A Case of Coexistence of Severe Coronary and Carotid Artery Stenosis Treated with Carotid Artery Stenting Using Intra-Aortic Balloon Pumping and a Temporary Pacemaker

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Summary
The risk factors of carotid stenosis and coronary stenosis are similar, and therefore, certain patients with carotid stenosis may have coronary heart disease. Coronary artery bypass graft (CABG) is the major therapy for ischemic heart disease with three-vessel and left main coronary artery (LMCA) disease. However, CABG can induce cerebral infarctions in cases with carotid stenosis. Carotid endarterectomy (CEA) was used to be the standard therapy for carotid stenosis; however, CEA requires general anesthesia and has a high risk of cardiovascular events in patients with ischemic heart disease. In recent times, carotid artery stenting (CAS), which does not need general anesthesia, is the new strategy for carotid stenosis. However, CAS induces hypotension and bradycardia because of a carotid node reflex, which is dangerous in patients with ischemic heart disease. We reported a case of the coexistence of severe coronary stenosis including the LMCA and three vessels and carotid stenosis. CAS before CABG under local anesthesia was successful with the use of intra-aortic balloon pumping (IABP) and a temporary pacemaker.

Key words: Coronary artery bypass graft, Carotid node reflex, Hypotension, Bradycardia, Carotid endarterectomy, Atherosclerosis

The standard therapy for carotid stenosis is antiplatelet therapy. However, 2%-13% of patients treated with antiplatelet therapy, unfortunately, have cerebral infarctions despite medication therapy.1,2 Carotid endarterectomy (CEA) is revealed to reduce the risk of cerebral infarctions and has been performed for symptomatic cases. In recent times, carotid artery stenting (CAS), which can be performed under local anesthesia, is another therapeutic strategy for carotid stenosis. After reporting that the clinical outcome of CAS showed no significant difference from that of the CEA,3 the number of CAS cases is now increasing in Japan.

Coronary heart disease and cerebrovascular disease are major causes of death in recent times.4 The risk factors of coronary heart disease are dyslipidemia, hypertension, smoking, and diabetes mellitus, which induce atherosclerosis and are similar risk factors of carotid stenosis. Therefore, some patients with carotid stenosis may have coronary heart disease. The therapy for coronary heart disease is percutaneous coronary intervention (PCI) or coronary artery bypass graft (CABG). According to the guidelines, CABG is recommended for cases with the left main coronary artery (LMCA) and/or three-vessel disease.

A CEA requires general anesthesia; however, patients with severe coronary heart disease are at high risk of cardiovascular events during general anesthesia. CABG also has a high risk of cerebrovascular events in patients with carotid stenosis. CAS does not require general anesthesia. However, CAS induces low blood pressure and bradycardia due to carotid sinus reflex. This reflex is dangerous for patients with coronary heart disease because vital changes can reduce cardiac output and coronary blood flow, which could induce heart failure or fatal arrhythmias.

We reported a case of carotid stenosis and coronary heart disease of the LMCA and three vessels treated by CAS using intra-aortic balloon pumping (IABP) and a temporary pacemaker.

Case Report
A 69-year-old man who presented with difficulty ambulating was admitted to our hospital for a further examination. He had a past medical history of chronic kidney disease (serum creatinine level: 1.24 mg/dL), cerebral infarction, and incomplete paralysis of his right leg. Carotid MRI and echography revealed severe stenosis of the right carotid artery 3 cm above the bifurcation with ulceration and semicircular calcification and extremely high peak systolic velocity of the internal carotid artery (ICA) at 2.6
m/second. Moreover, CT angiography revealed that the stenosis of the ICA was 76% by the NASCET method, which meant high-grade stenosis, and the brain MRI revealed that the stroke area was in the watershed area. These results suggested that the diagnosis was a hemodynamic infarction. To determine the strategy for the treatment of the carotid stenosis, cardiac examinations were performed. The electrocardiography (ECG) showed a complete right bundle branch block without ST-T changes. The echocardiogram showed akinesis of the posteroinferior wall with a thin wall, indicating an old myocardial infarction, and the left ventricular ejection fraction was 47% by the Simpson method. A coronary angiogram (CAG) revealed three-vessel disease including the LMCA (Figure 1A, B). The syntax score was 33 points with the stenosis of the LMCA, and our heart team conference decided to perform CABG. CEA requires general anesthesia, which has a high risk due to severe ischemic heart disease. CABG before the CEA, which is the standard strategy for severe ischemic heart disease, had a higher risk of cerebrovascular events because of the severe stenosis of the right carotid artery. Meanwhile, CAS can induce hypotension and bradycardia due to carotid sinus reflex, and vital changes could reduce the cardiac output. Finally, CAS would have induced severe heart failure or fatal arrhythmias in this case.

