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A case of sclerosing angiomatoid nodular transformation of the spleen with increased accumulation of fluorodeoxyglucose after 5-year follow-up



Keiso Matsubara^a, Akihiko Oshita^{a,b,*}, Takashi Nishisaka^c, Tamito Sasaki^d,
Yasuhiro Matsugu^a, Hideki Nakahara^a, Takashi Urushihara^{a,b}, Toshiyuki Itamoto^{a,b}

^a Department of Gastroenterological Surgery, Hiroshima Prefectural Hospital, Japan

^b Department of Gastroenterological and Transplant Surgery, Applied Life Sciences, Institute of Biomedical and Health Sciences, Hiroshima University, Japan

^c Department of Pathology Clinical Laboratory, Hiroshima Prefectural Hospital, Japan

^d Department of Internal Medicine, Hiroshima Prefectural Hospital, Japan

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ABSTRACT

INTRODUCTION: Sclerosing angiomatoid nodular transformation (SANT) of spleen is a new entity defined as a benign pathologic lesion. Fluorodeoxyglucose (FDG) positron emission tomography/computed tomography (PET/CT) shows weak accumulation, thereby ruling out the malignancy in preoperative diagnosis is difficult. Herein, we reported a case of shrinking SANT with increased FDG accumulation during a 5-year follow-up period, which was treated by laparoscopic splenectomy.

PRESENTATION OF CASE: A 64-year-old female had been referred to our hospital for the evaluation of a splenic tumor. Initial contrast-enhanced computed tomography (CT) showed a well-defined, and ovoid hypoattenuating lesion, measuring 52 mm in diameter in the spleen. Initial PET/CT revealed accumulation of FDG in the tumor (maximum standardized uptake value [SUVmax]: 2.8). The mass was diagnosed as SANT, and the patient was followed-up every 6–12 months for 5 years. Follow-up PET/CT revealed increased accumulation of FDG (SUVmax: 3.5). As it was suspicious considering the differential diagnosis, including malignant lymphoma and inflammatory pseudotumor, she underwent laparoscopic splenectomy. The pathological results showed three types of vessels including capillaries, ectatic small veins, and sinusoids-like vessels, consistent with the features of SANT.

DISCUSSION: A SANT may have features that resemble those of malignancy, including the growing mass and the increase of FDG accumulation.

CONCLUSION: Although the preoperative diagnosis of SANT is difficult, it is necessary to make a diagnosis of SANT comprehensively, even when accumulation of FDG increased slightly during the follow-up period and suggested the possibility of malignant diseases.

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1. Introduction

Solid tumors of the spleen are rare, with an incidence of 0.007% of all operation and autopsy specimens [1]. Sclerosing angiomatoid nodular transformation (SANT) of the spleen is sometimes found incidentally via abdominal ultrasonography or computed tomography (CT). Ruling out malignancy in preoperative imaging studies is hard. Fluorodeoxyglucose (FDG) positron emission tomogra-

phy/computed tomography (PET/CT) shows weak accumulation, leading to a difficult preoperative diagnosis to be difficult. Tissue sampled by fine-needle aspiration (FNA) is not easily obtained because of the risk for bleeding [2]. Therefore, splenectomy would be necessary for a precise diagnosis and treatment of splenic tumors. Herein, we report a case of splenic SANT, diagnosed and followed-up with for 5 years, treated by laparoscopic splenectomy, performed due to the increased accumulation of FDG. This work has been reported in line with the SCARE criteria [3].

2. Presentation of case

A 64-year-old female had been first referred to our hospital for the evaluation of a splenic tumor, which had been incidentally found on Ultrasonography during a medical checkup. He had no history of previous abdominal surgery or trauma. Initial contrast-

Abbreviations: SANT, sclerosing angiomatoid nodular transformation; CT, computed tomography; FDG, fluorodeoxyglucose; PET/CT, positron emission tomography/computed tomography; FNA, fine-needle aspiration; MRI, magnetic resonance imaging; SUVmax, maximum standardized uptake value.

