Case report - Congenital

Intraoperative fluorescence imaging during surgery for coronary artery fistula

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Received 19 October 2009; received in revised form 4 December 2009; accepted 8 December 2009

Abstract

A 45-year-old man had a history of myocardial infarction at one month prior to admission. Coronary angiography revealed a dilated fistula originating from the left anterior descending coronary artery to the pulmonary artery. Two orifices of the draining artery were closed through pulmonary arteriotomy. Ligation of the fistulous vessels was performed at three places to ensure complete closure of the fistula. Before and after the cardiopulmonary bypass, fluorescent dye angiography was performed with indocyanine green. Fluorescence imaging revealed complete closure of the fistula and no residual shunt flow. Postoperative coronary angiography revealed neither a residual fistula nor injury to the coronary artery.

Keywords: Coronary artery imaging; Fistula; Congenital heart disease; Ischemic heart disease; Pulmonary artery

1. Introduction

Coronary artery fistula (CAF) is a relatively rare congenital anomaly. There are some previous reports of residual shunts after surgical treatment for CAF [1, 2]. To prevent this troublesome complication, some surgical procedures and intraoperative assessments were considered in those previous reports. Recently, fluorescence imaging has been used for intraoperative assessment during coronary artery bypass grafting. In the present case, we used fluorescence imaging for intraoperative assessment of a CAF.

2. Case

A 45-year-old man was admitted to our hospital with a history of myocardial infarction. The myocardial infarction occurred at one month before admission. Coronary angiography revealed a dilated fistula originating from the left anterior descending coronary artery to the pulmonary artery (Fig. 1a). The right coronary artery was normal. There were no stenoses in the coronary artery. Since there was no other possible cause of the ischemic event except for the CAF, the patient was referred to our hospital for surgical treatment for the fistula.

The patient underwent surgery through a median sternotomy. Prior to starting the cardiopulmonary bypass, fluorescent dye angiography was performed using 2.5 mg of indocyanine green (ICG) (Fig. 2a). ICG was injected through the central venous line. Immediately after the injection, a fluorescence image was acquired by a laser light camera and video recorder unit (Photodynamic Eye, Hamamatsu Photonics K.K., Hamamatsu, Japan). Fluorescence imaging showed the dilated fistula originating from the left anterior descending coronary artery and draining to the pulmonary artery. Cardiopulmonary bypass was established between the ascending aorta and the bicaval cannulation. Cardiac arrest was obtained with antegrade cold blood cardioplegic solution. Two orifices of the draining artery to the pulmonary artery were 1 cm above the anterior cusp of the pulmonary valve and these orifices were closed through pulmonary arteriotomy. Ligations of the fistulous vessels were performed at three places to ensure complete closure of the fistula. After weaning from the cardiopulmonary bypass, fluorescence imaging was performed again. The imaging revealed complete closure of the fistula and no residual shunt flow (Fig. 2b).

Postoperative coronary angiography revealed no residual fistula and no injury to the coronary artery (Fig. 1b).

3. Discussion

CAF is a relatively rare congenital anomaly. The reported incidence of CAF was about 0.2% in patients undergoing cardiac catheterization [1, 3]. A fistulous connection to the pulmonary artery was found in approximately 15–20% of CAF cases [4]. It is well accepted that symptomatic patients should be treated by surgical ligation or closure. Some complications are also operative indications, including myocardial infarction, rupture of a coronary artery aneurysm, and bacterial endarteritis.

The surgical procedures vary depending on the type and location of the fistulous communication and its surgical accessibility. A previous report described that four of 41
patients who underwent surgery for CAF had a recurrent or residual fistula [1]. The incidence was higher in the external ligation or division group than in the intracardiac closure group [1]. To achieve complete interruption, we performed both external ligation and intracardiac closure. In addition to the technical considerations for preventing a residual coronary fistula, intraoperative assessment is important. In previous reports [5, 6], intraoperative transesophageal echocardiography has been recommended to detect residual small shunts. However, it is difficult to assess the details of the coronary artery anatomy by transesophageal echocardiography.

To the best of our knowledge, this is the first report describing the use of a fluorescence imaging system during surgery for CAF to prevent a residual fistula. Fluorescence imaging has been used to assess anastomosis and graft quality in coronary artery bypass grafting [7]. Some reports have described that fluorescence cardiac imaging using ICG with a portable imaging device is clinically safe and accurate, and allows simple visualization of the coronary anatomy and grafts intraoperatively [7, 8]. When ICG is combined with plasma proteins, fluorescence can be excited with a light-emitting diode. The signals of the excited fluorescence are visualized with a near-infrared camera system and real-time images are displayed on a monitor. Since this fluorescence imaging does not involve fluoroscopic imaging, its disadvantage is invisibility caused by the posterior location of the heart and the thick adjacent tissues surrounding the coronary artery (fat, connective tissue, and myocardium). In our case, the location of the fistulous vessel was on the left side of the pulmonary valve, and the surrounding tissues were not thick. Furthermore, the laser light camera used in our case was relatively small and portable rather than fixed. Therefore, this disadvantage did not cause any problems in our case. Using this technology, we can also identify native coronary injuries as well as residual coronary fistulas. We believe that intraoperative fluorescence imaging using ICG is quite useful during surgery for CAF.

References