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ORIGINAL ARTICLE

Retrospective Study

Risk factors of organ failure in cholangitis with bacteriobilia

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Ethics approval: The study was reviewed and approved by the Institutional Review Board of Seoul National University Hospital (IRB No. H-1308-086-514).

Informed consent: Not applicable (due to the retrospective study using information contained in medical charts and computerized records).

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Data sharing: The technical appendix, statistical code, and dataset are available from the corresponding author at [gidoctor@snuh.org]. Consent was not obtained but the presented data are anonymized and risk of identification is low.

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Abstract

AIM: To identify the risk factors for organ failure (OF) in cholangitis with bacteriobilia.

METHODS: This study included 182 patients with acute cholangitis who underwent percutaneous transhepatic biliary drainage between January 2005 and April 2013. We conducted a retrospective analysis of comprehensive clinical and laboratory data.

RESULTS: There were 24 cases (13.2%) of OF and five deaths (2.7%). Bile culture was positive for microbial growth in 130 out of 138 (94.2%) patients. In multivariate analysis of 130 patients with positive

bile cultures, significant predictive factors for OF were the presence of extended-spectrum beta-lactamase (ESBL) organisms in blood cultures, pre-existing renal dysfunction, and choledocholithiasis as an etiology, with odds ratios of 15.376, 6.319, and 3.573, respectively. We developed a scoring system with a regression coefficient of each significant variable. The OF score was calculated using the following equation: (2.7 × ESBL organisms in blood cultures) + (1.8 × pre-existing renal dysfunction) + (1.3 × choledocholithiasis). This scoring system for predicting OF was highly specific (99.1%) and had a positive predictive value of 86.2%.

CONCLUSION: ESBL organisms in blood cultures, pre-existing renal dysfunction, and choledocholithiasis are risk factors for OF in cholangitis with bacteriobilia. The OF scoring system may aid clinicians to identify a poor prognosis group.

Key words: Acute cholangitis; Bacteriobilia; Bile culture; Organ failure

Core tip: There has been no study of the prognostic factors in acute cholangitis with bacteriobilia. The current study identified three risk factors for organ failure in cholangitis with bacteriobilia: extended-spectrum beta-lactamase organisms in blood cultures, pre-existing renal dysfunction, and choledocholithiasis as an etiology. In addition, a organ failure scoring system created by these risk factors may aid clinicians to identify a poor prognosis group.

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INTRODUCTION

Acute cholangitis occurs mainly by bacterial infection in an obstructed biliary system, and choledocholithiasis has been reported as the leading cause[1,2]. The range of its severity varies, from mild to life-threatening, with a mortality rate of approximately 5%-10%[3]. Initial therapy includes administration of empiric broad-spectrum antibiotic and prompt biliary decompression[4]. If appropriate treatment is not provided, acute cholangitis may cause organ failure, including septic shock, which could cause a significant increase in the mortality rate to 88%-100%[5]. Therefore, the choice of appropriate antibiotics is very important and identification of the causative microorganism is an essential step in the management of acute cholangitis.

Bile cultures provide an opportunity to detect the causative microorganism and to establish antibiotic susceptibility testing and bacterial resistance profiling. In previous studies, positive rates of bile cultures among patients with acute cholangitis ranged from 59% to 93% and were higher than blood cultures[6-9]. This high sensitivity of bile cultures is physiologically plausible because the material for microbiological analysis is obtained directly from the site of inflammation.

According to previous studies on bacteremic cholangitis, organ failure has been reported as an important prognostic factor of mortality[10-12]. In addition, Lee *et al*[11] investigated several factors associated with organ failure in bacteremic cholangitis. Although some studies have reported correlation of a positive bile culture (bacteriobilia) with increased incidence of post-operative infective complications[13,14], the risk factors of organ failure have not yet been identified in cholangitis with bacteriobilia.

The aim of this study was to identify the risk factors for organ failure in acute cholangitis with bacteriobilia and to develop a prognostic scoring system that could be used to predict organ failure using the risk factors.

