

Case Report/ Case Report

HYBRID PROCEDURE IN AORTOILIAC BIFURCATION AND FEMORAL LESION

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ABSTRACT

Critical limb ischemia is a condition that threatens the viability of lower extremities and must be treated promptly to avoid major amputation. Revascularization is the most effective treatment method for critical limb ischemia. Revascularization using a hybrid of endovascular and open surgery is a minimally invasive procedure that performs well as the treatment for medically high-risk patients. A hybrid procedure should be considered for patients with high surgical risk. However, there are factors that could compromise its long-term patency, such as critical limb ischemia and diabetes. This study reported a case of a 53-year-old Asian male with history of insulin-dependent diabetes mellitus and long-standing tobacco use, presented with pain in the right leg at rest approximately 30 days prior to admission. Physical examination revealed a low temperature and remarkable non-palpable pulses in the right femoral, posterior tibial, and dorsalis pedis segments. Arteriography with run-offs revealed a long segment of total occlusion from the proximal right common iliac and anterior tibial artery. There was non-significant stenosis in the right popliteal artery. The patient was treated using a combination of percutaneous transluminal angioplasty (PTA) of the right common iliac artery using vascular stent and the Fogarty thrombectomy of the common femoral artery, equipped with an X-ray system and a moveable radiolucent surgical table. The anticoagulant used on the patient during the procedure was heparin. There was no residual stenosis after the procedure on the occlusion along the right common iliac artery to the common femoral artery. In conclusion, multilevel artery occlusive diseases could be treated by hybrid procedure, with shorter hospitalization, less perioperative morbidity, and similar early- and long-term efficacy compared with open revascularization.

Keywords: Percutaneous transluminal angioplasty; surgery; thrombectomy; critical limb ischemia; hybrid procedure; tobacco use

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H i i j n i j t u r

1. A patient had a long segment of total occlusion to the proximal right common iliac and anterior tibial artery.
2. The treatment is a combination of percutaneous transluminal angioplasty (PTA) using vascular stent and the Fogarty thrombectomy.
3. Hybrid procedure can treat multilevel artery occlusive diseases, with shorter hospitalization, less perioperative morbidity, and similar early- and long-term efficacy.

INTRODUCTION

Critical limb ischemia (CLI) is a manifestation of chronic peripheral arterial disease characterized by complaints of typical ischemic pain during resting. This condition requires immediate management to prevent amputation of the lower extremity. Revascularization is the most effective method in CLI cases, which may be performed using endovascular techniques or open operative techniques (Tendera et al. 2011, Primasari et al 2022).

Jung et al. (2018) studied 38 patients with CLI related to multistage peripheral arterial disease in 43 limbs that were treated with a one-stage hybrid interventional procedure. The primary and secondary patency rates were at 24 months, and the limb salvage rate was high.

Percutaneous transluminal angioplasty (PTA) and stenting procedures are methods of endovascular revascularization. These are minimally invasive procedures performed in peripheral arterial disease (PAD) cases, such as CLI and intermittent claudication (Norgren et al. 2007). Some advantages of the PTA procedure are low complication rate (0.5% to 4%), technically high successful rate, even in the case of a long occlusion, and clinically acceptable outcomes. PTA procedure is the standard of revascularization in aortoiliac, femoropopliteal, and other below-the-knee blood vessel cases in various vascular intervention centers (Thomas et al. 2015).

In the last few years, hybrid procedure has been developing rapidly. Hybrid technology was first reported in the 1970s (Porter et al. 1973). Since then, most studies have examined common femoral artery endarterectomy or femoro-femoral bypass in combination with endovascular infusion therapy. They reported long-term outcomes comparable to open surgery, with similar or lower morbidity and mortality (Aho & Venermo 2012, Zhou et al. 2014).

