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Case Report

Modified Isolation Selective Cerebral Perfusion Technique for Intracardiac Disease with Mobile Atheroma

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Isolation selective cerebral perfusion (ISCP) technique is reportedly an effective method for preventing brain complications during the treatment of arch aneurysms. Here we present the case of a patient with intracardiac disease complicated by mobile atheroma in the proximal aorta. In this patient, not only the arterial cannulation of the ascending aorta might have posed a high risk of brain stroke but also the original ISCP technique could not be applied. We applied the ISCP technique for non-aortic disease without using circulatory arrest to prevent aortogenic brain embolism. The patients who underwent treatment using this technique were discharged without neurologic complications.

Keywords: isolation selective cerebral perfusion, intracardiac surgery, mobile atheroma

Background

Mobile atheroma in the proximal aorta is a risk factor for brain stroke during cardiopulmonary bypass (CPB) because extracorporeal perfusion may destabilize the atheroma and scatter it as embolic sources. Therefore, it is important to determine the location of cannulation and the process of perfusion. These problems can be resolved using isolation selective cerebral perfusion (ISCP) technique for aortic surgery.[1–4] In this report, we present the case of patient in whom the ISCP technique was applied for intracardiac disease complicated with mobile atheroma. This technique enables safer and minimally invasive surgery for preventing brain stroke complications.

Case Report

The patient was a 73-year-old man who was diagnosed with an atrial myxoma coexistent with protruding and mobile atheroma in the ascending aorta. The presence of atheroma was a hindrance to the safe conduction of the surgery (**Fig. 1**).

Through median sternotomy incision, the left common carotid artery (LCCA) and both axillae arteries (AxA) were exposed for arterial cannulation. An epiaortic echography showed a thick mobile atheroma in the proximal aorta. After systemic heparinization, a 10-mm Gelweave graft (Vascutek-Terumo, Tokyo, Japan) was anastomosed to the right AxA to use it as the systemic perfusion line of the main pump. Then, 3.4-mm JMS (JMS, Hiroshima, Japan) and 12-Fr FEM FLEX II (Edwards Lifesciences, Ir-

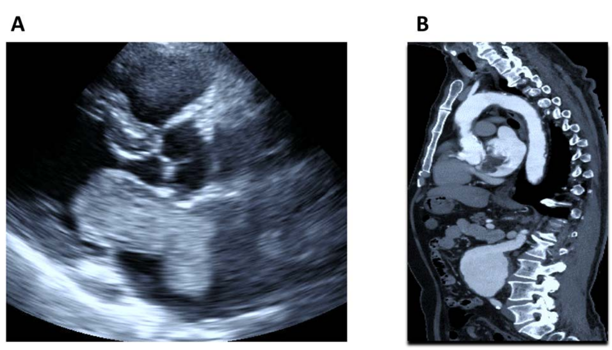

Fig. 1 (**A**) Transthoracic echocardiography showed a left atrial myxoma prolapsing through the mitral valve during diastole. (**B**) Computed tomography demonstrated the site and extent of the atheroma in the proximal aorta and infra-renal abdominal aortic aneurysm.

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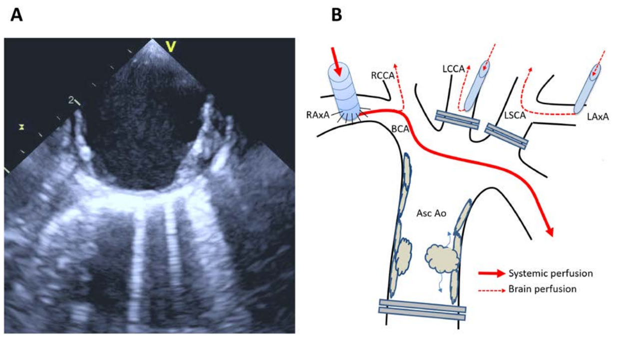

