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Expanding Role of Endovascular Therapy for Peripheral Arterial Disease

Yoshiaki Yokoi

Abstract: *Panvascular disease:* In peripheral arterial disease (PAD), Cardiovascular multimorbidity, at least two major vascular beds is frequent occurring. The risk of a major vascular event was twice as high. A panvascular concept of an interdisciplinary integrated management of these patients should be introduced in PAD population. *Aorto-Iliaic artery disease:* TASC document offers sensible guidelines. However, the current options are modified constantly. Even in TASC (C), (D) can be safely treated via endovascular approach. Revascularization of iliac occlusive diseases shows similar initial technical success rates for open versus percutaneous transluminal angioplasty. *Femoropopliteal artery disease:* Endovascular interventions for TASC (C) and (D) lesions are associated with restenosis/occlusion rates that are at least as good as those of open femoropopliteal bypass surgery from historical, previously published series. Self-expanding stents produce acceptable outcomes for treatment of SFA disease. Nitinol stents provides good long-term primary and assisted-primary patency. Poorer patency rates are associated with TASC (D) lesions and poor initial runoff score. *Infrapopliteal artery disease:* Limb salvage rates with infrapopliteal percutaneous transluminal angioplasty (PTA) are high enough that these techniques are offering an alternative to bypass surgery. Current patency rates from infrapopliteal PTA can be improved further by new devices and close patient surveillance for early reintervention. *Conclusion:* In contemporary practice, endovascular techniques are replacing surgical bypass as the first-line revascularization strategy for PAD, based on high technical success rates and low rates of procedure-related morbidity and mortality. Future efforts should focus on early detection of PAD patients and in these PAD patients, other vascular disease should be correctly diagnosed. And open surgical procedures can be reserved for lesions technically unsuitable for endovascular procedures and patients who do not demonstrate clinical improvement after repeated endovascular therapy.

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Key words: peripheral arterial disease, endovascular therapy

Peripheral arterial disease (PAD) usually caused by atherosclerosis, is defined as an obstructive arterial disease of the lower extremities that reduces arterial flow during exercise or, in advanced stages, at rest. It may appear as an asymptomatic arterial disease with abnormal ankle brachial index, or intermittent claudication, or critical limb ischemia. The spectrum of PAD is not a continuum. Patients who present with critical limb ischemia may have experienced minimum symptoms. PAD results in limitation of exercise and walking ability, described as intermittent claudication. Patients with PAD are physically impaired and have a higher risk of cardiovascular events.[1] Therefore, the treatment goals are aimed at decreasing their cardiovascular risk, particularly

Department of Cardiology, Kishiwada Tokushukai Hospital, Osaka, Japan

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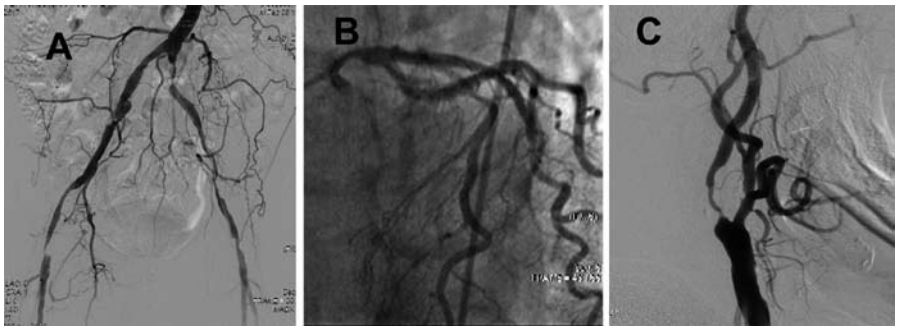

Figure 1 78 year old male, Severe claudication.
A: Severe stenosis in bilateral iliac artery.
B: Left main trunk lesion in left coronary angiography.
C: Asymptomatic right internal carotid artery.
Angiogram were performed at the time of iliac artery intervention. Pan vascular disease were noted in atherosclerotic disease.

carotid, coronary and renal artery disease should be paid attention and to be intervened. There have been significant pharmacological breakthroughs in the treatment of PAD that increases blood flow to the ischemic limb.[2] Revascularization is most beneficial for patients with lifestyle limiting symptoms, acute or chronic limb ischemia with resting pain or nonhealing ulcers.[3] Although bypass surgery continues to play an important role for revascularization for PAD, endovascular therapy has markedly improved the treatment options of PAD. In the following review article I will discuss about the role of endovascular therapy for PAD.

