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Analysis of the incidence of post-cholecystectomy diarrhea and its influencing factors in Hainan Province

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Abstract

Background and aims Cholecystectomy is one of the most common surgical procedures for the treatment of diseases associated with gallstones, and the incidence of post-cholecystectomy diarrhea (PCD) has attracted attention in recent years. The aim of this study was to assess the prevalence of PCD in patients with gallstones and to analyze the factors influencing it.

Methods Between August 2022 and December 2024, there were 3385 cases of gallstones diagnosed by abdominal ultrasound or CT examination and laparoscopic cholecystectomy in tertiary hospitals in Hainan Province. All participants in this study were followed up by telephone within 1 year postoperatively and by telephone survey using a standardized questionnaire. The incidence of PCD was calculated, and the relevant components of the follow-up were analyzed by one-way and multifactorial logistic regression using SPSS 26.0 statistical software.

Results Four hundred seventy-nine patients (14.2%) developed PCD after undergoing laparoscopic cholecystectomy. Univariate analysis showed that age, BMI, dietary patterns, history of diabetes, alcohol consumption, gallstones and fatty liver disease were associated with the development of PCD ($P<0.05$). Binary logistic regression analysis showed that age (OR = 0.532, $P=0.010$), BMI (OR = 40.615, $P<0.001$), dietary patterns (OR = 0.635, $P=0.013$), and history of diabetes (OR = 0.263, $P<0.001$) were independent risk factors.

Conclusion The incidence of PCD in Hainan Province is 14.2%. Over 50 years old, BMI, dietary pattern and history of diabetes were independent risk factors for the occurrence of PCD.

Keywords Laparoscopic cholecystectomy, Gallstones, Morbidity, Risk factors, Post-cholecystectomy diarrhea

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Introduction

In recent years, with the development of the times and the advancement of science and technology, the prevalence of gallstones has been on the rise, and cholecystectomy has become the standard surgery for gallbladder diseases, including open cholecystectomy (OC) and laparoscopic cholecystectomy (LC) [1]. Because of the significant reduction in morbidity and mortality after laparoscopic cholecystectomy is now the treatment of choice [2]. Therefore, the risk of complications associated with undergoing cholecystectomy is a growing concern. Post-cholecystectomy diarrhea (PCD) is one of the common symptoms of post-cholecystectomy syndrome, the incidence of which varies widely. Previous studies have reported the incidence of PCD to be as high as 2.1%−57.2%, with a wide variation [3–8]. This may be related to different dietary patterns、individual differences、sample size and differences between intestinal motility function in different age groups. This seriously affects people's quality of life [9]. However, the understanding of the diagnosis, influencing factors, pathogenesis and etiology leading to PCD has not been fully investigated [10, 11]. It has been shown that cholecystectomy results in malabsorption of bile acids in the terminal ileum, which enters the colon in large quantities and leads to diarrhea through a cAMP-dependent mechanism and an increase in Cl- secretion via calcium channels in the colonic epithelium.One study found that about 65.5% of patients with PCD had impaired bile acid absorption [12].There is controversy regarding the pathogenesis of bile acid malabsorption in postoperative LC patients, and Alan [13] and others have shown that alterations in the enterohepatic circulation, shortened intestinal transit time, and reduction in FGF-19 are thought to be important pathogenic mechanisms.It has also been previously suggested that post-cholecystectomy diarrhea may be a physical and mental illness, and the exact mechanism needs to be further investigated.Sciarretta et al. [14–17] reported that bile acid diarrhea (BAD) is considered to be the most common cause of postoperative diarrhea due to disturbed bile acid metabolism in the feces of PCD patients. In addition, there is no specific drug for the treatment of PCD, clinical treatment is mostly based on conventional treatment, including antidiarrheal drugs、antispasmodic drugs、microbial agents and other symptomatic supportive therapy, after stopping the drug there is still the possibility of recurrence, the overall effect is not ideal.