Fig. 2 (**A**) Transesophageal echography showed ascending aorta with protruding and mobile atheroma. (**B**) Schematic drawing of the technique used.
Asc Ao: ascending aorta; BCA: brachiocephalic artery; LAxA: left axillae arteries; LCCA: left common carotid artery; LSCA: left subclavian artery; RAxA: right axillae arteries; RCCA: right common carotid artery

vine, Calif., USA) cannulas were inserted into LCCA, and left AxA were connected to the brain separation pump. The drainage cannulas were inserted in the superior and inferior vena cava. To prevent mobile atheroma scattering to the brain, the perfusion flow of the two pumps was simultaneously increased, and, then, the origins of LCCA and left subclavian artery (LSCA) were clamped. The amount of total cerebral perfusion was calculated according to the body size, and half of that was defined as the perfusion amount of LCCA and LSCA from the brain separation pump. The main pump was raised to the scheduled systemic perfusion under mild hypothermia (34°C). During brain perfusion, cerebral tissue oxygenation was monitored using near-infrared spectroscopy (INVOS Oximeter 5100C, Covidien, Mansfield, Mass., USA). At this stage, antegrade cardioplegia cannula was inserted, and a cross-clamp was placed at the proximal part of the ascending aorta without atheromatous plaques (**Fig. 2**). After a cardiac arrest, the tumor resection was performed. The ascending aorta was unclamped with a high flow of retrograde cardioplegia perfusion to prevent coronary embolization. Then, the clamps attached to LCCA and LSCA were released before the weaning of CPB. Transesophageal echography showed that the mobile atheroma had not migrated. Postoperative computed tomography demonstrated no neurologic complications or atheroembolism in the abdominal organs and lower torso.

Discussion

Shiiya and colleagues[1,2] have described an original ISCP technique under deep hypothermic circulatory arrest for replacing the ascending and transverse aortic aneurysms with mobile atheromas. It has been reported that patients with protruding (≥ 5 mm) or mobile aortic arch atheromas were at a high risk for intraoperative stroke during cardiac surgery.[5] Therefore, they adopted the ISCP technique according to Katz classification[6] (grades 4 and 5) to reduce the risk of aortogenic embolic stroke. In our patient, the ascending aorta was characterized by multiple plaques such as protruding or mobile atheromas (the so-called shaggy aorta) that could not be cannulated. However, the patient had no aortic disease such as aneurysm or dissection that could be an indication for aortic surgery. In addition, an atrial myxoma was detected immediately after the surgical repair of the ruptured abdominal aortic aneurysm, and the patient had coagulopathy affected by surgical invasiveness. Therefore, the ISCP technique was applied for a non-aortic operation to achieve safer and less invasive intracardiac manipulation without using circulatory arrest.

Two roller pumps are used to manage the systemic and cerebral perfusions separately in this technique. One pump manages the left-brain perfusion from LCCA and left AxA, and the other pump manages the systemic and right-brain perfusions from the right AxA. The pediatric arterial cannulas inserted into LCCA and left AxA are placed with the outlet directed upwards to be sent to the brain side, and the neck vessels are clamped.

In our first experience of ISCP application, retrograde flow from three arch vessels had been characterized by preventing a mobile atheroma from scattering to the brain, as well as providing multiple systemic perfusions, because the neck vessels were unclamped. Although it seemed to be an effective method to prevent cerebral embolism, it had a disadvantage that there was no assurance regarding whether adequate perfusion could be maintained because the cerebral perfusion was completely autoregulated.

It has been reported that the blood supply for the left vertebral artery is important and that the perfusion for LSCA should be isolated to prevent cerebral infarction.[7] Therefore, we believe that LCCA and LSCA should be clamped to ensure reliable and effective brain protection in case of a clampable vascular condition. Regarding the shortcomings of this method, cerebral perfusion pressure could not be monitored, and INVOS was the only indicator during the operation. It is necessary to put the pressure monitoring line into the superficial temporal artery to maintain safer and more reliable cerebral perfusion.

Finally, this technique achieved by direct cross-clamping of the ascending aorta could not reduce the risk of lower-body embolism. The careful assessment of atheromas and postoperative observation of atheroembolism to the abdomen and lower torso are mandatory. Although we should consider the possible complications and adverse effects of leaving the atheroma, it is important to consider the necessity of an extended operation of atheroma removal according to the individual patient and pathology.

Conclusion

We reported our successful conduction of intracardiac surgery using the ISCP technique. This technique is feasible for patients with intracardiac disease complicated by mobile atheroma in the ascending and transverse aorta.

Disclosure Statement

All authors declare no conflict of interest.

Author Contributions

Study conception: SM
Data collection: SM
Investigation: SM
Writing: SM
Critical review and revision: all authors
Final approval of the article: all authors
Accountability for all aspects of the work: all authors

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