WELCOME *To the*

2026 SYMPOSIUM

Drug Eluting Balloons: Data update

Gordon McLennan, MD FSIR

Conflicts of Interest

DSMB: Becton Dickenson

AGILITY Trial

Connect-AV Trial

Objectives

At the conclusion of this presentation, you should be able to:

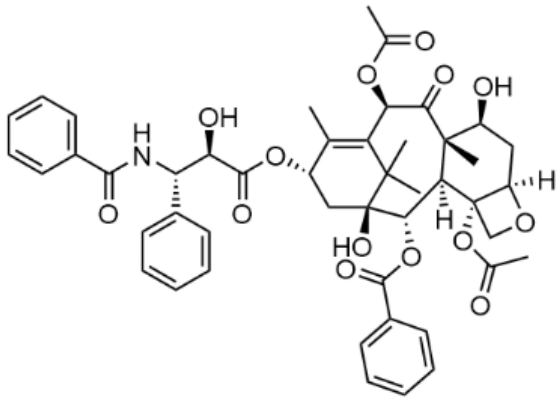
1. Summarize the data regarding target lesion patency & access circuit patency from different drug eluting balloons
2. Describe the differences in the drug eluting balloons
3. Determine how you want to integrate the used of DEB into your practice.

Drug Eluting Balloon Technology

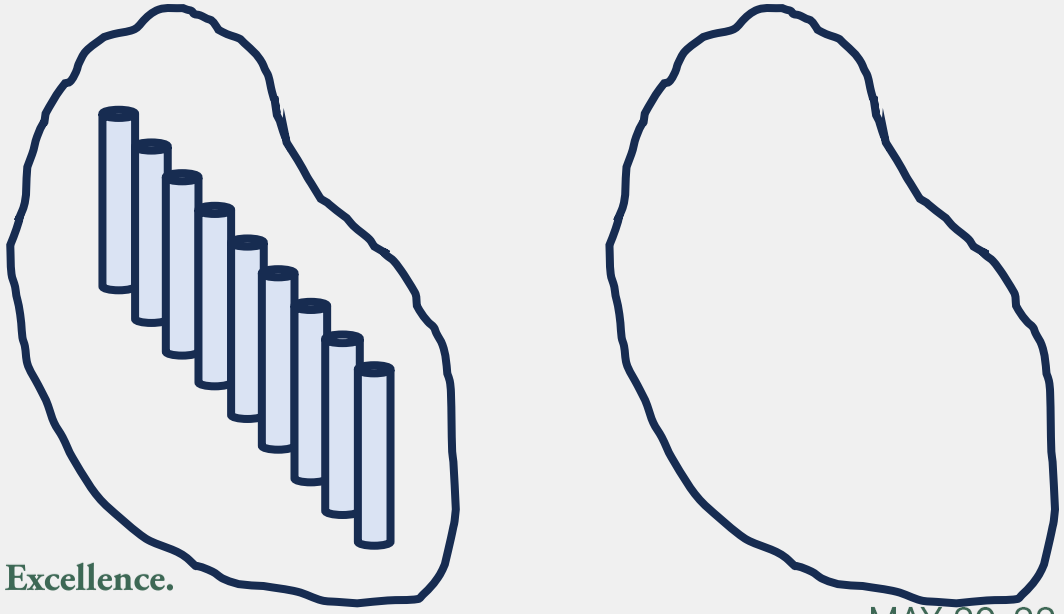
What makes a Drug Eluting Balloon

- Standard Balloon Base
- Drug to be eluted – Paclitaxel
- Excipient

Paclitaxel



- Primarily used for cancer therapy
- Derived from the Yew tree *Taxus baccata*
- Most of the tree is toxic
- Mechanism of Action:
  - Inhibition of microtubule depolymerization





Current Platforms

- Lutonix
  - 0.018” & 0.035” platforms
  - 2ug/mm2 Paclitaxel
  - Polysorbate & sorbitol excipients
- In.Pact
  - 0.018” & 0.035” platforms
  - 3.5 ug/mm2 Paclitaxel
  - Excipient is Urea
- Passeo-18 Lux
  - Passeo-18 Balloon Base
  - 3 ug/mm2 Paclitaxel
  - Butyryl-tri-n-hexyl citrate excipient (BTHC)

DCB Device	Paclitaxel dose	Excipient	Excipient properties
Lutonix	2 ug/mm2	Polysorbate & Sorbitol	Polysorbate is an amphiphilic surfactant with high hydrophilicity & Sorbitol is hyrodphilic
IN.Pact	3.5 ug/mm2	Urea	Acts as a surfactant to weaken hydrophobic effects
Passeo-18	3 ug/mm2	BTHC	Lipiphilic

