Sclerosing Angiomatoid Nodular Transformation (SANT) of the spleen was first described by Martel et al. in 2004, and this rare benign vascular lesion is composed of angiomatoid nodules, a sclerotic internodular stroma, and a lymphoplasma cell infiltration. Macroscopically, the tumor presents as a multinodular, uncapsulated, well-circumscribed mass in the fibrosclerotic background. Angiomatoid nodules which is the most characteristic microscopic feature of SANT are composed of three types of endothelial cells; the cord capillary-type, the sinusoid-type, and the small vein-type, resembling the normal vascular structure of splenic red pulp. Martel et al. suggested that angiomatoid nodules may represent an unusual transformation of the red pulp of the spleen in response to the vascular blockage.

The clinical process of SANT is benign without recurrence after splenectomy. We report herein on the first Korean case of SANT in the spleen with its pathologic features, and review the related literature.

CASE REPORT

A 50-year-old woman presented with mild left upper quadrant discomfort and tenderness. She had a history of iodine-ablation therapy due to hyperthyroidism 8 years ago and she was then medicated for hypothyroidism. The computed tomography image showed a lobulated and heterogeneously enhanced,
6 cm-sized solitary mass in the spleen (Fig. 1A). The spleen was resected by laparoscopy under the clinical diagnosis of tumor of the spleen. Grossly, the resected spleen weighed 102 g. There was a relatively well-circumscribed, round-shaped, and solid mass that measured $6.5 \times 6.0 \times 3.5$ cm in size. The external surface of the mass was multinodular and red-brown in color. On sectioning, the tumor was composed of multiple small hemorrhagic nodules separated by fibrous bands (Fig. 1B). Microscopically, multiple nodular vascular lesions presented in a fibrocollagenous connective tissue background (Fig. 2A). Each nodule was composed of irregular-shaped vessels lined by prominent endothelial cells (Fig. 2B). The endothelial cells were bland-looking and intermingled with perinodular fibroblasts. Cellular atypia and mitotic activity were rarely identified (Fig. 2C). With Masson-trichrome staining, the interangionodular spaces consisted of dense fibrous and collagenous tissue (Fig. 2D). The nodules contained spindle cells without atypia and inflammatory cells, and especially lymphocytes and plasma cells. Dispersed red blood cells and hemosiderin-laden macrophages were identified in both the nodular and interangionodular spaces. No necrosis was presented in the mass.

Immunohistochemically, CD31, CD30, CD34, and VWF-VIII were detected in the plump endothelial cells of the angiomatoid nodule, but CD8 was not detected (Fig. 3A). Alpha-smooth muscle actin antigen was positive in the vascular network and the spindle cells of the interangionodular spaces (Fig. 3B). Reactivity for anaplastic lymphoma kinase protein, and D2-40 was not identified. The Ki-67 proliferation index was approximately 10%. The lesion was negative for Epstein-Barr virus in situ hybridization.

**DISCUSSION**

SANT was recently described by Martel et al. in 2004 as a vascular lesion in the splenic red pulp. SANT presents as a well-circumscribed, but unencapsulated, solid single mass with a round to bosselated contour. The mass shows numerous variable sized red brown nodules separated by whitish fibrous tissue. The most distinctive microscopic finding in SANT is multiple angiomatoid nodules separated by collagenous bundles. The angiomatoid nodules are composed of variable shaped vessels that are lined by prominent, bland-looking endothelial cells. Cellular atypia and mitotic activities are extremely rare. The angiomatoid nodules are composed of three types of blood vessels; the cord capillary-type that are, CD31+/CD34+/CD8-, the sinusoid-type that are, CD31+/CD34-/CD8+, and small vein-type that are, CD31+/CD34-/CD8-, and these blood vessels resemble the normal vascular structure of splenic red pulp. The endothelial cells that composed the angiomatoid nodules also express CD30, which is an activation marker of endothelial cells. In our case, the angiomatoid nodules showed prominent proliferation of the cord capillary type (CD31+/CD34+/CD8-) and small vein type (CD31+/CD34-/CD8-) blood vessels. Moreover, the immunohistochemical staining for CD30 in this case showed positive reactivity. An inflammatory cell infiltration was present and this was, mostly cytotoxic T lymphocytes and polytypic plasma cells in an interangionodular, collagenous

Fig. 1. (A) Post-contrast abdominal computed tomography shows a lobulated and heterogeneously enhanced, 6 cm-sized solitary mass in the spleen. (B) The solitary, well-circumscribed round tumor, measuring 6.5 cm in diameter. The cut surface shows multiple hemorrhagic nodules separated by fibrocollagenous stroma.
stroma, but the inflammatory cell infiltration was not prominent like that in inflammatory pseudotumor. The differential diagnosis for SANT includes other splenic vascular tumors such as hamartoma, hemangioma, littoral-cell angioma, hemangiendothelioma, and nodular transformation of the red pulp in association with metastatic carcinoma.

Fig. 2. (A) The angiomatoid nodules are surrounded by a dense fibrocollagenous stroma. (B) The angiomatoid nodule shows complex vascular networks with extravasated red blood cells. (C) The endothelial cells are plump and bland-looking without cellular atypia. (D) Masson-trichrome staining shows extensive collagen deposition in the interangionodular spaces (Masson-trichrome).

Fig. 3. (A) Immunohistochemical staining for CD31 shows nodular positive staining. (B) The vascular network and the spindle cells of the interangionodular spaces are reactive for alpha-smooth muscle actin antigen.
The cases of SANT reported by Martel et al.\(^1\) had been described as splenic hamartoma\(^4\) or hemangiendothelioma.\(^5\) Some authors have designated SANT with using different terms.

After using the designation of SANT, a total of sixty two cases have been reported in the English medical literature.\(^1\)\(^-\)\(^\)\(^3\)\(^-\)\(^10\) In the literature, SANT was more frequent in females with a female to male ratio of 1.4 : 1 and it showed broad age range from 22 years old to 82 years old. Most patients were asymptomatic and SANT was found incidentally in the stage of evaluating for malignancy. Only 11 patients presented mild abdominal or back pain. Fever, an elevated erythrocyte sedimentation rate, and splenomegaly were observed in a minority of cases.\(^1\)\(^-\)\(^3\) Fifty five patients underwent splenectomy and thirty six patients were followed up without recurrence.

The pathogenesis of angiomatoid nodules is still unknown. Martel et al.\(^1\) proposed that angionodular transformation of the red pulp was the result of vascular obstruction. Diebold et al.\(^3\) who reported on 16 cases, suggested that disturbance of the intrasplenic blood circulation in the red pulp as a possible mechanism of angiomatoid nodules. They also pointed that all their cases showed inflammatory pseudotumor (IPT)-like lesion in the interangionodular spaces and so this may imply an association between SANT and IPT. Although Martel et al.\(^1\) proposed that many lesions arose from IPT, Diebold et al.\(^3\) considered SANT and IPT to be related to one disease and they recommended careful examination for the presence of angiomatoid nodules. One case of SANT reported by Lee et al.\(^7\) presented with the coexistence of two rare lesions of SANT and calcifying fibrous pseudotumor. They supposed that these two lesions may have a common mechanism. Weinreb et al.\(^2\) reported on six cases of SANT and they described the the expression of CD30 in the endothelial cells of the angiomatoid nodules.

SANT is a distinctive benign splenic lesion. Our new case is in accordance with the pathologic findings of Martel et al.\(^1\) that SANT may represent a peculiar transformation of the red pulp in response to an exaggerated stromal proliferation.

REFERENCES