Independent prediction of aspartate aminotransferase to alanine aminotransferase ratio for adverse outcomes of patients with pyogenic liver abscess

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**Independent prediction of aspartate aminotransferase to alanine aminotransferase ratio for
adverse outcomes of patients with pyogenic liver abscess**

Short title: AST/ALT association with PLA

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Abstract

Background: In viral hepatitis, an increase in the ratio of aspartate aminotransferase to alanine aminotransferase (AAR) is associated with poor prognosis. However, the relationship between AAR and pyogenic liver abscess (PLA) remains to be unclear. In this study, the relationship between AAR and adverse outcomes in PLA patients were explored, and the predictive value of AAR were evaluated.

Methods: In total, 240 PLA patients were consecutively enrolled in this study and followed up at 3 months. Univariate analysis, receiver-operating characteristic (ROC) curve analysis and multivariate logistic regression analyses were performed.

Results: According to the ROC curve of AAR for adverse outcomes, the patients were divided into two groups using a cutoff of 0.97. Patients with high AAR had higher risk of mortality rate (16.5% vs 2.9%), empyema (23.7% vs 10.4%), metastatic infection (19.1% vs 9.7%), acute myocardial (7.3% vs 0.7%), acute hepatic failure (7.3% vs 2.2%) and septic shock (13.7% vs 4.4%) than patients with low AAR (all $P < 0.05$). after adjusting for potential confounding factors in our logistic model, high AAR was independently associated with death (odds ratio (OR)=6.17, 95% of confidence interval (CI)=1.88-20.26) and all adverse outcomes (OR=4.03, 95% CI=2.12-7.66). AAR had the largest area under ROC curve (AUC) than ALT, AST in all adverse outcomes (AUC=0.690, cutoff value=0.97, $P < 0.01$) and death prediction (AUC=0.821, cutoff value=1.31, $P < 0.01$).

Conclusion: In the clinical application of PLA, AAR may be a good method to predict the prognosis.

Key words: pyogenic liver abscess; aspartate aminotransaminase; alanine aminotransaminase; poor prognosis; mortality

Background

Pyogenic liver abscess (PLA) is a rare disease, but it poses a serious threat to personal life. Its incidence in North America reaches 2.3 in every 10000 inpatients, and 275.4 in every 100100 hospitalized patients in Taiwan[1, 2]. Due to appropriate treatment and improved diagnosis, the mortality of PLA has been significantly reduced, ranging from 10% to 40%[3, 4]. However, there are some therapeutic and diagnostic problems[5]. In emergency department, it is necessary to determine the prognostic indicators, provide patients with more timely and active recovery, and plan the treatment of PLA patients in the future, so as to obtain a good prognosis.

Aminotransferases, including aspartate aminotransferase (AST) and alanine aminotransferase (ALT), are enzymes released from hepatocytes into blood, representing hepatocyte injury. Therefore, these are considered to be common methods to evaluate liver function[6]. In 1957, AAR activity in serum was first described by de Ritis and called De Ritis ratio (AAR)[7]. Although it initially considered as a feature of viral hepatitis, this proportion later proved to be a useful marker for other diseases [8]. In recent years, several studies have shown that different levels of aminotransferase, including De Ritis ratio, which may be a useful prognostic biomarkers for some patients with malignant tumors [9, 10]. Serum AST, ALT and other inflammation related components are related to oxidative stress and systemic inflammation [11]. Oxidative stress in turn is also associated with prognosis.

There are few studies on the relationship between AAR and prognosis of PLA patients are limited. Our study aims to explore the relationship between AAR and PLA and the prognostic value of AAR in determining adverse outcomes in PLA patients.

Methods

Study design

The medical records of all PLA patients who were admitted into the Second Affiliated Hospital and Yuying Children's Hospital of Wenzhou Medical University from January 2014 to December 2016 were retrospectively analyzed. 240 inpatients with PLA were retrieved from the institutional database of the international classification of diseases (Revision 9). This study was approved by the ethics committee of the Second Affiliated Hospital and Yuying Children's hospital of Wenzhou Medical University (No. LCKY 2014-01), and the written informed consent of all subjects has been obtained.

Study population

Inclusion criteria: Patients with at least one lesion in the image of liver, covering computed tomography (CT) or ultrasound (US), or after antibacterial treatment, abnormal imaging or blood pus culture was completely eliminated. Exclusion criteria: Patients with amebic liver abscess and liver cirrhosis.

