Case report - Coronary
Safety of coronary artery bypass grafting in patients with bilateral total carotid occlusions

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Abstract

The presence of bilateral carotid artery occlusions in patients that require coronary artery bypass surgery is rare. Here, we report the successful coronary revascularization of two patients with cardiopulmonary bypass under moderate hypothermia. Routine preoperative carotid artery duplex sonographies revealed bilateral total internal carotid occlusions. However, no neurological deficits or abnormalities were found on clinical examination or brain computed tomography, respectively. The vertebral blood flows of both patients were also found to be highly increased. Following successful surgery, the postoperative courses were uneventful and patients were discharged from the hospital on the seventh postoperative day.

Keywords: Coronary artery bypass grafting surgery; Carotid arteries; Bilateral occlusion

1. Introduction

The presence of even unilateral carotid artery disease in coronary artery diseased (CAD) patients requiring surgery is associated with increased stroke incidence. Bilateral carotid artery occlusion in patients requiring coronary artery bypass grafting (CABG) is rare [1–3], and its optimal management is not well established. Although advanced surgical and anesthesiological techniques for CABG minimize the risk of severe complications in patients with advanced arteriosclerotic cerebrovascular disease, the decision of whether to operate requires careful consideration. Severe angina can necessitate CABG in patients with bilateral internal carotid occlusions, however, individual perioperative management use can enable an uneventful postoperative course.

2. Case reports

2.1. Case 1

A 59-year-old man presented with unstable angina. Bilateral carotid occlusion was demonstrated in preoperative examination using duplex scanning and cerebral digital subtraction angiography (DSA). No neurological deficits were found on clinical examination and no abnormalities were found with brain computed tomography (CT). The right and left vertebral artery flows by duplex flowmetry were 160 and 195 ml/min, respectively. Cerebral DSA revealed total internal carotid artery (ICA) occlusion, but no vertebral artery stenoses. Collateral circulation feeding the intracranial carotid system originated mainly from the vertebrobasilar system.

The patient underwent CABG of the two vessels with cardiopulmonary bypass (CPB) under moderate hypothermia (28 °C). The left internal thoracic artery and saphenous vein were grafted to the left anterior descending (LAD) artery and right coronary arteries, respectively. The patient displayed no evidence of motor, sensory, or cognitive neurological dysfunction on awakening. The patient was discharged in good condition after an uneventful postoperative course. Eleven months later, his neurological condition continues unchanged from the preoperative state and he has good cardiac status.

2.2. Case 2

Coronary angiography and carotid artery duplex sonography in a 62-year-old man presenting with stable angina revealed CAD in four arteries and bilateral total carotid occlusion, respectively. No neurological deficits were found on clinical examination, and no abnormalities were seen on the brain CT. The right and left vertebral artery flows by duplex flowmetry were 221 and 150 ml/min, respectively. Cerebral DSA revealed bilateral total ICA occlusion, but no vertebral artery stenoses. Collateral circulation feeding the intracranial carotid system originated mainly from the ophthalmic and vertebral arteries (Fig. 1).

The patient underwent CABG with CPB of the four vessels under moderate hypothermia (28 °C). After cardioplectic...
Cerebrovascular bypass surgery before coronary artery operation in patients with total carotid occlusion and symptomatic cerebral insufficiency may improve outcomes [5]. It was reported that there was no increased incidence of perioperative neurologic events using a perfusion pressure of ≥70 mmHg during CPB in bilateral carotid artery stenosis patients [6]. While the degree of carotid artery stenoses may not affect the distal cerebral hemisphere neurologic complications, a relationship does exist between the cerebral hemodynamics and arteriographic circulation [7]. Hence, adequate collateral supply is the most probable explanation for preserved cerebral circulation. Since our asymptomatic patients displayed high vertebral and extracranial compensatory circulations, we did not perform any preoperative screening for cerebral insufficiency. Intraoperative electroencephalogram monitoring was used for the actual cerebral blood perfusions during CPB.

Use of a high mean arterial pressure during CPB reportedly reduces the overall incidence of combined cardiac and neurologic complications [8]. We provided cerebral protection during CABG with moderate hypothermia and pulsatile high-flow extracorporeal circulation (2.2–2.4 L/min/m^2 pump flow, 80 mmHg mean systemic perfusion pressure). No patient experienced stroke perioperatively or during follow-up.