Currently, there is a lack of large-scale studies on the incidence of PCD in Hainan Province. Therefore, this study investigated the incidence and risk factors of PCD with the aim of providing new insights into the assessment, prevention, and treatment.

Method

During the period from August 01, 2022 to December 31, 2024, our study included 3385 patients who had undergone laparoscopic cholecystectomy, and data from these studies were mainly from five different city and county areas of Haikou, Sanya, Qionghai, Dongfang, and Wuzhishan cities of Hainan Province. The inclusion criteria for this study were patients 18 years of age and older who had perfected the relevant examinations for the definitive diagnosis of gallstones with or without cholecystitis and underwent cholecystectomy. The exclusion criteria included: (1) age less than 18 and more than 85 years old; (2) those who combined with gallbladder cancer or other gastrointestinal malignant tumors or those who were suspected of malignancy by perfecting the relevant examinations before surgery; (3) those who had taken drugs affecting gastrointestinal dynamics before and after surgery;(4) those who combined with serious organ damage or hematopoietic system and mental diseases. All patients in this study were mainly interviewed face-to-face, followed up by telephone, and filled out questionnaires to obtain baseline information, sociological characteristics, lifestyle, and comorbid chronic disease (hypertension, diabetes mellitus, and fatty liver disease) information of cholecystectomy patients.We calculated the incidence of PCD, and compared the differences in basic information, sociological characteristics, lifestyle and medical history of patients who developed PCD. The study was authorized by the Ethics Committee of the Second Affiliated Hospital of Hainan Medical University (117NB202433) and written informed consent was obtained from all participants. The whole flowchart is shown in Fig. 1.

Diagnostic criteria for severity of PCD

The main manifestations are urgency of defecation,increased frequency of defecation,thin feces,and visible watery stools for more than 3 months.Diarrhea that occurs ≤ 3 times/day, lasts < 2 months, does not require the use of any medication, and does not affect normal life is called mild diarrhea.Diarrhea that occurs 4–10 times/day and lasts for 2–3 months, with the help of medicines, but has no significant impact on life,it is called moderate diarrhea.Diarrhea that occurs > 10 times/day, lasts > 3 months, requires the use of medication and severely interferes with normal life is called severe diarrhea.