Panvascular disease

Atherosclerosis manifests as a broad spectrum of clinical pathology involving peripheral vascular circulation. PAD and coronary artery disease (CAD) have an important negative impact on each other. Despite the increased cardiovascular morbidity and mortality risk of patients with PAD, Other peripheral vascular disease (PVD) were underdiagnosed and undertreated of cardiovascular risk factors in patients with PAD, we should take an active role in the care of patients with global atherosclerotic disease.[4] Other than CAD, the areas of particular interest are renal artery stenosis and carotid artery stenosis. Both lesions are closely related to vascular and renal event. PAD causes reduction in exercise tolerance and limitation in arterial access. In **Fig. 1**, a 78 year old man with the typical claudication. The angiography showed the bilateral aortoiliac artery lesions (**Fig. 1A**). Coronary angiography revealed left main stenosis (**Fig. 1B**). In this patient, the significant stenosis in right internal carotid artery was found (**Fig. 1C**). These angiography was performed prior before iliac artery intervention.

Cardiovascular multimorbidity, arbitrarily defined as a clinically relevant disease of at least two major vascular beds in a single individual is frequent occurring in 30% to 70% of patients depending on the patient population.[5] The risk of a major vascular event was twice as high in patients with panvascular involvement than in those who only had one affected artery.[5] Management of patients with cardiovascular multimorbidity is complex requiring an interdisciplinary consensus and coordination. A panvascular concept of an interdisciplinary integrated management of these patients is introduced. The collaboration with multidisciplinary specialists, including cardiologists, vascular surgeons and neurologists is advisable for the treatment of PAD.

Aorto-Iliac artery disease

The TransAtlantic Inter-Society Consensus (TASC) document offers sensible guidelines for the treatment of both suprainguinal and infrainguinal disease.[6] The goal of TASC guideline was to indicate the best form of treatment, endovascular (TASC A) or surgical (TASC D), for patients with lower-extremity

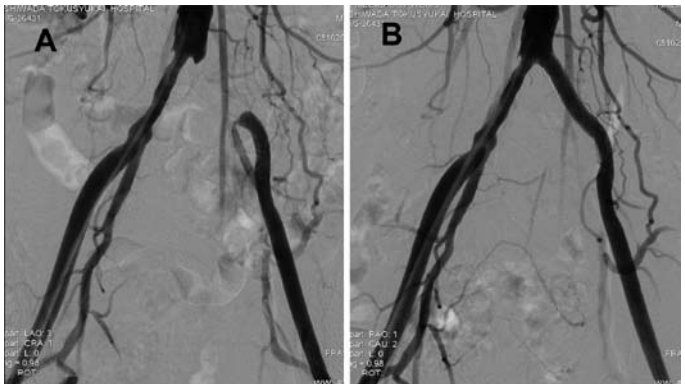

Figure 2 Common iliac artery occlusion: TASC (B).
69 year old male presented typical claudication. Angiogram revealed left common iliac artery occlusion (A). In TASC II, this lesion is classified B and endovascular therapy is recommended. Occlusion was easily recanalized and stented (B).

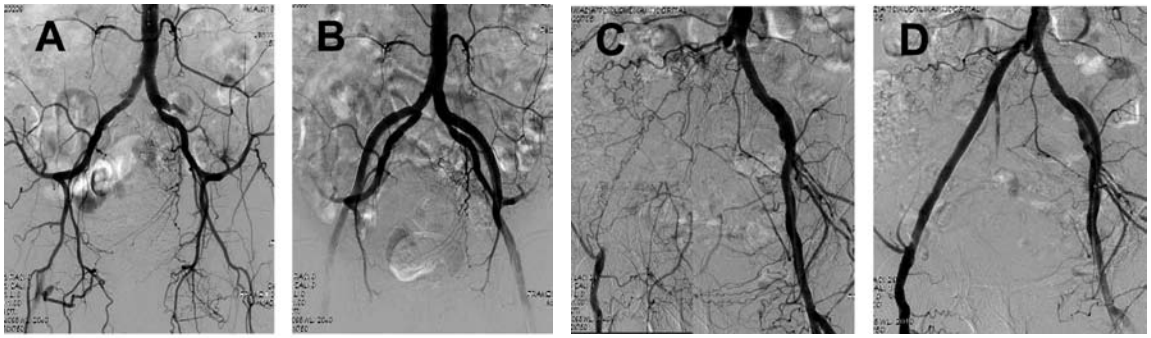

Figure 3 Endovascular therapy in TASC (C) and (D) of iliac artery lesions.
In TASC II, bilateral common iliac artery occlusion and long iliac artery occlusion are classified in (C) and (D). In A, bilateral common iliac artery occlusions were recanalized via transbrachial approach and succefully stented. Long iliac artery occlusion were crossed via a left femoral approach.

