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Variability in perioperative evaluation and resource utilization in pediatric patients with suspected biliary dyskinesia: A multi-institutional retrospective cohort study

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Abstract

Introduction: Biliary dyskinesia (BD) is a common indication for pediatric cholecystectomy. While diagnosis is primarily based on diminished gallbladder ejection fraction (GB-EF), work-up and management in pediatrics is controversial.

Methods: We conducted a multi-institutional retrospective review of children undergoing cholecystectomy for BD to compare perioperative work-up and outcomes.

Results: Six hundred seventy-eight patients across 16 institutions were included. There was no significant difference in gender, age, or BMI between institutions. Most patients were white (86.3%), non-Hispanic (79.9%), and had private insurance (55.2%). Gallbladder ejection fraction (EF) was reported in 84.5% of patients, and 44.8% had an EF < 15%. 30.7% of patients were initially seen by pediatric surgeons, 31.3% by pediatric gastroenterologists, and 23.4% by the emergency department with significant variability between institutions ($p < 0.001$). Symptoms persisted in 35.3% of patients post-operatively with a median follow-up of 21 days (IQR 13, 34). On multivariate analysis, only non-white race and the presence of psychiatric comorbidities were associated with increased risk of post-operative symptoms.

Conclusion: There is significant variability in evaluation and follow-up both before and after cholecystectomy for BD. Prospective research with standardized data collection and follow-up is needed to develop and validate optimal care pathways for pediatric patients with suspected BD.

Study type: Case Series, Retrospective Review.

Level of evidence: Level IV.

Keywords

Biliary dyskinesia; Cholecystectomy; Functional gallbladder disorder; Pediatric surgery; Gastroenterology

Despite rising rates of cholecystectomy for biliary dyskinesia (BD) in pediatric patients, post-operative symptom resolution or improvement is variable, ranging from 45% to nearly 100% [1–3]. Diagnosis of BD in the pediatric population is primarily based on the ROME III criteria for functional gastrointestinal or gallbladder disorders (FGBD) derived in large part from the adult literature [4–6]. With variable application of these criteria and poor consensus on diagnostic and treatment algorithms, studies have failed to demonstrate clear correlation between patient symptoms, work-up, and resolution of symptoms post-operatively [7,8].

Duration of symptoms, concurrent use of a proton pump inhibitor (PPI) for gastric reflux, ejection fraction on cholescintigraphy and abnormal gastric emptying have all been used with variable success to predict positive outcome [9]. Confusing the issue, other studies have reported high positive predictive values for symptom resolution after cholecystectomy in patients with pain, nausea, and EF < 15% on cholecystokinin cholescintigraphy [10,11]. The primary objective of this study is to evaluate the variability of and in documentation of preoperative symptoms, work-up, and outcomes following cholecystectomy through a multi-institutional retrospective case series. We predict that there will be significant variability in adherence to previously published diagnostic criteria for BD, with few predictors of symptom resolution specific to pediatric patients.

1. Methods

The study protocol and use of electronic medical records were reviewed by the Institutional Review Board (IRB) of the State University of New York, University at Buffalo and need for informed consent was waived (UB IRB: STUDY00000819). IRB approval was obtained from all participating institutions prior to collection of data. Institutions were identified for inclusion based on membership in the Pediatric Surgery Research Collaborative (PedSRC) (<https://www.pedsrsrc.org>).

1.1. Data source and patient selection

A retrospective, cohort study was performed including patients under age 19 who underwent cholecystectomy for biliary dyskinesia between January 1, 2010 and December 31, 2015 at participating institutions. Patients were identified using the Current Procedural Terminology (CPT) operative codes 47,562, 47,563, 47,564, 47,600, 47,605. *International Classification of Diseases, 9th Revision* (ICD-9) diagnostic codes were reviewed and patients were excluded who had a diagnosis other than biliary dyskinesia (BD) or functional disorder of the gallbladder. Data collected included metrics of diagnostic work up, symptomatology, operative and pathologic characteristics, post-operative symptoms, and patient outcomes.

To address the aforementioned objectives, several analyses were performed including a descriptive report of the population of pediatric patients undergoing cholecystectomy for BD; a review of the preoperative work-up and diagnostic testing performed in patients with a diagnosis of BD including analysis of variability between participating institutions; and evaluation of pre-operative presentation of work-up in patients with and without persistent symptoms post-operatively. Institutions with more than 20 patients in the database were included in the analysis of variability between sites. Where available, additional post-operative studies and interventions were analyzed.