Data collection and outcome measurements

The clinical record of patient's were reviewed retrospectively, and attention was paid to the demographic characteristics such as gender and age; Hypertension, diabetes and other common diseases; Height, body temperature, weight, diastolic blood pressure (DBP), systolic blood pressure (SBP), and other clinical characteristics; Laboratory tests: neutrophils (N), hemoglobin (Hb), white blood cells (WBC), red blood cells (RBC), C-reactive protein (CRP), prothrombin time (PT), platelets (PLT), procalcitonin, activated partial thromboplastin time (APTT), triglycerides (TG), low density lipoprotein cholesterol (LDL-c), high density lipoprotein cholesterol (HDL-c), total cholesterol(TC), Serum creatinine, aspartate aminotransferase (AST), albumin, alanine

aminotransferase (ALT), serum uric acid, total bilirubin and *Klebsiella pneumoniae* (KP) infection. Hypertension was defined as the recent use of antihypertensive drugs, diastolic blood pressure ≥ 90 mmHg and/or systolic blood pressure of ≥ 140 mmHg. Diabetes was defined as the recent use of hypoglycemic drugs, fasting blood glucose level ≥ 7 mmol/L, random blood glucose level ≥ 11.1 mmol/L. Anemia was defined as hemoglobin < 12 g/dl in female and hemoglobin < 13 g/dl in male. Body mass index (BMI) was calculated by dividing body weight (kg) by the square of height (m^2).

The treatments of each patient based on microbial testing and imaging performance were recorded, including antibiotics + percutaneous catheter drainage (PCD), antibiotics + surgery or the use of antibiotics alone and adverse outcomes, such as mortality, empyema and metastatic infection (referring to the same distal infection as the bacteria cultured in PLA); Septic shock[12]; acute liver failure (referring to the growth of severe acute liver injury, accompanied by encephalopathy and coagulation dysfunction); Acute respiratory failure (patient requirement for the mechanical ventilation); acute renal failure (serum creatinine up-regulated by 0.5 mg/dL from baseline) and upper gastrointestinal bleeding (UGI) (referring to pressure-related bleeding under endoscopy, blood is bright red); acute myocardial infarction. At the same time, the 3-month mortality rate of patient's was observed.

Statistical analysis

Continuous data was expressed as mean $\pm$ standard deviation or median [interquartile interval], and performed the independent t test or Mann-Whitney U test. Categorical data was also expressed as frequency (%) and chi-square test or Fisher's exact test were performed. Pearson correlation was used to estimate the correlation between AAR, BMI, albumin, hemoglobin and PT. Univariate

logistic regression analysis was used to determine the possible predictors, so as to find those predictors lead to all adverse outcomes or death. We selected each parameter which according to the results of initial univariate analysis, the p value was less than 0.05. In order to classify all adverse outcomes and death of these PLA patients, a receiver operating characteristic (ROC) curve was drawn. $P < 0.05$ means that the difference is significant.

Results

Baseline features

There were 240 patients with PLA, with an average age of 67.6 ± 10.7 years (60.8% male), and an average AAR of 1.05 ± 0.61 . The basic characteristics of non-survivors and survivors are shown in Table 1. Compared with the survivor patients, the non-survivor patients were older, with lower hemoglobin, RBC, TC, HDL-c and albumin, but higher levels of AAR, PT and procalcitonin, and higher detection rate of non-Klebsiella pneumoniae. According to the maximum value of Youden index, the AAR cutoff value was set to 0.97; Therefore, patients with an $\text{AAR} \geq 0.97$ were included in the high AAR group, and the $\text{AAR} < 0.97$ were included in the low AAR group, as shown in Table 2. Compared with patients with low AAR, patients with high AAR were older, and the levels of APTT, procalcitonin and PT were significantly higher. The levels of hemoglobin and RBC in high AAR group were significantly lower than those in low AAR group.

Pearson correlation

Pearson correlation between AAR, albumin, PT, hemoglobin and BMI is shown in Fig 1. AAR had a negative correlation with hemoglobin ($r = -0.249$, $P < 0.001$), albumin ($r = -0.191$, $P = 0.003$), BMI ($r = -0.148$, $P = 0.022$) and had a positive correlation with PT ($r = 0.275$, $P < 0.001$).