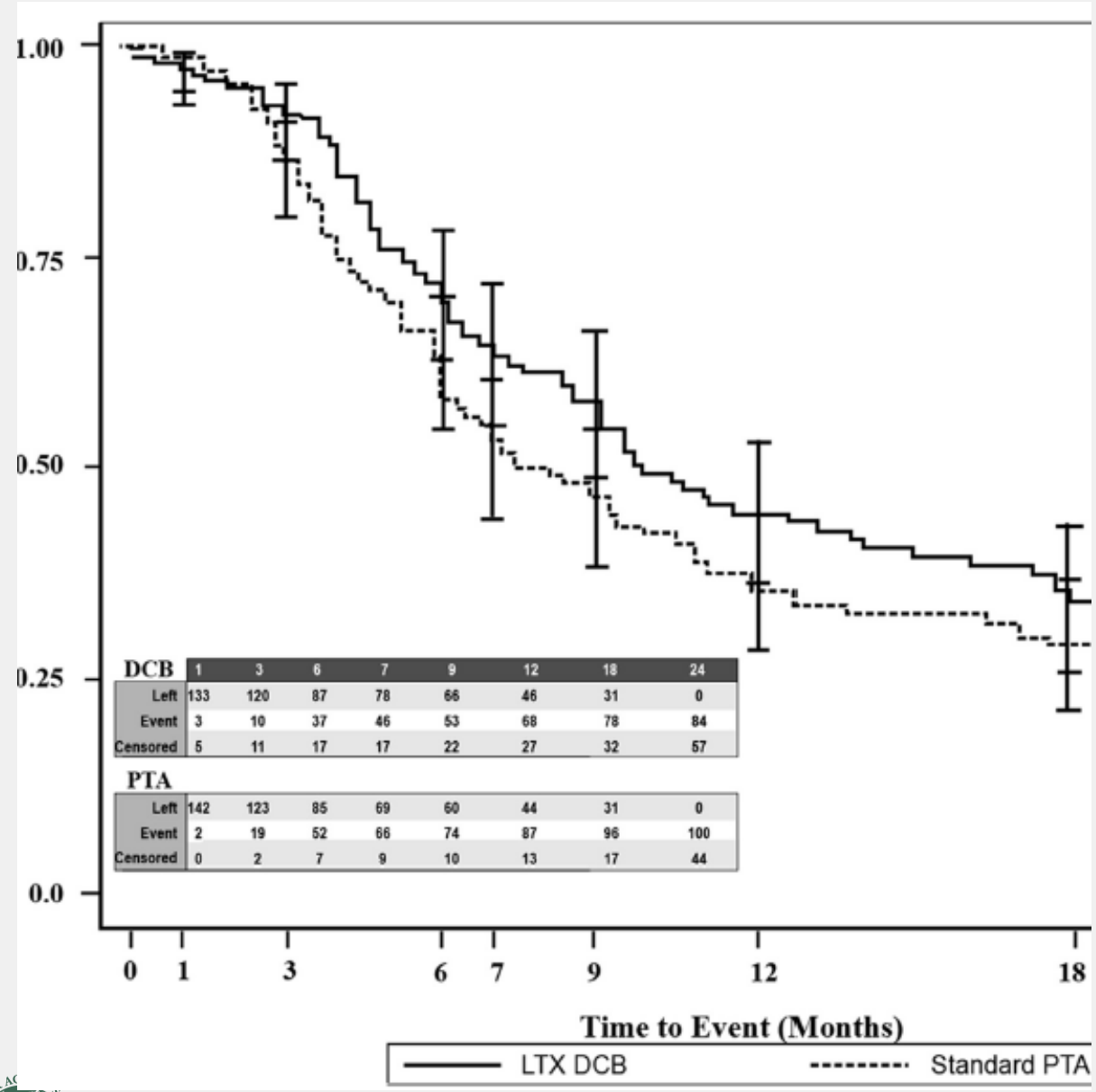
Primary Clinical Trial Data

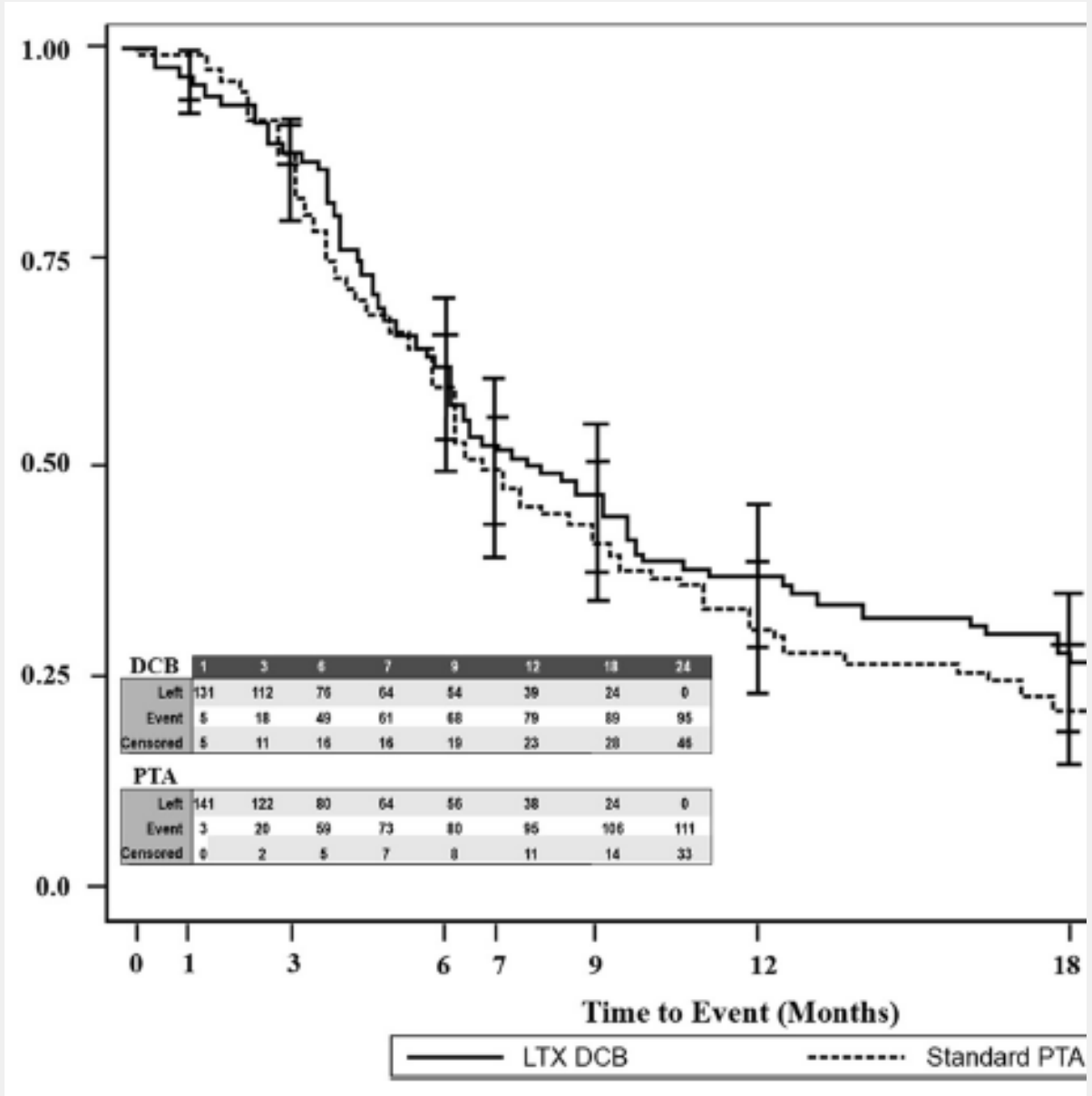
Lutonix 2 year outcome data

- 285 patients randomized to DCB v PTA
- Time to
  - Dual PTA (high pressure followed by low pressure balloon)
  - Drug: Paclitaxel 2 μg/mm^2
- Time to first event 322 days v 207 days
  - Fewer interventions in first 9 months (p=0.02)
- No difference in Access Circuit Patency

	6 mo	9 mo	12 mo	18 mo	24 mo
DCB	71.4%	58%	44.4%	234%	26.9%
PTA	63%	46.4%	36%	28.3%	24.2%
P=	0.057	0.023	0.045	0.058	0.087

Trerotola et. al JVIR 2020; 31:1-14


1.00
