Original Article

Prevalence and in-hospital outcomes of diabetes mellitus in elderly patients with liver cirrhosis

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Background: A retrospective, single-center, observational study aimed to evaluate the prevalence and in-hospital outcomes of diabetes mellitus (DM) in elderly patients with liver cirrhosis.

Methods: All electronic records of consecutive patients diagnosed with liver cirrhosis without malignancy at our hospital from January 2012 to June 2014 were retrospectively collected. Patient cohorts were subdivided according to age (elderly: above 60 years), presence of DM and glycemic control of DM patients (HbA1c </>7%). Patient characteristics, liver cirrhosis complications and in-hospital mortality were assessed.

Results: Overall, 36.9% (452/1,225) of cirrhotic patients were elderly, and 20.6% (252/1,225) of them had DM. Elderly patients had a significantly higher percentage of DM than non-elderly patients [25.9% (117/452) versus 17.5% (135/773), P=0.001]. Elderly patients with DM had a significantly higher in-hospital mortality than those without DM [8.5% (10/117) versus 1.8% (6/335), P=0.002], but Child-Pugh and MELD scores were similar between them. Additionally, good diabetic control was significantly associated with a lower Child-Pugh score, but not in-hospital mortality.

Conclusion: DM is more common in elderly patients with liver cirrhosis. DM may increase the in-hospital mortality in such patients, independent from the stage of cirrhosis.

Keywords: Diabetes mellitus (DM); liver cirrhosis; elderly; in-hospital death

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Introduction

Liver plays an important role in maintaining the blood glucose stability and hormone metabolism. Impaired liver function often affects the normal glucose metabolism, thereby leading to impaired glucose tolerance or even diabetes mellitus (DM). A variety of chronic liver diseases, especially liver cirrhosis, are associated with DM (1-3). DM in liver cirrhosis is primarily divided into classical type 2 DM (T2DM) and hepatogenous DM secondary to liver damage (4).

The prevalence of DM is increasing with age. An epidemiological investigation in China reported that the percentages of DM were 3.2%, 11.5%, and 20.4% among persons who were 20–39, 40–59, and ≥60 years of age, respectively (5). On the other hand, patients with liver cirrhosis have a high probability of developing DM (6,7) and the incidence of DM may be 5 times higher in patients with cirrhosis than in age-matched controls without liver diseases (8). In a retrospective analysis from France including 348 patients with chronic hepatitis C and liver cirrhosis, DM was an independent prognostic factor for the outcome of cirrhosis (9).

Some studies have investigated the prevalence and clinical features of DM in patients with liver cirrhosis (10-12). However, considering that both older age and DM are important risk factors for the progression to liver cirrhosis (13-17), the prevalence, risk factors, and in-hospital outcomes of DM in elderly patients with liver cirrhosis needs to be further clarified.

Methods

Study design

We conducted a retrospective, single-center, observational study at the General Hospital of Shenyang Military Area from January 2012 to June 2014. Patients were consecutively included. The inclusion criteria were: (I) patients diagnosed with liver cirrhosis; (II) no limit to age and sex; and (III) no limit to the etiology of liver cirrhosis. A diagnosis of liver cirrhosis was primarily established according to the history of liver diseases, clinical symptoms and signs, laboratory tests (e.g., liver function and coagulation tests), abdominal images (e.g., liver and spleen morphology) and/or liver biopsy, if necessary. The exclusion criteria were: (I) patients with non-cirrhotic portal hypertension; (II) patients with malignant tumors, especially hepatocellular carcinoma, etc.; and (III) patients with other endocrine diseases but DM. In the present study, repeated admissions were excluded to avoid over- or under-estimating the number of patients with DM.

All electronic records of patients were retrospectively collected. They were classified into two groups: (I) elderly patients; and (II) non-elderly patients. Additionally, the elderly patients were further divided two groups: (I) patients with DM; and (II) patients with non-DM. The elderly patients with DM were further classified into two groups: (I) patients with good diabetic control; and (II) patients with poor diabetic control.

Some relevant data were reported in our previous papers (18-22). This study was approved by the Medical Ethical Committee of our hospital [approval number k (2016)16]. Due to the retrospective nature of this study, the requirement for written informed consent was waived.

Data collection

The following data regarding demographic, clinical, and laboratory profiles and in-hospital outcomes were collected from the electronic medical records. Notably, the diagnosis of DM, duration of DM, fasting plasma glucose (FPG), and glycosylated hemoglobin (HbA1c) were recorded. We calculated the Child-Pugh (23) and model for end-stage of liver disease (MELD) scores (24).

Diagnosis of DM

DM was diagnosed according to the World Health Organization (WHO) diagnostic criteria in 1999: (I) a FPG level of >7.0 mmol/L (126 mg/dL); (II) a plasma glucose level of >11.1 mmol/L (200 mg/dL) at 2 h in a 75-g oral glucose tolerance test; and (III) typical symptoms related to DM together with a plasma glucose level of >11.1 mmol/L (200 mg/dL).

