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Association of non-alcoholic fatty liver disease with renal stone disease detected on computed tomography

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ABSTRACT

Objective: To evaluate the association between Non-alcoholic fatty liver disease (NAFLD) with renal stone disease detected on computed tomography (CT).
Method: A total 1812 patients who underwent abdomen-pelvis CT in July 2015 were included in this study. The inclusion criteria for NAFLD were as follows: (i) lower average Hounsfield unit (HU) of hepatic right lobe, left medial and lateral segment when compared with that of spleen, (ii) patients who having urolithiasis in kidneys, ureters and urinary bladder, and (iii) patients underwent abdomen-pelvis CT including noncontrast image. The statistical significance of the association between NAFLD and renal stone disease was assessed using Chi Square Test. The Odds ratios and 95% CI were calculated to assess the propensity of renal stones disease for NAFLD by using Logistic Regression analysis.
Results: The frequency of renal stone disease in patients with NAFLD was higher approximately 19% than those who having renal stone disease without NAFLD. In addition, the presence of NAFLD was linked with renal stone disease showing that detection rate of renal stone disease in patients with NAFLD was markedly high (odds ratio: 5, 95% CI, 3–8.2) ($p < 0.05$) in multivariate analysis.
Conclusion: The presence of significant association between NAFLD with renal stone disease and NAFLD may be considered to be an independent variable as a risk factor for renal stone disease.

1. Introduction

Non-alcoholic fatty liver disease (NAFLD) has been recognized as a liver manifestation of the metabolic syndrome [1]. The prevalence of NAFLD from United States, Europe and Asia is reported to be up to third of the human population [2,3]. NAFLD is defined as the presence of at least 5% of the fat component in the liver without any other liver disease including alcohol related liver disease, chronic viral hepatitis, use of medications resulting in hepatic steatosis such as tamoxifen, herb medication or other chronic liver disease such as autoimmune hepatitis. The guideline for NAFLD (endorsed as American Association for the Study of Liver Disease, American College of Gastroenterology and American Gastroenterological) defines significant alcohol use as current or recent alcohol consumption more than 21 drinks per a week in men and 14 drinks per a week in women [4]. NASH is a more progressive type of NAFLD and defined histologically by presence of hepatic cell injury with parenchymal steatosis [4].

Recent studies concluded that NAFLD has no direct association with renal function and mild renal function abnormality may have similar risk factors or disease process [5]. Renal stone disease is a common renal disorder associated with crystal deposition in the renal medulla and urinary tract. It is influenced by both intrinsic and extrinsic factors [6]. Recent epidemiological studies have demonstrated that renal stone disease has an association with obesity, diabetes mellitus, hypertension, and metabolic syndrome [7]. These results reveal that metabolic syndrome can result in changes in process of urine concentration and dilution, causing an increased risk of both uric acid and calcium oxalate stone formations [7]. In the basis of these studies, renal stone disease may be related to the metabolic syndrome and can be a component of the metabolic syndrome.

Recently, we noticed a concomitant diagnosis of both fatty liver and renal stones disease in same patient on the basis of computed tomography (CT) finding in routine daily practice. Literature reviews by using Pubmed articles demonstrate only two recent studies were performed and revealed the association between fatty liver and renal stone disease. Therefore, the purpose of our study was to evaluate the prevalence of renal stone disease in the patients with NAFLD by using the CT examination.

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Table 1
Total number and gender frequency of fatty liver and renal stone disease.

Gender	Fatty liver	Renal stone disease		Number	χ^2 (p)
		Negative	Positive		
Male	Negative	497 (92.2)	42 (7.8)	539 (100)	55.6
	Positive	100 (69)	45 (31)	145 (100)	($p < 0.05$)
Female	Negative	541 (91.5)	50 (8.5)	684 (100)	16.8
	Positive	83 (78.3)	23 (21.7)	591 (100)	($p < 0.05$)
Total	Negative	1038 (91.9)	92 (8.1)	1130 (100)	72
	Positive	183 (72.9)	68 (27.1)	251 (100)	($p < 0.05$)

2. Material and methods

This prospectively collected and retrospectively evaluated study was approved by the institutional review board, and informed consent from patients was waived.