0.75
0.50
0.25
0.0
0
1
3
6
7
9
12
18
Time to Event (Months)
DCB
Left 133 120 87 78 66 46 31 0
Event 3 10 37 46 53 68 78 84
Censored 5 11 17 17 22 27 32 57
PTA
Left 142 123 85 69 60 44 31 0
Event 2 19 52 66 74 87 96 100
Censored 0 2 7 9 10 13 17 44
LTX DCB
Standard PTA

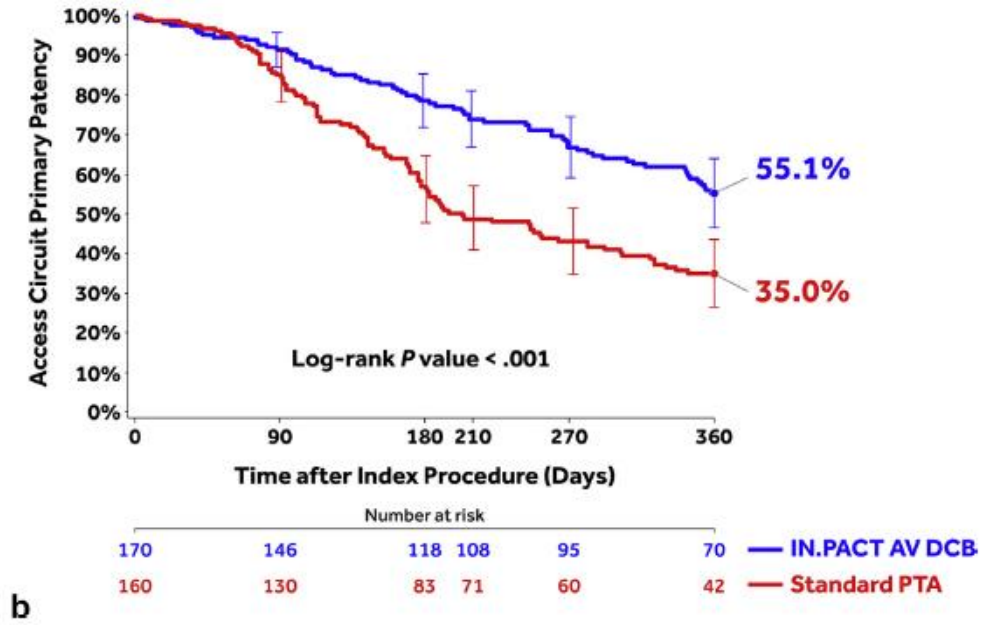

1.00
0.75
0.50
0.25
0.0
0
1
3
6
7
9
12
18
Time to Event (Months)
DCB
Left 131 112 76 64 54 39 24 0
Event 5 18 49 61 68 79 89 95
Censored 5 11 16 16 19 23 28 46
PTA
Left 141 122 80 64 56 38 24 0
Event 3 20 59 73 80 95 106 111
Censored 0 2 5 7 8 11 14 33
LTX DCB
Standard PTA