Clinical outcomes

The hospitalization cost in high AAR group was significantly higher than that in low AAR group ($P < 0.001$). The incidence of adverse outcomes ($P = 0.001$) in the patient group with low AAR increased by 27.5% to 47.4% from the 19.9% in the high AAR group, involving higher metastatic infection (19.1% vs 9.7%), acute myocardium (7.3% vs 0.7%), mortality (16.5% vs 2.9%), acute liver failure (7.3% vs 2.2%), septic shock (13.7% vs 4.4%) and empyema (23.7% vs 10.4%) (Table 3).

Univariate and multivariate logistic regression analysis

Univariate analysis showed that BMI $<24\text{kg/m}^2$, age ≥ 65 years old, anemia, albumin $<30\text{g/L}$, PT $>14.8\text{s}$, PLT <125 and AAR >0.97 were associated with death. Albumin $<30\text{g/L}$, age ≥ 65 years old, PLT <125 , anemia, hypertension, diabetes, AAR >0.97 were associated with adverse outcomes. Multivariate analysis showed that PT $>14.8\text{s}$, albumin $<30\text{g/L}$ and AAR >0.97 were significant predictors of death; PLT <125 , Albumin $<30\text{g/L}$, hypertension and AAR >0.97 were significant predictors of adverse outcomes in PLA patients (tables 4 and 5).

Prognostic value of AAR

In order to compare the mortality of PLA patients and the predictability of all adverse prognosis, the ROC curves of ALT, AST and AAR were drawn, as shown in Fig. 2a-b. It can be clearly seen that the area of AAR under the ROC curve was the largest and statistically significant (death was 0.821 and all adverse outcomes were 0.690). The optimal AAR cut-off value was 1.31 for predicting death and 0.97 for all adverse outcomes.

Discussion

To our knowledge, this is the first study providing evidence that AAR is a powerful predictor of poor prognosis for patients with PLA. This relationship still exists even after adjusting for related

confounding factors (including gender, age, albumin, BMI, PT, PLT, hypertension and diabetes). It was found that 0.97 is the best cut-off value for continuous AAR. AAR>0.97 at admission is associated with a 4.03-times increase in the probability of poor prognosis

The concept of AAR and its association with viral hepatitis were first proposed by De Ritis in 1957[13]. Subsequently, AAR was used to predict the low survival rate of chronic hepatitis B patients with progressive fibrosis and chronic hepatitis C patients [14]. In recent years, AAR has proved to be a useful prognostic biomarker for predicting non liver diseases and some types of malignancies[15-17]. For instance, in a general European group of nonmetastatic renal cell carcinoma patients, Bezan et al. detected pre-operating AAR as a predictor of an unfavorable clinic-related consequence[15]. According to Nishikawa et al., preoperative AAR displayed noticeable relationships to a fourfold increase in an unfavorable prognosis in patients with upper urinary tract urothelial carcinoma[18]. Rief et al. studied 1782 consecutive patients with peripheral arterial occlusive disease and reported that AAR at admission displayed relationships to critical limb ischemia[19]. Tan et al. found that in distal cholangiocarcinoma, AAR may be associated with an increased risk of lower long-term survival[20]

In terms of baseline characteristics, it is noted that the levels of procalcitonin, PT and APTT in the high AAR group were significantly higher than those in the low AAR group, and albumin and RBC were significantly lower than the low AAR group. Moreover, AAR has been widely used to evaluate the progress of functional liver damage and predict the degree of liver fibrosis in recent years[21, 22]. Considering the multiple risk indexes associated with adverse outcomes, a high AAR prompts doctors to consider more cautious resuscitation and appropriate and timely treatment.

Previous studies showed that in the NHANES study, AAR was more helpful in identifying heavy

drinking than when used alone[23]. Our study also noticed that compared with AST and ALT, AAR had a greater AUC in predicting mortality and adverse outcomes (death was 0.821 and all adverse outcomes were 0.690). Some previous studies have reported other prognostic values of PLA[24-26], including increased BUN, serum creatinine and older age, low hemoglobin and albumin levels, multiple abscesses, biliary liver abscess, pleural effusion and concomitant malignant tumors. So far, the most suitable biomarker for predicting liver abscess has not been determined. However, in addition to other biomarkers, AAR has shown great advantages as a biomarker. It is cost-effective, easy to obtain and simple, and there is little need for patient participation.

