

An Overview of Cryoplasty

Current and future applications of this technology show promising ability to resolve many of the troubling issues encountered in treating lower-extremity arterial disease.

BY JAMES D. JOYE, DO

Endovascular management of peripheral vascular disease has relied on the cornerstone of angioplasty for the past few decades, despite significant limitations in acute and long-term outcomes. During that time, many new devices have been evaluated and shown to have limited effect on the relentless process of restenosis. Not the least of these has been the increasing use of self-expanding nitinol stents, which improve the acute appearance of interventional procedures, but nonetheless carry their own set of limitations. The aggressive neointimal response to a foreign-body implant and its subsequent management, and the newly recognized problem of strut fracture are the most notable of the unfavorable outcomes associated with stenting. Fortunately, we have entered into a new era of vascular intervention that offers the potential of more durable solutions to arterial disease of the lower extremities.

CRYOPLASTY

Whereas many of the newer approaches to infrainguinal lesions involve complex mechanical solutions, cryoplasty represents a simple, yet effective, modification of the most common methods for vascular therapy. Cryoplasty uses nitrous oxide to optimize the dilation effects of standard angioplasty by delivering cryothermal energy to the target lesion. The beneficial effects of vascular cryotherapy include reduction of arterial dissection, limitation of vascular recoil, and promotion of positive remodeling, as well as increased apoptosis of smooth muscle cells.^{1,2} Each of these factors is known to con-

tribute to the restenosis process, and each is favorably impacted by cryoplasty.

EARLY STUDIES

The first human experience with cryoplasty in femoropopliteal lesions was reported by Fava et al in a group of 12 patients with a wide variety of lesions treated with stand-alone cryotherapy.³ Procedural success in this cohort was 93%, and the primary angiographic patency rate was 83.3% at 14±4 months. Based on these early suc-

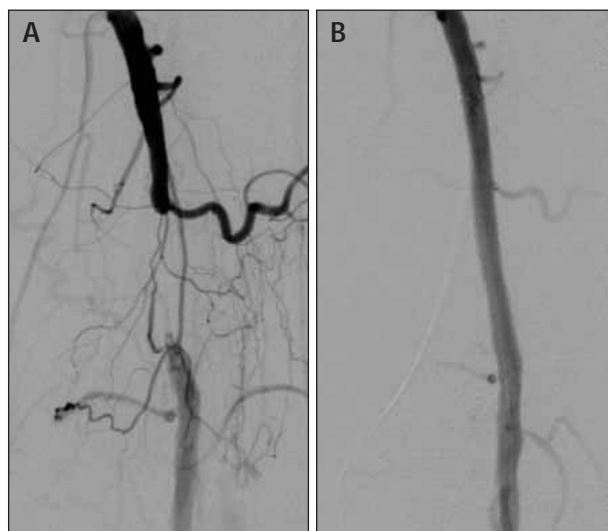


Figure 1. Baseline angiogram demonstrating chronic total occlusion of the proximal left popliteal artery (A). Final angiogram after stand-alone cryoplasty (B).

cesses, cryoplasty was evaluated on a much broader scale.

A multicenter, prospective registry using cryoplasty in 102 patients with femoropopliteal lesions completed enrollment in December 2002, under the leadership of John Laird, MD, and Giancarlo Biamino, MD. Patients enrolled in this trial had stenoses or occlusions ≤ 10 cm in length, with at least single-vessel tibioperoneal run-off. The primary endpoints of the trial were acute technical success of stand-alone cryoplasty and 9-month primary patency as judged by freedom from target lesion revascularization (TLR). Cryoplasty succeeded in achieving a $< 30\%$ acute residual stenosis and $<$ grade C dissection in 85% of the patients treated (Figure 1). In fact, the rate of significant dissection in this series was only 7%, which compares favorably to the expected rate of dissection with conventional angioplasty, reported to be nearly 45%. The primary patency rate in this study was 82.2%, despite the fact that 40% of the patients enrolled had TASC C lesions.

While the trials completed to date were not randomized against traditional angioplasty, there is no shortage of historical references that have demonstrated less favorable outcomes in similar patients followed for a similar duration. Contemporary meta-analyses of studies using angioplasty for femoropopliteal lesions generally demonstrate primary patency rates of 50% to 60% at 1 year.^{4,5} The pivotal cryoplasty trial resulted in ~50% reduction in restenosis compared to such studies.