Diagnostic criteria for hepatogenous DM

Hepatogenous DM was diagnosed as a state of impaired glucose regulation caused by impaired liver function as a consequence of liver cirrhosis. In short, DM develops after the onset of cirrhosis (25,26).

Definition of elderly patients

The elderly person should be over 60 years old in China.

Evaluation of good or poor diabetic control

According to the "expert consensus on measures for the diagnosis and treatment of elderly DM (2013 Edition) (27)" in China, the good diabetic control was defined as "HbA1c <7% or FPG<7.0 mmol/L". If a patient had both HbA1C and FPG, we preferred to choose the HbA1c as the evaluation criterion.

Statistical analysis

Categorical data were expressed as frequencies (percentages)

and were compared by using the chi-square test. Continuous data were expressed as mean ± standard deviation (SD) or median (range) and were compared by using the independent-sample t test. A two-sided P<0.05 was considered statistically significant. A multivariate logistic regression analysis was performed to explore the prognostic role of DM. An odds ratio with 95% confidence interval was calculated. All statistical analyses were performed using SPSS software version 17.0 (SPSS Inc. Chicago, IL, USA).

Results

A total of 1,225 patients were eligible for our study. The patient characteristics were summarized (*Table S1*). The mean age was 56.74±11.76 years. The mean Child-Pugh score was 7.51±2.07. The percentages of Child-Pugh class A, B, and C were 38.3%, 44.5%, and 17.3%, respectively. The etiology of liver cirrhosis primarily included viral hepatitis B alone (39.0%), viral hepatitis C alone (8.1%), alcohol abuse alone (29.9%), viral hepatitis plus alcohol abuse (11.9%), and others (11.1%). Among them, 36.9% (452/1,225) were elderly patients with a mean age of 68.59±6.84 years and 20.6% (252/1,225) had DM.

The characteristics were compared between elderly and non-elderly patients with liver cirrhosis (*Table S1*). Elderly patients had significantly higher percentages of DM (P=0.001) and Child-Pugh class B (P=0.005), platelet (PLT) (P=0.040), and blood urea nitrogen (BUN) (P=0.003), but significantly lower percentage of Child-Pugh class A and C (P=0.005), total bilirubin (TBIL) (P=0.030), indirect bilirubin (IBIL) (P=0.008), activated partial thromboplastin time (APTT) (P=0.002), prothrombin time (PT) (P<0.001), and international normalized ratio (INR) (P=0.022). Elderly patients had a higher percentage of viral hepatitis alone and a lower percentage of alcohol abuse alone than non-elderly patients (P<0.001). All of the 1,225 patients had available data to assess the prevalence of DM; among them, the percentages of DM in elderly and non-elderly patients were 25.9% (117/452) and 17.5% (135/773), respectively. A total of 206 patients with DM had available data to assess the prevalence of hepatogenous DM; among them, the percentages of hepatogenous DM in elderly and non-elderly patients were 28.8% (30/114) and 33.3% (34/102), respectively.

The characteristics were compared between elderly patients with and without DM (*Table 1*). Elderly patients with DM had significantly higher albumin (ALB) (P=0.022) and BUN (P=0.015), percentage of hepatic encephalopathy (HE) (P=0.035), and in-hospital mortality (P=0.002), but significantly lower age (P=0.002), TBIL (P=0.001), direct bilirubin (DBIL) (P<0.001), IBIL (P=0.016), alkaline phosphatase (P=0.021), and γ-glutamine transferase (P=0.007). The in-hospital mortality of elderly patients with DM was significantly higher than without DM [8.5% (10/117) *vs.* 1.8% (6/335), P=0.002]. After adjusting the age and Child-Pugh score, the DM was an independent risk factor for death in a multivariate logistic regression analysis (odds ratio =5.675, 95% confidence interval: 1.886–17.072, P=0.002). Causes of death were shown in *Table 2*.

The characteristics were compared between the elderly DM patients with good and poor diabetic control (*Table S2*). A total of 108 patients had available data to assess the glycemic control. Among them, the percentages of good and poor diabetic control patients were 43.52% (47/108) and 56.48% (61/108), respectively. The poor diabetic control group had significantly higher TBIL (P=0.015), DBIL (P=0.014), Child-Pugh score (P=0.049), and percentage of acute upper gastrointestinal bleeding (AUGIB) (P=0.018), but significantly lower age (P=0.009), ALB (P=0.014), and sodium ion (P=0.008).

Discussion

DM is a well-known risk factor for the development of liver cirrhosis in patients with non-alcoholic hepatitis. It might also constitute an important confounding risk factor for the prognosis of elderly patients with liver cirrhosis due to viral hepatitis or alcohol abuse. This had been exemplary demonstrated for a small cohort of patients with hepatitis C-related cirrhosis in France (9). We conducted a large retrospective single-center analysis on patients with liver cirrhosis admitted to our center in order to assess the relevance of DM for disease presentation and outcome. Our study had several major findings.