* Corresponding author at: Department of Gastroenterological Surgery, Hiroshima Prefectural Hospital, 1-5-54, Ujina-Kanda, Minami-ku, Hiroshima 7348530, Japan.

E-mail address: oshita-akihiko@umin.ac.jp (A. Oshita).

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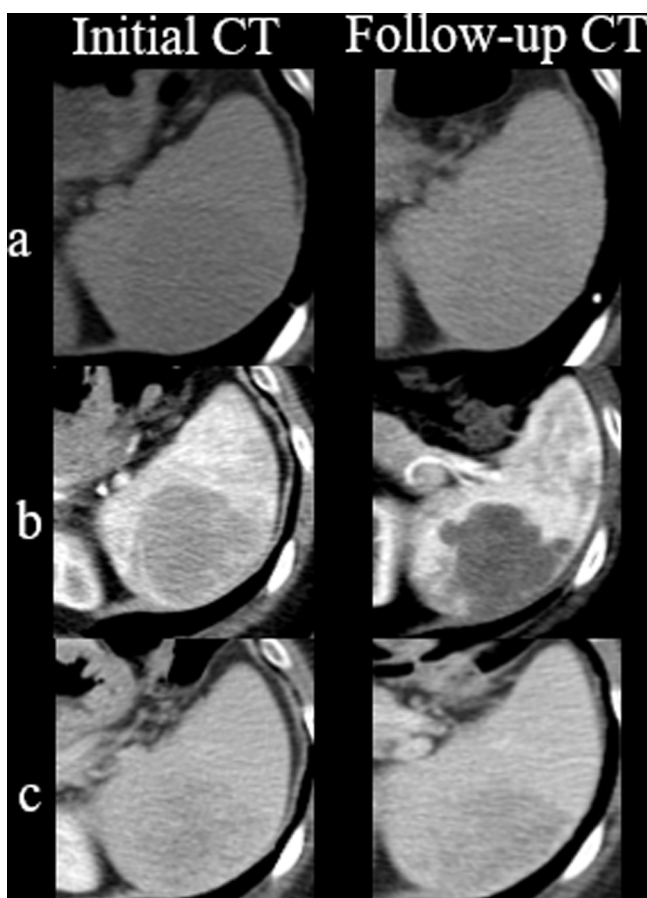


Fig. 1. Computed tomography (CT) scans of sclerosing angiomatoid nodular transformation. a Plain CT. A slightly low-density mass on both initial and follow-up CT. b Dynamic CT on arterial phase. The density of the mass was lower than the surrounding normal spleen. On initial CT, the mass was 48 mm in diameter. On follow-up CT, the mass was reduced to 43 mm in diameter and its border had changed irregularly. c Dynamic CT on portal phase. The mass was heterogeneously enhanced from its margin on both initial and follow-up CT.

enhanced CT showed a well-defined and ovoid-hypoattenuating lesion measuring 52 mm in diameter in the spleen on the portal phase, and “filling-in” of contrast and increasing homogeneity of the splenic parenchyma on the delayed phase (Fig. 1a–c). Initial magnetic resonance imaging (MRI) revealed a low-intensity mass on T1-/T2-weighted images with heterogenous contrast effect (Fig. 2a–d). Initial PET/CT revealed an accumulation of FDG in the tumor (SUVmax: 2.8) (Fig. 3a). The mass was diagnosed as SANT, and follow-up was completed every 6–12 months for 5 years.

Five years later, a follow-up CT revealed an enhanced mass that was similar to that observed in the initial CT, although it demonstrated a mild-interval-size decrease, measuring 44 mm in diameter (Fig. 1a–c). A follow-up MRI revealed a central low-signal, non-enhancing focus on T1-/T2-weighted images (Fig. 2a–d). However, follow-up PET/CT revealed more accumulation of FDG (SUVmax: 3.5) (Fig. 3b). It was suspicious considering the differential diagnosis including malignant lymphoma. Therefore, she underwent laparoscopic splenectomy. The postoperative course was uneventful, and the patient was discharged on postoperative day seven.