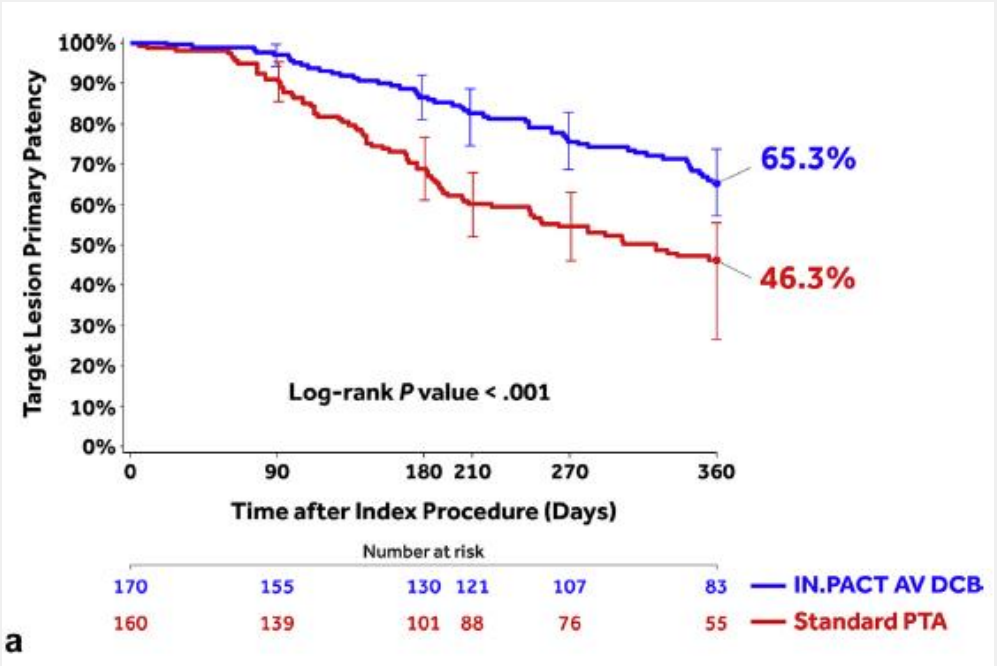
In.Pact Data – 1-year

- 330 patients randomized between In.Pact DEB & PTA
  - Dose Paclitaxel 3.5 μg/mm^2
  - High pressure balloon followed by study balloon
- # of interventions less with DEB than PTA (93 v 144)
  - 0.5 ± 0.9 v 0.9 ± 1.0, p<0.001

		90 day	180 day	210 day	270 day	360 day
TLPP P<0.001	DCB	91.1%	76.4%	71.1%	62.9%	48.8%
	PTA	86.8%	63.1%	55.0%	47.5%	34.4%
ACPP P<0.001	DCB	85.8%	69.4%	63.5%	55.8%	41.1%
	PTA	81.2%	51.9%	44.4%	37.5%	26.3%

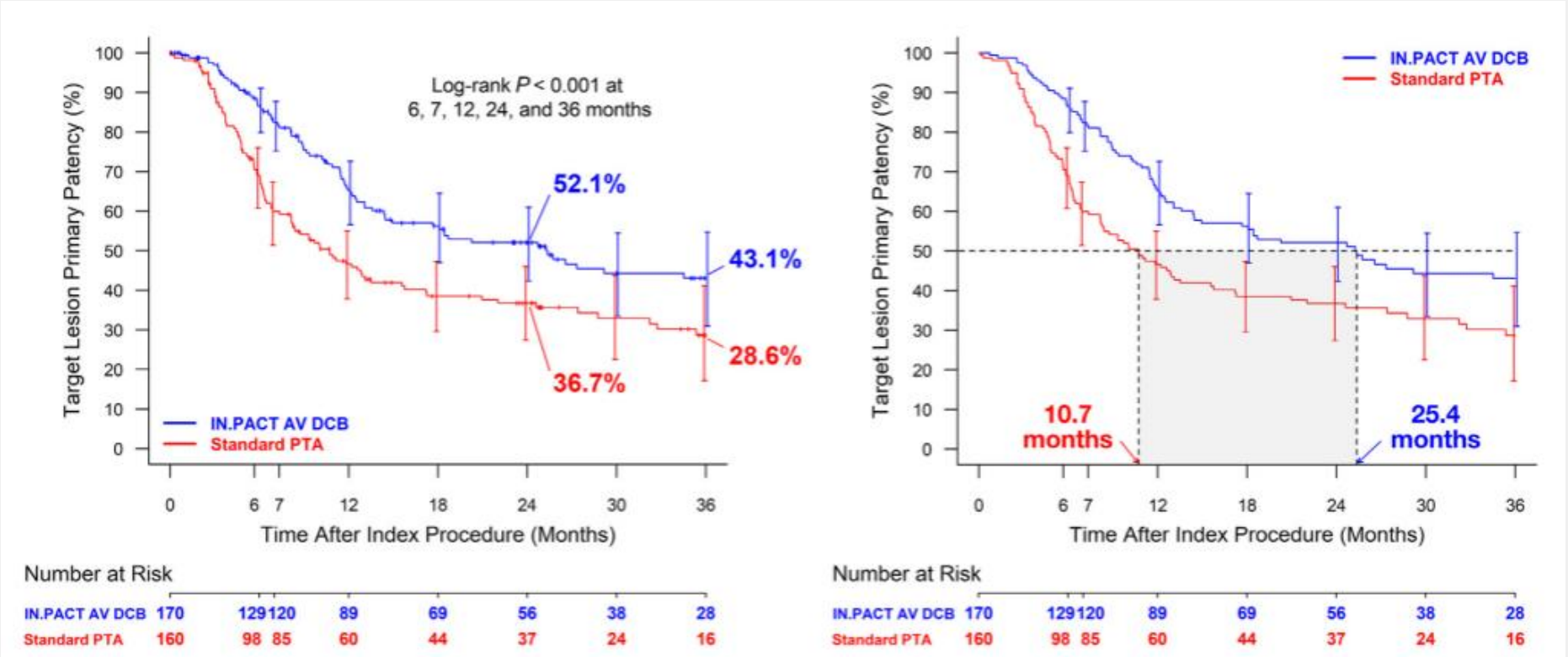
Holden et. al. JVIR 2022; 33:884-894.


