

## Case Report

# Diagnostic contribution by the radiographer : A case of superior mesenteric artery dissection in a rural hospital

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## Abstract

A 59-year-old man presented with sudden onset of severe epigastric pain at the emergency room of a rural hospital. The emergency physician ordered abdominal computed tomography (CT), and a radiographer (non-physician) notified the physician that the Hounsfield units in the lumen of the superior mesenteric artery (SMA) were elevated. A contrast-enhanced CT study was then added and revealed SMA dissection. The patient was transferred to a tertiary hospital. On the same day, rupture of the middle colic artery occurred. Massive blood transfusion and emergent surgery were life-saving. Appropriate transfer of a seriously ill patient to the referral hospital based on a correct diagnosis is crucial in rural medicine. In Japan, CT is deployed even in rural areas, although remote image interpretation systems are not yet functioning sufficiently. The real-time interpretation of CT images by the radiographer can contribute to the diagnosis of critical disorders, especially in emergencies occurring in rural area.

(Key words : diagnosis, radiographer interpretation support, rural area emergency, superior mesenteric artery dissection)

## Introduction

In rural medicine, prompt transfer of a seriously ill patient to the referral hospital is crucial to save the patient's life. The mortality rate of critical disease such as abdominal aortic aneurysm at rural emergency departments has been reported to be higher than that at their urban counterparts<sup>1</sup>. The difference in this fatality rate may be related to a delay of appropriate care<sup>1</sup>. Accurate medical image interpretation is important for preventing misdiagnosis of serious diseases and essential for prompt transfer from the rural hospital to the tertiary hospital.

In Japan, diagnostic imaging devices are diffusing to rural areas<sup>2</sup>. The number of CT scanners per 10,000 population is about one, which is the highest among those of the Organization for Economic Co-operation and Development (OECD) countries<sup>3</sup>. However, real-time remote image

interpretation systems are not sufficient. To prevent overlooking important findings on diagnostic imaging, the effectiveness of a non-physician radiographer reporting has been reported in each field<sup>4,5</sup>. On the other hand, there are few reports of real-time radiographer interpretation support of abdominal CT in the emergency field.

Here, we describe the contribution of real-time CT image interpretation support by a radiographer for the diagnosis of superior mesenteric artery (SMA) dissection in a rural area.

## Ethics approval

Informed consent was obtained from this patient for publication of this case report.

**Case**

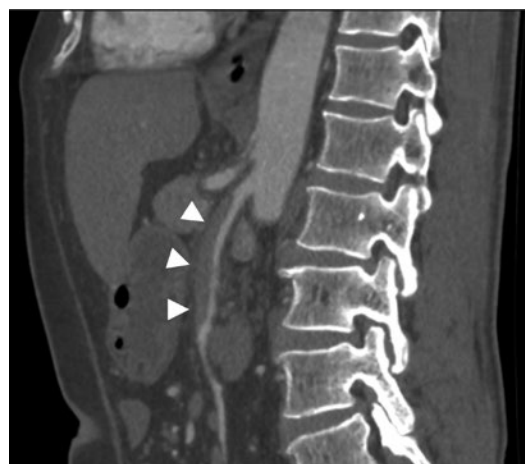
A 59-year-old Japanese man with sudden onset of severe epigastric pain presented to the Ohchi municipal hospital. The hospital is a rural community hospital with 98 beds, located in Shimane prefecture at a distance of 84 km west from the prefectural office. The nearest tertiary hospital is located in Kabe city in Hiroshima prefecture 44 km away. It takes one hour and 20 minutes to transport a patient by ambulance. For emergent medical care at night and on holidays, a single physician stays at the hospital. The physician can order a CT at any time. The remote image interpretation system by a radiologist is available only once a week at the hospital. It is not available for emergency cases. At this hospital, radiographers interpret all CT images in real time. As soon as they detect an abnormality, they call the physician and discuss the assessment of the abnormality and the necessity for any additional imaging.