The hybrid procedure is a combination of endovascular revascularization with open operative techniques performed simultaneously. A hybrid of open and endovascular procedures can be performed in the same setting or as multi-step procedures. A simultaneous hybrid surgery is performed under fluoroscopy. A staged approach is associated with longer hospital stays, higher costs, groin scarring issues, and multiple surgeries compared to simultaneous hybrid surgery. It is also associated with increased heart risk. The chance of treatment success can improve if the treatment can be confirmed immediately (Patel et al. 2014, Fekry et al. 2021). CLI patients are generally elderly, frail, and have high mortality. With this in mind, a simultaneous hybrid procedure is a viable and effective treatment for CLI patients with multilevel and high-risk atherosclerosis. Recently, a hybrid of femoral endarterectomy and endovascular therapy for multistage occlusive arterial disease was established. Concurrent common femoral artery endarterectomy (CFE) and endovascular therapy (EVT) for iliac or superficial femoral artery lesions has been proposed as a valid alternative technique in opening the aortofemoral or infrainguinal bypass grafts (Nelson et al. 2002, Patel et al. 2014). The hybrid procedure has begun to be a choice along with the development of vascular imaging system in the operating room and the development of endovascular expertise. Some types of re-vascularization in hybrid procedures can be divided into bypass surgery or thromboendarterectomy combined with catheterization-based endovascular interventions to increase inflow and outflow in the vessels (Norgren et al 2007).

This study reported a case of a CLI hybrid procedure performed on a 53-year-old male patient with clinical findings of right leg pain for approximately 30 days, with a physical examination that revealed a low temperature and remarkable non-palpable pulses in the right femoral, posterior tibial, and dorsalis pedis arteries.

CASE REPORT

A patient, Mr. S, a 53-year-old male patient from Tuban, East Java, Indonesia, was admitted to Dr.

Soetomo General Academic Hospital, Surabaya, Indonesia, to carry out a catheterization of the heart and right leg blood vessels. The patient complained right leg pain since the last 30 days with left chest pain two months before being hospitalized. The chest felt burning sensation, especially with activities and improved with rest. Past medical history showed that the patient had risk factors, i.e. hypertension for 5 years, type 2 diabetes mellitus for 5 years, newly discovered dyslipidemia, and heavy smoking for 20 years. The patient claimed to visit the doctor regularly and take medication regularly in the last 5 years.

The physical examination showed good general condition, sound mental health, blood pressure of 120/80 mmHg, regular pulse of 70 per minute, respiration rate of 18 per minute, and afebrile condition. The head and neck examination did not show anemia, jaundice, cyanosis, and dyspnea. The jugular venous pressure (JVP) did not increase. The physical examination of the heart showed an apex beat (ictus cordis) on the left intercostal space (ICS) VI along the midclavicular line, single S1 and S2 heart sound regularity, while no murmur, gallop, or extrasystole were obtained. The pulmonary examination showed vesicular breath sounds in both lung fields, while rhonchus and wheezing were not found. The examination of the abdomen showed suppleness and normal bowel sounds, meanwhile the liver and spleen were not palpable. Both upper extremities were warm, dry, and red, with no presence of edema. The right lower extremity showed reddish skin from the knee to the toe tips. Palpation did not show from the right femoral artery to the right dorsalis pedis artery. The Ankle Brachial Index (ABI) values were 0.58 in the right lower extremity and 0.9 in the left lower extremity.

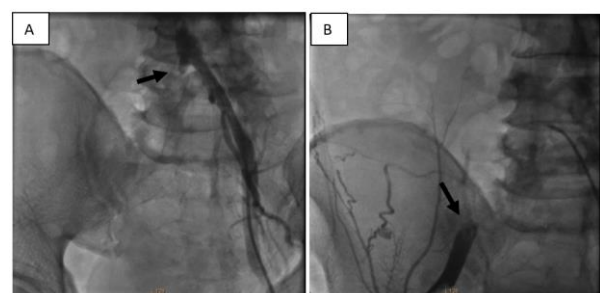


Figure 1. (A) Results of an angiography examination showing total occlusion of the right proximal common iliac artery (arrow) from an anterior approach; (B) total occlusion of the right external iliac artery (arrow) seen from a retrograde approach