arterial occlusive disease based upon highest levels of evidence in published reports. Bilateral/diffuse suprainguinal disease, aortobifemoral bypass remains the best option. Even in TASC II,[7] long iliac occlusions were classified to TASC (C) or (D). However, the current options in therapy are modified constantly. Therefore, published recommendations might be not up-to-date. In consideration of the number of interventions which are performed in Japan, a trend towards less invasive treatment becomes apparent. Iliac stenoses should be treated by angioplasty with stenting. Unilateral iliac occlusions can be treated by primary stenting (**Fig. 2**). Even in TASC (C), (D), bilateral common iliac occlusions and long iliac total occlusion can be safely treated via endovascular approach,[8] (**Fig. 3**). Bilateral common iliac artery occlusion was classified TASC (C) (**Fig. 3A, B**). Recanalization was performed through brachial approach and recanalized in both common iliac artery occlusions (**Fig. 3C, D**). Iliofemoral or femorofemoral bypass may be the best option when the disease extends down into the common femoral artery. In our iliac artery stenitng, Rutherford class ware significantly increased in post procedure and increased ABI were maintained and increased in long term (**Fig. 4, 5**). In general, a comparison of techniques for revascularization of iliac occlusive diseases shows similar initial technical success rates for open versus percutaneous transluminal angioplasty. Conversely, surgery frequently provides greater long-term patency, although late failure of percutaneous therapies may occur but still can be treated successfully with reintervention.[9]

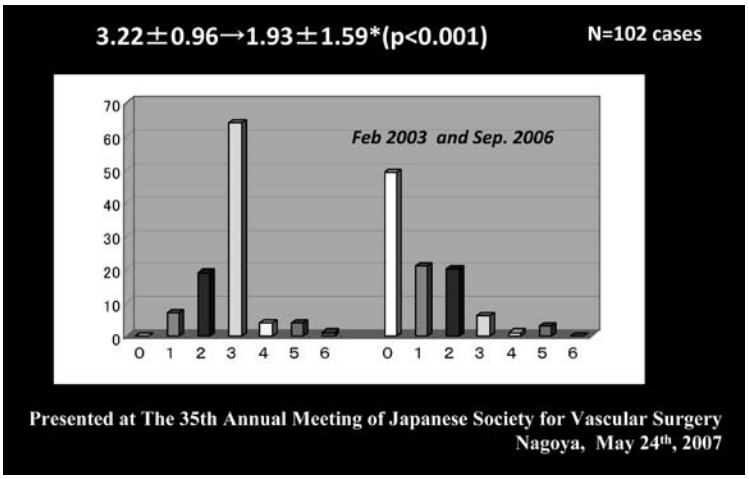

Figure 4 Rutherford class pre and post iliac artery stenting.
Rutherford class were significantly increased in post stenting.

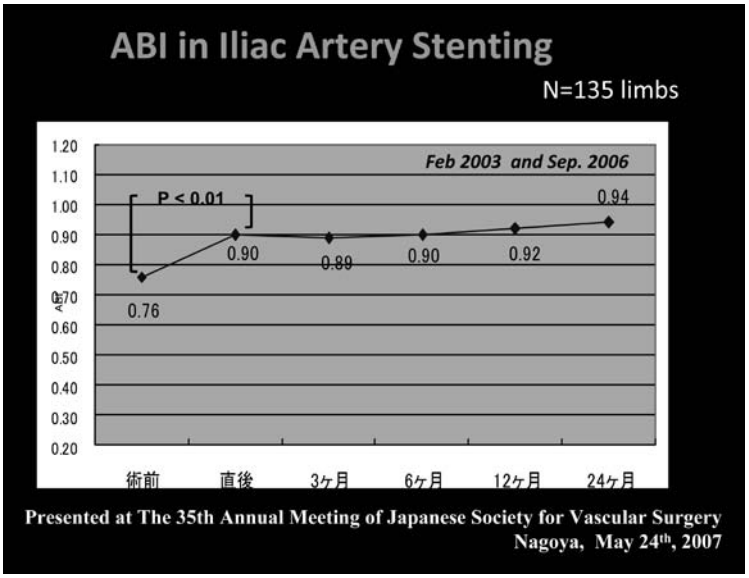

Figure 5 Ankle Brachial Index (ABI) in iliac artery stenting.
ABI significantly increased after intervention. Increased ABI were maintained in longterm and further increase of ABI were observed.