The exact mechanism of elevated AAR and poor prognosis of PLA remains to be unclear, and further research is needed. It is conceivable that this is caused by the different activities of ALT and AST. A large number of studies have shown that ALT is mainly concentrated in liver tissues, while AST is widely distributed in different organs such as the kidneys, muscles, heart and even the brain. This may cause AST to remain in a proliferative state higher than ALT, even if the condition of patient is getting worse[14, 15, 27]. Among patients with poor prognosis, the decrease in ALT levels is greater than that of AST, resulting in higher AAR associated with poor prognosis.

Inflammation-related components, such as serum ALT and AST, are generally considered to be good predictors of liver damage. In addition, ALT has been found to be related to systemic inflammation and oxidative stress, which in turn is related to treatment response[28]. The liver is susceptible to internal stimulation to produce reactive oxygen species (ROS). Oxidative stress and inflammation may be involved in the adverse outcome of PLA. However, large-scale clinical studies and more and more experimental studies are needed to confirm the relationship between AAR and PLA prognosis. It is very important to explore relevant mechanisms in the future.

This study has certain limitations. First of all, it is a retrospective single-center study, and there may be selection bias. Secondly, the mortality of PLA patient during hospitalization was significantly lower (21 deaths), and the number of enrolled cases was also lower. Therefore, a large-scale multicenter prospective cohort study is needed to confirm this result. Third, ALT and AST are affected by a variety of factors, such as the time interval between onset of symptoms and visits, the general condition of patient, which were not considered in this study.

Conclusions

In summary, AAR is associated with poor prognosis in PLA patients, and it is an independent prognostic factor for deaths and all adverse outcomes. The predictive value of AAR for adverse outcomes is better than that of ALT and AST. AST and ALT are the most commonly used serum biomarkers in our daily clinical practice. Future rigorous longitudinal studies, larger samples and longer follow-up time will enable us to clarify the role of AAR as a critical disease marker or poor prognostic indicator in the PLA population.

Abbreviations

PLA, Pyogenic liver abscess; BMI, body mass index; HbA1c, glycosylated hemoglobin; TC, total cholesterol; TG, triglyceride; HDL-c, High density lipoprotein cholesterol; LDL-c, Low density lipoprotein cholesterol

Declarations

Ethics approval and consent to participate

This study has obtained the approval from the Ethics Committee of the Second Affiliated Hospital of Wenzhou Medical University (No. LCKY2014-01) and has obtained the written informed consent of all subjects following the Declaration of Helsinki.

Consent for publication

Not applicable.

Availability of data and materials

The data that support the findings of this study are available from Institutional Review Board of the second affiliated hospital and Yuying Children's Hospital of Wenzhou Medical University but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Institutional Review Board of the Second Affiliated Hospital and Yuying Children's Hospital of Wenzhou Medical University.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

HFD and YJP – study concept and design; preparation, review and approval of manuscript. JX – data collection and interpretation; preparation, review and approval of manuscript.

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Figure legend

Figure 1. Scatter diagrams showing correlation between AST/ALT, PT, hemoglobin, BMI and albumin.

Figure 2a. ROC analysis of AST/ALT, AST, ALT to death among PLA patients.

Figure 2b. ROC analysis of AST/ALT, AST, ALT to adverse outcomes among PLA patients.

353 Table 1. the comparison of the clinical and liver imaging between survivors and non-survivors
 354 groups.

	Overall (n=240)	survivors (n=219)	Non-survivors (n=21)	P
Age, years	67.6±10.7	66.8±13.6	76.6±11.2	0.002
Male	146 (60.8)	135 (61.6)	11 (52.4)	0.635
BMI, Kg/m ²	23.3±2.9	23.4±2.9	22.0±2.8	0.099
SBP, mmHg	125±20	125±21	130±16	0.257
DBP, mmHg	71±11	71±11	73±11	0.442
Temperature, °C	39.3±0.8	39.4±0.8	39.1±0.9	0.360
White blood cell, 10 ⁹ /L	12.2±6.0	12.1±5.9	13.3±7.1	0.351
Neutrophil count, 10 ⁹ /L	10.17±5.89	10.06±5.85	11.41±6.39	0.146
Temperature, °C	39.3±0.8	39.4±0.8	39.1±0.9	0.360
Red blood cell, 10 ¹² /L	4.0±0.6	4.0±0.6	3.6±0.5	0.006
Hemoglobin, g/L	118.9±18.3	120.1±18.0	105.9±17.0	0.001
Platelet count, 10 ⁹ /L	222.9±133.9	226.1±127.2	188.5±193.8	0.309
C-reactive protein, mg/L	90.3±68.8	91.3±70.7	76.4±33.5	0.584
Procalcitonin, pg/ml	13.7±23.6	12.1±22.1	27.4±31.9	0.044
Creatinine, umol/L	72.7±54.1	71.9±55.1	81.9±40.9	0.489