First, the prevalence of DM in elderly patients with liver cirrhosis was about 1.5 times higher than non-elderly patients. Similarly, Petit *et al.* found that DM patients with liver cirrhosis were older (28); and Iovanescu *et al.* also mentioned that an age of above 60 years in patients with chronic hepatitis was significantly associated with a higher risk of DM (29). On the other hand, the percentage of DM was 25.9% in our elderly patients with liver cirrhosis, which was higher than in general elderly patients (20.4%) (5). This phenomenon seems to be consistent with previous findings that liver cirrhosis may increase the morbidity of DM in elderly population (6-8).

Table 1 Comparison between DM versus non-DM in elderly patients

Variables	DM (n=117)			Non-DM (n=335)			P value
	No. Pts available	Mean ± SD or frequency (percentage)	Median (range)	No. Pts available	Mean ± SD or frequency (percentage)	Median (range)	
Sex (male/female)	117	58 (49.6%)/59 (50.4%)		335	177 (52.8%)/158 (47.2%)		0.591
Age (years)	117	67.02±5.87	65.6 (60.04-83.12)	335	69.14±7.07	68 (60.01–89.16)	0.002
Etiology, n (%)	81			226			0.26
Viral hepatitis alone	–	45 (55.60%)		–	113 (50.00%)		
Alcohol abuse alone	–	21 (25.90%)		–	63 (27.90%)		
Viral hepatitis + alcohol abuse	–	7 (8.60%)		–	11 (4.90%)		
Others	–	8 (9.9%)		–	39 (17.30%)		
Ascites, n (%)	117			328			0.986
No	–	58 (49.60%)		–	161 (49.10%)		
Mild	–	15 (12.80%)		–	44 (13.40%)		
Moderate to severe	–	44 (37.60%)		–	123 (37.50%)		
Hepatic encephalopathy, n (%)	117			328			0.035
No	–	106 (90.60%)		–	311 (94.80%)		
Grade I–II	–	9 (7.70%)		–	17 (5.20%)		
Grade III–IV	–	2 (1.70%)		–	0 (0%)		
Laboratory tests							
RBC (10^{12}/L)	114	3.19±0.75	3.19 (1.69–5.57)	331	3.16±0.81	3.13 (1.28–5.33)	0.745
Hb (g/L)	115	95.94±25.43	91 (43.00–164.00)	331	99.65±28.99	101 (36.00–170.00)	0.224
WBC (10^9/L)	115	5.35±3.66	4.5 (0.5–26.3)	331	5.46±3.73	4.2 (1–26.3)	0.783
PLT (10^9/L)	114	101.88±66.28	83.5 (11.00–463.00)	331	108.58±75.24	86 (19.00–592.00)	0.398
TBIL (μmol/L)	111	25.5±26.6	18.4 (1.9–171.6)	325	38.81±52.48	21.3 (2.7–362.1)	0.001
DBIL (μmol/L)	111	12.85±18.51	7.9 (0.6–139.5)	325	22.94±41.01	9.5 (0.5–279.5)	<0.001
IBIL (μmol/L)	111	12.65±10.89	10.2 (0.9–83.9)	325	15.87±14.86	11.3 (1.3–128.3)	0.016
ALB (g/L)	113	33.02±6.99	32.9 (15.3–48.2)	316	31.37±6.41	31.05 (15.3–52.8)	0.022
ALT (U/L)	111	32.4±32.15	22 (6.00–175.00)	325	38.78±42.71	25 (6.00–368.00)	0.150
AST (U/L)	111	50.86±140.68	29 (9.00–1,487.00)	325	61.61±95.53	35 (10.00–1,293.00)	0.369