Femoropopliteal artery disease

Medical management and open surgical bypass have been the traditional options for superficial femoral artery (SFA) occlusive disease. Endovascular revascularization of the SFA, however, has been increasingly utilized during the past decade. Results of endovascular interventions for SFA stenoses and/or occlusions have been mixed. In addition, several different techniques have been developed to address similar lesions. This added complexity makes it difficult to compare endovascular therapies to surgical bypass. A recent randomized trial suggested nitinol self-expanding stents (SES) were associated with reduced restenosis rates compared with simple percutaneous transluminal angioplasty (PTA).[10] TASC (C) lesion can be easily recanalized by using nitinol stenting (**Fig. 6**). Long occlusive TASC (D) lesions can be recanalized by applying duplex echo (**Fig. 7**),[11] Endovascular interventions for TASC II (B) and (C) lesions are associated with restenosis/occlusion rates that are at least as good as those of open femoropopliteal bypass surgery

Figure 6 Endovascular therapy in TASC (C) of superficial artery (SFA) lesion.
TASC (C), long SFA stenotic lesion were safely intervened by ballooning and stenting with no residual stenosis.

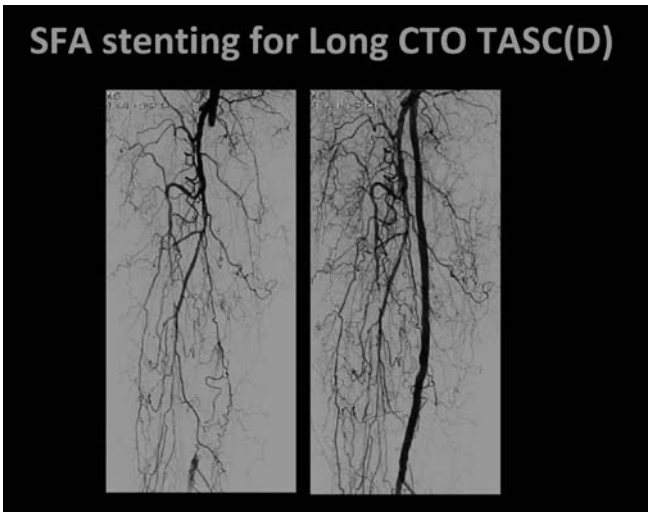

Figure 7 Endovascular therapy in TASC (D) of superficial artery (SFA) lesion.
TASC (D), long SFA occlusoin were recanalized and succeful stented.

from historical, previously published series. Furthermore, overall assisted-patency rates are excellent, although low preoperative ABIs continue to be associated with worse outcomes.[12] Self-expanding stents produce acceptable outcomes for treatment of SFA disease. In our SFA SMART stent implantation, long CTO showed low patency rate (**Fig. 8**). SFA recanalization with a standardized implantation technique and nitinol stents provides good long-term primary and assisted-primary patency. Poorer patency rates are associated with TASC (D) lesions and poor initial runoff score.[13]