CPB itself might be a risk factor for neurologic events. It requires aortic cannulation and cross-clamping, which can result in thromboembolism to the brain arteries. Postoperative hemoglobin levels tend to be lower during CPB, due to hemodilution by pump priming, which could cause reduced cerebral oxygen levels and/or ischemia. Other risk factors include hypotension, arrhythmia, hypocoagulability, and tissue edema, which are more common with CPB. Off-pump surgery is safe for CABG, however, hemodynamic alterations can result from aortic and cardiac manipulations during proximal saphenous vein anastomosis to the aorta, or during coronary artery bypass anastomosis. Off-pump surgery may cause hypotension and low cerebral blood flow, potentially causing cerebral ischemia. Although hypothermic CPB can improve the cerebral supply, both hypotension and normothermia have been successfully used in CPB. We employed moderate hypothermia, but suggest collateral blood flow as the vital component for maintaining cerebral circulation in bilateral carotid artery occlusion patients. Collateral circulation of the brain via the vertebral arteries was highly increased in our cases, possibly maintaining the brain functional state.

Table 1

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age/sex</th>
<th>CPB</th>
<th>Hypothermia</th>
<th>Neurologic symptom</th>
<th>Postoperative event</th>
<th>Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravlee et al. [1]</td>
<td>1</td>
<td>56/M</td>
<td>Yes</td>
<td>Moderate</td>
<td>Yes</td>
<td>No</td>
<td>CABG × 3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>58/M</td>
<td>Yes</td>
<td>Moderate</td>
<td>Yes</td>
<td>No</td>
<td>CABG × 4</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>56/M</td>
<td>Yes</td>
<td>Moderate</td>
<td>Yes</td>
<td>No</td>
<td>CABG × 3</td>
</tr>
<tr>
<td>Osvald et al. [2]</td>
<td>4</td>
<td>68/M</td>
<td>Yes</td>
<td>Moderate</td>
<td>No</td>
<td>No</td>
<td>CABG × 3</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>74/F</td>
<td>Yes</td>
<td>Normothermia</td>
<td>Yes</td>
<td>No</td>
<td>CABG × 2</td>
</tr>
<tr>
<td>Case 1</td>
<td>6</td>
<td>59/M</td>
<td>Yes</td>
<td>Moderate</td>
<td>No</td>
<td>No</td>
<td>CABG × 2</td>
</tr>
<tr>
<td>Case 2</td>
<td>7</td>
<td>62/M</td>
<td>Yes</td>
<td>Moderate</td>
<td>No</td>
<td>No</td>
<td>CABG × 4</td>
</tr>
</tbody>
</table>

CPB, cardiopulmonary bypass; M, male; F, female; CABG, coronary artery bypass grafting.
The precise mechanisms underlying post-surgical neurological injury in CABG patients with carotid artery stenoses remain obscure. Low flow, embolic, or thrombotic strokes may occur, or changes in flow hemodynamics, coagulation, or homeostasis regulation may alter stenosed artery behavior during or after CPB. Perioperative stroke risk is unpredictable. Patients with bilateral carotid disease, especially those with unilateral stenosis and contralateral occlusion, are at a particularly high risk for perioperative neurologic events, regardless of whether carotid artery disease is treated surgically at the time of the cardiac procedure [4, 9, 10]. However, strokes from the carotid artery are improbable, since the bilateral carotid arteries are totally occluded in these patients.

Our case studies and others strongly indicate that the cerebral collateral circulation functionality predicts the neurological outcome after coronary revascularization better than the specific occlusive anatomy of the carotid arteries. Use of appropriate preoperative evaluation and surgical strategies may allow CABG to be safely performed in patients with bilateral carotid occlusions.

References


EComment: Treatment of patients with combined coronary and carotid artery disease

Authors: Jamshid H. Karimov, Adult Cardiac Surgery, Fondazione G. Monasterio Heart Hospital, Via Aurelia Sud, 54100 Massa, Italy; Kaushal K. Tiwari, Nermir Granov, Mattia Glauber doi:10.1510/icvts.2009.224162A

Proper management of coronary artery disease with concomitant carotid stenosis remains an important and controversial issue in cardiovascular surgery [1]. Increase in strokes among these patients is related to carotid stenosis which can be a significant predictor of poor outcomes in patients undergoing a coronary revascularization procedure [2]. Patients with an indication for coronary artery bypass grafting (CABG) who also have carotid stenosis to deal with can be approached according to one of the following options: separate carotid procedure (carotid endarterectomy, surgery or stenting) performed prior to, during, or after CABG, combined carotid and CABG procedures, or CABG followed by carotid intervention. Each of these methods has its benefits and disadvantages, which can be measured by the incidence of myocardial infarction and stroke. Even if no strong evidence exists whether to perform carotid revascularization or endarterectomy prior to, during, or after CABG, patients with a significant asymptomatic carotid artery stenosis will have to be considered for carotid procedure at some stage [3]. It is difficult to say whether the incidence of stroke would have been lower if a carotid procedure had been performed. One more issue is proper timing between the carotid procedure and CABG, which also remains uncertain. Further studies will be necessary in order to satisfy this demand.

References