MATERIALS AND METHODS

Selection of the study population

This retrospective study initially included all patients (n = 411) with a discharge diagnosis of acute cholangitis who underwent PTBD at Seoul National University Hospital between January 2005 and April 2013, using information contained in medical charts and computerized records. To ensure statistical independence in the analyses, if multiple episodes of acute cholangitis occurred in the same patient (n = 49), only the first episode of acute cholangitis was included. In addition, patients were excluded for the following reasons: no definite or suspected diagnosis of acute cholangitis using the updated Tokyo guidelines for acute cholangitis and acute cholecystitis (TG13)[15] (n = 56), non-PTBD insertion (n = 43), underwent PTBD or bile culture after organ failure (n = 22), occurrence of organ failure from other causes (n = 7), and no initiation or completion of treatment in our institute (n = 52). A flow chart showing patient selection for the study is seen in Figure 1. Finally, 182 patients with acute cholangitis who underwent PTBD were included in the analysis. The study protocol was approved by the Institutional Review Board of Seoul National University Hospital (IRB No. H-1308-086-514).

Definitions of events

The definite or suspected diagnosis of acute cholangitis was defined according to TG13 diagnostic criteria for acute cholangitis[15]. Bacteriobilia was defined as the presence of microorganisms in the bile, documented by at least one positive bile culture. Unsuccessful biliary decompression was defined as a reposition

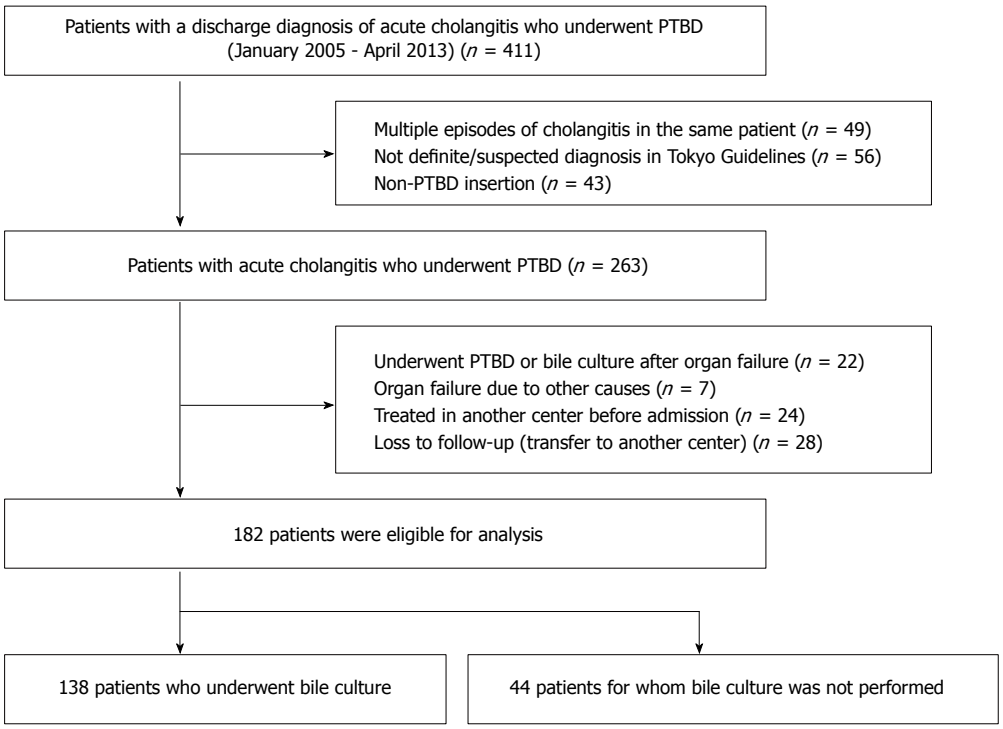

Figure 1 Flow chart of patient selection for the study. PTBD: Percutaneous transhepatic biliary drainage.

or additional insertion after initial PTBD insertion. Septic shock was defined as persistent sepsis-induced hypotension despite adequate fluid resuscitation[16]. Sepsis-induced hypotension was defined as a systolic blood pressure of less than 90 mmHg or a reduction of more than 40 mmHg from baseline in the absence of other causes of hypotension[16].

Organ failures assessed at emergency department admission and during hospitalization manifested as[10,17]: (1) septic shock; (2) acute renal failure (ARF)-serum creatinine level of greater than 3 mg/dL or, in the case of pre-existing renal dysfunction, doubling of previous serum creatinine values[18,19]; (3) altered consciousness level-Glasgow Coma Scale score of less than 12 or a decrease in the score of at least 3 if primary central nervous system injury is present; and (4) acute respiratory distress-pulse oxygen saturation of less than 90%.