The admission electrocardiogram (ECG) examination showed a sinus rhythm of 75 beats per minute, normal axis, and inferior occlusion myocardial infarction (OMI). The chest X-ray examination showed a cardiomegaly, with cardio thoracic ratio (CTR) of 59%, and lung conditions within normal limits. The laboratory test showed a hemoglobin (Hb) of 13.0 g/dl, a leukocyte count of 7,900 cells/ μ L, a platelet count of 290,000/ μ L, a serum glutamic-oxaloacetic transaminase (SGOT) of 30 U/L, a serum glutamic pyruvic transaminase (SGPT) of 30 U/L, a blood urea nitrogen (BUN) of 10 mg/dL, a streptokinase (SK) 1.0 mg/dL, a serum sodium concentration of 135 mmol/L, a potassium level of 4.3 mmol/L, a chloride level of 100 mmol/L, a random blood sugar level of 180 g/dL, a non-reactive hepatitis B surface antigen (HbsAg), a non-reactive hepatitis C virus (HCV) antibody, a partial thromboplastin time (PPT) of 10.6 seconds, and an activated partial thromboplastin time (aPPT) of 27.1 seconds. The echocardiographic examination showed that the valves had no abnormalities, the dimension of the four heart chambers was within normal limits, the decrease in left ventricular systolic function was 54%, and thrombus and intracardiac vegetation were not present. The segmental analysis of the left ventricle showed a ventricular hypokinesia and a concentric left ventricular hypertrophy (LVH). The vascular Doppler ultrasound showed a decreased peak of systolic rate of the right femoral artery and right popliteal artery, while no thrombus was found in the evaluated arterial and venous system. Non-specific lymphadenopathy was found in the inguinal region and right proximal femur.

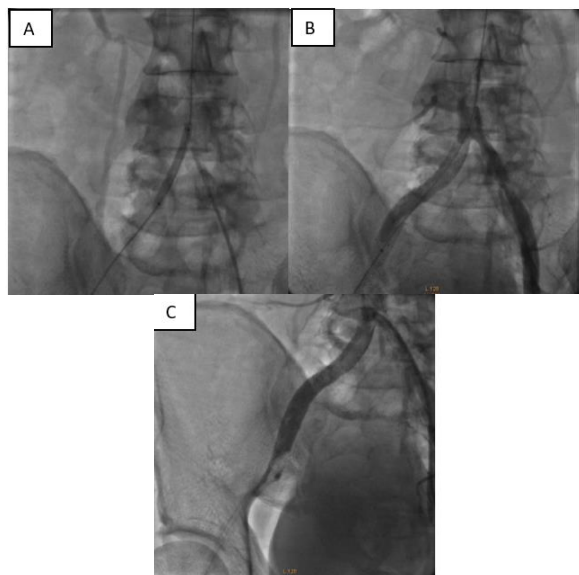


Figure 2. (A) The process of placing and inflating balloons in the right common iliac artery up to the right common femoral artery. (B) The process of placing and expanding vascular stent in right common iliac artery. (C) Multiple thrombus observed along the right common iliac artery up to the right common femoral artery

The patient underwent inferior lower extremity PTA procedure and coronary angiography with the following results. In the right lower extremity, the chronic total occlusion (CTO) was proximal to the common iliac artery. A non-significant stenosis of 40% was found in the popliteal artery. CTO was also seen in the anterior tibial artery. In the left lower extremity, a non-significant common iliac artery stenosis of 20% and a non-significant internal iliac artery stenosis of 40% were found. Non-significant stenosis was also present in the common femoral artery. The distal part of the common femoral artery was not evaluated. The coronary angiography results indicated a single-vessel disease (SVD).

