Diagn Interv Radiol 2006; 12:125-128

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 in 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 been undergone magnetic resonance (MR) 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 with 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*

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Received 12 May 2006; revision requested 15 June 2006; revision received 26 June 2006; accepted 27 June 2006.

Lesions referred to as Gamna-Gandy bodies, which were named after Carlo Gamna (1866-1950) and Charles Gandy (1872-1943), develop through organization of splenic micro-hemorrhages secondary to liver cirrhosis and portal hypertension, followed by hemosiderin and calcium deposition (1, 2). Gamna-Gandy bodies are also called siderotic nodules. Magnetic resonance (MR) imaging is a sensitive means of detection of such nodules due to technical aspects of the study. Many case reports (3, 4) and retrospective studies exist regarding MR imaging detection of splenic Gamna-Gandy bodies in portal hypertension (2, 5).

In this retrospective study, we measured the splenic vein diameter and longitudinal size of the spleen in patients with chronic liver parenchymal disease and splenic Gamna-Gandy bodies, and compared the obtained values to patients with chronic liver parenchymal disease, but without Gamna-Gandy bodies, and to a control group. The aim was to determine if a difference existed among the mentioned parameters.

Materials and methods

Patient population

According to the data in our department archive, a total of 902 patients had undergone liver MR imaging and hepatic MR angiography between July 2001 and February 2006. Of those, 670 of the studies were performed to evaluate chronic liver parenchymal disease. Our study was based on those patients with Gamna-Gandy bodies reported in their radiological records. The archive images of the patients recorded on compact discs were evaluated retrospectively in each of the study groups. Patients were divided into 3 groups according to their clinical and radiological findings:

Group 1 consisted of patients with splenic Gamna-Gandy bodies. At first evaluation, a total of 43 cases were included in this group and 42 of them had chronic liver parenchymal disease and portal hypertension. One patient with Gamna-Gandy bodies had a diagnosis of lymphoma; in this case, no evidence of chronic liver parenchymal disease was noted and it was discarded from the statistical evaluation. Also the values of 3 patients, each of whom had splenic thrombosis, were excluded from the statistical analysis as well. The etiological factors of chronic parenchymal disease in this group of patients with Gamna-Gandy bodies and portal hypertension were viral hepatitis (n = 21; HBV, HDV), hepatic venous occlusion (n = 8), cryptogenic cirrhosis (n = 3), autoimmune hepatitis (n = 3), and primary portal hypertension (n = 4). The age distribution of the 39 patients, which included 12 females and 27 males, was 19 to 70 years, with an average of 38.5 years. The values obtained in this group were compared to the control group and to the patients with chronic liver parenchymal disease, but no Gamna-Gandy bodies.

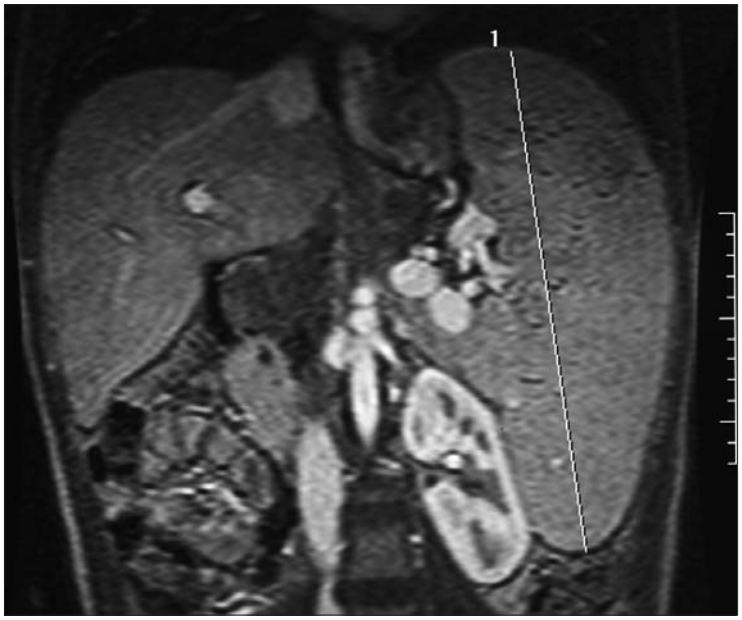

Figure 1. Coronal MR angiography source image demonstrates the craniocaudal measurement of the spleen.