1.2. Statistical analysis

A retrospective descriptive analysis of the data was performed. Categorical variables were compared using the Pearson's Chi-squared, with continuity correction if appropriate, or by Fisher's exact test; continuous variables were evaluated using Student's t test. Institution was included in multivariate analysis to evaluate effect of various institutions. Independent predictors of persistent symptoms at time of follow-up after surgery were identified by

logistic regression. Variables were included in this model if they had been identified in prior studies and/or they had a relationship ($p < 0.2$) with persistent symptoms in bivariate analysis. All statistical analyses were performed using Excel or IBM SPSS Statistics Software 25 where a p -value < 0.05 was considered for statistical significance.

2. Results

2.1. Patient characteristics

A total of 678 patients were identified at 16 institutions for inclusion in this analysis (Supplemental Table 1). Of the patients meeting inclusion criteria, 526 (78.2%) were female, 584 (86.3%) were white, and 473 (55.2%) had private insurance (Table 1). The median age of patients at time of surgery was 15.0 years (IQR 13.1, 16.4), ranging from 1.7–19.8 years with a median body mass index of 24.0 kg/m^2 (IQR 20.1, 29.2), ranging from $9.4\text{--}54.7 \text{ kg/m}^2$. One hundred nine (17.1%) patients had a psychiatric condition documented while 290 (43.1%) had a medical comorbidity. 394 (58.1%) of patients were seen in the Emergency Department either before or after surgical consultation (Table 2). 295 (43.5%) of patients undergoing cholecystectomy for BD were seen by a pediatric gastroenterologist pre-operatively either as a referring provider to surgery or on referral. A third of patients were either already on or started on an acid suppressing medication prior to operation while 75 (11.1%) required opioid analgesia for symptoms.

The most frequently documented symptoms at presentation included right upper quadrant pain in 444 (76.7%) patients followed by post-prandial abdominal pain in 388 (71.4%) and intermittent nausea in 375 (67.8%) (Supplemental Table 2). There was variability in testing performed preoperatively with right upper quadrant ultrasounds documented in 445 (65.6%) of patients, CT scan of the abdomen and pelvis in 149 (22.0%), and HIDA (hepatobiliary iminodiacetic acid) scan in 573 (84.5%). Invasive diagnostic studies performed included colonoscopy in 78.

(11.5%), esophagogastroduodenoscopy in 237 (35.0%), and ERCP (Endoscopic Retrograde Cholangiopancreatography) in 10 (1.5%) (Table 3). Of patients who underwent HIDA scan, EF (ejection fraction) was reported as hypokinetic or $< 15\%$ in 252 (44.8%), between 15% and 35% in 240 (42.7%), normal or 35–65% in 30 (5.3%), and hyperkinetic or greater than 65% in 40 (7.1%).

2.2. Operative details

Intraoperative cholangiogram was performed in only 20 (2.9%) patients while concurrent appendectomy was performed in 19 (2.8%) and lysis of adhesions in 7 (1.0%) (Supplemental Table 3). The majority of patients, 468 (75.7%), had a normal appearing gallbladder intraoperatively while only 292 (43.3%) had normal findings on pathologic exam. Despite exclusion of patients with preoperative findings of cholelithiasis, gallstones were identified on pathology for 23 (3.4%) patients. Intraoperative complications were rare, with bile spillage reported in 63 (9.3%) patients. The most common 30-day post-operative complication was revisit to hospital or emergency department for pain in 60 (10.0%) and

superficial wound infection in 24 (4.2%). Nausea and vomiting were reported by 63 (11.0%) patients.

2.3. Post-operative outcomes

Persistent symptoms as documented in the electronic medical record were identified in 257 (48.5%) patients with a median follow-up time of 21 days (IQR 15 to 34 days) (Supplemental Table 2). Follow-up data was available for 530 (78.2%) patients. On bivariate analyses, referring provider ($p < 0.001$), presence of psychiatric comorbidities ($p = 0.002$), pathology findings ($p = 0.006$), and time from symptom onset to surgical consult ($p = 0.015$) were significantly associated with any persistent symptom at follow up (Supplemental Table 4). Patient age at time of surgery, pathology findings, intraoperative findings, referring provider, psychiatric comorbidities, BMI, race, and time from symptom onset to referral were included in a logistic regression model to identify independent predictors of persistent symptoms. After adjustment for demographic and clinical variables and for study site, non-white race (OR, 2.02 (95% CI, 1.09–3.76), $p = 0.03$) and presence of psychiatric comorbidities (OR, 1.82 (95% CI, 1.04–3.19), $p = 0.04$) remained significant predictors of persistent symptoms at follow-up. (Table 4). The most commonly performed post-operative tests included additional laboratory studies (22.2%), EGD (9.7%), Abdominal plain films (7.4%), and colonoscopy (6.2%) (Supplemental Table 5).