Data collection and analysis

The following data were collected for analysis. The clinical and demographic variables included age, sex, smoking, alcohol, body temperature, Charcot's triad, symptom to door time (time from symptom onset until arrival at the hospital), Charlson comorbidity index score[20], pre-existing renal dysfunction, TG13 severity assessment criteria for acute cholangitis[15], and bile culture time (time from PTBD insertion until bile sample collection). Etiological variables were choledocholithiasis, benign biliary stricture, malignant biliary obstruction, and procedure-related causes. Microbiological and laboratory variables included causative microorganisms in blood or bile cultures, white blood cell count, total bilirubin, alkaline phosphatase, albumin, and C-reactive protein at admission. Treatment and outcome variables were unsuccessful biliary decompression, visit to decompression time (time from arrival at the hospital until intervention for biliary decompression), initial antibiotic resistance for microorganisms of blood or bile cultures, and length of hospital stay.

The above mentioned variables were analyzed for identification of risk factors for organ failure in patients with positive bile cultures.

Statistical analysis

In univariate analyses, the Mann-Whitney *U* test and the χ^2 test with Fisher's exact test were used for comparison of continuous or categorical variables, respectively. A logistic regression test analysis was performed using the stepwise method. All significant variables in the univariate analysis were entered in the multivariate analysis. Then, logistic regression coefficients of the factors were ascertained to develop equations (organ failure score) to predict organ failure. Finally, receiver operating characteristic (ROC) curves were constructed for the organ failure score to determine a specific threshold value that would optimize its predictive value. $P < 0.05$ for two-sided tests was considered statistically significant. In this study, odds ratios (ORs) are reported together with their 95%CI. All statistical analyses were performed using SPSS 20.0 (SPSS Inc., Chicago, IL, United States).

Table 1 Baseline characteristics of patients with acute cholangitis who underwent percutaneous transhepatic biliary drainage (*n* = 182)

Characteristic	*n* (%)
Age ⩾ 65 yr	95 (52.2)
Sex (male/female)	111/71
Heavy smoker[1]	12 (12.1)
Heavy alcohol drinker[2]	17 (9.3)
Body temperature > 38 or < 36 ℃	61 (33.5)
Positive Charcot's triad	23 (12.6)
Symptom to door time (h), mean ± SD	107.2 ± 171.2
CCIs ⩾ 4	90 (49.5)
Pre-existing renal dysfunction	14 (7.7)
Etiology	
Choledocholithiasis	59 (32.4)
Benign biliary stricture	31 (17.0)
Malignant biliary obstruction	88 (48.4)
Procedure-related	4 (2.2)
Laboratory finding	
WBC count > 12000 or < 4000/mm^3	70 (38.5)
Total bilirubin ⩾ 5 mg/dL	59 (32.4)
Alkaline phosphatase ⩾ 250 IU/L	106 (58.2)
Albumin ⩽ 2.8 g/dL	59 (32.4)
C-reactive protein ⩾ 5 mg/dL	120 (65.9)
The severity of acute cholangitis[3]	
Mild	73 (40.1)
Moderate	64 (35.2)
Severe	45 (24.7)
Performance of bile cultures	138 (75.8)
During PTBD insertion	58
Within 24 h after PTBD insertion	80
Positive blood culture	55/182 (30.2)
Unsuccessful biliary decompression[4]	14 (7.7)
Reposition	6
Additional insertion	8
Organ failure	24 (13.2)
Septic shock	13
Acute renal failure	8
Acute respiratory distress	3
Death	5 (2.7)

Values are presented as number or number (%). [1]Heavy smoker is defined as an individual with 20 or more pack-years (1 pack year = 1 pack per day for one year) of use; [2]Heavy drinker is defined as an individual currently drinking alcoholic beverages in a daily amount of ⩾ 80 g (male) or ⩾ 40 g (female); [3]TG13 severity assessment criteria for acute cholangitis (at admission); [4]Reposition or additional insertion after initial PTBD insertion. PTBD: Percutaneous transhepatic biliary drainage; CCIs: Charlson comorbidity index score; WBC: White blood cell.

