Available online at www.sciencedirect.com

ScienceDirect

Journal of the Chinese Medical Association 80 (2017) 125−132

www.jcma-online.com

Original Article

Higher platelet counts are associated with metabolic syndrome independent of fatty liver diagnosis

Kuan-Chieh Fang [a], Yuan-Lung Cheng [b,c], Chien-Wei Su [a,c], Yuan-Jen Wang [c,d], Keng-Hsin Lan [a,c,e], Teh-Ia Huo [a,e], Yi-Hsiang Huang [a,f], Chi-Jen Chu [a,c,*], Chung-Chi Lin [c,d], Ming-Chih Hou [a,c,d], Han-Chieh Lin [a,c], Fa-Yauh Lee [a,c], Jaw-Ching Wu [f,g], Shou-Dong Lee [c,h]

[a] *Division of Gastroenterology and Hepatology, Department of Medicine, Taipei Veterans General Hospital, Taipei, Taiwan, ROC*
[b] *Taipei Municipal Gan-Dau Hospital, Taipei, Taiwan, ROC*
[c] *Faculty of Medicine, National Yang-Ming University School of Medicine, Taipei, Taiwan, ROC*
[d] *Healthcare Center, Taipei Veterans General Hospital, Taipei, Taiwan, ROC*
[e] *Department and Institute of Pharmacology, National Yang-Ming University, Taipei, Taiwan, ROC*
[f] *Institute of Clinical Medicine, School of Medicine, National Yang-Ming University, Taipei, Taiwan, ROC*
[g] *Division of Translational Research, Department of Medical Research, Taipei Veterans General Hospital, Taipei, Taiwan, ROC*
[h] *Division of Gastroenterology, Department of Medicine, Cheng Hsin General Hospital, Taipei, Taiwan, ROC*

Received April 11, 2016; accepted June 30, 2016

Abstract

Background: Platelet count (PC) and fatty liver are both associated with metabolic syndrome (MS), obesity, and type 2 diabetes. While PC increases in obesity and type 2 diabetes, the severity of hepatic fibrosis caused by fatty liver reduces PC. We aimed to investigate the correlation of PC and MS in patients with and without fatty liver.

Methods: We enrolled consecutive patients who received health check-ups at Taipei Veterans General Hospital from 2002 to 2009. Ultrasonography was used to diagnose fatty liver, and MS was diagnosed according to the criteria defined by the International Diabetes Federation Task Force on Epidemiology and Prevention.

Results: Among the 29,797 patients, MS was present in 28.74%. Higher PC was correlated with MS using multivariate analysis, while fatty liver had the strongest association with MS. After dividing the patients by the presence or absence of fatty liver, higher PC was still associated with MS in both groups. The patients were further stratified by age and gender, and MS was correlated with PC among all age groups in women and in men under 60 years of age; however, the association between PC and MS did not reach statistical difference in men older than 60 years.

Conclusion: There is a significant correlation between PC and MS, and the correlation exists independent of gender, age, and fatty liver. PC may act as a surrogate marker for MS, and physicians should be concerned with the presence of MS among patients with high PC.

Keywords: body mass index; fatty liver disease; metabolic syndrome; platelet count; sonography

1. Introduction

Metabolic syndrome (MS) has several risk factors, including central obesity, dyslipidemia, raised blood pressure, and fasting glucose for cardiovascular disease and Type 2 diabetes mellitus.[1,2] Fatty liver disease used to be considered an incidental pathological finding in Type 2 diabetes and

Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

* Corresponding author. Dr. Chi-Jen Chu, Division of Gastroenterology and Hepatology, Department of Medicine, Taipei Veterans General Hospital, 201, Section 2, Shih-Pai Road, Taipei, 112, Taiwan, ROC.
E-mail address: cjchu@vghtpe.gov.tw (C.-J. Chu).

http://dx.doi.org/10.1016/j.jcma.2016.07.003

obesity; however, it is found to be strongly related with features of MS and even considered to be included in the definition of MS.[3,4]

Higher PC is associated with cardiovascular disease and vascular complications as a result of its role in inflammation and thrombosis; also, platelet activation is observed in people with diabetes, hypertriglyceridemia, and insulin resistance.[5–9] Diabetes, hypertriglyceridemia, and insulin resistance are strongly associated with MS, and previous studies have found that PC is also elevated in patients with MS after adjustment for age, gender, ethnicity, and total cholesterol.[10,11] On the contrary, decreased PC is observed when significant hepatic fibrosis develops in patients with fatty liver, especially in conditions of nonalcoholic steatohepatitis, which is another disease that is highly associated with MS.[12,13]

Although MS, PC, and fatty liver are closely related, the association between PC among patients with MS with or without fatty liver has not been clarified by comprehensive analyses. The present study therefore aimed to investigate the correlation of PC and MS in patients with and without fatty liver from a large-scale cohort in Taiwan.