Table 1 *(continued)*

Table 1 *(continued)*

Variables	DM (n=117)			Non-DM (n=335)			P value
	No. Pts available	Mean ± SD or frequency (percentage)	Median (range)	No. Pts available	Mean ± SD or frequency (percentage)	Median (range)	
ALP (U/L)	111	104.50±85.28	80 (30.00–719.00)	325	128.49±115.77	92 (20.00–980.00)	0.021
GGT (U/L)	111	77.24±89.46	46 (10.00–506.00)	324	128.95±304.15	46 (8.00–4,562.00)	0.007
BUN (mmol/L)	114	9.75±8.43	7.29 (1.97–62.45)	315	7.66±5.56	6.12 (1.73–46.54)	0.015
Cr (μmol/L)	114	102.59±134.74	65 (32.6–998)	315	83.35±111.99	61 (28.00–1,473.00)	0.174
K (mmol/L)	114	4.09±0.63	4.03 (2.6–6.16)	323	4.04±0.52	4 (2.56–5.81)	0.493
Na (mmol/L)	114	137.94±4.71	138.65 (123.4–147)	323	138.62±4.51	139.5 (123–149.5)	0.172
PT (second)	113	15.61±3.45	14.7 (10.7–36.1)	317	15.65±3.18	14.9 (10.8–33.7)	0.908
APTT (second)	112	40.42±7.10	39.7 (27.3–68.1)	318	42±10.2	41.1 (27.3–152.7)	0.128
INR	112	1.26±0.37	1.14 (0.76–3.62)	318	1.30±0.76	1.18 (0.77–13.4)	0.574
Child-Pugh class, n (%)	107			295			0.41
A	–	43 (40.20%)		–	98 (33.20%)		
B	–	51 (47.70%)		–	153 (51.90%)		
C	–	13 (12.10%)		–	44 (14.90%)		
Child-Pugh score	107	7.29±2.04	7 (5.00–14.00)	295	7.59±1.91	7 (5.00–13.00)	0.168
MELD score	107	7.26±7.02	6.63 (–4.56–37.65)	304	7.29±7.10	5.87 (–5.06–51.64)	0.973
AUGIB (yes/no)	117	30 (25.6%)/87 (74.4%)		332	89 (26.8%)/243 (73.2%)		0.903
In hospital death (yes/no)	117	10 (8.5%)/107 (91.5%)		335	6 (1.8%)/329 (98.2%)		0.002

ALB, albumin; ALP, alkaline phosphatase; ALT, alanine aminotransferase; APTT, activated partial thromboplastin time; AST, aspartate aminotransferase; AUGIB, acute upper gastrointestinal bleeding; BUN, blood urea nitrogen; Cr, creatinine; DBIL, direct bilirubin; DM, diabetes mellitus; GGT, γ-glutamine transferase; Hb, hemoglobin; HE, hepatic encephalopathy; IBIL, indirect bilirubin; INR, international normalized ratio; K, potassium ion; MELD, model for end stage liver disease; Na, sodium ion; NA, not available; PLT, platelet; PT, prothrombin time; Pts, patients; RBC, red blood cell; SD, standard deviation; TBIL, total bilirubin; WBC, white blood cell.

Table 2 Causes of in-hospital death in elderly patients

Causes	DM	Non-DM
Upper gastrointestinal bleeding	2	1
Liver failure	1	0
Multiple organ failure	1	3
Upper gastrointestinal bleeding plus hepatic encephalopathy	1	0
Liver failure plus cerebral hemorrhage	1	0
Lower gastrointestinal bleeding	0	2
Hepatic encephalopathy plus heart failure	1	0
Others (extrahepatic causes)	3	0
Total	10	6

DM, diabetes mellitus.

Second, the prevalence of hepatogenous DM might be lower in elderly patients than non-elderly patients, suggesting that elderly patients were more prone to develop classical T2DM, rather than hepatogenous DM.

Third, the elderly patients with liver cirrhosis had significantly higher PLT and BUN, but significantly lower TBIL, IBIL, APTT, PT, and INR. This finding suggested that the elderly patients with liver cirrhosis might be prone to worse nutritional status and liver and renal dysfunction.

Fourth, the elderly patients with DM had a 4.7 times higher in-hospital mortality than those without DM. Similarly, Quintana *et al.* conducted a prospective study of compensated liver cirrhosis patients and found that 40% of patients with DM and 20% of patients without DM died at the end of follow-up (30). In addition, a recent study showed that DM was significantly associated with an increased mortality of patients with liver cirrhosis (HR: 2.80; 95% CI: 2.04–3.83) (16).

Fifth, the elderly patients with DM had a 1.8 times higher incidence of HE than those without DM. Butt *et al.* reported similar conclusions that patients with decompensated cirrhosis and DM had significantly higher prevalence of HE (58.5% *vs.* 42.6%; P=0.03) and more severe HE (P=0.01) than those without DM and that older patients with DM had a significantly higher incidence of HE (P=0.03) (31). A study from Germany also mentioned that the risk of HE was significantly more frequent in diabetic cirrhotic patients than non-diabetic cirrhotic patients (36.6% *vs.* 20.7%) (32). The potential mechanisms should be that DM might increase the glutamine activity and risk of constipation, intestinal bacterial overgrowth, and bacterial translocation, thereby causing the HE (33).

Sixth, the elderly patients with DM had significantly higher BUN. In clinical practice, BUN is often considered as a sign of renal function. As known, both DM and liver cirrhosis contribute to the development of renal dysfunction. Indeed, our study also demonstrated that creatinine (Cr) level was higher in the elderly patients with DM, but no significant difference was observed. A Taiwanese study found that DM had an effect on renal function in cirrhotic patients and a BUN/Cr ratio was a better index of predicting the in-hospital mortality in cirrhotic patients with normal renal function (34). These results suggested that elderly patients with DM might aggravate the development of liver cirrhosis by affecting the renal function. By contrast, DM was not associated with Child-Pugh or MELD score, indicating that liver function was not significantly affected by DM. Indeed, our study found that patients with DM had higher ALB than those without DM.