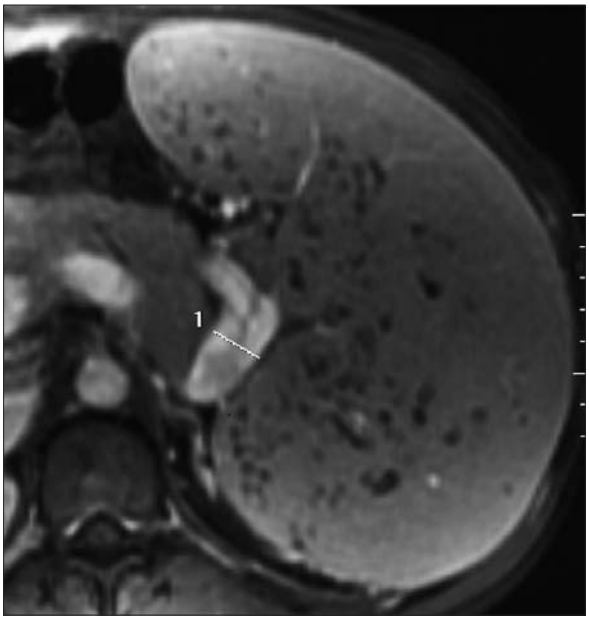

Figure 2. Post-contrast transverse T1-weighted fat saturated image demonstrates the splenic vein diameter measurement.

Group 2 consisted of 30 patients with chronic liver parenchymal disease, but no Gamna-Gandy bodies. In this group, 1 patient with splenic vein thrombosis was excluded from the statistical analysis. The ages of the 29 patients (14 females and 15 males) varied from 17 to 75 years (average age: 48.2 years). MR imagings were performed in this group to evaluate viral hepatitis (n = 16), primary portal hypertension (n = 5), primary biliary cirrhosis (n = 4), toxic hepatitis (n = 3), and cryptogenic cirrhosis (n =1).

Group 3, the control group, included consecutive patients referred for abdominal MR imaging for various reasons during the previous 4 months. The ages of these 31 patients (13 females, 18 males) who did not have clinical, laboratory, or imaging findings of chronic liver disease or portal hypertension, varied from 17 to 78 years with an average of 46.8 years.

MR imaging technique

MR imaging was performed in a 1.0 Tesla unit (Signa LX Horizon; General Electric Medical Systems, Milwaukee, WI) using phase array coils. Transverse T1 weighted gradient echo images of the upper abdomen are routinely performed for liver imaging in our department after IV contrast medium administration and following hepatic MR angiographies to evaluate the tissues not included in the imaging volume. 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 Gamna-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 Gamna-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 Gamna-Gandy bodies as small, multiple hypointense nodular lesions on T1 weighted gradient-echo images (Figure 3). Accordingly, the prevalence of Gamna-Gandy bodies was found to be 6.3%.

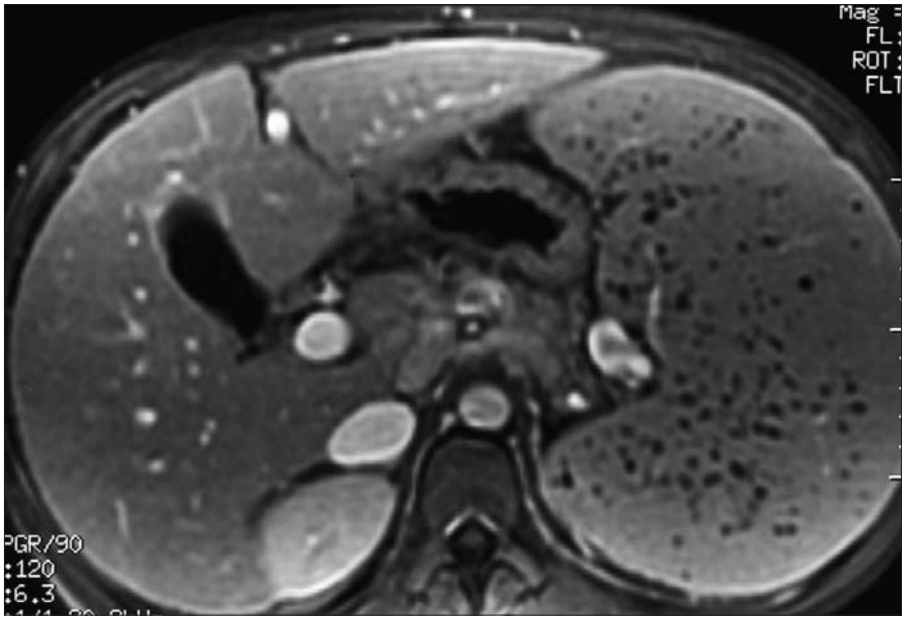

Figure 3. Post-contrast T1-weighted FSPGR transverse image shows multiple Gamna-Gandy bodies in the spleen of a 20-year-old patient with chronic liver parenchymal disease due to viral hepatitis.

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 (Gamma-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, leukemia 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 1cm 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 hyperechoic 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.

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

N: no measurement; SD: standard deviation.

enhanced computed tomography (CT), Gamna-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). Gamna-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 Gamna-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.

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