Access Circuit Primary Patency
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
55.1%
35.0%
Log-rank P value < .001
0
90
180
210
270
360
Time after Index Procedure (Days)
Number at risk
170 146 118 108 95 70 IN.PACT AV DCB
160 130 83 71 60 42 Standard PTA
b


Target Lesion Primary Patency
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
65.3%
46.3%
Log-rank P value < .001
0
90
180
210
270
360
Time after Index Procedure (Days)
Number at risk
170 155 130 121 107 83 IN.PACT AV DCB
160 139 101 88 76 55 Standard PTA
a

3- Year IN.PACT data

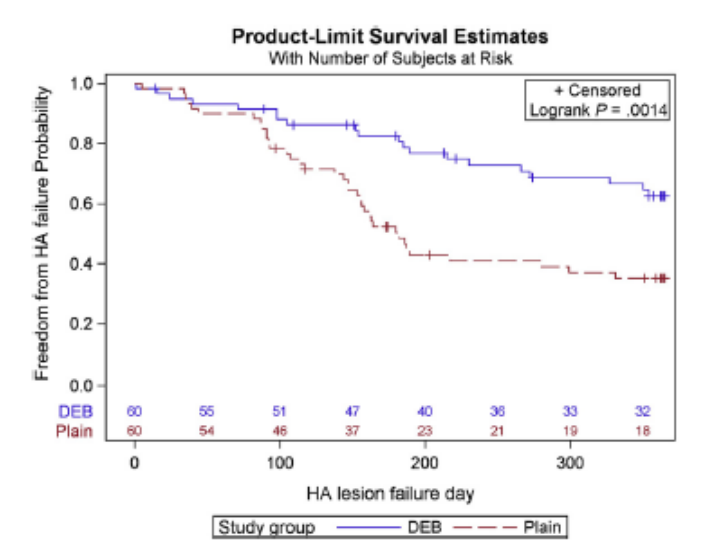
- 330 patient randomized
- 170 DCB, 156 PTA
- At 36 months, 62 DCB & 50 PTA

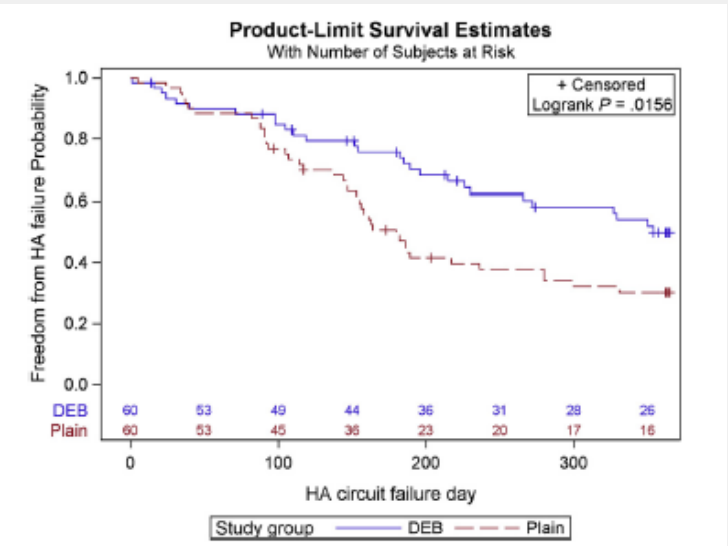


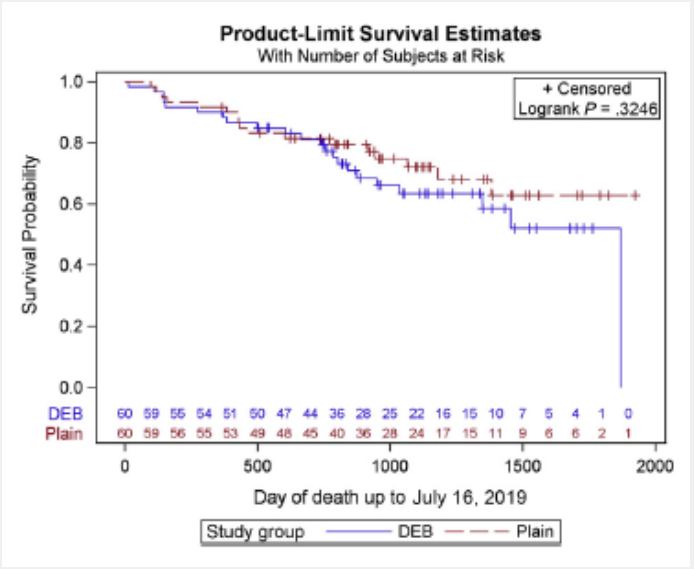
Lookstein R, Haruguchi H, Suemitsu K, Isogai N, Gallo V, Madassery S, Misra S, Wang H, Roffe PS, Holden A, Investigators IP. IN. PACT AV access randomized trial of drug-coated balloons for dysfunctional arteriovenous fistulae: clinical outcomes through 36 months. Journal of Vascular and Interventional Radiology. 2023 Dec 1;34(12):2093-102.

Passeo-18 Lux data

- 120 patients enrolled
- 60 DEB, 60 PTA
- 47 DEB & 53 PTA made it to 6 month f/u.
- 90% AVF & 10% Grafts
- Time to TL failure longer with DEB
  - 294 d v 218 d p=0.001
- Time to access failure longer with DEB
  - 267 d v 209 d p=0.11







Therasse E, Caty V, Gilbert P, Giroux MF, Perreault P, Bouchard L, Oliva VL, Lespérance J, Ethier J, Ouellet G, Francoeur M. Safety and efficacy of paclitaxel-eluting balloon angioplasty for dysfunctional hemodialysis access: a randomized trial comparing with angioplasty alone. Journal of Vascular and Interventional Radiology. 2021 Mar 1;32(3):350-9.