Seventh, the elderly DM patients with poor diabetic control had significantly higher TBIL, DBIL, Child-Pugh score, and percentage of AUGIB. The percentage of HE, ascites, Child-Pugh class B and C, and mortality were not significantly different between them. A study from New Zealand found that poor diabetic control (HbA1c ≥7.0%) was a predictor of liver cirrhosis complications (35). Another study also reported that DM patients had a significantly higher ratio of history of AUGIB than non-DM patients (36). AUGIB might be the most frequent complication affected by poor diabetic control. Besides, our results also indicated that elderly cirrhotic patients with poor diabetic control had more abnormal biochemical indicators and worse prognosis. It should be essential for the elderly cirrhotic patients with DM to improve the diabetic control.

There were several limitations in our study. First, this was a retrospective, single-center, observational study; second, the data regarding FPG and HbA1c were incomplete in some patients; third, anti-diabetic agents can affect the risk of developing liver cirrhosis complications and postprandial blood glucose may be a better evaluation criterion for the diabetic control in the DM with liver cirrhosis (37,38), but our retrospective study failed to examine these issues due to the absence of relevant data.

In conclusion, age was positively associated with the risk of DM in liver cirrhosis. DM may be a risk factor for the in-hospital mortality of the elderly patients with liver cirrhosis,

but was not significantly associated with the severity of liver dysfunction. Poor diabetic control may lead to abnormal biochemical indicators and worse outcomes. Altogether, DM is an independent adverse prognostic factor in elderly patients with liver cirrhosis, suggesting that improving diabetic control may be beneficial in the management of these patients.

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Footnote

Conflicts of Interest: The authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/amj.2017.07.14). Xingshun Qi serves as an Editor-in-Chief of *AME Medical Journal*. Andrea Mancuso serves as an unpaid editorial board member of AME Medical Journal from Mar 2017 to Mar 2019. The other authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Medical Ethical Committee of our hospital [No. k (2016)16]. Due to the retrospective nature of this study, the requirement for written informed consent was waived.

