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Tibiopedal Access for Lower Extremity Arterial Intervention: When to Use and How to Perform

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Tibiopedal artery access is being used with increasing frequency as an alternative access to facilitate procedural success in lower extremity arterial intervention. This technique is usually employed in the setting of critical limb ischemia and tibial artery intervention, but it may offer potential practical advantages for popliteal artery and even superficial femoral artery intervention in unique situations. As in all cases of lower extremity arterial intervention, consideration of access is important not only for initial approach to any obstructing lesion but also for exit strategy. The dorsalis pedis artery and posterior tibial artery can be readily accessed if necessary owing to their relatively superficial position in the foot or the ankle, yet their normal diameter and the presence of significant calcification (a common finding in patients with tibial occlusive disease and critical limb ischemia) can pose difficulties as well. In addition, the peroneal artery in the lower leg can be accessed percutaneously; however, its size and depth may present additional challenges. Meticulous attention to detail is paramount in avoiding complications in what may be the only distal vessel supplying the foot. This article describes common techniques in using tibiopedal artery access as a means of alternative access for successful infrainguinal intervention.

KEYWORDS Critical limb ischemia, Peripheral arterial disease, Tibiopedal access, Retrograde access techniques

Necessity is the mother of invention.

There has been growing interest in different approaches to treating lower extremity arterial occlusive disease, stimulated by numerous factors. The increasing incidence of peripheral arterial disease (PAD) in the worldwide population that is due to obesity and diabetes is well reported.[1] The overall effect of PAD on cardiovascular events and overall mortality has led to markedly increased awareness in both the medical field and the public. The general population may indeed have a longer life span,[2] resulting in patients potentially experiencing the long-term sequelae of chronic disease. In patients with PAD, this can mean progression to critical limb ischemia (CLI). A more complete understanding of the CLI epidemic and its implications on morbidity and mortality highlighted the lack of current data in the endovascular era as it applies to tibial intervention. The adaptation of existing tools and the development of new technology and techniques to address smaller vessels, longer segments, and more difficult lesions are of interest to treating physicians as well as the medical device industry. These previously mentioned factors have led to an unprecedented technology surge, affording physicians more opportunity to treat patients with PAD with an "endovascular-first" approach: a logical by-product of the technology explosion.

Techniques

Initial access for lower extremity arterial intervention (LEAI) is of utmost importance and can potentially "make or break" the success of the case. Certainly, femoral artery access (retrograde contralateral or antegrade ipsilateral) remains the commonest site for a number of reasons related to size, ease of access, familiarity, etc. However, alternative access sites must be considered in particular situations. Hostile groins from previous surgery, steep aortic bifurcations, presence of an aortic endograft, and obesity with a large panniculus are situations where femoral artery access may not be ideal and may add risk to the procedure and the patient.[3] Brachial artery access also has a higher rate of hemorrhagic complications and in

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fact is being used less frequently as radial artery access has become more popular.[4] Direct popliteal artery access has been used for LEAI in both a retrograde fashion (for superficial femoral artery and iliac artery intervention) and antegrade fashion (for tibiopedal artery intervention). Tibiopedal artery access (TPAA) is now well described as an effective and often advantageous access route for crossing complex occlusions.[5-11] This technique was initially described as a method for recanalization, but with more dedicated equipment and the miniaturization of interventional devices, definitive treatment can sometimes be performed directly from the TPAA site.

Initial Evaluation: Risks, Benefits, and Alternatives

In the context of this article, it is assumed that "routine" antegrade access across an atherosclerotic obstructive lesion has failed and the potential risks of TPAA have been considered. These risks include the usual access site issues of bleeding or hematoma, dissection, and pain, but more significantly, the risk of compartment syndrome and acute closure or thrombosis of the access vessel. Although this is fortunately infrequent, its effect on procedural and clinical outcome is potentially serious and must be taken into account. Dedicated chronic total occlusion devices, improved guidewire technology, and reentry catheters have ensured a very high rate of technical success of recanalization in various arterial segments, yet this rate is not 100% successful. In our practice, TPAA is necessary only in less than 5% of infrainguinal intervention and has been employed only in patients with CLI; it has not been necessary to perform TPAA in our patients with claudication. In those patients (who primarily demonstrate femoropopliteal disease), we have chosen popliteal or distal superficial femoral artery access to facilitate recanalization. That said, our threshold for moving to an alternative access site with failed antegrade recanalization in tibial arteries has been lowered.

Technical Considerations

With the excitement around TPAA, many authors have described their own techniques and modifications.[5-11] As is the case with any interventional or surgical technique, there are many ways to achieve technical success, and this is largely based on training and comfort level. The techniques described in this article are simply our way of using TPAA as an alternative access site for tibial artery intervention, and references to pertinent modifications of previously described techniques are made. The following 3 key elements should be considered if TPAA is being considered: patient preparation, entry strategy, and exit strategy.

Patient Preparation

Considerations regarding preparing the foot or the lower limb for access are many and include patient position or comfort; operator position, comfort, or exposure; and sterile preparation.

Patient position and comfort are issues that are important initially during access, as the pedal vessels can be quite small and incidental patient movement during access can be frustrating. Depending on the access vessel of choice, the leg can be internally or externally rotated at the hip or the foot or both to allow good visualization of the artery. It is important to support the foot in the chosen position such that the patient would be still during access. This can be achieved through use of towels or pillows beneath the sterile drape and also use of straps to secure the limb in ideal position. Judicious use of conscious sedation to minimize untimely patient movement can be invaluable in anxious patients.

Operator position and comfort is also a key consideration. To secure stable TPAA, attention should be given to where the operator will stand during access and possible treatment, the position of the image intensifier and monitors, position of ultrasound (US) (if used), and access to any antegrade access that may be needed as well. As interventionalists, we have all likely performed some kind of acrobatics during certain procedures; considering that the room setup and ergonomics of operator position before starting the procedure can improve comfort, minimize direct radiation exposure, and still allow adequate visualization of the appropriate monitors.

Sterile preparation of the access site may be considered to be routine; however, there are a few unique considerations to be taken into account. In the presence of obvious infection, ischemic ulceration, or an open wound, meticulous technique is necessary and should include a sterile preparation of the entire foot, even if the access site may be somewhat removed from the ulcer. In our laboratory, a wide, double preparation using chlorhexidine is employed. The toes are covered with a sterile towel if there is active ulceration and a drape is placed across the intended access site. Before the preparation, nitroglycerin (NTG) paste is sometimes applied to the access site to maximize vasodilatation. If this is chosen, it is applied a few minutes before application of chlorhexidine, so that it is not immediately cleared away.

Entry Strategy (Access)

Entry strategy is perhaps the most critical step in TPAA when typically an antegrade access approach has failed. Here, relevant considerations include imaging guidance and access systems.

Imaging guidance for obtaining access into the target vessel is by either US or fluoroscopy. The major advantage of US is real-time imaging without ionizing radiation. Typically, a linear, high-frequency transducer in a sterile cover is used (7 or 12 MHz) depending on the depth of the vessel. It is the operator's choice to use a transverse (axial) or a sagittal (longitudinal, "inplane") orientation for puncture. Once the artery is punctured, US can be used to follow the guidewire to the point of obstruction. However, some operators may not feel comfortable using sonographic guidance and typically resort to fluoroscopy. Fluoroscopy provides real-time imaging, but operator