Bidirectional Precordial ST Changes during Angioplasty to Right Coronary Artery

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Abstract

Emergency coronary angiography of a 53-year-old man with acute coronary syndrome revealed stenosis in right coronary artery. During angioplasty, the ECG change showed three kind of ST deviation, namely inferior ST elevation with precordial ST depression, inferior ST elevation with precordial ST elevation, and inferior ST depression with precordial ST elevation. The present case shows that the ST deviation of the inferior ischemia with right ventricular ischemia takes various patterns. This phenomenon is decided by degree of right main coronary and right side branch blood flow.

Key words: angioplasty, right ventricular ischemia, ECG

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Introduction

The mutual relationship of the ST deviations induced by inferior ischemia and right ventricular ischemia is very interesting but it is very rare to clinically experience such a phenomenon. We report the case in which the correlation of ST deviation in inferior leads and precordial leads induced by inferior ischemia or ST deviation in inferior leads and precordial leads induced by right ventricular ischemia was able to be observed.

Case Report

A 53-year-old man was admitted to our hospital for continuous chest pain. Vital sign was stable. Cardiac enzyme levels and white blood cell count was within normal limits. Emergency coronary angiography revealed 90% stenosis of the proximal-right coronary artery without collateral flow from the left coronary artery which had no organic lesion. He underwent direct STENT of the right coronary artery.

ECG during angioplasty displayed changes in 4 stages (Figs. 1, 2).

Stage 1: A 3.0 mm×15 mm STENT was deployed at 10 atm for 40 seconds. During balloon inflation, mild chest pain was accompanied by ST elevation in inferior leads (II, III and V_a) and by ST depression in the precordial leads (V_c-V_d).

Stage 2: The patient developed moderate chest pain shortly after balloon deflation with marked ST elevation in precordial leads (maximal elevation of 11 mm in leads V_b). Intracoronary nitroglycerin and nicorandil were injected at once.

Stage 3: At 10 seconds following balloon deflation, severe chest pain was accompanied by marked ST elevation in the precordial leads and by inverted T wave in the inferior leads. At that time, the right main coronary angiography showed good flow but its right side-branch namely conus branch, and right ventricular branch had become occluded.

Stage 4: The occluded right side-branch had reopened automatically. Those ST changes had improved following the improvement of the clinical symptoms.

Discussion

The relationship between right coronary angiography and ST deviation is as follows.

Stage 1: The ST elevation in inferior leads reflects transmural inferior ischemia that is due to occlusion of the right main coronary artery. The ST depression in the precordial
Figure 1. Right anterior oblique view of right coronary artery before (pre angioplasty), and at re-study (stage 3) during ST elevation showing loss of the conus branch and the right ventricular branch following angioplasty and STENT deployment.

<table>
<thead>
<tr>
<th>Pre PCI</th>
<th>Balloon inflation (stage 1)</th>
<th>Balloon deflation (stage 2)</th>
<th>2min. later (stage 3)</th>
<th>Post PCI (stage 4)</th>
</tr>
</thead>
</table>

V1, V2, V3, V4, V5, V6, I, II, III, aVR, aVL, aVF

Figure 2. Serial ST change in electrocardiogram during angioplasty.

Stage 2: After balloon deflation, inferior ischemia was released and the ST elevation in inferior leads improved. On the other hand, the isolated right ventricular ischemia following side-branch occlusion showed the ST elevation in precordial leads. The right side-branch occlusion was thought to be due to thrombus, STENT jail or spasm. Since the occluded right side-branch was reopened by nitroglycerin and nicorandil, spasm was most considered.

Stage 3: The continuous isolated right ventricular ischemia showed continuous the ST elevation in precordial leads and the ST depression in the inferior leads is believed to reflect reciprocal changes of right ventricular ischemia.

Stage 4: The inferior ischemia and right ventricular ischemia were released. Consequently clinical symptom and the ST deviation were improved.

The present case shows that inferior ST elevation reflected well in precordial leads and precordial ST elevation reflected well in inferior ST deviation. The ECG changes during angioplasty to right coronary artery can be considered to be a clinical model of early ST changes of inferior infarction. The ECG change in this present case showed three kind of ST deviation, namely the ECG changes of
stage 1, stage 2 and stage 3.

1) Inferior transmural ischemia

It is well known that the inferior ST elevation and precordial ST depression (stage 1) is usually seen in patients with acute inferior infarction. The precordial ST depression is considered to reflect reciprocal changes of inferior ST elevation.

2) Inferior transmural ischemia with right ventricular transmural ischemia

Right ventricular infarction is often accompanied by inferior infarction and the ECG shows inferior ST elevation with precordial ST elevation (1) (stage 2). Chou et al (2) proposed that ST elevation ≥ 1 mm in lead V1 in a standard 12-lead ECG might be a marker of right ventricular infarction. In present case, the range and magnitude of precordial ST elevation was wider and the degree of ST elevation was higher than the aforesaid criteria. This cause might be that the right ventricular is more near in the precordial leads and/or the precordial ST elevation is short duration (3). This reason for the short duration of ST elevation is not well understood but the mechanisms include the smaller muscle mass of the right ventricle, the lower wall tension in the right ventricular cavity and the potential for collateral flow to the right ventricle (4).

The degree of inferior ST elevation of stage 1 is more suppressed than inferior ST elevation of stage 2. The suppression of ST elevation may be caused by reciprocal ST changes in precordial ST elevation.

3) Isolated right ventricular transmural ischemia

During isolated right side-branch occlusion, the ECG shows precordial ST elevation with inferior ST depression (stage 3). For that reason, it is difficult to determine whether the ST changes of this type are caused by isolated right side-branch infarction or anterior left ventricular infarction (5). The inferior ST depression is considered to reflect reciprocal changes of precordial ST elevation.

The range of precordial ST elevation is wider and the degree of ST elevation was higher than the aforesaid criteria of right ventricular infarction. This reason of the ST deviation is same as stage 2.

**Conclusion**

The present case shows that the ST deviation in the patient with proximal right coronary occlusion takes various patterns. This phenomenon is decided by the degree of inferior and right ventricular ischemia based on balance of right main coronary and right side-branch artery flow. Additionally, mutual interference of inferior and precordial ST deviation complicates those ST deviation.

**References**