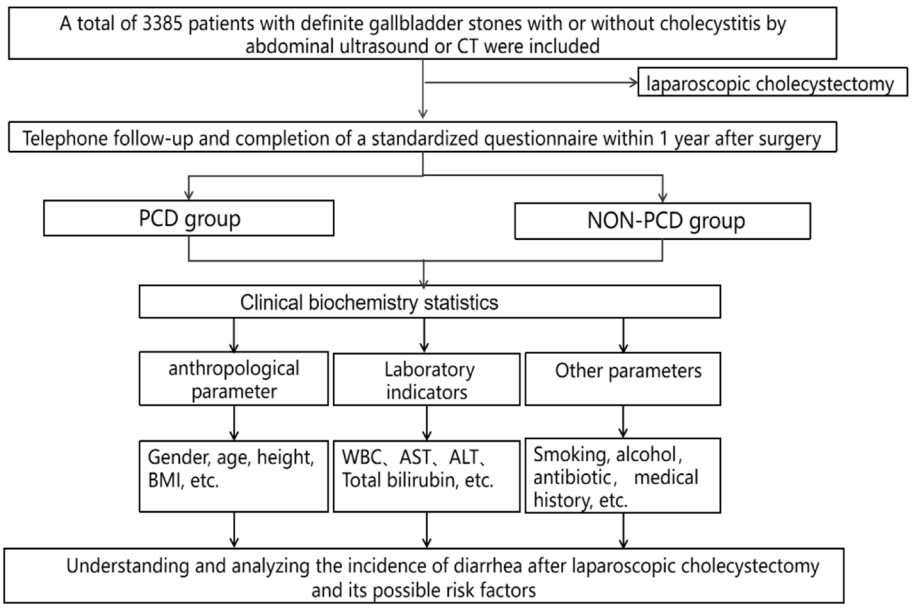

Fig. 1 Research roadmap

Statistical methods

This study was analyzed by SPSS26.0 statistical software. The count data were expressed as [n (%)], and χ^2 test was used. The measures that conform to a normal distribution are expressed as mean ± standard deviation. The possible influencing factors explored in this study were analyzed for a one-way analysis,on this basis, and the statistically significant relevant indexes were analyzed by binary logistic regression analysis to analyze the possible relevant risk factors for the occurrence of PCD. The difference was regarded as statistically significant at $P<0.05$.

Results

Demographic characteristics of the participants in the follow-up study

A total of 3385 patients, including 1724 males and 1661 females, aged 18–85 years, completed the follow-up test 1 year after cholecystectomy and provided a validated questionnaire. PCD was found in 479 patients with a incidence of 14.2%.Comparisons were made according to different influencing factors, in which the incidence of PCD was different in different age groups, 361 cases in the age group under 35 years old, 46 cases of diarrhea occurred, with an incidence of 32.18%, 1114 cases in the group between 35 and 50 years old, 135 cases of diarrhea occurred in the postoperative period with an incidence of 4.0%, and 1910 cases in the group older than 50 years old, 298 cases of diarrhea occurred, with an incidence of 8.8%.

Important risk factors for post-cholecystectomy diarrhea

As shown in Table 1, univariate analysis of the influencing factors showed that there was no statistically significant difference between the two groups in terms of gender, ethnicity, use of antimicrobial drugs during hospitalization, smoking, and history of hypertension ($P>0.05$). The difference between the two groups was statistically significant ($P<0.05$) when comparing risk factors such as age, BMI, dietary pattern, alcohol consumption, history of diabetes mellitus and fatty liver.

Independent risk factors for PCD

The statistically significant relevant indicators were also analyzed by binary logistic regression based on univariate analysis, and the results showed that age, BMI, dietary patterns, and history of diabetes mellitus were independent risk factors (in Table 2). In addition to this comparison, there were differences in the incidence of diarrhea and the severity of diarrhea symptoms between different dietary patterns, BMI, diabetes and other influencing factors ($P<0.05$, Table 3).

Discussion

With the emergence and development of laparoscopic cholecystectomy, the prevalence of gallstones、mortality and complications have been greatly reduced, and the pain of patients has been reduced, however, PCD as one of the postoperative complications is still a thorny problem in the clinic, and most of the patients who have PCD can have improvement of diarrhea after adapting to it for

Table 1 Results of univariate analysis of PCD risk factors [n (%)]

	Project PCD group ($n=479$ cases)	Non-PCD group ($n=3406$ cases)	χ^2	*P* value
Sex				
Male	245(7.2%)	1479(43.7%)	0.918	0.011
Female	234(6.9%)	1427(42.2%)		
Age				
< 35	46(1.4%)	315(9.3%)	7.688	0.021
(years) 35–50	135(4.0%)	979(28.9%)		
> 50	298(8.8%)	1612(47.6%)		
Ethnicity Chinese	413(12.2%)	2574(76.0%)	3.940	0.139
Li ethnic	57(1.7%)	303(9.0%)		
Manchu	9(0.3%)	29(0.9%)		
Use of antimicrobials				
Drugs				
Have	154(4.5%)	843(24.9%)	1.953	0.162
No-have	325(9.6%)	2063(60.9%)		
Smoking				
Have	133(3.9%)	782(23.1%)	0.153	0.696
No-have	346(10.2%)	2124(62.7%)		
Drinking				
Have	116(3.4%)	584(17.3%)	4.257	0.039
No-have	363(10.7%)	2322(68.6%)		
BMI				
Normalcy	370(10.9%)	2377(70.2%)	10.343	0.006
Obese	82(2.4%)	345(10.2%)		
Thin	27(0.8%)	184(5.4%)		
Diet				
Regular	345(10.2%)	2287(67.6%)	10.590	0.001
Light	134(4.0%)	619(18.3%)		
Hypertensive				
Have	92(2.7%)	550(16.2%)	0.021	0.885
No-have	387(11.4%)	2356(69.6%)		
Diabetes				
Have	116(3.4%)	550(16.2%)	7.284	0.007
No-have	363(10.7%)	2356(69.6%)		
Fatty liver				
Have	115(3.4%)	545(16.1%)	7.232	0.007
No-have	364(10.8%)	2361(69.7%)		