Table 2 Distribution of different microorganisms in positive bile cultures

Microorganism	*n* (%)
Enterococcus species	54 (24.4)
Escherichia coli	47 (21.3)
Pseudomonas species	27 (12.2)
Klebsiella species	26 (11.8)
Citrobacter species	18 (8.1)
Streptococcus species	12 (5.4)
Staphylococcus species	11 (5.0)
Enterobacter species	7 (3.2)
Proteus species	4 (1.8)
Stenotrophomonas maltophilia	4 (1.8)
Acinetobacter species	3 (1.4)
Aeromonas species	2 (< 1)
Morganella morganii	1 (< 1)
Corynebacterium species	1 (< 1)
Chromobacterium violaceum	1 (< 1)
Shewanella putrefaciens	1 (< 1)
Leuconostoc pseudomesenteroides	1 (< 1)
Candia albicans	1 (< 1)

RESULTS

Clinical and microbiological characteristics of the patients

A total of 182 patients (61.0% male, median 65 years, range 22-91 years) were enrolled. A summary of the demographic and clinical characteristics of the 182 patients is shown in Table 1. According to the TG13[15], the severities of acute cholangitis at admission were mild in 73 patients, moderate in 64, and severe in 45. The most common etiology was malignant biliary obstruction (48.4%), followed by choledocholithiasis (32.4%), benign biliary stricture (17%), and procedure-related causes (2.2%). The causes of PTBD insertion in 59 patients with choledocholithiasis were esophageal stricture (*n* = 3), gastric outlet obstruction (*n* = 7), previous gastric surgery (*n* = 27) and severe cardiopulmonary disease (*n* = 22). All patients received intravenous antibiotics within the initial 2 h and underwent biliary decompression through PTBD within the initial 48 h. All blood cultures (*n* = 182) were performed before the use of antibiotics. Unsuccessful biliary decompression occurred in 14 (7.7%) patients, of whom six patients required repositioning of the PTBD catheter and eight patients required insertion of new PTBD catheters. Except minor bleeding, no major complications of the PTBD procedure occurred in any patient. There were 24 cases (13.2%) of organ failure, including septic shock (*n* = 13), ARF (*n* = 8), and acute respiratory distress (*n* = 3). The median time taken until organ failure from the patient's initial arrival at the hospital was 14 h (range 4-312 h). The overall hospital mortality rate was 2.7% (*n* = 5) and all patients expired from septic shock. The mean length of the hospital stay was 25.3 ± 22.6 and 13.1 ± 11.6 d in patients with and without organ failure, respectively (*P* = 0.001).

All bile cultures were performed during PTBD insertion (*n* = 58) or within 24 h after PTBD insertion (*n* = 80). Bile culture was positive for microbial growth in 130 out of 138 (94.2%) patients. Monomicrobial growth (50.8%) was slightly more frequent than polymicrobial growth (49.2%). A total of 221 microorganisms were isolated, comprising 18 different species (Table 2). The most frequently encountered microorganisms were *Enterococcus species* (24.4%) and *Escherichia coli* (21.3%).

Risk factors for organ failure in patients with bacteriobilia who underwent PTBD because of acute cholangitis

A total of 130 patients with positive bile cultures were analyzed to determine the risk factors for organ failure

Table 3 Univariate and multivariate analysis of risk factors for organ failure in patients with bacteriobilia who underwent percutaneous transhepatic biliary drainage because of acute cholangitis (*n* = 130) *n* (%)