2.1. Pathological findings

The cut surface of the spleen showed a well-demarcated and solitary mass, measuring 45 mm in diameter. The mass was dark brown with a central large stellate fibrotic scar (Fig. 4a). Micro-

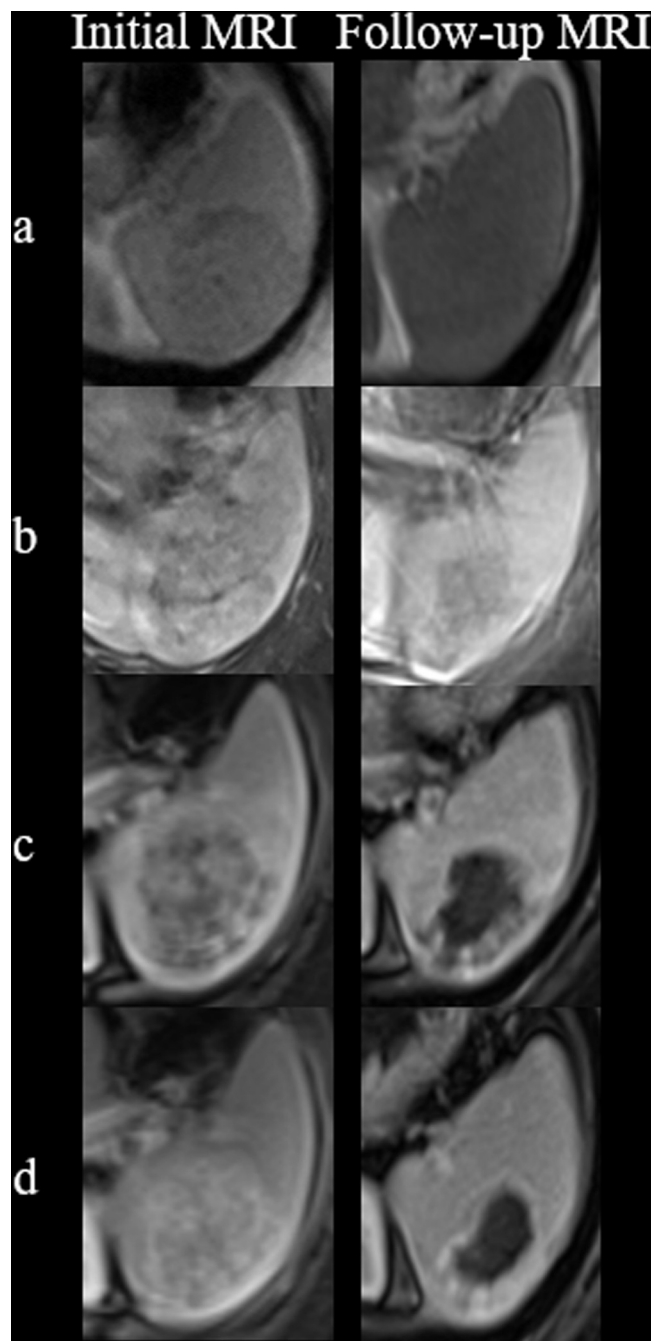


Fig. 2. Magnetic resonance imaging (MRI) of sclerosing angiomatoid nodular transformation. a MRI on T1-weighted images. The mass showed the ill-defined splenic mass that was hypointense compared with the splenic parenchyma both the initial and follow-up MRI. b MRI on T2-weighted images. In the mass, heterogeneously isointense and hypointense area can be recognized. On follow-up MRI, the border of the mass had changed, becoming irregular. c Dynamic MRI on the arterial phase. The mass had a slightly heterogeneous enhancement. On follow-up MRI, the dynamic study revealed central hypointensity and the mass was heterogeneously enhanced in its margin. d Dynamic MRI on the equilibrium phase. The mass was heterogeneously enhanced from its margin on initial MRI. The central hypointensity displayed poor contrast effect.

scopically, the mass was unencapsulated but well-demarcated, composed of multiple irregular fibrotic nodules. The center of the nodules showed many small-sized vessels and extravasated red blood cells, or so-called angiomatoid nodules. The stroma consist of the variably myxoid to dense fibrous tissue with scattered pulump myofibroblasts, haemosiderin-laden macrophages, plasma cells, and lymphocytes (Fig. 4b).