a period of time, so it does not attract the attention of the patients and seek medical treatment in a timely manner, and then it turns into chronic diarrhea, which seriously affects the quality of life of the patients. The quality of life of patients is seriously affected.In this study, we investigated the incidence of postoperative diarrhea (PCD) in patients after laparoscopic cholecystectomy through a prospective study, and explored the factors associated with diarrhea in patients after laparoscopic cholecystectomy, in order to provide individualized clinical guidance for the assessment, prevention, and treatment of postoperative diarrhea.

At present, the PCD incidence of domestic and foreign scholars reportedly hold different views, and some studies have shown that the incidence of PCD is as high as 17%, or even as high as 76%, which is a big difference [18]. Ho et al. [18] studied 200 post-cholecystectomy patients in a retrospective analytical manner and found 58 patients with PCD, with an incidence rate as high as 29.00%.Rong Wanshui et al. [19] found that the incidence of PCD was not significantly related to the mode of cholecystectomy (LC and OC) and patient age.Barthelsson et al. [20] attempted to predict and determine the likelihood of post-cholecystectomy syndrome over

Table 2 Results of multifactorial conditional logistic regression analysis of PCD risk factors

Variable	B	S.E	Wals	df	sig	(P)	Exp(B)95%CI	
							Lower limit	limit
Age(years)	−0.631	0.244	6.673	2	0.010	0.532	0.330	0.859
Drugs	−0.365	0.186	3.838	1	0.050	0.694	0.482	1.000
BMI	3.704	0.214	298.373	1	< 0.001	40.615	26.679	61.832
Diet	−0.454	0.182	6.225	1	0.013	0.635	0.444	0.907
Diabetes	−1.336	0.360	13.756	1	< 0.001	0.263	0.130	0.533
Fatty liver	−0.502	0.396	1.606	1	0.205	0.606	0.279	1.315
Constant	−1.516	0.265	32.625	1	0.000	0.220		

a prolonged period of time by using the Continuous Sensory Scale in post-cholecystectomy patients over a 1-week period,the scale involves questionnaire quantitative indicators of health, pain, anxiety, and symptom onset and exacerbation, but ultimately the predictive expectations assessed by the scale were not considered stable.The pathogenesis of PCD has not yet been confirmed, and the occurrence of PCD may be the result of a combination of factors.

In the present study, we found that PCD occurred in 14.2% of patients, which is at variance with the results reported by other scholars, and that patients with gallstones who had typical abdominal pain significantly improved after cholecystectomy,however, in analyzing the risk factors associated with PCD, BMI, dietary patterns, history of diabetes, alcohol consumption, and fatty liver were associated with the occurrence of PCD, which was more common in patients with gallstones over 50 years of age, Fisher et al. [21] concluded that younger patients, especially those aged ≤ 50 years, were independent risk factors for the development of PCD, which may be closely related to food intolerance in the elderly and reduced gastrointestinal function in the elderly.The current study also showed that the correlation between gender and PCD has not been clarified, however, the occurrence of PCD is a multifactorial combination of factors, and the effect on the occurrence of PCD in the context of a multifactorial combination of factors is not clear.In a study by Fisher et al. [21], it was found that BMI may predict the occurrence of PCD. In this study, both univariate and multivariate analyses of patients' BMI applying statistical software yielded a $P < 0.05$, so patients' BMI can be used as an independent risk factor for the development of PCD, however, this study did not comprehensively assess all follow-up indicators.In addition, in the initial phase of cholecystectomy, the common bile duct is in the decompensated phase, and in the inter-digestive phase, when hepatic bile is secreted so that the pressure in the common bile duct is > 30 cmH2O, bile is excreted by the intestine, whereas in the digestive phase the lack of bile reduces the emulsification of lipids leading to osmotic diarrhea.

