CASE REPORT

A case of cardiopulmonary arrest due to spontaneous coronary artery dissection in a pregnant woman

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SUMMARY

We present the case of a young pregnant woman with cardiopulmonary arrest due to acute coronary syndrome. Emergent coronary angiography (CAG) and intravascular ultrasound (IVUS) showed extensive coronary artery dissection in the left anterior descending artery, which was treated with primary percutaneous coronary intervention. After managing the heart failure and disseminated intravascular coagulation, a dead fetus was delivered via caesarean section 4 days after admission to the hospital. Follow-up CAG and IVUS at 18 months showed persistent dissection in the non-stented site; hence, another stent was implanted. Dual antiplatelet therapy was discontinued 6 months later; however, aspirin and beta-blockers were continued lifelong.

BACKGROUND

Acute coronary syndrome (ACS) due to spontaneous coronary artery dissection (SCAD) is likely to occur in young women without any cardiovascular risk factors, especially during pregnancy and the early postpartum period. When a catastrophic event due to SCAD occurs during pregnancy, the treatment to save the lives of both mother and fetus is complicated.

CASE PRESENTATION

A 32-year-old pregnant woman at 38 weeks of gestation was brought to the emergency department by ambulance due to sudden onset of chest pain. She had been healthy except for a history of miscarriage when she was 31 years old. No problems had been observed during her prenatal check-up. Electrocardiography (ECG) showed ST segment elevation in leads V2-6 ([figure 1](#)), and there were positive findings for heart-type fatty acid binding protein and troponin T. She was diagnosed with anterior ST segment elevated myocardial infarction. Her haemodynamics were stable on arrival (blood pressure: 159/102 mm Hg, regular sinus rhythm: 75 beats/min and oxygen saturation: 100% on room air). Twenty-four minutes after arrival, her consciousness level suddenly dropped due to ventricular fibrillation. Cardiopulmonary resuscitation (CPR) was started immediately and the emergency team called for cardiologists. It took 19 min to recover her haemodynamic status and heart rhythm after three rounds of electrical defibrillation and tracheal intubation. Since we lacked experience on handling perimortem caesarean delivery (PMCD) in the emergency department, we consulted an

obstetrician with the objective of saving the mother's life.

DIFFERENTIAL DIAGNOSIS

A young woman who did not have any cardiovascular risk factors presented with acute chest pain and cardiopulmonary arrest (CPA). Since the ECG showed ST segment elevation, we suspected ACS caused by coronary vasospasm or thrombus due to a hypercoagulable state. ACS, acute pulmonary embolism or both were considered the reasons of CPA.

TREATMENT

After obtaining informed consent from the patient's husband, we transferred her to the catheterisation laboratory 17 min after return of spontaneous circulation (ROSC). The obstetrician confirmed a critical drop of the fetal heartbeat to 40–50/min through an ultrasound scan. We performed coronary angiography (CAG), which revealed 99% stenosis of the middle left anterior descending artery (LAD) and gradual narrowing to complete occlusion without any hazy images ([figure 2](#)). Primary percutaneous coronary intervention (PCI) was subsequently performed with the support of an intra-aortic balloon pump to restore the stable haemodynamics. We tried to advance a SION blue guide wire (Asahi Intecc, Aichi, Japan) through the lesion; however, we failed and the wire was stuck in the lesion. Subsequently, we crossed an Athlete Joker guide wire (Japan Lifeline, Tokyo, Japan) to the distal LAD using a multifunctional probing catheter (Crusade, Kaneka, Osaka, Japan; [figure 3A](#)). Intravascular ultrasound (OptiCross, Boston Scientific, Massachusetts, USA) showed an intimal-medial flap and intramural haematoma without any atherosclerotic change ([figure 3B](#)), which are characteristic findings of SCAD. An enlarged haematoma compressed the true lumen, causing ongoing ischaemia ([figure 3C](#)). We first used a semicompliant balloon (Tazuna 2.5×15 mm, Terumo, Tokyo, Japan) for dilation of the true lumen. Subsequently, we used a cutting balloon (Flextome 3.0×10 mm, Boston Scientific) to attempt a re-entry of the pseudo lumen to the true lumen, which enabled us to perform thrombolysis in myocardial infarction grade 2 with transient flow. As it was difficult to maintain sufficient coronary flow due to the recoil of the true lumen, we implanted a bare metal stent (MULTI-LINK 8 3.0×23 mm, Abbott Vascular, California, USA) in the middle LAD, at the point