Table 1
Review of SANT that was followed-up.

Published year	Author	Initial modality	Follow-up period (Month)	Pre-operative modality	Operative indication
2007	Weinreb [14]	US	12	US	Growing mass
2009	Koreishi [15]	CT, MRI, PET/CT	24	CT	Growing mass
2010	Bamboato [16]	CT	4	MRI, PET/CT	Growing mass
2010	Raman [17]	CT	3	CT	Growing mass
2012	Falk [18]	US, CT, MRI	36	CT	Growing mass
2015	Yoshimura [19]	US, CT	12	CT, MRI	Growing mass
2017	Present case	US, CT, MRI, PET/CT	60	US, CT, MRI, PET/CT	Increased accumulation on PET/CT

US ultrasonography, CT computed tomography, PET/CT positron emission tomography/computed tomography, MRI magnetic resonance imaging.

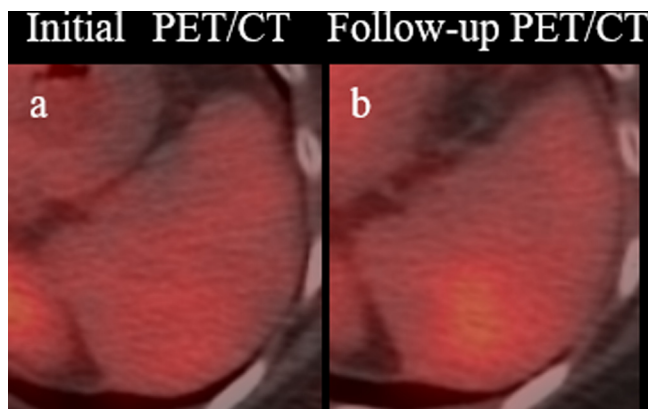


Fig. 3. Positron emission tomography/computed tomography (PET/CT) of sclerosing angiomatoid nodular transformation. a Initial PET/CT revealed accumulation in the tumor (maximum standardized uptake value [SUVmax]: 2.8). b Follow-up PET/CT revealed increased accumulation in the tumor (SUVmax: 3.5).

Immunohistochemistry revealed that three different vessels in the nodules showed distinct immunophenotypes. The capillaries showed CD34+/CD8-/CD31+, and the ectatic small veins were CD34-/CD8-/CD31+. Additionally, the dilated sinusoids like vessels presented CD34-/CD8+/CD31+, resulting in the final diagnosis of splenic SANT (Fig. 4c–e). The hemosiderin-laden macrophages were weakly positive for iron and CD68 staining (Fig. 4f and g).

3. Discussion

This is the first case with SANT of the spleen resected for differential diagnosis from a malignant tumor after a 5-year follow-up period. Preoperative diagnosis of SANT is highly difficult, and the only method to establish an unequivocal diagnosis is the pathological examination of the spleen. SANT is an exceedingly rare, benign and vascular lesion of the spleen. Since it was first reported by Martel et al. in 2004 [4], approximately 220 cases have been described in the English literature. While its pathogenesis has not been fully understood, Martel et al. suggested that the nodules in SANT are derived from splenic red pulp, and that they arise due to nodular transformation [4]. In a recent review, Cao et al. summarized a total of 128 relevant cases, including 57 males (44.5%) and 71 females (55.5%) [5]. The resected spleen was usually normal in size or mildly enlarged, with a mean weight of 386 (range 68–1425) grams [6]. The masses ranged from 3 to 17 cm in diameter [4,7].