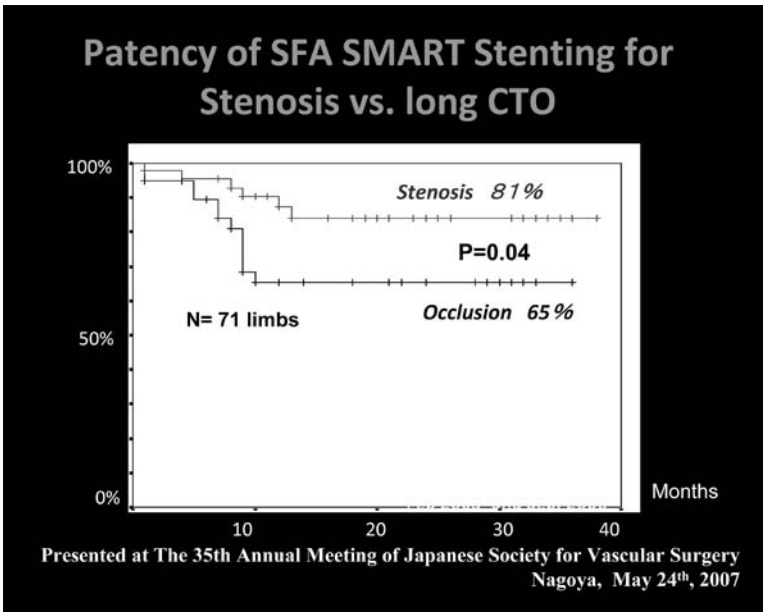

Figure 8 Patency of SFA SMART Stenting; Stenosis vs. long CTO.
Long term patency is significantly worse in occluded lesions.

Infrapopliteal artery disease

Patients with critical limb ischemia (CLI) are typically elderly with multiple co-morbidities and limited life expectancy. CLI due to infrapopliteal lesions are often no good candidates for infrageniculate bypass surgery (IBS), as they often present with prohibitive comorbidities, inadequate conduit, and lack of suitable distal targets for revascularization. Therefore, CLI patients due to blockage of below-the-knee (BTK) arteries are in benefit of the endovascular approach. In **Fig. 9**, a 65 year old female presented for resting pain. Angiogram revealed three tibial vessels were occluded and found no indication of distal bypass. Balloon angioplasty recanalized three vessels and her resting pain diminished after procedure (**Fig. 9**). Endovascular approach offers the advantages of local anesthesia, potentially reduced costs (even anticipating the need for reintervention in many patients), shorter hospital stays.[15] Above all, angioplasty can be applied immediately after confirming CLI. Therefore endovascular therapy is most commonly used to treat patients with CLI for limb salvage and wound healing. For the treatment of CLI, limb salvage rates with infrapopliteal percutaneous transluminal angioplasty (PTA) are high enough that these techniques are offering an alternative to bypass surgery. Clinical success is superior to angiographic patency, because once healing has occurred, should the artery restenose or occlude, collateral flow can be sufficient to preserve tissue integrity if there is no further injury. Current patency rates from infrapopliteal PTA can be improved further by proper patient selection, ensuring straight-line flow to the foot in at least one tibial vessel, and close patient surveillance for early reintervention.

Conclusion

Together with the development of new devices and with an increasing operator experience, endovascular approach has become established therapy in symptomatic claudicant and CLI, In contemporary practice, endovascular techniques are replacing surgical bypass as the first-line revascularization strategy for PAD, based on high technical success rates and low rates of procedure-related morbidity and mortality. Future efforts should focus on early detection of PAD

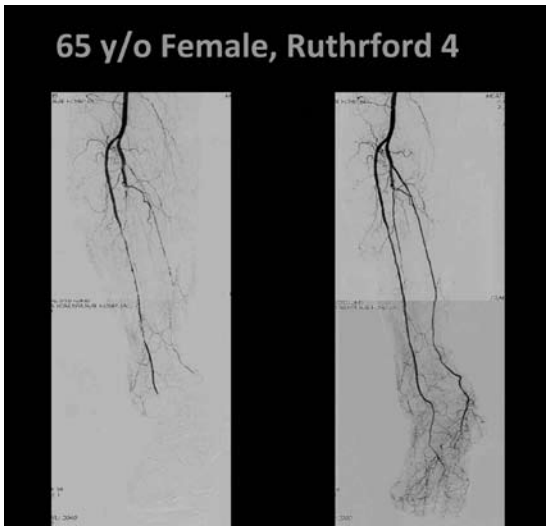

Figure 9 Infrapopliteal artery disease in critical limb ischemia.
65 year old female presented one week history of resting pain. She has diabetes and was on hemodyalysis. The angiogram showed three tibial vessels were occluded and considered to be a not good candidate for distal bypass (A). However, angioplasty were easily performed and resulted in the establishment of three tibial vessels (B). Clinically, after opening three tibial vessels, resting pain subsided.

patients and in these PAD patients, other vascular disease should be correctly diagnosed at the same time. And open surgical procedures can be reserved for lesions technically unsuitable for endovascular procedures and patients who do not demonstrate clinical improvement after repeated endovascular therapy.

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