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Figure 1 The electrocardiography showed ST segment elevation in lead V2-6.

of entry of the dissected site. However, distal coronary flow was not maintained despite several balloon dilations and additional stent implantation (Integrity 2.5×14 mm, Medtronic, California, USA). Since the spiral dissection reached the end of the LAD, it was not effective to implant more stents or attempt balloon dilation. We completed the PCI procedure in 3 hours and 30 min. Unfortunately, fetal cardiac arrest was confirmed after 2 hours and 45 min of initial ultrasound scan in the catheterisation laboratory.

OUTCOME AND FOLLOW-UP

The patient had severe pulmonary congestion with a low left ventricular ejection fraction (30%) due to myocardial infarction. Peak creatine kinase (CK) level was 6215 IU/L and CK muscle-brain level was 265 IU/L. We hesitated to deliver the fetus immediately because of the mother's serious general condition. Since her heart failure and consciousness recovered rapidly, and disseminated intravascular coagulation (DIC) had progressed due to the retained dead fetus syndrome, we delivered the fetus via caesarean section on the fourth day. DIC resolved after the delivery and her general condition improved rapidly without any neurological deficit. After she was extubated on the fifth day, we informed her of the death of the fetus following the caesarean section. It was hard for her to accept the fate of the fetus while she survived. The medical staff, including obstetricians and midwives, provided puerperal and mental care. In

addition, her husband and parents showed compassion and cooperated well. Fortunately, she did not show any significant post-traumatic stress disorder. She stayed in the hospital for 29 days and regained general exercise tolerance. Bisoprolol 2.5 mg, aspirin 100 mg and clopidogrel 75 mg were continued even after discharge.

Follow-up CAG (figure 4A) and optical frequency domain imaging (Fastview, Terumo) at 18 months revealed intimal healing of the stented sites (figure 4B) and distal LAD; however, there was a remnant dissection in the non-stented site between the implanted stents (figure 4C). Therefore, a drug-eluting stent (DES) (Ultimaster 2.5×15 mm, Terumo) was implanted, and clopidogrel was discontinued 6 months later.

DISCUSSION

Pregnancy-associated acute myocardial infarction (AMI) occurs in 0.7–10 per 100 000 pregnancies.^{1–3} It is complicated to manage and save the lives of both mother and fetus. To the best of our knowledge, 13 cases of patients surviving AMI due to SCAD during pregnancy have been reported (table 1).^{4–16}

Figure 2 Emergent coronary angiography. Cranial views of right (A) and left (B) anterior oblique projections. The left anterior descending artery was narrowing from the middle site and occluded at the distal site (arrows).

Figure 3 (A) Coronary angiography after balloon dilation and (B) intravascular ultrasound (IVUS) in the middle left anterior descending artery (LAD) corresponding to the arrow (a), which demonstrated intramural haematoma without any atherosclerotic change. (C) IVUS in the distal LAD corresponding to the arrow (b), which showed a compression of the true lumen with haematoma.

Figure 4 (A) Follow-up coronary angiography at 18 months. The coronary dissection had still remained between the two implanted stents. (B) Optical frequency domain imaging (OFDI) corresponding to the arrow (a) showed concentric neointimal proliferation in the stent. (C) OFDI image corresponding to the arrow (b) demonstrated both true and pseudo lumen at non-stented site between the two stents. An OFDI catheter was located in the true lumen.

Including the present case, all mothers and eight infants had survived (60%). AMI due to SCAD during pregnancy is likely to occur in women over 30 years old (71%) and after more than 8 months of gestation (71%). The LAD was the most frequently involved artery (79%) and the involvement of multiple vessels was observed in 36% cases. Six cases, including the present case (43%), had survived ventricular fibrillation and maternal cardiopulmonary collapse. Only one case (case 4 in table 1) has been reported where both mother and fetus had survived.