As most patients are asymptomatic, the splenic SANT is sometimes found incidentally during laparotomy or on imaging studies. On unenhanced CT, the lesion usually appears heterogeneously hypoattenuating, with circumscribed margins. Peripheral rim-style enhancement of the external borders of the lesion is observed following intravenous administration of a contrast medium [8]. On MRI, T2-weighted images typically show peripheral hypointensity with a central-hypointense focus [8]. Following intravenous administration of a contrast medium, a persistent low-central sig-

nal on T1-/T2-weighted images is usually seen, with progressive enhancement from the periphery to the center of the lesion [9]. On PET/CT, Imamura et al. reported that FDG accumulation of SANT was not high, with a median SUVmax of 2.8 (range, 2.0–5.4) [11]. A low degree of FDG accumulation might be reflected by the number of inflammatory cells and hemosiderin-laden macrophages in angiomatoid nodules [10]. In our case, many inflammatory cells and hemosiderin-laden macrophages in the angiomatoid nodules were observed in the pathological findings. This might be consistent with the increase of FDG accumulation in the mass after a 5-year follow-up period (Fig. 3f and g).

Microscopically, SANT is identified by multiple nodular aggregates of plump endothelial cells and prominent slit-like vascular spaces that are lined by pericytes [4,6,7,11]. The intervening collagenous stroma between the nodules contain a variable number of reactive myofibroblasts, hemosiderin-laden macrophages, lymphocytes, and plasma cells. SANT shows a distinct immunophenotype, in that the angiomatoid nodules of the SANT are composed of several morphologically and immunophenotypically distinct blood vessels, including a cord capillary-like type that co-expresses CD34 and CD31 but not CD8; a sinusoid-like type that expresses CD8 and CD31 but not CD34; and small veins that express only CD31 [12]. The pathologic results of our case were also consistent with those of other previously reported cases.

The differential diagnosis for splenic SANT includes other benign lesions, such as hamartomas; hemangiomas; hemangioendotheliomas; littoral cell angiomias; inflammatory myofibroblastic lesions; and malignant lesions such as metastatic tumors, angiosarcomas and lymphomas. Due to the difficulties surrounding preoperative diagnosis, FNA of the spleen was suggested by Gutzeit et al. [13]. Nevertheless, the high frequency of complications such as bleeding or splenic rupture was noted after percutaneous biopsy of vascular splenic regions. To the best of our knowledge, there were six cases reported in English literatures that were diagnosed as a SANT by imaging study and follow-up, and operations were finally completed, according to the growing mass (Table 1) [14–19]. The follow-up period ranged from 3 to 36 months. In our case, we underwent the surgical intervention for the increase of FDG accumulation at the 5-year follow-up PET/CT, although the size was decreased. A SANT may have features that resemble those of malignancy, including the growing mass and the increase of FDG accumulation. Concerns for malignancy and the potential for splenic rupture will render splenectomy, the primary means by which splenic SANT will be diagnosed and treated.

4. Conclusions

We reported a case of shrinking SANT of the spleen with increased FDG accumulation after a 5-year follow-up period. Although the preoperative diagnosis of splenic SANT is difficult, it is necessary to make a diagnosis of splenic SANT comprehensively, even when accumulation of FDG increased slightly during the follow-up period, suggesting the possibility of malignant diseases.

