Percutaneous Coronary Intervention for the Anomalous Origin of the Left Anterior Descending and Circumflex Coronary Arteries in a Patient with Acute Myocardial Infarction

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Abstract
This case report presents a patient with acute myocardial infarction (AMI) caused by left coronary artery anomalies and total occlusion of the left circumflex coronary artery (LCX). On March 15, 2007, a 73-year-old female was transferred to our emergency room with chest oppression and vomit. Electrocardiography showed ST elevation in leads I and aVL, meanwhile, ST depression in leads II, III, aVF and V1-4. Emergency coronary angiography (CAG) was performed because the patient was suspected as having AMI. Left CAG was unsuccessful; right CAG indicated no left main trunk (LMT) and three separate coronary arteries arising from the right coronary sinus. LCX 2±11, which was almost completely stenotic, was considered as a culprit lesion. Percutaneous coronary intervention (PCI) was performed from the right femoral artery; however, it failed to reach the diseased area. PCI was successfully performed from the right brachial artery and the stent was implanted. Follow-up multislice computed tomography (MSCT) showed the anomalous origin of the left coronary arteries arising from the right coronary sinus. The incidence of coronary artery anomalies has been reported in only 1% of patients undergoing CAG; especially 0.017% of those having anomalous origin of the left coronary arteries arising from the right coronary sinus. Coronary artery anomalies often require special techniques to perform CAG and PCI. Vascular anomaly with the left descending coronary artery (LAD) and the LCX being separate and arising from the right coronary sinus is very rare.

Key Words
Acute myocardial infarction, Coronary intervention, Coronary artery anomaly, Circumflex coronary artery, Multislice computed tomography

Introduction
Anomalies of the coronary artery are extremely rare and found in 0.26 to 1.2% of patients undergoing coronary angiography (CAG). When CAG or percutaneous coronary intervention (PCI) is performed in such patients, special techniques are often required. We encountered a patient with acute myocardial infarction (AMI) due to the anomalous origin of the left descending coronary artery (LAD) and the left circumflex coronary artery (LCX) arising from the right coronary sinus. We were forced...
to change the catheter insertion sites from the right femoral to brachial artery; PCI was successfully performed. Here, we report such a case with some quotations from previous studies.

A case report

The patient was a 73-year-old woman who had compression fracture of the cervical spine at the age of 55, no specific family and smoking histories. The patient felt well until a few months before admission, when she began to have slight chest oppression while she climbed up a hill. Around 22:00 o'clock on March 15, 2007, her sleep was disturbed by severe chest oppression and she started vomiting. She was immediately transferred to our emergency room and electrocardiography/EKG and echocardiography were performed. She was suspected as having AMI and was admitted to our hospital.

On admission, the consciousness level was clear, the height was 147 cm, the weight was 47 kg, the blood pressure was 111/63 mmHg, the pulse was 53 beats/minute, the body temperature was 34.5°C, the oxygen saturation by pulse oximetry (SpO2) was 98% (Room air), breathing sound was clear, neither rales nor murmur was heard, and no edema was observed in the lower limbs. The laboratory data showed a white blood cell count (WBC) of 8200/μl, C-reactive protein (CRP) of 0.03 mg/ml, creatine kinase (CK) of 172 IU/l, CK-myoglobin binding (CK-MB) of 19 IU/l, aspartate aminotransferase (AST) of 128 IU/l, alkaline phosphatase (ALT) of 62 IU/l, lactate dehydrogenase (LDH) of 311 IU/l, and positive heart fatty acid-binding protein (h-FABP). Chest X-ray showed the cardio-thoracic ratio of 57.8%, mild cardiac dilatation and no pulmonary congestion. ECG showed a heart rate of 53 beats/minute during atrioventricular junctional rhythm and ST elevation in leads I and aVL, meanwhile, ST depression in leads II, III, aVF and V1-4 (Fig. 1). Echocardiography revealed mild hypokinesia of left ventricular lateral wall motion and no myocardial wall thinning.

Accordingly, the patient was diagnosed as having AMI and was intravenously administered 400,000 units of monteplase. Emergency CAG was also performed using a 5-Fr. Judkins left coronary guiding catheter 3.5 (JL 3.5) inserted from the right femoral artery, however, JL3.5 was not adaptable. Then, a 5-Fr. Judkins right coronary guiding catheter 3.5 (JR 3.5) was used, which showed the right coronary artery (RCA), LAD and LCX arose from the right coronary sinus (Fig 2A). No significant stenosis was observed in RCA and LAD (Fig 2B, C), however, #11 LCX had 99% stenosis with delayed enhancement (Fig 2D). PCI was performed from the right femoral artery, however, the JR 3.5 could not reach the diseased area. At this point, ST elevation decreased to baseline in lead I and aVL and chest oppression also decreased (Fig 3). The patient was sent to the coronary care unit (CCU) under close observation with continuous infusion of heparin and nicorandil. Intraaortic balloon pumping (IABP) was not used because severe tortuosity from the descending to abdominal aortas was found. Nine hours later, ECG showed ST elevation with chest pain. Therefore CAG was performed again for PCI.

This time, a 6-Fr. JR 3.5 was inserted from the right brachial artery to the anomalous origin of LCX arising from the right coronary sinus, which took a lot of effort to insert a balloon catheter because it could not be maintained coaxial to LCX. Then, we used Runthrough and Fielder guide wires and finally sent the balloon catheter (Avion HP 2.75
Fig. 2. Coronary angiograms before intervention.

(A) The right coronary cusp angiogram showed that RCA, LAD, and LCX arose from the right coronary cusp: LAO 45° view.

(B) Right coronary angiogram showed no significant stenosis of the RCA: LAO 45° view.