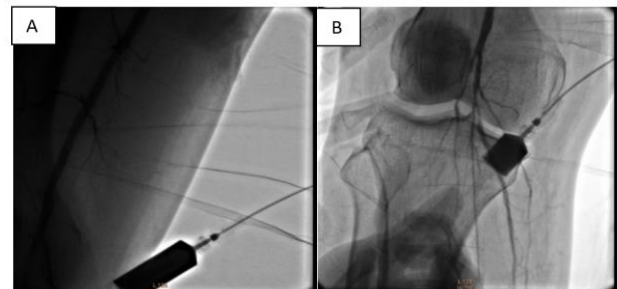


Figure 3. (A) A non-significant stenosis of 40% seen in the popliteal artery; (B) CTO observed in the anterior tibial artery.



Figure 4. Thrombus after the Fogarty thrombectomy procedure



Figure 5. Vascular stent migration appears more proximal in the aorto-iliac bifurcation.

DISCUSSION

This report provides an overview of the management of CLI with complex and multilevel lesions using a minimally invasive approach, the hybrid procedure. The hybrid procedure in CLI cases has been developed and until now the success rate has reached up to 93%-100% (Kwa et al. 2011). The most common typical location of atherosclerosis is the bifurcation of the common femoral artery. If atherosclerosis occurs in common iliac artery, the use of endovascular method in the revascularization is more appropriate. The method has a high success rate, a lower rate of complications, and a better long-term prognosis. However, the presence of lesion in common femoral artery poses many challenges if endovascular method is performed. The first reason is that the lesion often involves both branches of the common iliac artery, the internal iliac and external iliac. In addition, the placement of balloon angioplasty in common femoral artery may cause closure of the deep femoral artery if the guidewire is placed on the superficial femoral artery. The second reason is that the common femoral artery lesions in the groin is strongly affected by high and continuous mobility or movement, so that any installed stent will be vulnerable to fracture complications.

The lesion in this reported case belonged to the aortoiliac occlusive disease (AIOD) lesion type. AIOD lesion often involves lesions in distal sites and common femoral arteries. It also has a high success rate of blood vessel patency (80%-83%) if a combined procedure of angioplasty and stent placement in iliac artery (as the first line therapy) and arterial reconstruction in the distal part (hybrid) is performed (Mustapha et al. 2014).

Diagnosis

Critical limb ischemia (CLI) is considered as the most severe in the peripheral arterial disease (PAD) pattern. It is associated with a high risk of major amputation, death, and cardiovascular events (Murabito et al. 2002, Uccioli et al. 2018). CLI is a clinical manifestation of peripheral arterial disease (Rutherford II, Fontain III classifications) characterized by resting ischemic pain and accompanied by ischemic lesion due to blockage of peripheral arteries. This condition is chronic and must be distinguished from acute limb ischaemia (ALI) (Norgren et al. 2007, Tendera et al. 2011).

The mortality rates of reported cases were 20% within 6 months after the diagnosis and 50% at 5 years (Stoyioglou & Jaff 2004, Adam et al. 2005). This

excessive mortality may be related to the systemic cardiovascular diseases, including coronary artery disease and cerebrovascular arterial disease (Caro et al. 2005, Steg et al. 2007). Furthermore, CLI is associated with peripheral complications, such as ulceration, gangrene, infection, and a high risk of lower limb amputation estimated in non-treatable patients (Norgren et al. 2007, Abu Dabrh et al. 2015). Patients with CLI have three times higher risk of myocardial and stroke infarction (Mustapha et al. 2014). The incidence of CLI reaches 500 to 1000 per million people per year, with the highest frequency occurs in smokers, elderly individuals, and those with diabetes mellitus. The amputation in CLI cases ranges from 5% to 20% in patients who cannot undergo revascularization, those with neurological disorders and are unable to mobilize. In contrast, the success rate of CLI cases that can be revascularized can reach 90%.

The establishment of CLI diagnosis is based on history, physical examination, and investigations. Patient history reveals pain, even during a resting position, that lasts for more than two weeks. Physical examination shows ischemic or gangrene lesions, which indicate chronic vascular occlusion. The Ankle Brachial Index (ABI) examination can also be used in the diagnostic process. CLI is diagnosed if the ABI examination produces a ratio less than 0.9 and absolute ankle pressure less than 50-70 mmHg. Another examination is transcutaneous oxygen pressure of less than 30 mmHg, which can be used not only for diagnosis and prognosis, but also for determining amputation level. Other investigations that can be used are exercise tests (treadmill test), Doppler Ultrasonography (DUS), Computed Tomography Angiography (CTA), and Magnetic Resonance Angiography (MRA) (Tendera et al. 2011).

