Evaluation of the splenic vein diameter and longitudinal size of the spleen in patients with Gamna-Gandy bodies

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PURPOSE
The aim of this retrospective study was to compare the splenic vein diameter and longitudinal size of the spleen in patients with portal hypertension in whom Gamna-Gandy bodies were present to their spleen with those of cirrhotic patients without Gamna-Gandy bodies and a control group.

MATERIALS AND METHODS
Between July 2001 and February 2006, patients in whom Gamna-Gandy bodies were detected in their spleen and the number of patients who had undergone magnetic resonance imaging (MRI) imaging with the diagnosis of chronic liver disease were determined. A total of 43 cases with Gamna-Gandy bodies were noted. Out of these patients, a case of lymphoma was excluded from the study. Additional 3 cases with splenic vein thrombosis were not included in statistical analysis. Accordingly, the splenic vein diameter and longitudinal size of the spleen in 39 patients (group 1: 12 women, 27 men; mean age, 38.5 years) with portal hypertension in whom Gamna-Gandy bodies were detected in their spleen on T1-weighted gradient-echo MR images between July 2001 and February 2006 were measured. The values obtained were compared with those of 29 cirrhotic patients without Gamna-Gandy bodies (group 2: 14 women, 15 men; mean age, 48.2 years) and control group (group 3: 13 women, 18 men; mean age, 46.8 years). The differences between the groups were analyzed using ANOVA and student-t test.

RESULTS
Gamna-Gandy bodies were detected in 6.3% (42/670) of patients with chronic liver disease. The mean longitudinal axis of the spleen (20.2±4.2 cm) in group 1 was significantly greater (p<0.001) than in group 2 (14.4±3.9 cm). The mean splenic vein diameter was significantly larger in group 1 (14.3±4.0 mm) than those in groups 2 and 3 (11.2±3.2 mm and 7.8±1.4 mm, respectively).

CONCLUSION
The splenic vein diameter and longitudinal size of the spleen in portal hypertensive patients with Gamna-Gandy bodies are significantly larger than that of cirrhotic patients without Gamna-Gandy bodies and that of control group.

Key words: • portal hypertension • spleen • magnetic resonance imaging
Gradient echo imaging was performed using FSPGR (fast spoiled gradient recalled) sequences after IV contrast medium administration with fat suppression technique. The parameters of this sequence in which Gamma-Gandy bodies were most visible were as follows: TR: 120 ms; TE: 6.3 ms; flip angle: 90°; bandwidth: 20.83 kHz; imaging matrix: 256 x 160; NEX: 1; FOV: 32-40 cm; slice thickness: 7 mm; slice gap: 1.5 mm. Patients were instructed to hold their breath during the examination.

Image analysis
Archived images were retrospectively analyzed on a workstation (Advantage Windows, version 3.1, GE Healthcare). Splenic diameters were measured on T2 weighted coronal images routinely obtained in liver studies and coronal plane source images of MR angiograms in which the maximum craniocaudal length was most visible (Figure 1). The comparison of craniocaudal length of spleens was made only between Groups 1 and 2. The splenic diameters of the control group were reported as normal in the archived MR imaging reports and these cases were excluded from the statistical analysis. Two different radiologists measured the splenic vein diameters of all 3 groups 1-2 cm from the splenic hilus in the axial images (Figure 2). Mismatched values were analyzed together in order to reach a consensus.

Statistical analysis
All the measurements were expressed as mean ± standard deviation. The prevalence of Gamma-Gandy bodies was measured taking all 43 cases into consideration, disregarding their etiologies. Splenic vein measurements demonstrated normal distribution within the 3 groups; therefore, ANOVA test was used to evaluate the differences in the average splenic vein diameters. Bonferroni’s post-hoc test was used to determine the differences between the groups. Splenic craniocaudal length comparisons in coronal images were made only between Groups 1 and 2 and student-t test was used for this comparison. P < 0.05 was regarded as statistically significant.

Results
Among the 670 patients who had MR imaging performed due to chronic liver parenchymal disease and portal hypertension during the 56-month period, 42 retrospectively demonstrated Gamma-Gandy bodies as small, multiple hypointense nodular lesions on T1 weighted gradient-echo images (Figure 3). Accordingly, the prevalence of Gamma-Gandy bodies was found to be 6.3%.
The range of splenic vein diameters and splenic craniocaudal lengths of the 3 groups are provided in the Table as means ± standard deviation. When compared, the differences of the average splenic vein diameters were significant for each of the 3 groups (p < 0.001). When groups 1 and 2 were compared, a significant difference was noted in the splenic craniocaudal length when Gamna-Gandy bodies were present (p < 0.001).

