our series, three of the eleven patients with acute cholecystitis underwent surgery before the planned two-month interval because of persistent symptoms despite medical treatment. Thus, our experience supports an individualized approach that avoids both unnecessary emergency surgery in clinically stable patients and prolonged conservative management when clinical improvement is not achieved.

Preoperative imaging with ultrasound and MRI enabled accurate diagnosis of common bile duct stones in seven patients, all of whom subsequently underwent ERCP with papillotomy followed by LC two months later. This staged approach was effective and was not associated with complications in our series, supporting the selective use of MRI and ERCP in patients with suspected choledocholithiasis.[38-40]

Overall, our findings suggest that the epidemiology of pediatric gallstone disease is evolving, with obesity emerging as an important risk factor while hereditary and iatrogenic contributors remain significant, as reported in the recent literature. The increased use of sensitive diagnostic imaging modalities, together with the high success rate of minimally invasive surgical approaches, supports a proactive management strategy, particularly for symptomatic or high-risk patients.

In our experience, the timing of laparoscopic cholecystectomy was individualized according to the clinical presentation and response to conservative treatment. Elective surgery was generally performed in children with recurrent biliary symptoms or persistent gallstones despite medical therapy. In patients presenting with acute cholecystitis, an initial conservative approach was adopted in clinically stable patients, with antibiotic therapy, hydration, and fasting, allowing the inflammatory process to subside before surgery. However, lack of clinical improvement was considered an indication for earlier intervention. Indeed, three of the eleven patients with acute cholecystitis underwent surgery before the planned two-month interval because of persistent symptoms despite medical treatment. This approach reflects our preference for avoiding both unnecessary emergency surgery in clinically stable patients and prolonged conservative management when clinical improvement is not achieved.

Conclusions

Our complication rate of 3.8%, together with the absence of intraoperative complications and conversions to open surgery, supports the safety of laparoscopic cholecystectomy in experienced hands. However, the favorable outcomes observed in our series should not be interpreted as evidence that the procedure is technically risk-free. Previous inflammation, pericholecystic adhesions, and anatomical variations may increase operative difficulty. In our cohort, five patients with previous cholecystitis had significant pericholecystic adhesions. These findings underline the importance of surgical expertise, particularly in pediatric patients, in whom anatomical characteristics and the consequences of previous inflammation may make laparoscopic dissection more demanding. We believe that pediatric cholecystectomy should therefore be performed by surgeons with specific experience in pediatric minimally invasive surgery and biliary procedures, with appropriate multidisciplinary support when complex cases are encountered.

References

1. Svensson J, Makin E. Gallstone disease in children. Semin Pediatr Surg 2012;21:255-65.
2. Kang JY, Ellis C, Majeed A, et al. Gallstones--an increasing problem: a study of hospital admissions in England between 1989/1990 and 1999/2000. Aliment Pharmacol Ther 2003;17: 561-9.
3. Zdanowicz K, Daniluk J, Lebensztejn DM, Daniluk U. The etiology of cholelithiasis in children and adolescents - a literature review. Int J Mol Sci 2022;23:13376.
4. Poffenberger CM, Gausche-Hill M, Ngai S, et al. Cholelithiasis and its complications in children and adolescents: update and case discussion. Pediatr Emerg Care 2012;28:68-78.
5. Suarez AL, LaBarre NT, Cotton PB, et al. An assessment of existing risk stratification guidelines for the evaluation of patients with suspected choledocholithiasis. Surg Endosc 2016;30:4613-8.
6. Noviello C, Papparella A, Romano M, Cobellis G. Risk factors of cholelithiasis unrelated to hematological disorders in pediatric patients undergoing cholecystectomy. Gastroenterology Res 2018;11:346-8.
7. Maple JT, Ben-Menachem T, Anderson MA, et al. The role of endoscopy in the evaluation of suspected choledocholithiasis. Gastrointest Endosc 2010;71:1-9.
8. Mehta S, Lopez ME, Chumpitazi BP et al. Clinical characteristics and risk factors for symptomatic pediatric gallbladder disease. Pediatrics 2012;129:e82-8.