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Supplementary

Table S1 Comparison between elderly versus non-elderly patients

Variables	Total (n=1,225)			Elderly (n=452)			Non-elderly (n=773)			P value
	No. Pts available	Mean ± SD or frequency (percentage)	Median (range)	No. Pts available	Mean ± SD or frequency (percentage)	Median (range)	No. Pts available	Mean ± SD or frequency (percentage)	Median (range)	
Sex (male/female)	1,225	817 (66.7%)/408 (33.3%)		452	235 (52%)/217 (48%)		773	582 (75.3%)/191 (24.7%)		<0.001
Age (years)	1,225	56.74±11.76	56.73 (6.28–89.16)	452	68.59±6.84	67.07 (60.01–89.16)	773	49.82±7.86	50.99 (6.28–59.99)	0.001
Etiology	976			307			669			<0.001
HBV alone	–	381 (39.00%)		–	114 (37.10%)		–	267 (39.90%)		
HCV alone	–	79 (8.10%)		–	43 (14.00%)		–	36 (5.40%)		
Alcohol abuse alone	–	292 (29.90%)		–	85 (27.70%)		–	207 (30.90%)		
Viral hepatitis + alcohol abuse	–	116 (11.90%)		–	18 (5.90%)		–	98 (14.60%)		
Others	–	108 (11.10%)		–	47 (15.30%)		–	61 (9.10%)		
Ascites, n (%)	1,213			445			768			0.548
No	–	620 (51.10%)		–	219 (49.20%)		–	401 (52.20%)		
Mild	–	149 (12.30%)		–	59 (13.30%)		–	90 (11.70%)		
Moderate to severe	–	444 (36.60%)		–	167 (37.50%)		–	277 (36.10%)		
HE, n (%)	1,213			445			768			0.343
No	–	1,142 (94.10%)		–	417 (93.70%)		–	725 (94.40%)		
Grade I–II	–	61 (5.00%)		–	26 (5.80%)		–	35 (4.60%)		
Grade III–IV	–	10 (0.80%)		–	2 (0.40%)		–	8 (1.00%)		
Laboratory tests										
RBC (10^{12}/L)	1,213	3.19±0.86	3.15 (1.01–6.78)	445	3.17±0.80	3.15 (1.28–5.77)	768	3.20±0.90	3.15 (1.01–6.78)	0.582
Hb (g/L)	1,214	98.07±30.39	97 (27.00–218.00)	446	98.69±28.13	98.7 (36.00–170.00)	768	97.71±31.64	96 (27.00–218.00)	0.576
WBC (10^9/L)	1,215	5.43±4.05	4.3 (0.3–46.1)	446	5.43±3.71	4.3 (0.5–26.3)	769	5.43±4.23	4.3 (0.3–46.1)	0.986
PLT (10^9/L)	1,212	100.88±77.25	79 (10.00–775.00)	445	106.87±73.04	85 (11.00–592.00)	767	97.40±79.43	74 (10.00–775.00)	0.040
TBIL (μmol/L)	1,205	40.34±66.57	21.4 (1.9–809.8)	436	35.42±47.58	20.55 (1.9–362.1)	769	43.13±75.13	21.8 (2.1–809.8)	0.030
DBIL (μmol/L)	1,205	23.41±48.49	9.3 (0.3–562.8)	436	20.37±36.86	8.9 (0.5–279.5)	769	25.12±53.93	9.6 (0.3–562.8)	0.071
IBIL (μmol/L)	1,205	16.93±21.30	11.5 (0.7–276.1)	436	15.05±14.02	11.20 (0.9–128.3)	769	18.00±24.43	11.9 (0.7–276.1)	0.008
ALB (g/L)	1,188	32.13±6.95	31.9 (11.7–52.8)	429	31.80±6.60	31.4 (15.3–52.8)	759	32.31±7.14	32.40 (11.7–49.3)	0.214
ALT (U/L)	1,205	40.67±59.48	26.0 (5.00–1,064.00)	436	37.16±40.35	24.5 (6.00–368.00)	769	42.66±67.92	28 (5.00–1,064.00)	0.123
AST (U/L)	1,205	62.61±126.60	36 (8.00–2,454.00)	436	58.87±108.74	34 (9.00–1,487.00)	769	64.72±135.71	37 (8.00–2,454.00)	0.441
ALP (U/L)	1,205	116.46±103.45	86.1 (17.00–980.00)	436	122.39±109.23	88.65 (20.00–980.00)	769	113.10±99.94	85.2 (17.00–969.00)	0.144
GGT (U/L)	1,202	123.55±228.00	50 (7.00–4,562.00)	435	115.76±267.18	46 (8.00–4,562.00)	767	127.97±202.49	52 (7.00–1,716.00)	0.372
BUN (mmol/L)	1,181	7.49±6.11	5.75 (1.73–62.45)	429	8.21±6.50	6.35 (1.73–62.45)	752	7.08±5.83	5.41 (1.75–61.01)	0.003
Cr (μmol/L)	1,181	84.33±112.75	60 (20.00–1,473.00)	429	88.46±118.60	61.6 (28.00–1,473.00)	752	81.98±109.28	59 (20.00–978.00)	0.342
K (mmol/L)	1,198	4.04±0.55	4.0 (2.2–7.87)	437	4.05±0.55	4.0 (2.56–6.16)	761	4.03±0.55	4.0 (2.2–7.87)	0.425
Na (mmol/L)	1,199	138.23±4.68	138.9 (83–157.8)	437	138.44±4.57	139.1 (123.0–149.5)	762	138.10±4.74	138.8 (83.0–157.8)	0.222
APTT (second)	1,184	42.74±9.55	41.2 (27.3–152.7)	430	41.59±9.51	40.55 (27.3–152.7)	754	43.40±9.52	41.6 (28.0–134.1)	0.002
PT (second)	1,187	16.27±4.32	15.3 (10.7–62.8)	430	15.64±3.25	14.9 (10.7–36.1)	757	16.63±4.79	15.5 (11.0–62.8)	<0.001
INR	1,187	1.34±0.61	1.21 (0.76–13.4)	430	1.29±0.68	1.17 (0.76–13.4)	757	1.37±0.56	1.23 (0.78–7.96)	0.022
Child-Pugh class, n (%)	1,142			402			740			0.005
A	–	437 (38.30%)		–	141 (35.10%)		–	296 (40.00%)		
B	–	508 (44.50%)		–	204 (50.70%)		–	304 (41.10%)		
C	–	197 (17.30%)		–	57 (14.20%)		–	140 (18.90%)		
Child-Pugh score	1,142	7.51±2.07	7 (5.00–15.00)	402	7.51±1.95	7 (5.00–14.00)	740	7.51±2.14	7 (5.00–15.00)	0.981
MELD score	1,152	7.40±7.52	5.96 (–7.44–51.64)	411	7.28±7.07	5.97 (–5.06–51.64)	741	7.47±7.76	5.95 (–7.44–42.68)	0.672
AUGIB (yes/no)	1,219	325 (26.7%)/894 (73.3%)		449	119 (26.5%)/330 (73.5%)		770	206 (26.8%)/564 (73.2%)		0.947
In hospital death (yes/no)	1,221	42 (3.4%)/1179 (96.6%)		452	16 (3.5%)/436 (96.5%)		769	26 (3.4%)/743 (96.6%)		0.872
DM (yes/no)	1,225	252 (20.6%)/973 (79.4%)		452	117 (25.9%)/335 (74.1%)		773	135 (17.5%)/638 (82.5%)		0.001
HD (yes/no)	206	64 (31.1%)/142 (68.9%)		104	30 (28.8%)/74 (71.2%)		102	34 (33.3%)/68 (66.7%)		0.548