Table 1 | Randomized controlled trials with 3 different DCBs

No.	Name or country or both	Investigators	Journal and year	Subjects	Balloon	Primary endpoint	Result	Comments
1	PAVE (United Kingdom)	Karunanithy *et al.*[5]	*Kidney Int.* 2021	212	Lutonix	Time to loss of TLPP at 6 mo	Negative: $P = 0.44$ (159 d [P] vs. 215 d [C])	75% of operators blinded Included maturing AVF
2	Lutonix IDE	Trerotola *et al.*[3]	*Clin J Am Soc Nephrol.* 2018	285	Lutonix	TLPP at 6 mo	Negative: $P = 0.06$ (62% [P] vs. 58% [C])	No maturing AVF
3	Medtronic IDE (United States, New Zealand, Japan)	Lookstein *et al.*[4]	*N Engl J Med.* 2020	330	IN.PACT	TLPP at 6 mo	Positive: $P < 0.001$ (82.2% [P] vs. 59.5% [C])	No maturing AVF
4	Australian	Swinnen *et al.*[S1]	*J Vascular Access.* 2018	132	IN.PACT	LLL at 6 mo	Positive: $P = 0.0002$ (0.045 mm/mo [P] vs. 0.23 [C])	Mandated ultrasonogram 48% in-stent restenosis
5	Singapore	Irani *et al.*[S2]	*Radiology.* 2018	119	IN.PACT	TLPP at 6 mo	Positive: $P = 0.03$ (81% [P] vs. 61% [C])	Mandated angiogram at 6 mo; AVG = 21
6	Spain	Moreno-Sanchez *et al.*[S3]	*Cardiovasc Intervent Radiol.* 2020	136	Passeo-18 Lux	Time to loss of TLPP at 6 mo	Negative: $P = 0.068$ (153 d [P] vs. 142 d [C])	Mandated angiogram at 6 mo; AVG = 12
7	France	Therasse *et al.*[S4]	*J Vasc Interv Radiol.* 2021	120	Passeo-18 Lux	LLL at 6 mo	Negative: $P = 0.082$ (0.64 mm [P] vs. 1.13 mm [C])	Mandated angiogram at 6 mo

AVF, arteriovenous fistula; AVG, arteriovenous graft; C, control; DCB, drug-coated balloon; IDE, investigational device exemption; IN.PACT, IN.PACT AV Access Study; LLL, late lumen loss; PAVE, Paclitaxel-coated Balloons and Angioplasty of Arteriovenous Fistulas (study); Rx, different drug-coated balloons; TLPP, target lesion primary patency. Note the variation and differences in the balloons used, the endpoints, the use of a mandated angiographic or ultrasonogram procedure at 6 months, the presence or absence of maturing AVFs and AVGs, and the final results.

Roy-Chaudhury P, Saad TF, Trerotola S. Drug-coated balloons and dialysis vascular access: is there light at the end of the tunnel... Kidney International. 2021 Aug 1;100(2):278-80.

Meta-Analyses & Systematic Reviews

Recent Summary

- Review of Prior systematic reviews
- Criteria:
  - Patients with AVF requiring PTA procedures
  - DCB used as an intervention with standard or high-pressure balloons as control
  - Included RCT, Non-Randomized studies and cohort studies
- Outcomes
  - Primary Patency
  - Target Lesion Revascularization
  - Mortality at 6, 12, & 24 months
- 11 Studies included

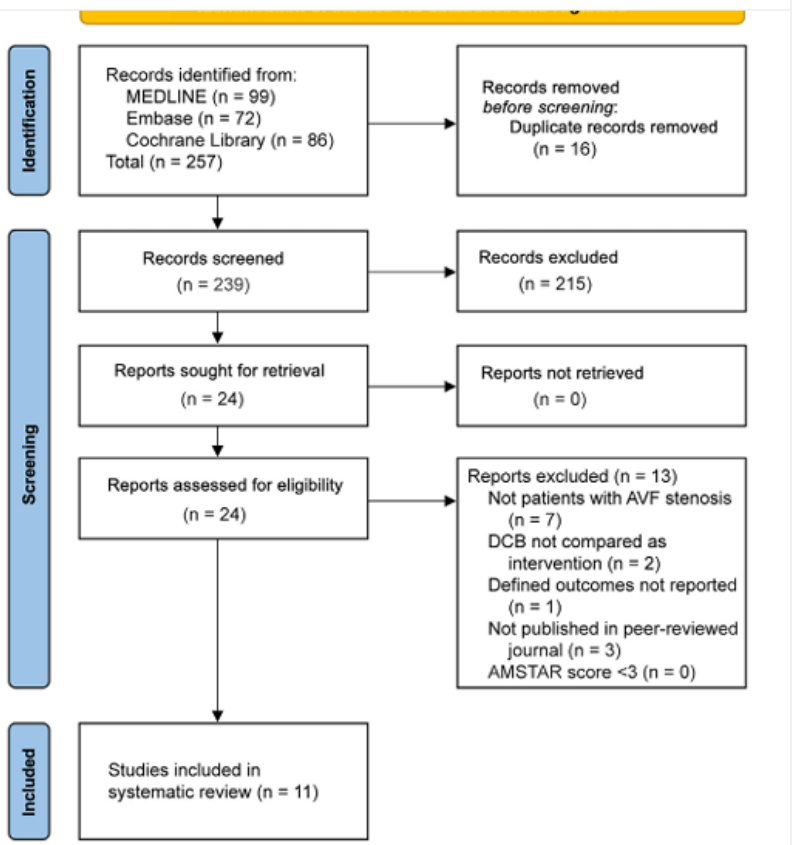


Figure 1. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram for review of systematic reviews. AMSTAR = A Measurement Tool to Access Systematic Reviews; AVF = arteriovenous fistula; DCB = drug-coated balloon.

Lee H, Choi H, Han E, Kim YJ. Comparison of clinical effectiveness and safety of drug-coated balloons versus percutaneous transluminal angioplasty in arteriovenous fistulae: a review of systematic reviews and updated meta-analysis. Journal of Vascular and Interventional Radiology. 2024 Jul 1;35(7):949-62.

