Minimally invasive off-pump unroofing of left anterior descending artery myocardial bridge

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March 31, 2022

Abstract

Currently, myocardial unroofing, coronary artery bypass grafting and percutaneous coronary intervention are chosen as treatments for myocardial bridge. We performed a male patient off-pump unroofing of left anterior descending coronary artery with techniques of minimally invasive surgery through the 4 th intercoastal space. Intraoperative coronary angiography was performed to evaluate residual lesions. Since this treatment strategy does not require full heparinization, it can be expected to reduce the amount of bleeding. This procedure not only has small incision, but also has some major advantages.

Introduction

For the same case, Shuichiro Yamauchi, a cardiologist at our hospital, has published a previous paper on the usefulness of perioperative coronary angiography (CAG) and fractional flow reserve (FFR) using high-dose dobutamine infusion as a diagnosis of myocardial bridge (MB) [1]. Surgical techniques are also very useful, so I would like to report this case focusing on surgical techniques.

In MB, the muscular bridge results in systolic compression of the tunneled portion of the coronary artery and infrequently causes myocardial ischemia and sudden death [2]. As a surgical method of MB, coronary artery bypass grafting (CABG) is reported to be most beneficial in long or deep MB. In the absence of long or deep bridges, surgical unroofing of the overlying muscle fibers is an effective option. Unroofing is generally performed under cardio-pulmonary bypass support or cardioplegic arrest [3]. Though minimally invasive approach is beneficial for patients with MB, there is a limited number of reports.

Herein, we present a case of minimally invasive off-pump unroofing via left mini-thoracotomy for MB of the left anterior descending coronary artery (LAD). We had written consent from the patient about this case report. IRB number is B202112-01 and date of approval is 12/23/2021.

Technique

A 41-year-old man referred to our hospital with an exertional chest pain. Coronary computed tomography (CT) angiography showed MB located from the mid segment of the LAD to the first diagonal branch (Fig. 1A). Preoperative CAG revealed severe stenosis of LAD at the site of MB during systole (Fig. 2A). FFR at the lesion was 0.72 with 50 γ of dobutamine administration. Medical therapy with beta blocker was initiated, but the symptom did not improve. Since there was no long or deep bridges, minimally invasive surgical unroofing (off-pump and left mini-thoracotomy) was selected for early rehabilitation.

Surgical technique. After general anesthesia and double-lumen endotracheal intubation, the patient was positioned at 30°right lateral decubitus position. A 6-cm incision was made on the 4th intercoastal space. After pericardium was incised anterolaterally, an octopus NUVO stabilizer (Medtronic Inc., Minneapolis, MN, USA) was inserted via 5thintercoastal space on the mid-clavicular line to stabilize the LAD. By using

VeriQ system probe (MediStim, Oslo, Norway), we confirmed the location of MB and squeezing of the LAD(Fig. 1B and C). The LAD was buried in the myocardium for 25 mm from the first diagonal branch (Fig. 3A). The epicardium at the MB was dissected with small circular knife blade and fat above the LAD was removed using a Harmonic Scalpel (Ethicon Endo- Surgery, Inc, Somerville, NJ). The MB was resected by using small potts scissors. Intraoperative CAG showed residual squeezing at the peripheral side of the MB. Therefore, additional unroofing was performed and buried LAD was completely exposed (Fig. 3B and C).

Postoperative course was uneventful and CAG showed no residual squeezing of the LAD (Fig. 2B). Postoperative FFR was 0.92 under 50 γ of dobutamine administration. There was no wound trouble of the 6-cm main incision at the left 4^{th} intercoastal space and 1-cm incision for stabilizer at the 5^{th} intercoastal space (Fig. 3D).

Comment

Optimal treatment strategy for MB is still controversial. As a treatment option, medication therapy, transcatheter stenting, CABG, and unroofing were reported. Lee, et al. reported that the rate of major adverse cardiac events was significantly higher in the MB group compared to the non-MB group (18.1% vs. 9.8%, p = 0.024) in 551 patients who underwent percutaneous coronary intervention by drug eluting stents [4]. New atherosclerotic lesion proximal to MB generated by endothelium-mediated vasodilators and in-stent restenosis caused by fractures of stent were major causes [5]. On the other hand, Ji, et al. compared the outcomes between unroofing and CABG [3]. For the treatment of MB in LAD without concomitant proximal coronary stenosis, unroofing had a significantly lower incidence of adverse angiographic results than bypass grafting (3.7% vs. 75.0%, p = 0.001). Acute obstruction of the internal thoracic artery graft was thought to be related to the presence of a competitive flow of the native coronary arteries. Therefore, CABG was recommended in a case with concomitant proximal stenosis in symptomatic MB patients. In results, patients without atherosclerotic lesions are good candidate for unroofing.

Unroofing is commonly performed by using cardio-pulmonary bypass and cardioplegic arrest. However, cardiac arrest increases a risk of incomplete unroofing due to inadequate intraoperative evaluation. Mitsuharu, et al. reported successful off-pump unroofing of MB and intraoperative CAG was useful to evaluate remaining MB [6]. Avoidance of full heparinization can reduce surgical bleeding. Three-dimensional reconstruction of cardiac CT was useful to determine the appropriate incision site and products for MICS-CABG were helpful for good exposure [7]. As a less invasive surgery, Mirzai, et al. reported totally endoscopic robotic assisted off-pump approach for symptomatic MB of LAD [8].

Minimally invasive off-pump unroofing for MB was beneficial for patients requiring early rehabilitation and intraoperative evaluation under heart beating was a different advantage to reduce residual lesions.

Conflict of interest

All authors declare that there are no conflicts of interest.

Author contributions

Shohei Morita is the main author of this case report. Taichi Sakaguchi and Arudo Hiraoka were involved in a significant modification of the article. Taichi Sakaguchi was the main surgeon of this surgery and Shuichiro Yamauchi performed the intraoperative CAG as a physician. Akihiro Hayashida performed preoperative medical evaluations and determined that surgery was indicated.

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Figure Legends

Figure 1. Three-dimensional coronary computed tomography shows a MB at the mid segment of the LAD (white arrow) (A). LAD is normal at diastolic phase (B) and collapsed at systolic phase (C) in intraoperative epicardial echocardiography.

Figure 2. Preoperative CAG shows a severe stenosis of the LAD at systolic phase (A). Postoperative CAG shows no squeezing of the LAD (B).

Figure 3. The LAD was buried in the myocardium for 25 mm from the first diagonal branch (white arrowhead) (A). LAD was exfoliated all around (white arrowhead) (B). LAD was exposed after surgical unroofing (C). There were two ports for thoracoscopy that consisted of a 6-cm main incision in the left 4th intercoastal space and a 1-cm stabilizer incision in the 5th intercoastal space(D).