Total bilirubin, mg/L	16.2±14.5	16.0±14.3	18.6±16.8	0.535
ALT, U/L	71±72	73±73	49±53	0.145
AST, U/L	68±86	66±79	95±139	0.134
AST/ALT	1.05±0.61	0.98±0.51	1.85±0.88	<0.001
Albumin, g/L	30.8±6.7	31.3±6.7	25.3±4.6	<0.001
Uric acid, umol/L	241±240	239±91	265±134	0.291
TC, mmol/L	3.5±1.0	3.6±1.0	3.1±0.8	0.049
TG, mmol/L	1.5±0.9	1.5±0.9	1.5±0.8	0.793
HDL-C, mmol/L	0.6±0.4	0.7±0.4	0.4±0.3	0.011
LDL-C, mmol/L	2.1±0.8	2.1±0.8	1.7±0.7	0.074
PT, s	14.9±1.6	14.8±1.6	15.8±1.5	0.007
APTT, s	41.8±6.0	41.8±5.8	41.2±7.2	0.615
KP infection	180 (75.0)	169 (77.2)	11 (52.4)	0.047
Abscess features				
Solitary lesion	189 (78.8)	175 (79.9)	14 (66.7)	0.147
Mean size of abscess, cm	6.3±2.8	6.3±2.8	6.0±2.9	0.617

355 Values are expressed as mean±SD or number (%); ALT, alanine aminotransferase; AST, aspartate

356 Transaminase; TC, total cholesterol; TG, triglyceride; HDL-c, high-density lipoprotein cholesterol;

357 LDL-C, low-density lipoprotein cholesterol; KP, klebsiella pneumoniae; PT, prothrombin time;

358 APTT, activated partial thromboplastin time

359

360 Table 2. the comparison of the clinical and liver imaging between low AST/ALT and high AST/ALT
 361 groups.

	Overall (n=240)	Low AST/ALT (n=137)	High AST/ALT (n=103)	P
Age, years	67.6±10.7	64.7±13.7	71.3±12.7	<0.001
Male	146 (60.8)	90 (65.7)	56 (54.4)	0.083
BMI, Kg/m ²	23.3±2.9	23.6±2.8	22.9±3.0	0.091
SBP, mmHg	125±20	125±21	125±20	0.826
DBP, mmHg	71±11	71±11	71±11	0.934
Temperature, °C	39.3±0.8	39.4±0.8	39.3±0.7	0.416
White blood cell, 10 ⁹ /L	12.2±6.0	12.4±6.2	11.9±5.8	0.508
Neutrophil count, 10 ⁹ /L	10.17±5.89	10.34±6.13	9.94±5.59	0.607
Red blood cell, 10 ¹² /L	4.0±0.6	4.1±0.6	3.9±0.6	0.003
Hemoglobin, g/L	118.9±18.3	121.5±17.6	115.5±18.7	0.013
Platelet count, 10 ⁹ /L	222.9±133.9	219.7±115.7	227.2±155.2	0.669
C-reactive protein, mg/L	90.3±68.8	97.2±77.8	78.1±47.7	0.179
Procalcitonin, pg/ml	13.7±23.6	10.3±18.0	17.9±28.7	0.047
Creatinine, umol/L	72.7±54.1	72.1±63.0	73.5±39.5	0.839

Total bilirubin, mg/L	16.2±14.5	15.0±10.9	17.7±18.1	0.146
Albumin, g/L	30.8±6.7	31.4±6.4	30.1±7.1	0.136
Uric acid, umol/L	241±95	238±88	246±103	0.513
PT, s	14.9±1.6	14.7±1.4	15.1±1.8	0.029
APTT, s	41.8±6.0	41.0±5.7	42.9±6.2	0.014
KP infection	180 (75.0)	112 (81.8)	68 (66.0)	0.078
Abscess features				
Solitary lesion	189 (78.8)	108 (78.8)	81 (78.6)	1.000
Mean size of abscess, cm	6.3±2.8	6.2±2.7	6.4±2.9	0.637

362 Values are expressed as mean±SD or number (%); ALT, alanine aminotransferase; AST, aspartate

363 Transaminase; KP, klebsiella pneumoniae; PT, prothrombin time; APTT, activated partial

364 thromboplastin time

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374 Table 3. the comparison of the treatment and clinical outcome between low AST/ALT and high
 375 AST/ALT groups.