Factor	Univariate analysis			Multivariate analysis	
	Patients with OF (*n* = 22)	Patients without OF (*n* = 108)	*P* value	OR (95%CI)	*P* value
Age ⩾ 65 yr	14 (63.6)	57 (52.8)	0.351		
Male/female	11/11	64/44	0.423		
Heavy smoker[1]	0 (0.0)	10 (9.3)	0.211		
Heavy alcohol drinker[2]	1 (4.5)	6 (5.6)	1.000		
Body temperature > 38 or < 36 ℃	8 (36.4)	33 (30.6)	0.593		
Positive Charcot's triad	3 (13.6)	13 (12.0)	0.734		
Symptom to door time (h)[1]	96.6 ± 88.8	99.4 ± 175.2	0.106		
CCIs ⩾ 4	10 (45.5)	65 (60.2)	0.202		
Pre-existing renal dysfunction	7 (31.8)	4 (3.7)	0.000[9]	6.319 (1.348-29.629)	0.019[9]
Etiology					
Choledocholithiasis	11 (50.0)	25 (23.1)	0.010[9]	3.573 (1.195-10.686)	0.023[9]
Benign biliary stricture	2 (9.1)	17 (15.7)	0.528		
Malignant biliary obstruction	9 (40.9)	62 (57.4)	0.157		
Procedure-related	0 (0.0)	4 (3.7)	1.000		
Laboratory finding					
WBC > 12000 or < 4000/mm^3	13 (59.1)	44 (40.7)	0.114		
Total bilirubin ⩾ 5 mg/dL	10 (45.5)	32 (29.6)	0.148		
ALP ⩾ 250 IU/L	14 (63.6)	60 (55.6)	0.485		
Albumin ⩽ 2.8 g/dL	13 (59.1)	36 (33.3)	0.023[9]		
C-reactive protein ⩾ 5 mg/dL	16 (76.2)	74 (69.8)	0.557		
The severity of acute cholangitis[3]					
Mild	5 (22.7)	40 (37.0)	0.198		
Moderate	7 (31.8)	41 (39.9)	0.586		
Severe	10 (45.5)	27 (25.0)	0.053		
Bile culture-Causative microorganism					
Escherichia coli	4 (18.2)	15 (13.9)	0.740		
Klebsiella species	2 (9.1)	7 (6.5)	0.648		
Pseudomonas species	1 (4.5)	10 (9.3)	0.689		
Enterobacter species	0 (0.0)	2 (1.9)	1.000		
Enterococcus species	5 (22.7)	9 (8.3)	0.062		
Other organism	2 (9.1)	9 (8.3)	1.000		
Multiorganism	8 (36.4)	56 (51.8)	0.185		
Bile culture-ESBL	3 (13.0)	11 (9.6)	0.705		
Bile culture-MRSA	1 (4.3)	3 (2.6)	0.528		
Bile culture-Antibiotic resistance[4]	10 (45.5)	52 (48.1)	0.818		
Positive blood culture	8 (36.4)	36 (33.3)	0.784		
Blood culture-Causative microorganism					
Escherichia coli	5 (62.5)	18 (50.0)	0.542		
Klebsiella species	1 (12.5)	9 (25.0)	1.000		
Pseudomonas species	1 (12.5)	5 (13.9)	1.000		
Other organism	0 (0.0)	3 (8.3)	1.000		
Multiorganism	1 (12.5)	1 (2.8)	0.311		
Blood culture-ESBL	3 (13.6)	2 (1.9)	0.034[9]	15.376 (1.748-135.267)	0.014[9]
Blood culture-Antibiotic resistance[5]	3 (13.6)	5 (4.6)	0.133		
Same microorganisms[6]	4 (50.0)	16 (44.4)	0.747		
Unsuccessful biliary decompression[7]	4 (18.2)	8 (7.4)	0.121		
Visit to decompression time (h)[8]	21.6 ± 13.0	16.7 ± 11.3	0.103		

[1]Heavy smoker is defined as an individual with 20 or more pack-years (1 pack year = 1 pack per day for one year) of use; [2]Heavy drinker is defined as an individual currently drinking alcoholic beverages in a daily amount of ⩾ 80 g (male) or ⩾ 40 g (female); [3]TG13 severity assessment criteria for acute cholangitis (at admission); [4]Antibiotic susceptibility of microorganisms in bile culture; [5]Initial antibiotic resistance of microorganisms in blood culture; [6]The same microbial growth in bile cultures among patients with positive blood cultures; [7]Reposition or additional insertion after initial PTBD insertion; [8]Values are presented as mean ± SD; [9]Statistically significant. PTBD: Percutaneous transhepatic biliary drainage; OF: Organ failure; CCIs: Charlson comorbidity index score; WBC: White blood cell; ALP: Alkaline phosphatase; ESBL: Extended-spectrum beta-lactamase; OR: Odds ratio.

in acute cholangitis with bacteriobilia. Organ failure occurred in 22 (16.9%) patients and did not occur in 108 (83.1%) patients. Univariate analysis identified four variables showing significant ($P < 0.05$) association with organ failure. In multivariate analysis, variables showing significant association with organ failure in patients with bacteriobilia included the presence of ESBL organisms in blood cultures, pre-existing renal dysfunction, and choledocholithiasis, with ORs of 15.376, 6.319, and 3.573, respectively (Table 3).