2.1. Study population

From July 1, 2015 to July 31, 2015, a total of 1812 patients who visited our institute with performed abdomen-pelvis CT initially eligible. The inclusion criteria for NAFLD group were as follows: (i) lower average Hounsfield unit (HU) of hepatic right lobe, left medial and lateral segment when compared with that of spleen [8,9], (ii) patients having radiopaque stones in the urinary tract including kidneys, ureters or urinary bladder, and (iii) patients underwent abdomen-pelvis CT including noncontrast image. Control group were defined as follows: (i) patients underwent abdomen-pelvis CT including noncontrast image, and (ii) patients whose HU of liver parenchyma showed higher than that of spleen. Exclusion criteria were follows: (i) those who underwent abdomen-pelvis CT without noncontrast image, (ii) those who had suboptimal image quality of CT examination due to beam hardening artifact or respiration artifact, and (iii) those who having other liver disease including viral hepatitis, liver cirrhosis, hepatocellular carcinoma, metastasis from other primary cancer, splenectomy status or abundant alcohol consumption.

Of the 1812 cases, 431 were excluded due to absence of noncontrast image (n = 257), viral hepatitis, liver cirrhosis or hepatocellular carcinoma (n = 134), splenectomy status (n = 12), metastasis from other primary malignancy (n = 12), abundant alcohol consumption (n = 8) and suboptimal image quality (n = 8). Finally, 1381 cases (mean age: 55.8 years; range: 19–91 years; male:female = 684:697) were enrolled in this study. The case accrual process is summarized in Fig. 1.

2.2. CT protocols

A 128-detector row CT scanner (Definition AS+, Siemens Healthcare, Forchheim, Germany) was used to perform the abdomen-pelvis CT scan. All patients were in the supine position and were scanned from the lung base to the pubic symphysis. We performed a noncontrast scan. The scanning parameters were as follows: tube voltage, 120 kVp; collimation, 128 × 0.6 mm; rotation speed, 0.5 s; pitch, 0.8; reconstruction thickness, 3 or 5 mm; and no reconstruction interval. Automatic exposure control (caredose 4D, Siemens Healthcare) was activated to decrease the radiation dose, however, automatic tube potential modulation (careKV, Siemens Healthcare) was not switched on. Sagittal and coronal reformatted images were generated with a thickness of 3 mm.

2.3. Image analysis

All imaging analysis was performed by a fellowship-complete academic radiologist with 3-year experience in reading abdomen-pelvis CT who was blinded to clinical and laboratory data. To obtain HU of liver parenchyma and spleen, the radiologist derived average HU value of liver parenchyma from three different hepatic segments including right hepatic lobe, left medial and lateral segment by measuring region of interest in each segment. Fatty liver was defined when average HU of liver parenchyma lower than that of spleen [8]. Then 4 weeks later, the radiologist reviewed electronic medical report of all enrolled patients to exclude those who having other liver disease including viral hepatitis, liver cirrhosis, hepatocellular carcinoma, metastasis from other primary cancer, splenectomy status or abundant alcohol consumption (Fig. 2).

2.4. Statistical analysis

To assess the association between fatty liver and renal stone disease, the Chi Square test was used. The Odds ratios and 95% CI were calculated to assess the propensity of renal stones disease for fatty liver patients by using Logistic Regression analysis. A *P* value less than 0.05 was considered to indicate asignificant difference. The statistical analysis was performed using Medcalc software for Window (Medcalc Software Version 11.3.8.0, Mariakerke, Belgium).

3. Results

Of the 1381 cases, 1038 were healthy group suggestive of no fatty liver or renal stone disease (75% of total number). Fatty liver were 251 patients (145 men, 106 women; mean age; 54.7 years; age range, 19–90 years) and renal stone disease were 160 patients (87 men, 73 women; mean age, 54.9 years; age range, 20–86 years). The frequency of renal stone disease in fatty liver patient group was 27% (n = 68) (p < 0.05). In contrast, only 8% was noted as renal stone disease in non-fatty liver patient group (n = 183) (p < 0.05) (Table 1). The frequency of renal stone disease in male fatty liver patient group was 31% (n = 45) and in female fatty liver patients group was 21.7% (n = 23) (p = 0.208). Diagnosis of fatty liver demonstrated an association with higher risk of developing renal stone disease (odds ratio: 5, 95% CI, 3–8.2) (p < 0.05) (Table 2). The mean and standard deviation of HU of liver was 51.9 ± 12 in patient with renal stone disease and fatty liver and 56.4 ± 11 in patient with renal stone disease without fatty liver, respectively (p < 0.05). The frequency of fatty liver in renal stone disease (n = 160) was 42.5% (n = 68), with the frequency of 54.4% and 45.6% in male and female, respectively (p = 0.208). In contrast, the frequency of fatty liver in patient without renal stone disease was 15%.

4. Discussion

Our study showed that frequency of renal stone disease in patient with NAFLD was higher approximately 19% than those who