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9. Andrassy RJ, Treadwell TA, Ratner IA, Buckley CJ. Gallbladder disease in children and adolescents. Am J Surg 1976;132:19-21.
10. Bogue CO, Murphy AJ, Gerstle JT, et al. Risk factors, complications, and outcomes of gallstones in children: a single-center review. J Pediatr Gastroenterol Nutr 2010;50:303-8.
11. Stinton LM, Shaffer EA. Epidemiology of gallbladder disease: cholelithiasis and cancer. Gut Liver 2012;6:172-87.
12. Mattson A, Sinha A, Njere I, et al. Laparoscopic cholecystectomy in children: A systematic review and meta-analysis. Surgeon 2023;21:e133-41.
13. Liu Y, Jin S, Li Y, et al. Treatment of asymptomatic gallstones in children with hereditary spherocytosis requiring splenectomy. J Pedi-atr Surg 2023;58:756-61.
14. Rothstein DH, Harmon CM. Gallbladder disease in children. Semin Pediatr Surg 2016;25:225-31.
15. Frybova B, Drabek J, Lochmannova J, et al. Cholelithiasis and choledocholithiasis in children; risk factors for development. PLoS One 2018;13:e0196475.
16. Kelly DA. Preventing parenteral nutrition liver disease. Early Hum Dev 2010;86:683–7.
17. Biner B, Oner N, Celtik C, et al. Ceftriaxone-associated biliary pseudolithiasis in children. J Clin Ultrasound 2006;34:217-22.
18. Schweizer P, Lenz MP, Kirschner HJ. Pathogenesis and symptomatology of cholelithiasis in childhood. A prospective study. Dig Surg 2000;17:459-67.
19. Bertozzi M, Bizzarri I, Angotti R, et al. Multiseptate gallbladder in a child. Journal of Pediatric Surgery Case Reports 2019;45: 101212.
20. Murphy PB, Vogt KN, Winick-Ng J, et al. The increasing incidence of gallbladder disease in children: A 20-year perspective. J Pediatr Surg 2016;51:748-52.
21. Lacher M, Yannam GR, Muensterer OJ, et al. Laparoscopic cholecystectomy for biliary dyskinesia in children: frequency increasing. J Pediatr Surg 2013;48:1716-21.
22. Vegunta RK, Raso M, Pollock J, et al. Biliary dyskinesia: the most common indication for cholecystectomy in children. Surgery 2005;138:726-33.
23. Karami H, Kianifar HR, Karami S. Cholelithiasis in children: a diagnostic and therapeutic approach. J Pediatr Rev 2016;5: e9114.
24. Koyuncu H, Oflu AT, Güngör A et al. Evaluation of pediatric cases with cholelithiasis: 5-year single-center experience. Clin Pediatr (Phila) 2025;64:1726-32.
25. Wesdorp I, Bosman D, de Graaff A, et al. Clinical presentations and predisposing factors of cholelithiasis and sludge in children. J Pediatr Gastroenterol Nutr 2000;31:411–7.
26. Nakeeb A, Comuzzie AG, Martin L, et al. Gallstones: Genetics versus environment. Ann Surg 2002;235:842–9.
27. Della Corte C, Falchetti D, Nebbia G, et al. Management of cholelithiasis in Italian children: a national multicenter study. World J Gastroenterol 2008;14:1383-8.
28. Bhaumik K. Asymptomatic cholelithiasis in children: management dilemma. J Indian Assoc Pediatr Surg 2021;26:228-33.
29. Ignacio RC Jr, Kelley-Quon LI, Ourshalimian, et al. Pediatric DUCT Score: a highly specific predictive model for choledocholithiasis in children. J Am Coll Surg 2023;236:961-70.
30. Çakar S, Eren G, Erdur CB, et al. Cholelithiasis in infants: risk factors, management, and the role of ursodeoxycholic acid. Children (Basel) 2024;11:1553.
31. Patiño JF, Quintero GA. Asymptomatic cholelithiasis revisited. World J Surg 1998;22:1119-24.
32. Lund J. Surgical indications in cholelithiasis: prophylactic cholecystectomy elucidated on the basis of long-term follow up on 526 nonoperated cases. Ann Surg 1960;151:153-62.
33. Bonnard A, Seguier-Lipszyc E, Liguory C, et al. Laparoscopic approach as primary treatment of common bile duct stones in children. J Pediatr Surg 2005;40:1459-63.
34. Pogorelić Z, Lovrić M, Jukić M, Perko Z. The laparoscopic cholecystectomy and common bile duct exploration: a single-step treatment of pediatric cholelithiasis and choledocholithiasis. Children (Basel) 2022;9:1583.
35. Treider M, Ohnesorge S, Bjørnland K. Few serious complications after cholecystectomy in paediatric patients. Acta Paediatr 2020;109:630–1.
36. Babb J, Davis J, Tashiro J, et al. Laparoscopic versus open cholecystectomy in pediatric patients: a propensity score-matched analysis. J Laparoendosc Adv Surg Tech 2020;30: 322–7.
37. Balanescu R, Moga A, Balanescu L, et al. Cholecystectomy in children: indications and timing. Children 2025;12:1052.
38. Issa H, Al-Salem AH. Role of ERCP in the era of laparoscopic cholecystectomy for the evaluation of choledocholithiasis in sickle cell anemia. World J Gastroenterol 2011;17:1844-7.
39. Rocca R, Castellino F, Daperno M, et al. Therapeutic ERCP in paediatric patients. Dig Liver Dis 2005;37:357-62.
40. Green JA, Scheeres DE, Conrad HA, et al. Pediatric ERCP in a multidisciplinary community setting: experience with a fellowship-trained general surgeon. Surg Endosc 2007;21:2187-92.

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Conflict of interest: the authors declare that they have no conflicts of interest.

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Informed consent: written informed consent was obtained from the patient's parents/legal guardian for publication and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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