Of note, on subset analysis of only patients with a follow-up appointment at greater than 30 days post-op, there was no difference in postoperative symptoms compared to the cohort as a whole. When documented, most symptoms were reported to have resolved immediately after recovering from surgical pain.

2.4. Institutional variability

Of the 16 participating institutions, 10 contributed greater than or equal to 20 patients and were included in analysis for heterogeneity in practice patterns and patient outcomes. There were significant differences in the proportion of patients with persistent symptoms ($p < 0.001$), pathologic findings ($p < 0.001$), gallbladder ejection fraction ($p < 0.001$), referring provider ($p < 0.001$), time from symptom onset to visit ($p < 0.001$) and BMI at time of surgery ($p = 0.009$) (Supplemental Table 6).

3. Discussion

Several studies have identified an increasing rate of diagnosis and cholecystectomy for FGBD or more specifically, biliary dyskinesia [1,2]. The rates of post-operative symptom resolution, however, have not improved despite this apparent increase in recognition and experience with management [12]. In this study reviewing pediatric patients diagnosed with biliary dyskinesia at 16 institutions, we found an overall rate of symptom resolution of 48.5%, a rate consistent with that reported in previous studies (ranging from 42 to 66%) [10,13,14]. The only factors independently associated with symptom resolution were race and psychiatric comorbidities. We also noted significant variability in work up, diagnostic criteria, and outcomes for patients at the various participating institutions.

The management of BD, which has plagued surgeons and gastroenterologists for decades, is complicated by the combination of vague symptomatology and a lack of definitive diagnostic criteria. As a result, significant variability in the diagnosis and management of suspected functional gallbladder disorders is observed. We found significant variability in multiple aspects of patient care including referral patterns, GB EF of patients treated with cholecystectomy, pathologic findings, and persistence of symptoms. Notably, greater than half of patients treated at the institutions with the highest rate of symptoms present postoperatively had GB EF > 15% [10]. The significance of this, however, remains somewhat unclear given discrepancies in the literature and in this study on the association between GB EF and outcomes after cholecystectomy for BD. While some details of patient evaluation are not available in the present study, this variability likely correlates with variable resource utilization, and potentially prolonged duration of symptoms or unnecessary procedures based solely on institution [15].

In a recent survey of pediatric gastroenterologists describing the decision-making used in the diagnosis of BD, striking variability was observed in criteria for surgical referral, GBEF cut-off limits, and technical performance of HIDA scan with CCK [16]. One area of particular interest was the use of PPI or histamine-2 antagonists to empirically treat gastroesophageal reflux disease (GERD) prior to performance of extensive investigations for FGBDs [5,7,12,16]. While this has been recommended and shown to have some efficacy in identifying patients with resolution of symptoms without surgery, 304 (44.9%) patients in our study were reported as taking an anti-reflux or acid-suppressing medication.

Further complicating this component of pre-operative workup, only 211 (31.3%) patients were referred to surgery by a gastroenterologist with 56.5% never being seen by a gastroenterologist prior to surgery. While a consultation with a gastroenterologist is not essential in the diagnosis of BD, we did find significant differences on univariate analysis for persistence of symptoms by referring providers though these did not persist in multivariate analysis. This suggests, as has been described elsewhere, that in addition to a trial of anti-reflux medications, evaluation for gastric motility disorders, *Helicobacter pylori* infection, and Sphincter of Oddi dysfunction may influence outcomes [12,17].

By identifying characteristics associated with lower rates of symptoms post-operatively, one can potentially improve the accuracy with which we predict favorable surgical outcomes and therefore improved quality of life [18]. While this study was robust in number of patients, only race and presence of psychiatric comorbidities were predictive of post-operative symptoms on multivariate analysis. As hypothesized, this study identified significant variability in the work-up of patients with BD where more thorough evaluation and documentation prior to surgery may help identify patients with concurrent or alternate diagnoses to BD [13].