According to the guidelines, PMCD should be considered within 4 min of the onset of maternal cardiac arrest or failure of resuscitative efforts, if there is no ROSC.^{17 18} The indication of PMCD varies depending on the gestational age. For the mother, PMCD should be considered after 20 weeks of gestation because maternal cardiac output reduction due to IVC compression by the gravid uterus may occur. On the other hand, 22 weeks of

gestation is necessary for the fetus to be alive, and gestational age is closely related to fetal outcome.¹⁹ The MBRRACE-UK (mother and babies: reducing risk through audits and confidential enquiries in the UK) programme reported that 75% babies died if delivered by PMCD at less than 37 weeks of gestation.²⁰ Therefore, PMCD is not indicated in the first trimester and the early second trimester (16–21 weeks). Fetal outcome is related to maturity of preterm births in the late-second to the early-third trimester (22–36 weeks). After 37 weeks of gestation, PMCD is recommended because positive outcomes for both mother and fetus are expected.

While guidelines suggest that PMCD should be considered within 4 min and delivery within 5 min of the onset of maternal cardiac arrest, there are cases of good fetal outcome with PMCD performed after 15 min as well. The average time elapsed from arrest to PMCD was shorter in fetal survivors than in non-survivors. The mean time of elapse was 14 ± 11 min.²¹ Nonga *et al*²² reported that the reason a fetus can survive long periods of maternal hypotension was that the fetus has an intrinsic autoregulation mechanism to survive poor conditions. The fetal and the maternal condition as well as the possibility of caesarean section should be considered whenever fetal distress appears. Ideally, independent teams cooperating with each other for the safety of both maternal and fetal lives should be established for these emergencies. Immediate caesarean section after CPA due to AMI caused by SCAD has been reported in only one case (case 4), which showed stable haemodynamics after CPR. In this case, we performed PCI first because of the instability of maternal haemodynamics due to ongoing myocardial ischaemia. We knew that caesarean section under cardiogenic shock posed a high risk for maternal death.

Although standard therapy for SCAD in a pregnant woman has not been established, there are several case reports of its successful management with medical therapy, coronary artery bypass grafting and PCI. In this case, we considered that immediate revascularisation by PCI was better to manage ongoing ischaemia with unstable haemodynamics. Since cardiac surgeons or their medical staff are not always available during night at our hospital, initiation of bypass surgery would require more than

Table 1 14 cases of acute myocardial infarction due to spontaneous coronary artery dissection during pregnancy

Case no	Age (years)	Gestation period (weeks)	Culprit vessel	CPA due to Vf	PCI	Special treatment	CABG	Caesarean section		Infant
								Situation	Timing	
1	43	38	LAD	P	P	POBA	N	Emergent	After PCI	ND
2	37	21	LAD	P	P	BMS	N	Elective	6 days later	Abortion
3	32	7	LAD, LCX	P	N		N	Elective	2 weeks later	Abortion
4	27	37	LAD, LCX	P	N		N	Emergent	After CPR	Survive
5	ND	36	RCA	P	P	Stent	ECMO	ND	ND	ND
6	21	6	LAD	N	P	DES	N	Elective	8 months later	Survive
7	28	36	LAD, LCX	N	P	POBA	P	Emergent	After CABG	Survive
8	45	25	LAD	N	P	BMS	N	Elective	13 weeks later	ND
9	31	36	LAD	N	P	POBA	IABP	Emergent	After PCI	Survive
10	36	36	LAD, LCX	N	N		IABP	Emergent	After CAG	Survive
11	33	36	LAD, LCX	N	N		IABP	Emergent	After CAG	Survive
12	34	34	LMT	N	N		P	Emergent	After CAG	Survive
13	34	32	RCA	N	P	BMS	N	Elective	1 month later	Survive
14 (present)	32	38	LAD	P	P	BMS	IABP	Elective	4 days later	Abortion

BMS, bare metal stent; CAG, coronary angiography; CABG, coronary artery bypass grafting; CPA, cardiopulmonary arrest; CPR, cardiopulmonary resuscitation; DES, drug-eluting stent; ECMO, extracorporeal membrane oxygenation; IABP, intra-aortic balloon pump; LAD, left anterior descending artery; LCX, left circumflex artery; LMT, left main trunk; N, negative; ND, not described; P, positive; PCI, percutaneous coronary intervention; POBA, plain old balloon angioplasty; RCA, right coronary artery; Vf, ventricular fibrillation.