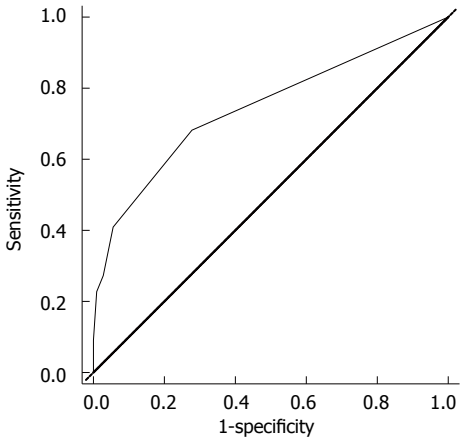

Figure 2 Receiver operating characteristic curves of organ failure score to predict organ failure in patients with bacteriobilia who underwent percutaneous transhepatic biliary drainage because of acute cholangitis. The area under the receiver operating characteristic curves was 0.744 (95%CI: 0.615-0.873), and the best cut-off point of the organ failure score was 2.9 (sensitivity 22.7%, specificity 99.1%, positive predictive value 86.2%, negative predictive value 83.3%).

Proposal of organ failure scoring system in patients with bacteriobilia who underwent PTBD due to acute cholangitis

The regression coefficients (standard error) for ESBL organisms in blood cultures, pre-existing renal dysfunction, and choledocholithiasis in the multiple logistic regression model to predict the risk of organ failure were 2.733 (1.109), 1.844 (0.788), and 1.273 (0.559), respectively. Therefore, the regression equation for predicting organ failure was proposed as the following: Organ failure score = (2.7 × ESBL organisms in blood cultures) + (1.8 × pre-existing renal dysfunction) + (1.3 × choledocholithiasis). This equation could be used to provide a numerical score that gives prognostic information for acute cholangitis with bacteriobilia. When dichotomizing the organ failure score to a value $\geqslant$ 2.9 with ROC curves, the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy for organ failure in patients with bacteriobilia who underwent PTBD because of acute cholangitis were 22.7%, 99.1%, 86.2%, 83.3%, and 86.3 %, respectively (Figure 2).

DISCUSSION

Previous studies have reported that bile culture for microbiological analysis may become a valuable diagnostic tool because it leads to more adequate therapy in patients with cholangitis[21,22]. Although these studies focused on the microbial profile and antibiotic sensitivity pattern in bile cultures, they did not identify prognostic factors in cholangitis with bacteriobilia. In the current study, multivariate analysis identified three risk factors for organ failure in acute cholangitis with bacteriobilia: ESBL organisms in blood cultures, pre-existing renal dysfunction, and choledocholithiasis as an etiology. In addition, we proposed a scoring system to predict organ failure in acute cholangitis with bacteriobilia. This organ failure scoring system was highly specific and had a good positive predictive value.

According to previous studies on acute cholangitis, the most commonly isolated microorganisms were *Enterococcus species, Escherichia coli*, and *Klebsiella species*[6,22-24]. These results are consistent with our findings. In addition, our bile samples were collected by PTBD, which is less prone to contamination by intestinal bacteria than endoscopic retrograde cholangiopancreatography (ERCP). These findings support the view that bile culture results in our study had a higher reliability than those reported in previous prospective studies[21,22], which included bile samples through ERCP. Of particular interest, the results of our study showed a high bacterial colonization rate in bile (94%). This phenomenon may be explained by our selected patient cohort, which includes many patients with prior biliary tract manipulations (79/138; 57.2%). Negm *et al*[22] reported that risk factors of bacteriobilia include biliary stenting and repeated biliary interventions. In particular, biliary stenting is associated with bacteriobilia because stenting of the common bile duct remains a cause of ascending cholangitis[25]. These findings are consistent with our results.

Gotthardt *et al*[26] recently reported an association of bacteriobilia with outcome in patients who underwent endoscopic treatment for biliary complications after liver transplantation; however, its association with clinical prognosis in acute cholangitis remains unclear. Furthermore, the prognostic factors for cholangitis with bacteriobilia have not yet been identified. The current study identified three risk factors for organ failure in acute cholangitis with bacteriobilia. Among them, the presence of ESBL organisms in blood cultures was the most significant risk factor. Lee *et al*[11] reported an association of the presence of ESBL organisms in blood cultures with organ failure in bacteremic cholangitis. Although there was no statistical significance because of the small number of ESBL patients in our study, inappropriate initial antibiotic use was more frequent in patients with organ failure than in those without organ failure (3/3; 100% *vs* 0/2; 0%, P = 0.100). Detection of ESBL organisms takes a few days in current clinical practice; however, new methods for rapid detection of ESBL organisms in blood cultures have recently emerged[27-30]. These facts support the clinical relevance of our result, because detection of ESBL patients during the early period of hospitalization is possible using newly emerging methods.