The classification of lesions according to the 2007 Trans-Atlantic Inter-Society Consensus Document on Management of Peripheral Arterial Disease (TASC II) had been subjected to several revisions as compared to the initial version. The changes were based on technological progress. However, the basic principle of the classification has not changed. The basic principle is based on revascularization techniques. Type A lesions are lesions that can provide remarkable outcome if endovascular revascularization is performed. Type B lesions are lesions with a choice of first-line revascularization by means of endovascular method, and, if needed, can use open operative techniques in the same anatomical segment. Type C lesions may have a good prognosis in the long term if revascularization is done using open operative techniques. This type of

endovascular technique in type C is only used in patients at high risk without adequate distal vein or vascularization. Type D lesions do not produce good results if revascularization with endovascular techniques is performed (Norgren et al. 2007, Klein et al. 2014).

The Trans-Atlantic Inter-Society Consensus Document on Management of Peripheral Arterial Disease (TASC) has provided management guidelines according to the classification of lesions. However, patients with CLI often have multiple anatomical lesions, so the use of lesion classification is sometimes difficult to apply. The management of revascularization is still based on a comprehensive evaluation of individual patient and the characteristics of the lesions and target lesions. In the patient of this case study, the angiography revealed type C vascular lesions involving the common iliac artery, external iliac artery, common femoral artery, and internal iliac artery.

Management

According to the 2011 European Society of Cardiology guidelines, the initial management of CLI, if possible, is immediate revascularization (class of recommendation (COR) I; level of evidence (LOE) A). The revascularization technique recommended as the first line is the endovascular technique (COR IIB; LOE B) (Tendera et al. 2011). The TASC II data showed that the management of 2,222 iliac artery cases (76% intermittent claudication cases and 24% CLI cases) using angioplasty procedures had technical success rate of 96%. Follow-ups after one, three, and five years show that the success rates of blood vessel patency managed with angioplasty were 86%, 82% and 71%. Other research on 505 aortoiliac cases managed with angioplasty and/or stent procedures showed that the success rate after 9 years was 98%, with only 0.5% mortality rate after 30 days (Norgren et al. 2007, Scheinert & Schmidt 2011).

In general, endovascular procedure is not performed as a prophylaxis procedure in asymptomatic patients. Data showed that until now there has been no other method besides the installation of stents to increase blood vessel patency during angioplasty (Scheinert & Schmidt 2011). The achievement of optimal blood vessel patency after angioplasty is higher if it is performed on the common iliac artery. The patency will be lower if the angioplasty is carried out more distally, especially if the lesion is long, multiple, and wide, and the patients suffer from diabetes and kidney failure (Stone & Cambria 2005).

The use of drug-eluting balloons (DEB) is promising. However, data supporting its use are still very limited in general population. The primary goal of stenting is preventing residual stenosis, extensive recoil, and dissection, while also improving long-term vascular patency. The installation of stent should avoid areas with sharp angles, such as the groin and knee, although special stents have now started to develop. In addition, it is not recommended for vascular stents to be installed in sites that can be used as a ground zone in the implementation of bypass procedures (Scheinert & Schmidt 2011, Zou et al. 2012). The strategy of installing primary stenting on lesions of the external iliac arteries using self-expandable stent is more recommended than provisional stenting in terms of the risk of dissection and elastic recoil (Stone & Cambria 2005).