	Overall (n=240)	Low AST/ALT (n=137)	High AST/ALT(n=103)	P
Percutaneous drainage	126 (52.5)	71 (51.8)	55 (53.4)	0.896
Operation	4 (1.7)	2 (1.5)	2 (1.9)	1.000
Hospital length of stay, days	17.6±9.2	17.0±8.2	18.3±10.3	0.272
Hospitalization expenses, *10 ⁴ CNY	3.2±2.5	2.7±1.4	4.0±3.3	<0.001
Adverse outcomes	75 (31.3)	27 (19.7)	48 (46.6)	<0.001
Mortality	21 (8.8)	4 (2.9)	17 (16.5)	<0.001
Metastatic infection	33 (13.8)	13 (9.5)	20 (19.4)	0.005
Acute renal failure	9 (3.8)	3 (2.2)	6 (5.8)	0.169
Acute hepatic failure	10 (4.2)	3 (2.2)	7 (6.8)	0.048
Acute respiratory failure	11 (4.6)	5 (3.6)	6 (5.8)	0.533
Acute myocardial infarction	8 (3.4)	1 (0.7)	7 (6.8)	0.010
UGI bleeding	18 (7.5)	7 (5.1)	11 (10.7)	0.134
empyema	38 (15.8)	14 (10.2)	24 (23.3)	0.010
Septic shock	20 (8.3)	6 (4.4)	14 (13.6)	0.015

376 Values are expressed as mean $\pm$ SD or number (%); UGI bleeding, upper gastrointestinal bleeding

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398 Table 4. Univariate and multivariate logistic regression for risk factors associated with mortality

Variable	Univariate analysis	Multivariate analysis
	Odd ratio (95%CI)	Odd ratio (95%CI)
age≥65 years	4.23 (1.48-12.06) *	
Male	0.74 (0.29-1.87)	
BMI<24	3.52 (1.01-12.33)	
Albumin<30g/L	3.74 (1.32-10.56)	4.55 (1.33-15.57)
Anemia ^a	3.56 (1.31-9.62) *	
PLT<125	3.51 (1.38-8.94) *	
PT>14.8s	3.23 (1.19-8.72) *	3.90 (1.26-12.05)
Percutaneous drainage	0.80 (0.32-2.02)	
size>6cm	1.92 (0.64-5.75)	
creatinine>1.3mg/dL	2.50 (0.65-9.55)	
Diabetes	0.71 (0.28-1.80)	
hypertension	0.84 (0.29-2.43)	
AST/ALT>0.97	6.57 (2.14-20.19)	6.17 (1.88-20.26)

399 ^aHemoglobin <13g/dL in men, <12g/dL in women; CI, confidence interval

400 *P<0.05

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405 Table 5. Univariate and multivariate logistic regression for risk factors associated with adverse
 406 outcomes

Variable	Univariate analysis	Multivariate analysis
	Odd ratio (95%CI)	Odd ratio (95%CI)
age≥65 years	2.14 (1.22-3.76) *	
Male	0.79 (0.45-1.39)	
BMI<24	1.72 (0.94-3.15)	
Albumin<30g/L	2.45 (1.38-4.34)	2.20 (1.15-4.23)
Anemia	1.81 (1.03-3.17) *	*
PLT<125	3.11 (1.67-5.78) *	2.69 (1.34-5.42)
PT>14.8s	1.72 (0.99-3.01)	
Percutaneous drainage	0.71 (0.41-1.23)	
size>6cm	1.02 (0.48-2.15)	
creatinine>1.3mg/dL	1.80 (0.95-3.39)	
Diabetes	1.74 (1.00-3.05)	
hypertension	1.82 (1.00-3.31) *	2.23 (1.13-4.43)
AST/ALT>0.97	3.64 (2.04-6.50)	4.03 (2.12-7.66)

407 ^aHemoglobin <13g/dL in men, <12g/dL in women; CI, confidence interval

408 *P<0.05

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Figures

Figure 1

Scatter diagrams showing correlation between AST/ALT, PT, hemoglobin, BMI and albumin.

Figure 2

a. ROC analysis of AST/ALT, AST, ALT to death among PLA patients. b. ROC analysis of AST/ALT, AST, ALT to adverse outcomes among PLA patients.