The patient arrived at the hospital one hour after the onset of abdominal pain. He did not have any history of recent trauma. He had untreated hypertension. There was no family history of either aortic disease or sudden death. On arrival, he did not have fever, nausea, constipation, or diarrhea. On physical examination, his blood pressure was 190/103 mmHg, respiratory rate 26/minute, and the remaining vital signs were normal. He wiggled his body because of pain. Mild periumbilical tenderness without guarding was observed. There were no abnormal bowel sounds. Laboratory values were as follows : leukocyte count 8,100/  $\mu$  L ; hemoglobin 16.0 g/dL ; platelet count 240,000/  $\mu$  L ; creatine kinase : 276 IU/L ; normal liver and kidney function ; and normal electrolytes. The emergency physician ordered non-contrast CT and a radiographer noted that there were two different Hounsfield units in the lumen of the SMA ; the inside one was 20, and in contrast the outside one was 55 (Fig. 1).



**Figure 1.** Non-contrast CT showed a high Hounsfield units in the lumen of the superior mesenteric artery (arrow).

The radiographer notified the physician about these findings. Then contrast-enhanced CT was added and revealed spontaneous isolated SMA dissection (SISMAD) (Fig. 2). The dissecting portion began at 1 cm from the origin of the SMA, and measured 5 cm in length. The false lumen was thrombosed without any localized blood-filled pouch protruding into a false lumen. The middle colic artery (MCA) branched from the false lumen and occlusion or intra-luminal thrombus was not noted in MCA. No dissections or aneurysms were observed in other abdominal arteries and there were no signs of bowel ischemia.



**Figure 2.** Contrast-enhanced CT showed isolated dissection of the superior mesenteric artery with completely thrombosed false lumen (arrowhead).

He was transferred to a regional tertiary hospital in Kabe city by ambulance. His abdominal pain disappeared completely during transportation. CT examination was performed again after his arrival and it showed no complete occlusion of SMA and no dissection or occlusion of MCA. He was diagnosed with SISMAD and conservative treatment was selected. On the same day, 12 hours from the onset of symptoms, a rupture of the MCA occurred (Fig. 3). The CT image revealed no change of the SMA and no dissection of MCA. He underwent emergent operation for the ruptured lesion of MCA while receiving massive blood transfusion. The ruptured MCA lesion was ligated and resected ; then colectomy and colostomy were added. Transverse colon showed ischemic change and thus the ischemic part of transverse colon was resected (10 cm of length). Since direct colo-colostomy may cause insufficient anastomosis, transverse colostomy was placed. The resected transverse colon histologically showed ischemic change, such as edematous appearance of mucosal-submucosal tissue and submucosal bleeding. The ruptured MCA lesion was not submitted for pathological examination. On the other hand, a part of the MCA together with the resected transverse colon disclosed no abnormal findings. After the surgery,

follow-up CT examination showed no changes of the SMA or remaining MCA. He was discharged on the 22nd postoperative day. Closure of the colostomy was scheduled later.



**Figure 3.** Dynamic CT showed the middle colic artery rupture (arrow), and pool of contrast agent (arrowheads)

### Discussion

SISMAD is more common in men than in women, with age at onset varying from youth to advanced age (men : 90.5%, mean age :  $52.5 \pm 10$  years)<sup>6</sup>. The sole risk factor is hypertension and the overall in-hospital mortality rate is reported as 0.4%<sup>6</sup>. Abdominal pain without muscular defense is common until intestinal necrosis occurs. It can cause intestinal ischemia by complete SMA occlusion or rupture of SMA and surrounding arteries<sup>7</sup>.