Choosing which strategy to penetrate the lesions in CTO cases with anatomic variations greatly affects the level of success. The determination of intervention strategies using retrograde or antegrade techniques is based on the lesion configuration and the presence or absence of hibernating lumen (HL). The HL is a patent arterial lumen segment that is located between two CTO caps and has a heterogeneous calcium distribution. If HL is present, the CTO cap needs to be identified to determine the approach of lesion penetration, whether antegrade or retrograde. The next step is to determine the configuration of proximal and distal CTO cap surface, which can be concave or convex (Figure 5). In general, the intervention approach follows the concave form of the CTO cap surface, so that it can increase the likelihood of success in penetrating CTO lesions (Hardman et al. 2014).

Aortoiliac occlusive disease (AIOD) often involves lesions on the distal side and common femoral artery. It has a high success rate of blood vessel patency (80%-83%) if a hybrid procedure of angioplasty and arterial stenting (first line), as well as simultaneous operative reconstruction of the distal artery, is performed. AIOD lesion indicates a need of hybrid procedure if it extends into the common femoral artery, if there is a long occlusion lesion in the external iliac artery, and if a stent is to be installed. Hybrid procedure is used to correct vascular inflow and outflow. In AIOD lesion, inflow is corrected by performing endovascular procedure in the aortoiliac and open surgery in the distal artery, especially along the common femoral artery to the distal part. In the patient of this case study on hybrid procedure, the PTA stent was installed in the right common iliac artery, while the Fogarty thrombectomy

was performed on the distal part of the common femoral artery.

Complications

Percutaneous transluminal angioplasty (PTA) in the iliac artery, whether or not accompanied by stents, is a safe procedure, although complications can still occur afterwards. Complications of PTA in iliac arteries, although rare (7.9% to 23.7%), can cause significant disability (Ahmed et al. 2005). Some complications are classified into two, those related to the procedures performed and those related to the installed equipment.

Complications related to PTA include complications in the entry point of the procedure, dissection, rupture or perforation, aneurysm/pseudoaneurysm formation, distal embolization, and closure of internal iliac artery. Complications associated with stents attached are stent thrombosis, stent migration, stent crush, and infection. In this reported case, the complication that occurred was the migration of the stent, which moved closer to the proximal part of the right aortoiliac bifurcation.

Prognosis

A study by Nelson et al. (2002) showed that stenting procedures in external iliac arteries combined with open surgery on common femoral arteries provided satisfactory outcome, reaching 100% success rate technically and hemodynamically at the beginning after the procedure. After a year, the success rate of the vascular patency reached 84% and 97%. The technical success occurs if the residual stenosis found to be less than 30% and without complications, such as embolism or thrombosis. Whereas, the hemodynamic success arises from the Ankle Brachial Index (ABI) value increase of more than or equal to 0.01. Another study by (Cotroneo et al. 2007) also provided similar results, with the success of vascular patency after two years reached 79% and 86%.

Strength and limitation

By finding critical limb ischemia in the patient in this study who has a history of insulin-dependent diabetes and long-term tobacco use, this case report can contribute to recent studies on surgery. This study also provides additional evidence that efficient therapies using open surgery and a hybrid of endovascular procedures, revascularization

CONCLUSION

A 53-year-old male patient was reported with a history of hypertension risk for 5 years, type 2 diabetes mellitus for the past 5 years, newly discovered dyslipidemia, and heavy smoking for 20 years. The patient was admitted to the hospital with complaints of right leg pain since the last 30 days, accompanied by left chest pain for two months before admission. Chest burning occurred especially during activities and improved with rest. The Ankle Brachial Index (ABI) values were 0.58 in the right extremity and 0.9 in the left extremity. PTA procedure on the right lower extremity revealed a CTO that was proximal to the common iliac artery, a non-significant stenosis of 40% in the popliteal artery, and a CTO in the anterior tibial artery. A hybrid procedure using the PTA stent and the Fogarty thrombectomy was performed simultaneously with satisfactory results.

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Patient's consent for publication

The patient signed the informed consent form and agreed that this case report is published.

Conflict of interest

I had no conflict of interest in this research.

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Author contribution

Yudi Her Oktaviano wrote, revised, and edited the methodology and manuscript, and also collected the sources used.

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