ALB, albumin; ALP, alkaline phosphatase; ALT, alanine aminotransferase; APTT, activated partial thromboplastin time; AST, aspartate aminotransferase; AUGIB, acute upper gastrointestinal bleeding; BUN, blood urea nitrogen; Cr, creatinine; DBIL, direct bilirubin; DM, diabetes mellitus; GGT, γ-glutamine transferase; Hb, hemoglobin; HD, hepatogenous diabetes; HE, hepatic encephalopathy; IBIL, indirect bilirubin; INR, international normalized ratio; K, potassium ion; MELD, model for end stage liver disease; Na, sodium ion; NA, not available; PLT, platelet; PT, prothrombin time; Pts, patients; RBC, red blood cell; SD, standard deviation; TBIL, total bilirubin; WBC, white blood cell.

Table S2 Comparison between good versus poor diabetic control in elderly patients with DM

Variables	Total (n=108)			Good diabetic control (n=47)			Poor diabetic control (n=61)			P value
	No. Pts available	Mean ± SD or frequency (percentage)	Median (range)	No. Pts available	Mean ± SD or frequency (percentage)	Median (Range)	No. Pts available	Mean ± SD or frequency (percentage)	Median (range)	
Sex (male/female)	108	55 (50.9%)/53 (49.1%)		47	24 (51.1%)/23 (48.9%)		61	30 (50.8%)/31 (49.2%)		1
Age (years)	108	66.84±5.74	65.39 (60.04–83.12)	47	68.55±6.53	67.32 (60.35–83.12)	61	65.53±4.69	64.21 (60.04–77.71)	0.009
Etiology	78			34			44			0.232
HBV alone	–	31 (39.70%)		–	18 (52.90%)		–	13 (29.50%)		
HCV alone	–	13 (16.70%)		–	5 (14.70%)		–	8 (18.20%)		
Alcohol abuse alone	–	20 (25.60%)		–	5 (14.70%)		–	15 (34.10%)		
Viral hepatitis + alcohol abuse	–	7 (9.00%)		–	3 (8.80%)		–	4 (9.10%)		
Others	–	7 (9.00%)		–	3 (8.80%)		–	4 (9.10%)		
Ascites, n (%)	108			47			61			0.859
No	–	55 (50.90%)		–	23 (48.90%)		–	32 (52.50%)		
Mild	–	14 (13.00%)		–	7 (14.90%)		–	7 (11.50%)		
Moderate to severe	–	39 (36.10%)		–	17 (36.20%)		–	22 (36.10%)		
HE, n (%)	108			47			61			0.401
No	–	97 (89.80%)		–	44 (93.60%)		–	53 (86.90%)		
Grade I–II	–	9 (8.30%)		–	2 (4.30%)		–	7 (11.50%)		
Grade III–IV	–	2 (1.90%)		–	1 (2.10%)		–	1 (1.60%)		
Laboratory tests										
RBC (10^{12}/L)	106	3.20±0.77	3.23 (1.69–5.57)	46	3.36±0.75	3.35 (2.05–5.57)	60	3.08±0.77	3.04 (1.69–4.95)	0.065
Hb (g/L)	107	97.03±25.87	96 (43.00–164.00)	46	100.43±23.46	102.5 (61.00–152.00)	61	94.47±27.45	89 (43.00–164.00)	0.239
WBC (10^9/L)	107	5.25±3.71	4.4 (0.5–26.3)	46	4.71±2.68	4.1 (1.5–13.1)	61	5.66±4.30	4.5 (0.5–26.3)	0.192
PLT (10^9/L)	106	101.77±67.39	81.5 (11.00–463.00)	46	103.72±76.05	79.5 (26.00–463.00)	60	100.28±60.55	83.5 (11.00–270.00)	0.796
TBIL (μmol/L)	103	26.17±27.43	18.6 (1.9–171.6)	45	19.38±12.21	21.6 (1.9–56.3)	58	31.43±34.16	17.85 (4.7–171.6)	0.015
DBIL (μmol/L)	103	13.36±19.11	8.4 (0.6–139.5)	45	8.64±6.03	8.4 (0.6–25.6)	58	17.01±24.38	8.25 (1–139.5)	0.014
IBIL (μmol/L)	103	12.81±11.22	10.1 (0.9–83.9)	45	10.74±7.58	10.80 (0.9–33.8)	58	14.41±13.22	10.1 (2–83.9)	0.1
ALB (g/L)	105	32.97±6.93	32.9 (15.3–48.2)	46	34.84±6.44	35.8 (16.7–45.2)	59	31.52±7.00	32.10 (15.3–48.2)	0.014