1 hour. Although maternal mortality in emergent surgery is 9.8 times as high as in elective surgeries,²³ mortality from cardiac surgery in pregnant women is 1.5%–5%, which is similar to that in non-pregnant women.²⁴ Several successful cases of cardiac surgery in different gestational periods have been reported.^{22 25 26} A case of successful survival of both lives in unstable haemodynamics with type A acute aortic dissection was similar to the present case.²² However, cardiac arrest in pregnancy is rare and PMCD has been performed in 0.004% of 24 883 deliveries in Canadian tertiary care centre over 22 years.²⁷ The lack of knowledge and experience on PMCD in hospital systems^{28 29} may result in hesitation to perform this procedure. Because our staff at the emergency room, including the obstetrician, had never experienced CPA due to cardiovascular emergency in pregnant women, we decided to prioritise the maternal resuscitation. Recently, PMCD was introduced in the Netherlands, and its utilisation has increased during the last 15 years, but it is still not so frequent. PMCD was performed in 12 out of 55 women with cardiac arrests (12 per 2 929 289 deliveries (0.000004%)).³⁰ Since such complicated situations are rarely observed, an international collaboration may play an important role in sharing advanced knowledge to prevent any unfortunate incidents.

Another serious concern is the high rate of recurrence of SCAD (13%–22%).^{31–33} The probability of its recurrence depends on the interval between prior AMI and pregnancy. Nakashima *et al*³¹ reported that the rate of major adverse cardiac events (MACE) is seven times higher in SCAD than in atherosclerosis. It was also reported that the rate of MACE was highest in the first 30 days (17%) and increased slowly during the following 5 years (37%). A pregnancy should not be planned within 1 year after vessel revascularisation or AMI due to the requirement of dual antiplatelet therapy (DAPT) and frequent MACE.¹¹ In this case, aspirin, clopidogrel and bisoprolol were continued after the first PCI. We discontinued clopidogrel 6 months after the implantation of a DES in the remaining dissection site at the 18-month follow-up visit. Since data on the safety of thienopyridines during pregnancy are limited, they should only be used for the shortest possible duration. In this case, angioplasty using a scoring balloon catheter or a bare metal stent implantation is advantageous over DES implantation, which requires a long DAPT period in pregnant women. A successful delivery of healthy infants via elective caesarean surgery was reported in cases where clopidogrel was withdrawn and there was a limited duration of DAPT use (cases 6, 8 and 13 in table 1). Because of the high frequency of recurrence and necessity of DAPT, we advised her to avoid conception in the following year. She was married and had had a miscarriage before. Although she and her husband wanted a child, they did not want to encounter such threatening complication again. Finally, they adopted a child, and they have been happy since then.

Although standard therapy for SCAD in pregnant women has not been established, primary PCI may be one of the best methods to manage the ongoing ischaemia and improve patient outcomes. We succeeded in saving maternal life by performing CPR and subsequent PCI. After surviving the catastrophic event, we should consider reducing the duration of DAPT and using medication without any significant adverse effects on the mother or fetus. The next pregnancy should be postponed for at least a year after AMI considering the frequent recurrence of SCAD and prolonged DAPT therapy.

Finally, it is important to note that management of pregnancy involves taking care of both mother and fetus. All physicians in the emergency team, as well as obstetricians, should have the skills to manage CPA during pregnancy and be aware of the

indications of PMCD. Taking careful and timely decisions with a multidisciplinary collaboration can help to provide an optimal treatment to such patients.

Learning points

- The patients survived from cardiopulmonary arrest (CPA) due to acute coronary syndrome that occurred at 38 weeks of gestation.
- Primary percutaneous coronary intervention for spontaneous coronary artery is one of the best methods to manage ongoing myocardial ischaemia.
- Minimal medication should be continued, and physicians should follow up carefully due to the high rate of recurrence.
- As CPA in pregnancy can be catastrophic for mother and fetus, the medical team should always make efforts to save both lives.
- Knowledge and experience on the critical care in pregnancy should be disseminated, and the emergency team should be trained for such situations, which can occur any time.

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