NEW CRYOPLASTY OPTIONS EMERGE

The favorable outcomes demonstrated with cryoplasty have led to a broader application of the technology. The reduction in significant dissection rates established in the pivotal trial (and the corresponding decreased need for stenting) has identified cryoplasty as a viable treatment strategy for lesions that are best treated without an implanted stent. Arterial disease involving the distal external iliac artery, common and deep femoral arteries, ostial superficial femoral artery, and popliteal arteries are all targets that have traditionally been avoided or approached with caution for fear of suboptimal angioplasty outcomes. Cryoplasty in these locations can be expected to yield favorable acute results without compromising future treatment options, such as surgical bypass and endarterectomy (Figure 2). Furthermore, the late impact of cryoplasty on neointimal formation may result in sustained patency. This attribute of cryoplasty may help to remove some of the controversy that exists in the decision to treat femoropopliteal lesions with an endovascular approach because the main detractors have focused on suboptimal acute and long-term results with conventional PTA.

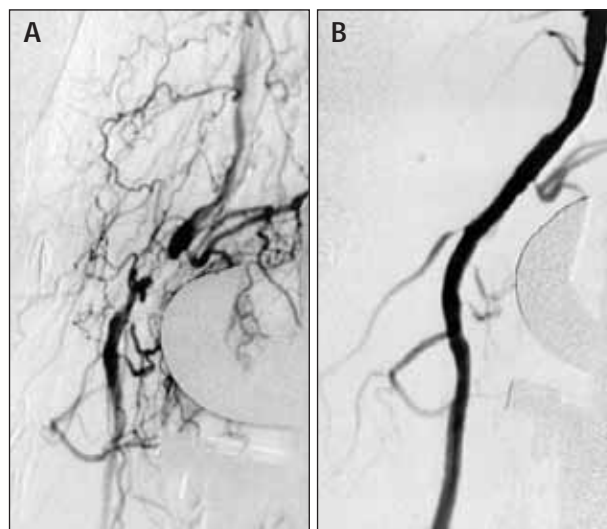


Figure 2. Baseline angiogram showing a short segmental occlusion of the midpopliteal artery directly behind a prosthetic knee replacement (A). Final angiogram after cryoplasty with an excellent acute result and no need for stent implantation (B).

IN-STENT RESTENOSIS

Although data surrounding the use of stents in femoropopliteal arteries continue to evolve, the management of in-stent restenosis remains troublesome. The aggressive neointimal response to stent implantation that is frequently observed often results in lesions that are difficult to treat by endovascular methods. At the recent annual SIR meeting in Phoenix, Arizona, we presented data based on our experience using cryoplasty on such lesions. We treated 18 patients with lesions ranging from 4 cm to 40 cm in length (mean, 14 cm) that included six in-stent occlusions. Stenoses were treated with cryoplasty alone, and occlusions were treated with a combination of either laser or excisional atherectomy followed by cryoplasty. Patients were followed for clinical events and underwent ankle-brachial index assessment and duplex imaging every 3 months. Procedural success was 94% and was accompanied by reduced diameter stenosis from a baseline of $92 \pm 13\%$ to $22 \pm 11\%$ after cryoplasty ($P < .05$). Ankle-brachial indexes improved from a baseline of 0.65 ± 17 to 0.82 ± 15 at 9 months, and clinical patency at 10-month follow-up was 78%, as judged by the composite of TLR and duplex assessment of restenosis. Although far from conclusive, these data approximate in a small series the results seen with *de novo* lesions and suggest that cryoplasty might have utility in this difficult lesion subset.

BELOW-THE-KNEE INTERVENTION

Perhaps the most important endovascular arena in

need of improved outcomes is found in tibioperoneal intervention. Classically reserved for patients with critical limb ischemia, below-the-knee intervention is drastically underutilized, despite reported limb salvage rates of nearly 90%.⁶ The stigma that prevents consideration of percutaneous intervention in these arteries is an amplified concern for angioplasty-induced dissection, a high frequency of stent occlusion, and overall patency rates at 1 year of <50%. The potential to treat these lesions with limited risk of dissection, limited need for stenting, and improved long-term patency would dramatically alter current opinion. We recently reported results of cryoplasty of 26 tibioperoneal lesions in 20 patients with critical limb ischemia in whom the technical success of the procedure was 95%. Adjunct atherectomy was used in six lesions, but no patient required stent implantation. Freedom from major amputation measured at 6 months was 95%, with one patient requiring below-the-knee amputation and another undergoing subsequent femorotibial bypass. Based on these outcomes, a multicenter, prospective trial using cryoplasty for limb salvage was recently initiated under the multidisciplinary guidance of Tony Das, MD, Bruce Gray, MD, and Thomas McNamara, MD. An additional study using cryoplasty for tibioperoneal lesions in claudicants is also being formalized.

CONCLUSION

From its inception to the present day, the data surrounding cryoplasty continue to evolve in favor of improved clinical outcomes. The ability to achieve a stent-free interventional outcome in treating lower-extremity disease represents an attractive alternative for many patients. Pending further data, cryoplasty may prove to be a significant step forward in our efforts to limit restenosis. ■

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