ALT (U/L)	103	33.76±32.93	23 (8.00–175.00)	45	31.76±33.05	21 (8.00–169.00)	58	35.32±33.04	26 (9.00–175.00)	0.589
AST (U/L)	103	53.28±145.80	31 (9.00–1,487.00)	45	38±29.63	28 (9.00–140.00)	58	65.14±192.45	32.5 (9.00–1,487.00)	0.351
ALP (U/L)	103	105.99±87.38	82 (37.00–719.00)	45	100.02±69.37	76 (43.30–340.00)	58	110.62±99.49	85.5 (37.00–719.00)	0.544
GGT (U/L)	103	78.25±91.16	46 (12.00–506.00)	45	76.49±87.44	38 (16.00–409.00)	58	79.62±94.68	47 (12.00–506.00)	0.864
BUN (mmol/L)	105	9.75±8.70	7.11 (1.97–62.45)	46	11.18±11.53	6.92 (1.97–62.45)	59	8.64±5.46	7.41 (2.03–29.39)	0.173
Cr (μmol/L)	105	105.49±139.89	65 (32.6–998)	46	138.52±198.52	64.5 (32.6–998)	59	79.73±54.50	68 (37.00–327.00)	0.057
K (mmol/L)	106	4.07±0.64	4.0 (2.6–6.16)	47	4.01±0.66	3.91 (2.65–6.04)	59	4.12±0.62	4.2 (2.6–6.16)	0.382
Na (mmol/L)	106	137.97±4.71	138.75 (123.4–147)	47	139.32±4.28	139.8 (124.5–147)	59	136.89±4.79	138.10 (123.4–144.2)	0.008
APTT (second)	103	40.48±7.26	39.8 (27.3–68.1)	45	39.95±6.31	39.3 (31.4–68.1)	58	40.90±7.94	39.95 (27.3–63.9)	0.514
PT (second)	104	15.55±3.51	14.65 (10.7–36.1)	46	14.87±2.60	14.3 (11.3–25.2)	58	16.08±4.04	15.15 (10.7–36.1)	0.069
INR	103	1.25±0.38	1.14 (0.76–3.62)	45	1.17±0.28	1.10 (0.82–2.4)	58	1.31±0.43	1.21 (0.76–3.62)	0.06
Child-Pugh class, n (%)	99			44			55			0.109
A	–	42 (42.40%)		–	23 (52.30%)		–	19 (34.50%)		
B	–	44 (44.40%)		–	18 (40.90%)		–	26 (47.30%)		
C	–	13 (13.10%)		–	3 (6.80%)		–	10 (18.20%)		
Child-Pugh score	99	7.28±2.11	7 (5.00–14.00)	44	6.82±2.04	6 (5.00–14.00)	55	7.65±2.11	7 (5.00–13.00)	0.049
MELD score	99	7.31±7.16	6.63 (–4.56–37.65)	44	7.18±6.68	6.56 (–4.56–24.4)	55	7.41±7.58	6.89 (–4.19–37.65)	0.871
AUGIB (yes/no)	108	24 (22.2%)/84 (77.8%)		47	5 (10.6%)/42 (89.4%)		61	19 (31.1%)/42 (68.9%)		0.018
In hospital death (yes/no)	108	10 (9.3%)/98 (90.7%)		47	4 (8.5%)/43 (91.5%)		61	6 (9.8%)/55 (90.2%)		1
HbA1c (%)	21	8.28±3.55	6.5 (4.9–16.1)	9	5.78±0.63	5.9 (4.9–6.5)	12	10.15±3.70	10.05 (5.4–16.1)	0.002
FPG (mmol/L)	108	8.82±4.23	7.48 (2.25–21.27)	47	5.56±1.27	5.81 (2.25–7.96)	61	11.33±3.99	10.69 (4.33–21.27)	<0.001
Duration of DM (years)	101	8.90±6.58	9 (0.00–30.00)	44	9.44±6.06	10 (0.00–30.00)	57	8.48±6.97	8.0 (0.1–30)	0.469

ALB, albumin; ALP, alkaline phosphatase; ALT, alanine aminotransferase; APTT, activated partial thromboplastin time; AST, aspartate aminotransferase; AUGIB, acute upper gastrointestinal bleeding; BUN, blood urea nitrogen; Cr, creatinine; DBIL, direct bilirubin; DM, diabetes mellitus; FPG, fasting plasma glucose; GGT, γ-glutamine transferase; Hb, hemoglobin; HbA1c, glycosylated hemoglobin; HE, hepatic encephalopathy; IBIL, indirect bilirubin; INR, international normalized ratio; K, potassium ion; MELD, model for end stage liver disease; Na, sodium ion; NA, not available; PLT, platelet; PT, prothrombin time; Pts, patients; RBC, red blood cell; SD, standard deviation; TBIL, total bilirubin; WBC, white blood cell.