We decided to perform CAS before CABG using IABP and a temporary pacemaker to prevent hypotension and bradycardia. CAS was performed under local anesthesia (Figure 1C, D). Figure 2 shows the summary of the clinical course during the perioperative period. Neurosurgeons performed stenting of the carotid artery with a distal protection device after cardiologists started IABP and ventricular pacing (heart rate; 60/minute). The systolic blood pressure immediately dropped to 80 mmHg, and the heart rate was 60/minute with a 100% paced rhythm. Because hypotension was sustained despite the IABP support, the transvenous administration of dopamine (10γ) was initiated. The hypotension and bradycardia continued for more than 12 hours after the CAS. The next morning, the systolic blood pressure and heart rate improved. Dopamine was stopped, and IABP and the temporary pacemaker were removed. The patient was discharged from our hospital, and CABG was planned 1 month after CAS.

Discussion

Hennen, et al. reported a case of severe carotid artery stenosis treated with CAS using IABP support.4 IABP support was useful to prevent cerebral infarction by increasing the cardiac output. However, an unstable hemo-
Atherosclerosis induces both carotid stenosis and coronary artery stenosis. Patients with carotid stenosis have coronary stenosis and vice versa. This means that a lot of patients with carotid stenosis are high-risk patients for cardiovascular events during general anesthesia.

CABG is recommended for ischemic heart disease with three-vessel and LMCA disease. However, CABG has a four-fold higher risk of perioperative stroke in patients with a history of stroke and a ten-fold higher risk in asymptomatic patients with carotid stenosis of > 75%. In the present case, a low blood flow of the carotid artery due to general anesthesia would further induce a stroke because of a hemodynamic infarction. On the one hand, CEA is the standard therapeutic strategy for carotid stenosis. On the other hand, it has a four-fold higher risk of myocardial infarction in patients with ischemic heart disease.

CAS used to be the second strategy because CAS is associated with some complications, such as a distal embolism. Bonati, et al. reported that 50% of patients undergoing CAS had cerebral infarctions because of distal emboli. After that report, an embolic protection device has been developed. The SAPPHIRE study showed that the incidence of cerebral infarctions during CAS with a protection device was not inferior to that during a CEA. In the present case, CAS is recommended as the first-line strategy in cases with a high risk of a CEA, such as those with advanced age, coronary artery disease, or general complications. CEA requires general anesthesia, whereas CAS can be performed with local anesthesia or shallow sedation without tracheal intubation. Furthermore, the stenosis in the present case was located 3 cm above the carotid bifurcation. For those reasons, CAS was selected for the carotid stenosis in the present case. Kiesz, et al. reported a case who underwent a bilateral internal CAS and three-vessel PCI during the same procedure. In the present case, the patient had chronic kidney disease and contrast-induced nephropathy was of concern. We could not perform the CAS and PCI during the same procedure.

CAS induces a carotid sinus reflex, resulting in hypotension and bradycardia lasting for a few hours and sometimes up to 1 week. Some papers have stated that 73% of patients treated with CAS has bradycardia requiring a temporary pacemaker. Another paper stated that the incidence of bradycardia ranged from 9 to 60%, and the incidence of hypotension ranged from 14 to 31%. Coronary heart disease, older age of more than 77 years, ulcerated plaque, and presence of calcification are risk factors for bradycardia and hypotension after CAS. In our case, the patient had coronary heart disease, ulcerated plaque, and calcification. Bradycardia and hypotension were strongly expected to occur after the CAS. Therefore, we used IABP and a temporary pacemaker to prevent hypotension and bradycardia during the perioperative period. The systolic blood pressure was still 90 mmHg despite IABP support and the administration of dopamine, and the heart rate was 60/minute with a paced rhythm. Although the use of the Impella instead of IABP could be useful for reducing the fluctuation of blood pressure, our hospital was not allowed to use the Impella; so, we used the IAPB. These vital sign changes lasted for 12 hours after the CAS due to severe reflex. We were able to prevent both cerebral infarction and heart failure by using IABP and a temporary pacemaker, which are a basic technique for cardiologists. In general, CAS and CEA are performed by neurologists such as neurosurgeons, neuro-radiologists, and neurologists; and CABG is performed by cardiothoracic surgeons. In this case report, our medical care team consisted of neurosurgeons, cardiothoracic surgeons, and cardiologists; we succeeded in safely treating the carotid stenosis in this patient with a severe ischemic heart disease. Cardiologists should know that a carotid sinus reflex after CAS can last for a long time and IABP and a temporary pacemaker are useful during this period.

**Figure 2.** The summary of the clinical course during the perioperative period. The stenting of the carotid artery was performed after starting the IABP and ventricular pacing (heart rate: 60/minute). The systolic blood pressure immediately dropped to 80 mmHg, and the heart rate was 60/minute with a 100% paced rhythm. Hypotension and bradycardia continued for more than 12 hours after the CAS. CAS indicates carotid artery stenting; IABP, intra-aortic balloon pumping; and DEX, dexmedetomidine.
This will be a very important message in the near future when CAS will become a first-line therapeutic strategy and the number of cases will increase.

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Disclosure

Conflicts of interest: None declared.

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