Compliation of Systematic Reviews

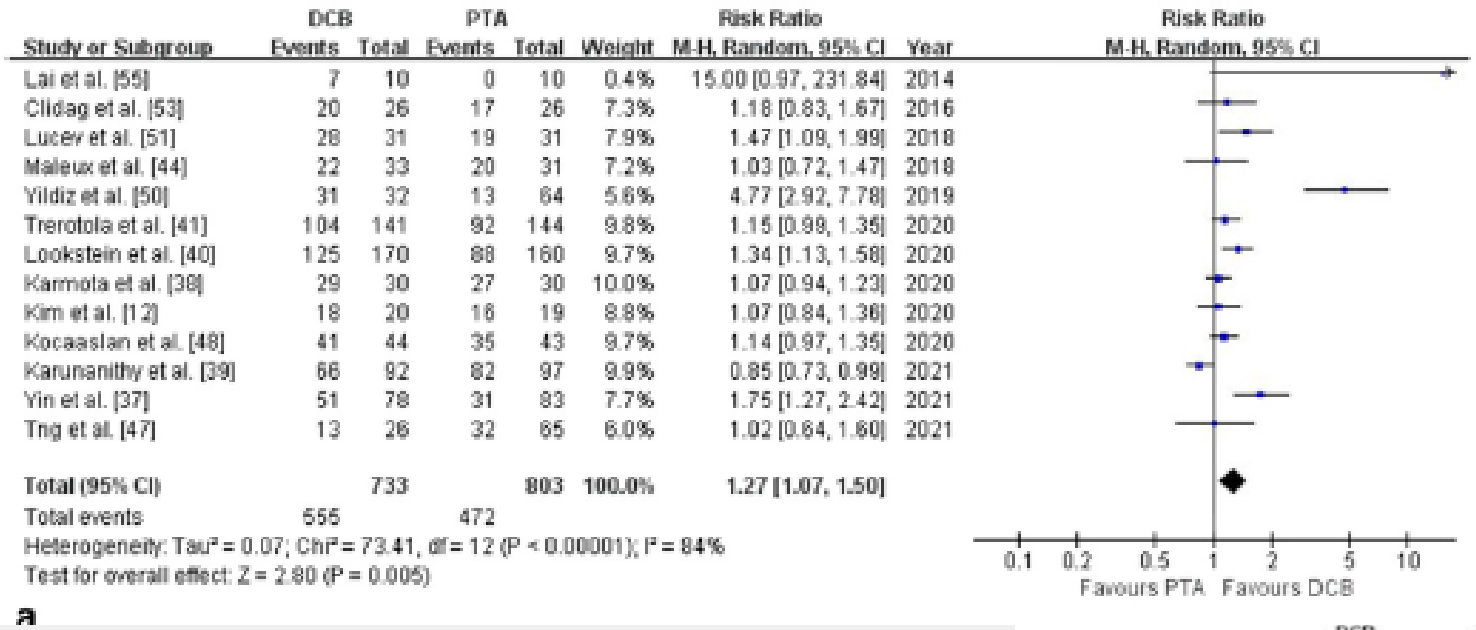
Table 1. A Measurement Tool to Access Systematic Reviews Checklist

	AMSTAR score											AMSTAR score summary					
Study	Was an a priori design provided?	Was there duplicate study selection and data extraction?	Was a comprehensive literature search performed?	Was the status of publication (ie, gray literature) used as an inclusion criterion?	Was a list of studies (included and excluded) provided?	Were the characteristics of the included studies provided?	Was the scientific quality of the included studies assessed and documented?	Was the scientific quality of the included studies used appropriately in formulating conclusions?	Were the methods used to combine the findings of studies appropriate?	Was the likelihood of publication bias assessed?	Was the conflict of interest stated?	Y	N	CA	NA	Funding or support	Level
Luo et al (10)	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	10	1	0	0	Y	H
Liu et al (12)	CA	Y	Y	N	N	Y	Y	Y	Y	Y	N	7	3	1	0	N	M
Han et al (6)	Y	Y	Y	Y	N	Y	Y	CA	Y	Y	Y	9	1	1	0	N	H
Liao et al (11)	Y	N	Y	N	N	Y	Y	CA	Y	Y	Y	7	3	1	0	N	M
Abdul Salim et al (9)	Y	N	Y	N	N	Y	N	N	Y	Y	Y	6	5	0	0	N	M
Cao et al (21)	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	9	2	0	0	Y	H
Yuan et al (26)	Y	Y	Y	N	N	N	Y	CA	Y	Y	N	6	4	1	0	Unclear/ not stated	M
Chen et al (27)	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	8	3	0	0	N	M
Rokoszak et al (28)	Y	Y	Y	Y	N	Y	Y	CA	Y	N	Y	8	2	1	0	N	M
Kennedy et al (8)	Y	CA	Y	N	N	Y	Y	Y	Y	N	Y	7	3	1	0	Unclear/ not stated	M
Khawaja et al (29)	Y	CA	Y	Y	N	N	Y	Y	Y	Y	Y	8	2	1	0	Y	M

AMSTAR = A Measurement Tool to Access Systematic Reviews; CA = cannot answer; H = high; M = moderate; N = no; NA = not applicable; Y = yes.