(C) Left descending coronary angiogram showed no significant stenosis of the LAD: LAO 45° view.

(D) Left circumflex coronary angiogram showed 99% stenosis with delayed enhancement: LAO30° CRA30° view.
×10 mm) to #11 LCX. The bare metal stent (Driver stent 3.0×15 mm) was implanted after balloon predilatation (Fig 4A, B, C). CK was 2383 IU/l and CK-MB was 193 IU/l in the early recovery phase after successful PCI, and the patient started to take rehabilitation. We continued medication of antiplatelet aggregation drug.

Multislice computed tomography (MSCT) showed LAD and LCX were separated, and the anomalous origin of LAD, LCX and RCA arose from the right coronary sinus the same as the CAG views. RCA was in its normal position, LAD and LCX arose from the right coronary sinus coursing in front of the pulmonary artery to the left ventricle (Fig 5ABC). No chest symptom was observed. We performed follow-up CAG 9 months after PCI. A 4-Fr. JR 3.5 was inserted from the right brachial artery, which could easily reach LAD and LCX. No restenosis was observed in the diseased area after stent implantation and the left ventricular systolic movement was normal on LVG.

Discussion

Some studies have demonstrated that coronary artery anomalies are found in 0.26 to 1.2% of patients undergoing coronary angiography (CAG)1,2,3, and the various types of coronary artery anomalies have been reported. Yamanaka et al4 have demonstrated that only 22 (0.017%) of the 126,595 patients undergoing CAG had an ectopic origin of the left coronary artery arising from the right coronary
sinus. Kelly et al have described the onset mechanism of myocardial ischemia due to coronary artery anomalies as follows: ① an anomalous coronary artery arises in a sharp angle from a single ostium which is buried within the aortic wall. On exertion, the dilated aorta causes valvular stenosis at the ostia of the coronary artery, or ② an anomalous coronary artery, which passes between the aorta and the pulmonary artery, is compressed on exertion due to the dilation of both arteries. Taylor et al have reported the association between the onset mechanism of ischemia and arteriosclerosis. They have

Fig. 5. Multislice computed tomography (MSCT) findings in the patient.
(A) 3-D view shows anomalous left anterior descending artery (LAD) and left circumflex artery (LCX) originating from the right sinus of Valsalva.
(B) Sagittal images showing the separate origins of the LAD, LCX, and right coronary artery (RCA) from the right sinus of Valsalva.
(C) The LCX courses in front of the pulmonary artery (PA).
suggested that unstable coronary blood flow due to coronary artery anomalies impairs capillary endothelium, which might induce severe atherosclerosis with ageing. In the present case, MSCT after PCI showed the anomalous origin of all three coronary arteries from separate ostia within the right coronary sinus at right angles. LAD and LCX passed not between the aorta and the pulmonary artery but in front of the pulmonary artery. Accordingly, no ischemia occurred before AMI. In the present case, we detected stenosis in CX passing in front of the pulmonary artery. We presumed that stenosis was caused by capillary endothelium impairment due to coronary artery anomalies, which was similar to the study described by Taylor et al\textsuperscript{7}.

When PCI is performed to patients with ischemic heart disease due to coronary artery anomalies, it is important to choose the right catheter insertion site along with a guiding catheter. There are some reports in coronary artery anomalies the approach from the right upper limb is useful to engage with the coronary artery even if the approach from the femoral artery is unsuccessful\textsuperscript{8}. In the present case, we failed to insert the guiding catheter from the right femoral artery, even though LAD and LCX arose from the right coronary sinus. Finally, we successfully delivered the stent to the diseased area using a 6-Fr. JR 3.5 with double wire technique which was inserted from the right brachial artery.

Nowadays, coronary artery anomalies can be detected on regular basis and some cases require PCI. Technicians, who perform PCI, have to decide the insertion site and a guiding catheter. Unfortunately, we were forced to insert guiding catheters from the right femoral and brachial arteries because the diseased lesion was complicated. When PCI is performed in such cases, diagnostic MSCT should be necessary to clarify the anatomical features of the diseased area and to make a strategy.

References
左冠動脈分離起始異常に対し経皮的冠動脈形成術（PCI）を施行した急性心筋梗塞の1例

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抄録

ST上昇を伴う胸部圧迫感にて救急搬送され、冠動脈造影検査（CAG）上、左冠動脈起始異常及び、分離した回旋枝が完全閉塞し急性側壁心筋梗塞を発症した症例を経験したので報告する。症例は73歳、女性。2007年3月15日、胸部圧迫感、嘔吐を認め救急搬送された。心電図上I、aVLにST上昇、II、III、aVF、V1-4にST低下を認める急性側壁心筋梗塞を疑い緊急CAGを行った。左冠動脈造影に難渋し、右冠動脈造影にて右冠動脈洞より発生する3本の冠動脈を認めた。左冠動脈は左主幹部が存在せず、前下行枝、回旋枝は分離し右冠動脈洞より起始していた。回旋枝≧11に99%狭窄を認め梗塞責任血管と考え冠動脈インターベンション（PCI）を施行した。右大円形動脈からのアプローチでは施行困難であり、右主幹動脈からのアプローチでステント留置に成功した。術後冠動脈CTにて左冠動脈が分離起始し右冠動脈洞から発生していることが確認された。冠動脈起始異常の頻度はCAG全体の約1%前後と報告されている。しばしばCAGやPCIに難渋し手技的工夫が必要になる。特に左冠動脈全てが右冠動脈洞から発生するものは0.017%と報告され、なかでも前下行枝と回旋枝が分離起始し右冠動脈洞より発生する起始異常は極めて稀と思われ報告した。