### Discussion

Portal hypertension develops when blood in the portal venous system cannot be channeled into the systemic circulation due to pre-hepatic, intrahepatic, or post-hepatic etiologies. The congestion that forms in the portal vein, superior mesenteric vein, and splenic vein, later transmits to the end organs. The congestion in the spleen causes hyperplasia of the reticulohistiocytic system cells that line the sinusoids and leads to splenomegaly. The raised intra-organ pressure in the enlarged spleen causes micro-hemorrhages. Hemosiderin and calcium deposition are noted in the fibrous foci that form by organization of the micro-hemorrhages, which are called siderotic nodules (Gamna-Gandy bodies). Detection of these nodules with imaging methods offers morphological evidence of portal hypertension of long duration (2, 3, 6). Gamna-Gandy bodies may present not only with portal hypertension, but with splenic vein thrombosis, hemolytic anemia, leukaemia or lymphoma, blood transfusion, acquired hemochromatosis, and paroxysmal nocturnal hemoglobinuria (7). In one of our patients with lymphoma, Gamna-Gandy bodies were present. The lesions are usually less than 1 cm in size, but may range from a few millimeters to 1 cm (3).

In a retrospective study by Minami et al., in 1989, 21 patients with Gamna-Gandy bodies were detected among 233 patients with portal hypertension. In these 233 patients, Gamna-Gandy bodies were detected in 2 of the 65 patients with normal splenic volumes, in 11 of the 72 patients with mild splenomegaly, in 7 of the 79 patients with moderate splenomegaly, and in 1 of the 17 patients with massive splenomegaly (5) In our series, we observed that splenic volumes were increased in portal hypertensive patients with Gamna-Gandy bodies as compared to those without, and the difference was statistically significant (p < 0.001).

Gamna-Gandy bodies are detected in an average of 9%-12% of portal hypertensive patients (8). In our study, the prevalence of Gamna-Gandy bodies was 6.3% (42 of 670 patients); this ratio was somewhat smaller than the 12.5% reported by Sagoh et al. in a series of 64 patients in which 8 patients had Gamna-Gandy bodies and the 9% reported by Minami et al. in a study of 233 patients. Although FSPGR technique was used in all cases sensitive to siderotic nodules, this decreased prevalence may have been due to the large number of patients included in the study, more frequent use of MR imaging in the evaluation of chronic liver parenchymal disease, and the relative decrease in the long-term findings secondary to early phase imaging.

In ultrasound examination, splenic siderosis is observed as multiple, punctate hypechoic foci (2, 5). In the study by Sagoh et al., Gamna-Gandy bodies were detected in only 1 of 4 patients who had undergone sonographic imaging, and this patient was reported to have had diffuse nodules visible in spin echo sequences as well (2). In un-

### Table. Splenic vein diameters and splenic craniocaudal lengths in the study groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Splenic vein diameter (mm) (minimum-maximum)</th>
<th>Splenic vein diameter (mm) (average ± SD)</th>
<th>Splenic craniocaudal length (cm) (minimum-maximum)</th>
<th>Splenic craniocaudal length (cm) (average ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (n = 39)</td>
<td>8.0-22.0</td>
<td>14.3 ± 4.0</td>
<td>13-30</td>
<td>20.2 ± 4.2</td>
</tr>
<tr>
<td>2 (n = 29)</td>
<td>6.3-18.2</td>
<td>11.2 ± 3.2</td>
<td>8-23</td>
<td>14.4 ± 3.9</td>
</tr>
<tr>
<td>3 (n = 31)</td>
<td>5.0-10.5</td>
<td>7.8 ± 1.4</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

N: no measurement; SD: standard deviation.
enhanced computed tomography (CT), Gamma-Gandy bodies may be detected as multiple, subtle hyperdense foci. These foci represent calcifications in the nodules, which CT can visualize when calcium in the nodules reaches a certain level (4).

MR imaging is sensitive to paramagnetic substances. Deoxyhemoglobin, methemoglobin, and hemosiderin are hemoglobin products, which have paramagnetic effects. Therefore, these substances are easy to recognize on MR imaging (5). Gamma-Gandy bodies, due to their hemosiderin content are visualized as areas of signal void in all pulse sequences, especially gradient-echo sequences (2). Gradient-echo is known as the sequence most sensitive to hemosiderin and the blooming effect makes the nodules appear more exaggerated (6). Intravenous contrast medium injection increases the detection of the nodules, but the nodules themselves do not enhance. Other multiple, small, low intensity splenic lesions that may cause the same appearance on MR imaging, such as vascular structures, calcified miliary tuberculosis, histoplasmosis, phleboliths, and micro-abscesses, should be ruled out (5). In Turkey, calcifications secondary to malaria should also be considered.

To the best of our knowledge, no comparative studies that evaluated splenic vein diameter and splenic volume in patients with chronic liver parenchymal disease and Gamma-Gandy bodies have been published. The present study found that the increase in splenic vein diameter and splenic volume were significant in this latter group. Given the fact that portal venous congestion exists in portal hypertension of long duration, we think a relation exists between both splenic vein diameter and splenic volume increase, and the development process of siderotic nodules.

References