Table 3 Comparison of risk factors between levels of PCD [n(%)]

Variable	examples (n)	mild PCD	Moderate /severe PCD
Age(years)			
< 35	46	14(2.92)	32(6.68)
35–50	135	45(1.04)	90(18.80)
> 50	298	201(41.96)	97(20.25)
Diet			
Normalcy	345	62(12.94)	283(59.08)
Light (low-fat)	134	77 (16.08)	57(11.9)
Diabetes			
Have	116	71(14.82)	45(9.39)
BMI			
Normalcy	370	278(58.04)	92(19.21)
Obese	82	17(3.55)	65(13.57)
Thin	27	10(2.09)	17(3.55)

In this study, the incidence of PCD was 13.1% in 2632 cases in the normal diet group and 17.8% in 753 cases in the light diet group, suggesting that the different dietary patterns of the patients may be associated with the occurrence of PCD in the postoperative period.However, due to the differences in dietary habits among individuals and the impracticality of instructing patients to follow nutritional dietary standards in clinical practice, there is a certain error in the inclusion of patients with different dietary styles, therefore, the relationship between age、BMI and the occurrence of PCD under the combined effect of different dietary styles and other factors still needs to be further investigated.This is largely consistent with most of the literature reports [22, 23].

On the other hand, Kim et al. [11] did not identify any influencing factors, including age, BMI, gender, ERCP, comorbidities, and surgical approach.Wanjura et al. [24] found that including women, gallstone pain as an indication for surgery could be one of the predictors of worsening of gastrointestinal symptoms after cholecystectomy, however, this was not specifically associated with diarrhea, which may be related to the short period of time we had for follow up, dietary aspects, certain medications, enhanced secretory function of the intestinal tract, visceral hypersensitivity, and abnormal intestinal dynamics. Therefore, the question about the incidence and risk factors of PCD still needs to be further validated by further prospective and larger-scale studies.

Our study has several limitations that need to be recognized.We need to note that, first, we included a small sample size of patients with gallstones who underwent cholecystectomy, resulting in limited representativeness and possibly affecting the generalizability of our findings. Second, we had a short follow-up period after surgery, which may introduce some bias to our results; third, we need to analyze the effects of different gallstone types on intestinal microecology,We did not consider the effects of certain important risk factors, such as physical and mental illnesses like anxiety and depression, gallbladder function, and certain medications in our study.

Therefore, this study may provide further insight into the effects of cholecystectomy on the intestinal microbiota and the incidence of diarrhea occurring postoperatively in Hainan Province,further understanding of the etiology, pathogenesis, and associated risk factors of postoperative PCD provides new insights into the diagnosis and treatment of PCD and helps to improve people's quality of life.

Abbreviations

LC	Laparoscopic cholecystectomy
OC	Opencholecystectomy
PCD	Post-cholecystectomy diarrhea

Supplementary Information

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Supplementary Material 1.

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Authors' contributions

FJ M, DY Z, and XF H contributed equally to this work; FJ M and FH B designed the study and performed statistical analysis. FJ M, DY Z, XF H and FH B drafted the manuscript. D L, W R C, F Z, C C and SM H recruited participants. YT L, YL H, RY C, Y M, QL N, S Z, XD Z, QC Y, YP D, B R, Y T, N L, YQ X, and FH B collected data. All authors read and approved the final manuscript.

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Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The protocol was approved by the institutional ethics committee of the Second Hospital of Hainan Medical University (LW2022126) and performed per Helsinki's Declaration. All participants provided written informed consent for data collection and storage.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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