3.1. Limitations

This study has a few limitations worth noting that may affect its generalizability. Most importantly, this is a retrospective review carried out at a number of different institutions. As such, there is inherent variability in the documentation of relevant demographic and clinical characteristics. The inconsistent and subjective nature of the evaluations, with the exception

of GB-EF, limits the ability to create a highly specific and sensitive set of factors associated with high likelihood of symptom resolution. GB-EF, while objective compared to other diagnostic criteria, is equally flawed by variability in protocol and reproducibility, especially in pediatric patients [19,20]. The failure of this study to identify corollary relationships between GB-EF or symptom duration and outcomes, for example, further supports the need for robust, prospective data collection [21,22]. Finally, in the absence of widely accepted diagnostic and treatment algorithms for BD in the pediatric population, significant institutional variability was identified which limits the generalizability of our findings and understanding of the disease process.

4. Conclusions

This multi-institutional series demonstrates significant variability in evaluation and follow-up of patients both before and after cholecystectomy for BD. Though we identified similar rates of symptom resolution postoperatively to those previously reported, the wide variability in documentation and factors associated with this outcome precluded the creation of predictive model. Prospective research in the form of a multi-institutional study with standardized data collection, evaluation, and follow-up is needed to develop and validate optimal care pathways for pediatric patients with suspected BD.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

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References

- [1]. Campbell BT, Narasimhan NP, Golladay ES, et al. Biliary dyskinesia: a potentially un-recognized cause of abdominal pain in childre. *Pediatr Surg Int* 2004;20(8):579–81. [PubMed: 15322841]
- [2]. Bielefeldt K The rising tide of cholecystectomy for biliary dyskinesia. *Aliment Pharmacol Ther* 2013;37(1): 98–106. [PubMed: 23106129]
- [3]. Lacher M, Yannam GR, Muensterer OJ, et al. Laparoscopic cholecystectomy for biliary dyskinesia in children: frequency increasing. *J Pediatr Surg* 2013;48(8):1716–21. [PubMed: 23932611]
- [4]. Hansel SL, DiBaise JK. Functional gallbladder disorder: gallbladder dyskinesia. *Gastroenterol Clin North Am* 2010;39(2):369–79 [x]. [PubMed: 20478492]
- [5]. Behar JCE, Guelrud M, et al. Functional gallbladder and sphincter of Oddi disorders. *Gastroenterology* 2006;130(5):1498–509. [PubMed: 16678563]
- [6]. Drossman DA, Dumitrascu DL. Rome III: new standard for functional gastrointestinal disorders. *J Gastrointest Liver Dis* 2006;15(3):237–41. [PubMed: 17013448]

- [7]. Scott Nelson R, Kolts R, Park R, et al. A comparison of cholecystectomy and observation in children with biliary dyskinesia. *J Pediatr Surg* 2006;41(11):1894–8. [PubMed: 17101366]
- [8]. Al-Homaidhi HS, Sukerek H, Klein M, et al. Biliary dyskinesia in children. *Pediatr Surg Int* 2002;18(5–6):357–60. [PubMed: 12415355]
- [9]. Chumpitazi BP, Malowitz SM, Moore W, et al. Concomitant gastroparesis negatively affects children with functional gallbladder disease. *J Pediatr Gastroenterol Nutr* 2012;54(6):776–9. [PubMed: 22588599]
- [10]. Carney DE, Kokoska ER, Grosfeld JL, et al. Predictors of successful outcome after cholecystectomy for biliary dyskinesia. *J Pediatr Surg* 2004;39(6):813–6. [PubMed: 15185202]
- [11]. Mahida JB, Sulkowski JP, Cooper JN, et al. Prediction of symptom improvement in children with biliary dyskinesia. *J Surg Res* 2015;198(2):393–9. [PubMed: 25891671]
- [12]. Karnsakul W, Vaughan R, Kumar T, et al. Evaluation of gastrointestinal pathology and treatment in children with suspected biliary dyskinesia. *Pediatr Surg Int* 2011; 27(12):1307–12. [PubMed: 21706177]
- [13]. Srinath AI, Youk AO, Bielefeldt K. Biliary dyskinesia and symptomatic gallstone disease in children: two sides of the same coin? *Dig Dis Sci* 2014;59(6):1307–15. [PubMed: 24715545]
- [14]. Wybourn CA, Kitsis RM, Baker TA, et al. Laparoscopic cholecystectomy for biliary dyskinesia: which patients have long term benefit? *Surgery* 2013;154(4):761–7 [discussion 767–768]. [PubMed: 24074413]
- [15]. Aggarwal N, Bielefeldt K. Diagnostic stringency and healthcare needs in patients with biliary dyskinesia. *Dig Dis Sci* 2013;58(10):2799–808. [PubMed: 23934412]
- [16]. Nakayuenongsuk W, Choudry H, Yeung KA, et al. Decision-making patterns in managing children with suspected biliary dyskinesia. *World J Clin Pediatr* 2017;6(2):124–31. [PubMed: 28540197]
- [17]. Kaye AJ, Jatla M, Mattei P, et al. Use of laparoscopic cholecystectomy for biliary dyskinesia in the child. *J Pediatr Surg* 2008;43(6):1057–9. [PubMed: 18558182]
- [18]. Maxwell D, Thompson S, Richmond B, et al. Quality of life after laparoscopic cholecystectomy for biliary dyskinesia in the pediatric population: a pilot study. *Am Surg* 2012;78(1):111–8. [PubMed: 22273327]
- [19]. Rose JB, Fields RC, Strasberg SM. Poor reproducibility of gallbladder ejection fraction by biliary scintigraphy for diagnosis of biliary dyskinesia. *J Am Coll Surg* 2018;226(2):155–9. [PubMed: 29157795]
- [20]. Goussous N, Maqsood H, Spiegler E, et al. HIDA scan for functional gallbladder disorder: ensure that you know how the scan was done. *Hepatobiliary Pancreat Dis Int* 2017;16(2):197–201. [PubMed: 28381385]
- [21]. Johnson JJ, Garwe T, Katseres N, et al. Preoperative symptom duration predicts success in relieving abdominal pain caused by biliary dyskinesia in a pediatric population. *J Pediatr Surg* 2013;48(4):796–800. [PubMed: 23583136]
- [22]. Santucci NR, Hyman PE, Harmon CM, et al. Biliary dyskinesia in children: a systematic review. *J Pediatr Gastroenterol Nutr* 2017;64(2):186–93. [PubMed: 27472474]

