A Review of Drug-Coated Balloon Technology for Peripheral Vascular Disease

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Introduction

- Drug-coated balloon (DCB) technology began as an alternative to drug-eluting stents for treatment of below the knee (BTK) peripheral arterial disease (PAD).
- Unlike percutaneous transluminal angioplasty (PTA) using an uncoated balloon, DCB technologies are coated with antiproliferative agents (e.g., paclitaxel) that prevent neointimal hyperplasia and improve vessel patency.
- Previously, the safety and efficacy of paclitaxel DCB for PAD has been questioned, with concern for increased risk of death, paclitaxel embolization, and an increased major amputation rate when compared to PTA.

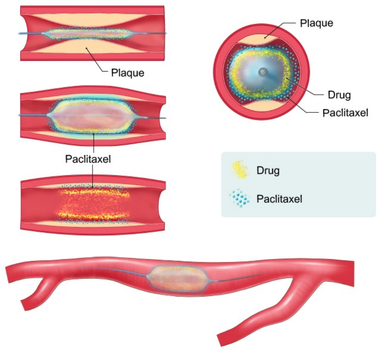

Figure 1. Schematic of an atherosclerotic blood vessel with a coated vascular balloon to prevent early thrombosis and restenosis.

Objectives

- Here, we review literature around DCB technology for BTK PAD, identify limitations of existing studies, and discuss future directions.

Methods

- A literature search was performed using the electronic database PubMed using the following terms: ([drug-coated balloon] OR [drug-eluting balloon]) AND ([below-the-knee] OR [BTK] OR [infrapopliteal]).
- Randomized controlled trials (RCTs) were prioritized for direct comparison of safety and efficacy outcomes between the investigated DCBs and PTAs.

Results

		Drug-Coated Balloon	PTA	p-value
		IN.PACT™ Amphirion (Medtronic)	Unspecified PTA	
6 months[1]	All-cause mortality, major amputation or CD-TLR (%)	17.7	15.8	0.021 (noninferiority margin 10%, 1-sided α=0.048)
12 months[1]	All-cause mortality (%)	10.1	8.1	0.551 (2-sided, α=0.048)
	All-cause mortality, major amputation or CD-TLR (%)	26.9	23.4	0.496 (2-sided, α=0.048)
	CD-TLR (%)†	11.9	13.5	0.682 (2-sided, α=0.048)
	Major amputation (%)	8.8	3.6	0.080 (2-sided, α=0.048)
60 months[2]	All-cause mortality (%)	39.4	44.9	0.727 2-sided, (α=0.048)
	All-cause mortality, major amputation or CD-TLR (%)	59.8	57.5	0.309 (2-sided, α=0.048)
	CD-TLR (%)†	29.1	24.0	0.406 (2-sided, α=0.048)
	Major amputation (%)	15.4	10.6	0.108 (2-sided, α=0.048)
		Lutonix® 014 (Lutonix)	Unspecified PTA	
30 days[3]	Major adverse limb event or perioperative death	0.7	0.6	<0.001 (noninferiority margin 12%, 1-sided α=0.025)
6 months[3]	CD-TLR (%)	8.7	18.6	<0.01 (1-sided, α=0.025)
12 months[4]	All-cause mortality, major amputation or major intervention†† (%)	7.2		
	Amputation (%)	5.2		
	CD-TLR (%)	23.2		
		Passeo-18 LUX (Biotronik)	Uncoated Passeo-18 PTA	
30 days[5]	Major adverse events††† (%)	0.0	8.3	
6 months[5]	All-cause mortality (%)	6.1	2.9	0.499 (2-sided, α=0.05)
	Major adverse events††† (%)	24.8	25.0	0.944 (2-sided, α=0.05)
	Major amputation (%)	3.3	5.6	0.631 (2-sided, α=0.05)
	TVR (%)	16.8	17.5	0.881 (2-sided, α=0.05)
12 months[5]	All-cause mortality (%)	9.4	6.0	0.575 (2-sided, α=0.05)
	CD-TLR (%)	31.3	26.9	0.805 (2-sided, α=0.05)
	Major adverse events††† (%)	41.1	39.1	0.957 (2-sided, α=0.05)
	Major amputation (%)	3.3	5.6	0.631 (2-sided, α=0.05)
	TVR (%)	34.9	30.0	0.817 (2-sided, α=0.05)
24 months[6]	All-cause mortality (%)	20.8		
	CD-TLR (%)	9.1		
	Major adverse events††† (%)	21.0		
	Major amputation (%)	9.9		

Table 1. Comparison of safety and efficacy of reviewed drug-coated balloons versus PTA. Clinically driven target lesion revascularization, CD-TLR; major adverse limb events, MALE; percutaneous transluminal angioplasty, PTA; perioperative death, POD; target vessel revascularization, TVR.
†Includes all intent-to-treat subjects instead of just the amputation-free surviving population.
††Major reintervention (i.e., bypass graft, jump/interposition graft revision, or thrombectomy/thrombolysis of the index limb involving a BTK artery)
†††Defined as all-cause mortality, major amputation, target lesion thrombosis, and TVR.

Conclusions

- Limitations of the existing literature are attributed to the high heterogeneity of treatment and control groups. Variables such as balloon design and polymer, excipients, coating technique, and antiproliferative agent and dose differ across the commercially available DCBs. Control groups also vary across studies.
- The Ranger DCB (Boston Scientific) was not included, as only data from a small, single-center study was available.
- More data on the safety and efficacy of DCBs for BTK revascularization is needed with standardized study designs. A large RCT comparing the different DCB technology would be useful for direct comparison of outcomes.

Future Directions

- Improvements of DCB technology to address complications of BTK revascularization might involve systematic modification of independent variables in DCB design, application of nanotechnology, characterization of the lesion with new imaging modalities, and/or determination of the need for specific, directed therapy.
- Beyond the DCB technology, other topics to explore include: 1) optimal duration of post-intervention dual antiplatelet therapy (DAPT) and 2) preoperative evaluation of patient sensitivity to DAPT to select the optimal medical management for the patient.

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