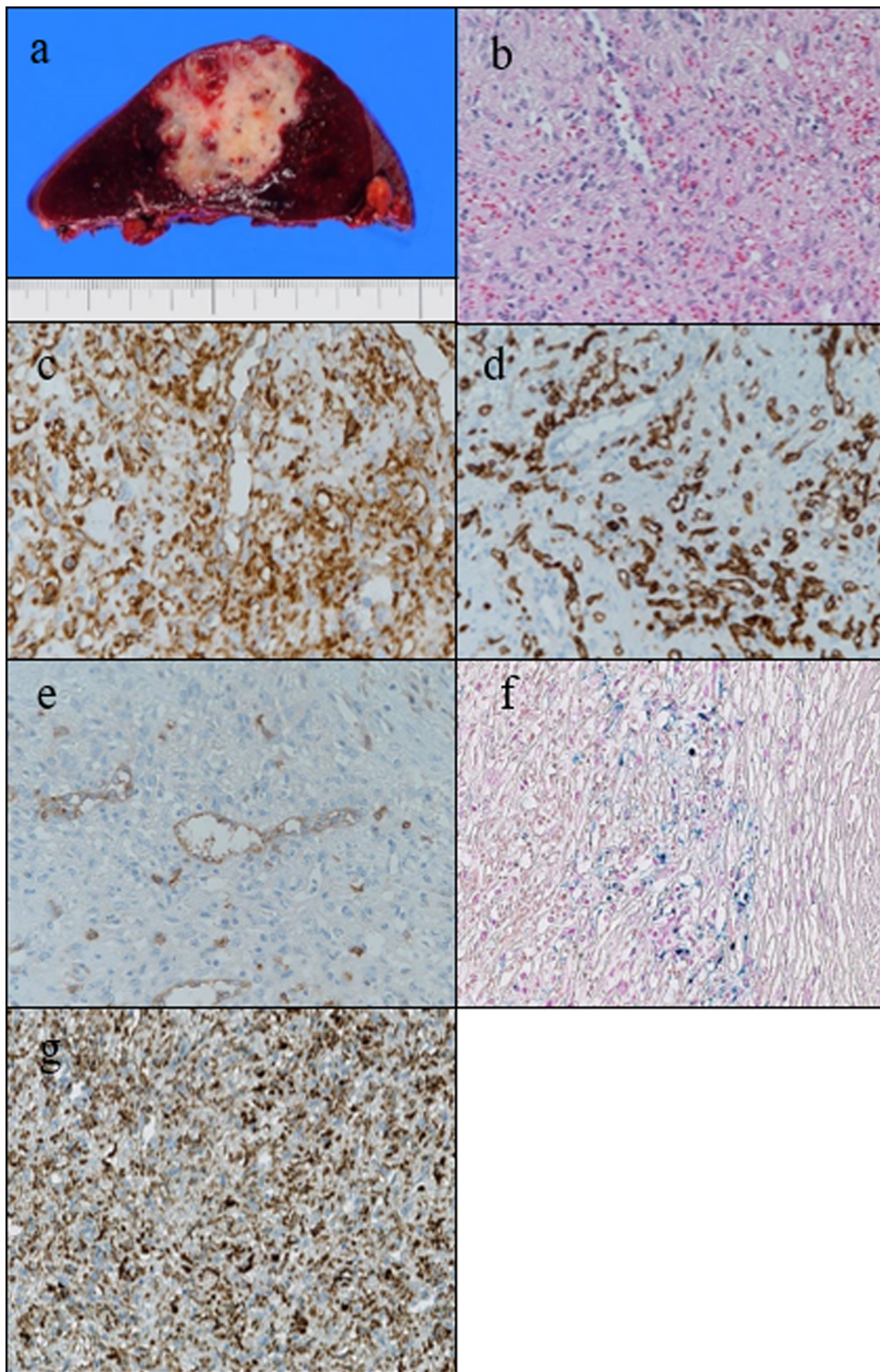


Fig. 4. Pathological findings. a The cut surface of the tumor. b The splenic lesion consisted of multiple angiomatoid nodules surrounded by variable fibrous bands (hematoxylin and eosin, original magnification $\times 100$). c CD31 immunostain highlights the abundant vascular structures (i.e., capillaries, sinusoid-like spaces, and veins) along with numerous single cells within the nodules, generating a complex network of CD31 immunoreactive cells (original magnification $\times 100$). d CD 34 immunostain highlights the capillaries, but not the sinusoid-like spaces or any single cells (original magnification $\times 100$). e CD8 immunostain highlights occasional sinusoid-like spaces and scattered inflammatory cells or any single cells (original magnification $\times 100$). f Iron stain shows hemosiderin-laden macrophages in angiomatoid nodules (original magnification $\times 100$). g CD68 immunostain shows the tumor cells were weakly positive (original magnification $\times 100$).

Conflict of interest

The authors have no conflicts of interest.

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Ethical approval

Ethical approval was not required and patient identifying knowledge was not presented in the report.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Authors' contributions

K. Matsubara and A. Oshita conceived and designed this case report. Authors other than K. Matsubara and A. Oshita contributed to the collection, and interpretation of data. K. Matsubara and A. Oshita drafted the manuscript, and other authors critically revised the manuscript. All authors gave final publication approval for the manuscript. A. Oshita has overall responsibility for the manuscript, and guarantees the scientific integrity.

Guarantor

Akihiko Oshita.

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