Table 1

Patient demographics.

Variable	
Age at time of OR, mean (SD)	14.4 (2.8) years, range 1.7–19.8
BMI, mean (SD)	25.5 (7.6) kg/m ² , range 9.4–54.7
Sex, n (%)	
Male	147 (21.8)
Female	526 (78.2)
Race, n (%)	
White	584 (86.3)
Black/African American	32 (4.7)
Asian	6 (0.9)
American Indian/Alaska Native	3 (0.4)
Other/More than one	23 (3.4)
Unknown/not reported	29 (4.3)
Ethnicity, n (%)	
Hispanic or Latino	73 (10.8)
Not Hispanic/Latino	540 (79.9)
Unknown/not reported	17 (2.5)
Other	46 (6.8)
Insurance Type, n (%)	
Medicaid	225 (33.2)
Private	374 (55.2)
Self-pay	2 (0.3)
Unknown/none	48 (7.0)
Other	28 (4.2)
Medical comorbidities	
Any	290 (43.1)
Diabetes	19 (2.8)
Inflammatory bowel disease	10 (1.5)
Irritable bowel syndrome	22 (3.3)
HTN/HLD	4 (0.6)/6 (0.9)
Blood dyscrasias	14 (2.1)
Other	249 (37.0)
Psychiatric comorbidities	
Any	109 (17.1)
Depression	35 (5.5)
Anxiety	41 (6.4)
ADD/ADHD	37 (5.8)
Other behavior disorder	9 (1.4)
Other adjustment/mood disorder	7 (1.1)
Other	26 (4.1)

Abbreviations: HTN (hypertension), HLD (hyperlipidemia), ADD (attention deficit disorder), ADHD (attention deficit hyperactivity disorder).

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Table 2

Pre-operative work up for patients with biliary dyskinesia.

Variable	Frequency, n (%)
Emergency Department Visits	
Before initial consultation	194 (28.6)
After initial consultation, before surgery	55 (8.1)
Initial presentation/consultation via ED	78 (11.5)
No ED visit documented	284 (41.9)
Unknown	57 (8.4)
Initial provider type	
Primary care provider	85 (12.6)
Pediatric gastroenterologist	211 (31.3)
Pediatric surgeon	207 (30.7)
Emergency department	158 (23.4)
Other	13 (1.8)
Pre-operative referrals	
Pediatric gastroenterologist	295 (43.5)
Adult gastroenterologist	4 (0.6)
Pediatric surgeon	454 (67.0)
Adult surgeon	7 (1.0)
Medications given pre-operatively	
On antacids (H2 blocker, proton pump inhibitor)	238 (35.1)
New antacids	66 (9.7)
Non-opioid analgesia	63 (9.3)
Opioid analgesia	75 (11.1)
Stool softener/laxative	71 (10.5)
Anti-emetics	92 (13.6)
Procedures performed prior to cholecystectomy	
Appendectomy	38 (5.7)
Nissen fundoplication	4 (0.6)
Feeding tube placement	5 (0.7)
Diagnostic laparoscopy	3 (0.4)
Other	69 (10.3)
None	554 (83.0)

Abbreviations: ED (emergency department).