In this case, the SISMAD was thought to be a Sakamoto's modified classification type IV<sup>8</sup>. It is classified according to the state of the false lumen and occlusion of the true lumen. Type IV means the SMA false lumen is completely thrombosed without ulcer-like projections. This type is considered to be stable, with severe bowel ischemic change or vessel rupture rarely occurring<sup>8</sup>. According to the systematic review, only 1.5% of SISMAD symptomatic patients undergo surgery. Of the patients who received conservative treatment, 18.1% required additional treatment, such as intravascular treatment and surgery<sup>9</sup>. In this case, unexpected rupture of the MCA occurred.

The mechanism of MCA rupture is difficult to determine in this case, because the ruptured lesion of the MCA was not examined pathologically. However, the MCA rupture occurred 12 hours after the onset of SMA dissection. The MCA rupture is considered to be closely related to the SMA dissection. Speculated mechanisms of MCA rupture are as follows : the dissecting lesion of MCA might not be visualized by CT images, nevertheless the SMA dissection extended to the rupture lesion of MCA. Magnetic resonance (MR) angiography was reported to be more suitable for evaluating abdominal artery dissection than CT<sup>10</sup>, although

MR imaging was not performed in this case. Another possibility is segmental arterial mediolysis (SAM). SAM is a non-atherosclerotic and non-inflammatory vascular disease, and it can cause multiple dissecting aneurysm<sup>11,12</sup>. This might cause the MCA rupture followed by the SMA dissection.

Intramural hematoma is an acute form of artery dissection. In the CT image, coagulated blood in the arterial wall is detected with increased Hounsfield values<sup>13</sup>. The radiographer was able to recognize the difference in the Hounsfield units in the lumen of the SMA, thereby contributing to the correct diagnosis.

Remote image interpretation support by a radiologist is not sufficient in Japanese rural areas, and physicians often conduct the image interpretation by themselves. Without sufficient image interpretation support, critical findings can be missed in the emergency medicine setting, especially in rural areas. According to a study of radiologists, diagnostic error in the interpretation of images is considered to have two major causes : perceptual errors and cognitive errors. Perceptual errors indicate that an abnormality is not detected and cognitive errors indicate that an abnormality of the image is detected, but not recognized as important. Perceptual errors are common accounting for 60% to 80% of the causes of interpretation errors<sup>14</sup>.

Elmore et al. suggested the importance of checking images by multiple persons to prevent diagnostic error in the interpretation of images<sup>15</sup>. The outcomes depend on how well the reading techniques or patterns of the two readers complement each other. Some reports documented the effectiveness of radiographer reporting<sup>16,17</sup>, and their confidence in detecting abnormalities<sup>18</sup>. As countermeasures against errors of interpretation of CT images in rural emergencies, irrespective whether the errors are perceptual or cognitive cooperation between physician and radiographer is thought to be one approach to the prevention of overlooking important findings.

### Conclusion

A radiographer real-time interpretation support of CT images can contribute to the diagnosis of SMA dissection. Such contribution may be expected in various critical disorders in rural emergencies by preventing the overlooking of critical findings.

### Declaration of interest

The authors declare no conflicts of interest associated with this manuscript.

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# 放射線技師の診断への貢献：遠隔地診療施設における上腸間膜動脈解離の1例

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## 抄 録

症例は59歳の男性で、急性発症の強い腹痛のため救急外来を受診した。当直医師は腹部単純CTをオーダーし、放射線技師は上腸間膜動脈管腔内のCT値上昇を医師に報告した。その情報をもとに造影CT検査が追加され、上腸間膜動脈解離と診断した。患者は三次病院に搬送され、同日に中結腸動脈破裂を発症し、大量輸血と緊急手術で救命できた。

僻地医療では、重篤な疾患をもつ患者を正確に診断し、後方病院に適切に搬送することが重要である。日本におけるCTの遠隔地画像読影システムは、体制整備が不十分である。放射線技師によるCT画像のリアルタイム読影支援は、特に僻地医療で発生する緊急事態において診断に寄与することができる。

(キーワード：診断, 放射線技師の読影支援, 僻地救急医療, 上腸間膜動脈解離)