2. Methods

2.1. Study population

From the years 2002 to 2009, a total of 34,346 consecutive patients received health check-ups in the Healthcare Center at the Taipei Veterans General Hospital.[14–16] After excluding patients with hepatitis B virus (HBV) infection, hepatitis C virus (HCV) infection, and HBV/HCV dual infections, 29,797 patients were enrolled for the final analysis (Fig. 1). All of them received complete clinical evaluations, laboratory examinations, and abdominal sonography. Body mass index (BMI) was defined as body weight in kilograms divided by the square of body height in meters.

Three of the following five abnormal findings are required for a diagnosis of MS according to the joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention[1]: elevated waist circumference (WC, men ≥90 cm or women ≥80 cm), triglyceride (TG) ≥150 mg/dL, low high-density lipoprotein (HDL)−cholesterol (men <40 mg/dL or women <50 mg/dL), systolic blood pressure (BP) ≥130 mm Hg and/or diastolic BP ≥85 mm Hg, and fasting glucose ≥100 mg/dL. Ultrasonography was performed to diagnose fatty liver according to the practice guideline proposed by the American Gastroenterological Association.[17]

This study followed the standards of the Declaration of Helsinki and was approved by the Institutional Review Board of Taipei Veterans General Hospital. As the dataset used in this study consisted of de-identified data from a retrospective cohort, the requirement for written informed consent was waived.

2.2. Biochemical, hematology, and serological markers

Venous blood samples were collected after an overnight fast. Serum HBV surface antigen (HBsAg) was tested by a radioimmunoassay (Abbott Laboratories, North Chicago, IL, USA), and antibodies to HCV were tested using a second-generation enzyme immunoassay (Abbott Laboratories). Serum biochemistry were measured with a Roche/Hitachi Modular Analytics System (Roche Diagnostics GmbH, Mannheim, Germany). Hematological analysis was performed using a Beckman Coulter LH 780 Hematology Blood Analyzer (Beckman Coulter, Miami, FL, USA).

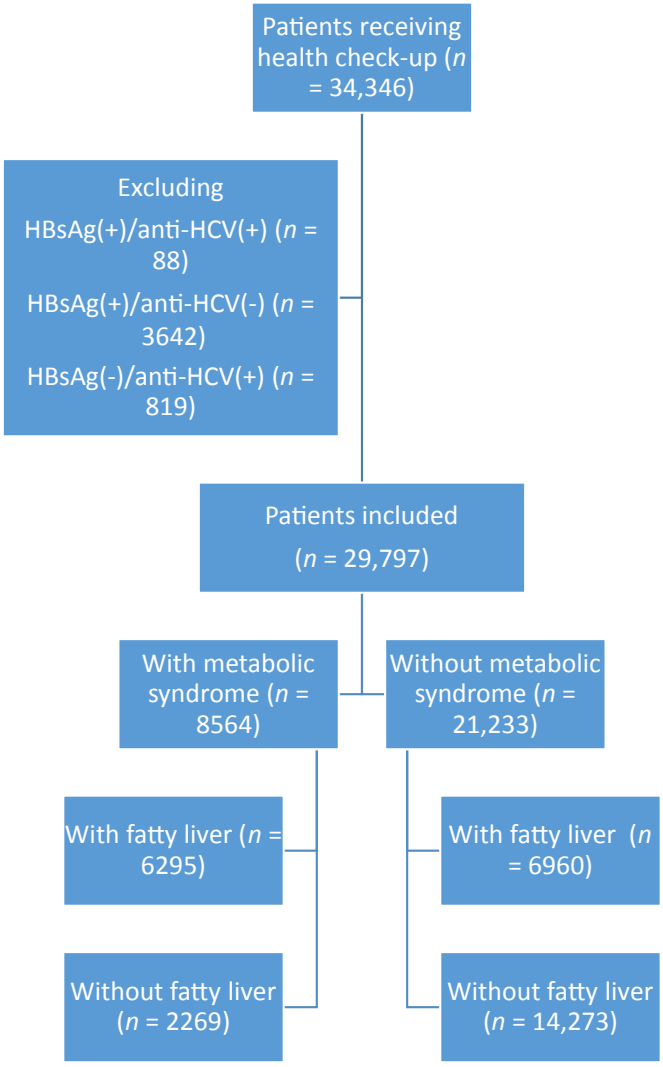

Fig. 1. Flow chart of patients in the study.

2.3. Statistical analysis

The study cohort was first stratified by gender, and patients with fatty liver were selected for further analysis. PC was stratified by age to show association with MS in both men and women. Pearson χ^2 and Student t test analyses were performed to compare categorical and continuous variables with two samples, respectively. Variables with statistical significance ($p < 0.05$) or approximate significance ($p < 0.1$) in univariate analysis were further included in multivariate analysis using a logistic regression model with the forward stepwise selection procedure. A p value < 0.05 was considered