Table 3

Results of pre-operative studies.

Pre-operative testing	n (%) of total	n (%) of tested
Laboratory studies	468 (69)	
Right upper quadrant ultrasound	445 (65.6)	
Abnormal GB wall thickness		38 (9.4)
Pericholecystic fluid		6 (1.6)
Gallstones		55 (13.6)
Common bile duct diameter, median [range]		2.9 mm [0.1–11.0 mm]
Abdominal plain films	134 (19.8)	
CT scan abdomen/pelvis	149 (22.0)	
HIDA scan	573 (84.5)	
EF <5–15% or “hypokinetic”		252 (44.8)
EF 15–35%		240 (42.7)
EF 35–65%		30 (5.3)
EF >65% or “hyperkinetic”		40 (7.1)
Colonoscopy	78 (11.5)	
Normal		65 (83.3)
Polyps		1 (1.3)
Other concerning findings		10 (12.8)
Biopsies performed		9 (11.5)
Gastric emptying study	39 (5.8)	
Abnormal, slight delay		8 (20.5)
Abnormal, significant delay		8 (20.5)
MRCP	19 (2.8)	
Esophogram	17 (2.5)	
ERCP +/- sphincterotomy	10 (1.5)	
Normal		2 (20.0)
Abnormal		7 (70.0)
EGD (upper endoscopy)	237 (35.0)	99 (41.8)
Normal		138 (58.2)
Mild/severe esophagitis		38 (16.0)/1 (0.4)
Mild/severe gastritis		50 (21.1)/2 (0.8)
Other		31 (13.1)

Abbreviations: CT, computed tomography. HIDA, hepatobiliary iminodiacetic acid scan. EF, ejection fraction. MRCP, magnetic resonance cholangiopancreatography. ERCP, endoscopic retrograde cholangio-pancreatography. EGD, esophagogastroduodenoscopy.

Table 4

Independent predictors of presence of post-operative symptoms following cholecystectomy for biliary dyskinesia.

Variable	aOR (95% C.I.) ¹	p-Value	aOR (95% C.I.) ²	p-Value
Age category				
< 11 years	Reference	--	Reference	--
11–15 years	1.65 (0.86–73.19)	0.14	1.23 (0.59–2.54)	0.58
16–19 years	1.78 (0.92–3.42)	0.08	1.27 (0.61–2.65)	0.52
BMI	1.02 (0.99–1.05)	0.14	1.02 (0.99–1.05)	0.18
Race				
White	Reference	--	Reference	--
Non-white	1.50 (0.86–2.61)	0.15	2.02 (1.09–3.76)	0.03
Any psychiatric comorbidity				
No	Reference	--	Reference	--
Yes	1.81 (1.08–3.04)	0.03	1.82 (1.04–3.19)	0.04
Pathology				
Normal	Reference	--	Reference	--
Chronic cholecystitis	1.42 (0.95–2.12)	0.09	0.99 (0.61–1.62)	0.98
Gallstones	0.36 (0.07–1.03)	0.06	0.30 (0.07–1.30)	0.11
Acute on chronic/necrotic	0.20 (0.02–1.74)	0.14	0.18 (0.02–1.79)	0.14
Other abnormal	1.43 (0.67–3.06)	0.36	1.12 (0.47–2.64)	0.80
Referring provider				
Pediatrician	Reference	--	Reference	--
Gastroenterologist	0.47 (0.74–2.91)	0.28	1.94 (0.84–4.47)	0.12
Surgeon	0.67 (0.34–1.35)	0.26	1.25 (0.52–3.00)	0.61
None	0.65 (0.30–1.42)	0.28	1.20 (0.45–3.17)	0.72

¹ Adjusted for demographic and clinical variables only; n = 481 cases with complete data for inclusion in analysis.

² Adjusted for demographic and clinical variables and study site; n = 481 cases with complete data for inclusion.