Previous studies have reported that the creatinine level is a prognostic factor in various conditions, including cholangitis[31-33]. Kent *et al*[34] reported that pre-existing renal disease promotes sepsis-induced acute kidney injury and is associated with worse outcome. In the current study, among 14 patients with existing renal dysfunction, organ failure occurred in seven patients

(50%), including chronic renal failure (n = 5) and end stage renal disease (n = 2). These data indicated a close association of pre-existing renal failure with progression to ARF related to organ failure.

Arima *et al*[35] reported that bacterial cholangitis caused by impacted bile duct stones could become a serious condition in elderly patients, despite emergency biliary decompression, which is consistent with our finding. In our study, among patients with choledocholithiasis, higher rates of impacted bile duct stone were observed in patients with organ failure than in those without organ failure (8/11; 72.5% *vs* 7/25; 28%, P = 0.025). Although the mechanism is unclear, the abrupt increment of intrabiliary pressure is probably a key factor, which may cause a higher incidence of septicemia and endotoxemia by adversely affecting the defensive mechanisms such as bile flow, Kupffer cell functions, and secretory IgA production[36].

In the current study, the organ failure scoring system developed with three significant factors was highly specific and positively predictive for predicting organ failure when dichotomizing the score to a value $\geqslant$ 2.9. This scoring system and its cut-off value of $\geqslant$ 2.9 would allow clinicians to identify the group with poor prognosis even after biliary decompression. However, this scoring system has low sensitivity. This finding may be explained by the very low incidence of organ failure. Therefore, we think that the high specificity and the positive predictive value are more worthwhile than high sensitivity in the organ failure scoring system.

The limitations of this study were the small sample size and retrospective design without a systemized management protocol in a single center. Therefore, a prospective randomized multicenter study should be conducted in the future to confirm our results and validate the organ failure score. Nevertheless, to the best of our knowledge, our work is the first to report prognostic factors in cholangitis with bacteriobilia.

In conclusion, ESBL organisms in blood cultures, pre-existing renal dysfunction, and choledocholithiasis are risk factors for organ failure in acute cholangitis with bacteriobilia. The organ failure scoring system may aid clinicians to recognize a poor prognosis group that could be monitored closely in an intensive care setting.

COMMENTS

Background

Although some studies have reported correlation of bacteriobilia with increased incidence of post-operative infective complications, there has been no study of prognostic factors in cholangitis with bacteriobilia.

Research frontiers

Previous studies focused on the microbial profile and antibiotic sensitivity pattern in bile cultures. The current research hotspot was to identify the risk factors for organ failure in acute cholangitis with bacteriobilia and to develop a prognostic scoring system that can be used to predict organ failure using the risk factors.

Innovations and breakthroughs

The current study identified three risk factors for organ failure in acute cholangitis with bacteriobilia: extended-spectrum beta-lactamase (ESBL) organisms in blood cultures, pre-existing renal dysfunction, and choledocholithiasis as an etiology. In addition, the authors proposed a scoring system to predict organ failure in acute cholangitis with bacteriobilia: Organ failure score = (2.7 × ESBL organisms in blood cultures) + (1.8 × pre-existing renal dysfunction) + (1.3 × choledocholithiasis). This organ failure scoring system was highly specific and positively predictive.

Applications

The authors proposed a scoring system to predict organ failure in acute cholangitis with bacteriobilia. This organ failure scoring system may aid clinicians to recognize a poor prognosis group that could be monitored closely in an intensive care setting.

Terminology

Bacteriobilia was defined as the presence of microorganisms in the bile, documented by at least one positive bile culture.

Peer-review

This is a good descriptive study in which the authors identified the risk factors for organ failure in cholangitis with bacteriobilia. The conclusion has good diagnostic value and clinical significance, because the organ failure scoring system introduced by the authors may aid clinicians to identify a poor prognosis group.

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