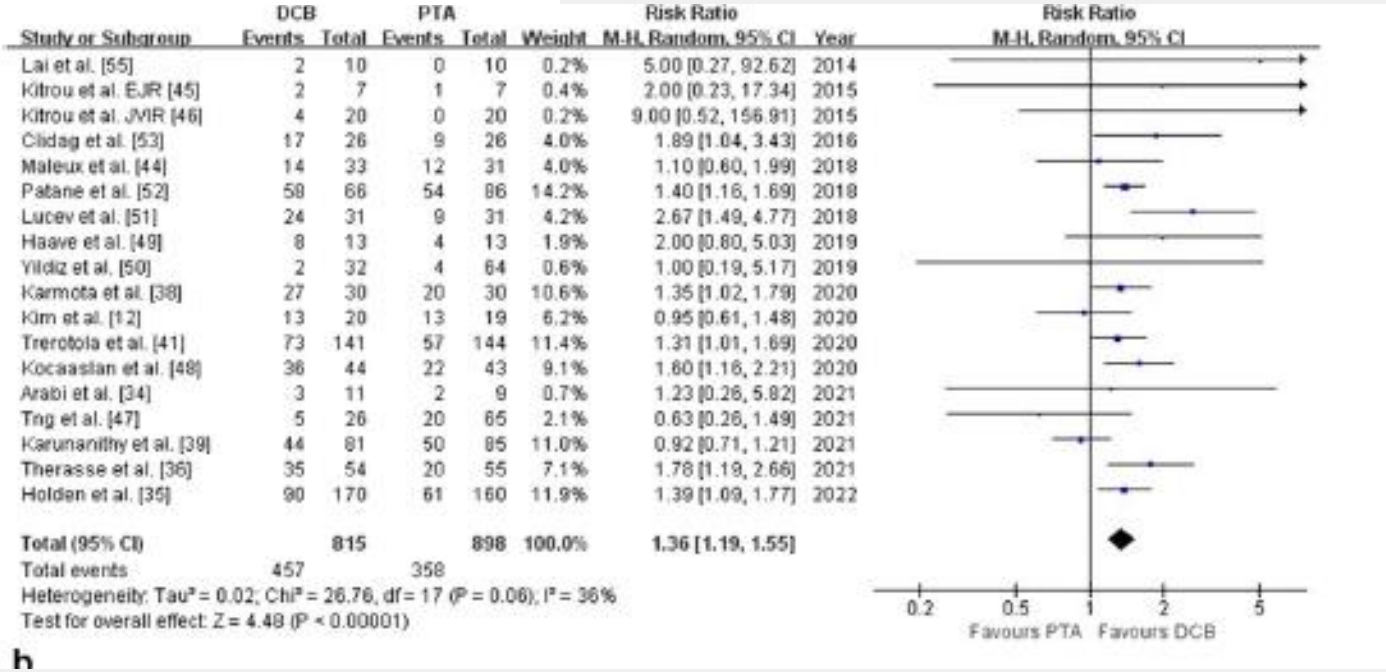
Methods

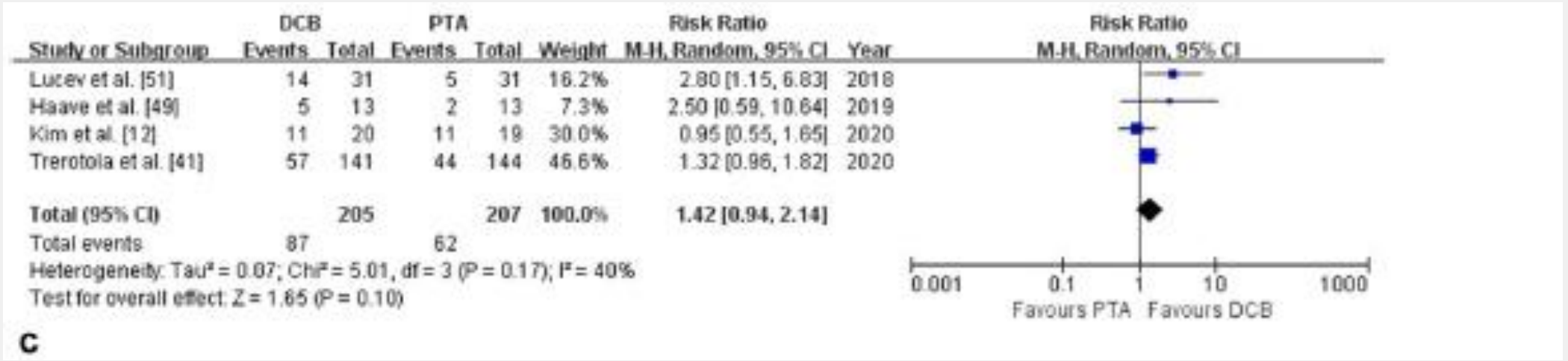
- 11 Systematic reviews were divided into 2 groups:
  - SR with RCTs only (4 studies)
  - RCT + observational studies (7 studies)
- Only 2 studies had f/u top 24 months
- All had 12 mo data
- 2 from USA, 2 from Canada, 1 from UK, 4 from China, 1 from Taiwan, 1 from ROK
- 5 were AVF only & 6 included AVF & Grafts
- Metanalysis found 23 patient (Lookstein 3 yr data not included)
  - Primary Patency @ 6 & 12 months better with DCB, RR 1.27, p=0.05)
  - Non-significance at 24 months



6 month data

12 month data





24 month data

Overall findings

- Systematic reviews are still limited to 12 month data for the most part
- There is heterogeneity in the devices used
- In general, there is better Primary patency & lower TLR with DEB at 6 & 12 months
- In the systematic reviews, 7 studies suggest better TLPP with DEB, 3 NS at 12 mo
- 3 SR looked at TLR, 2 studies showed improvement with DEB but 1 did not.

Economic Impact

Economic impact of DCB

- DCB are expensive.
- Is it worth the expense?
- Cost difference between DCB & PTA at 1 year in USA
- Based on trial observed reinterventions (0.65±1.05 v 1.05±1.18)
- Projected events to 3 years. Actual rates: 0.9 v 1.14
- Result: $1632 savings at 1 year
- Estimated savings over 3 years is $4,263 per patient based on a reduction of 1.06 reinterventions. Actual data is a reduction of 0.24
  - 0.9 for DEB & 1.14 for PTA incidence over 3 years
  - Savings = $4,263/1.06 x 0.24 = $965.21/patient over 3 years

Pietzsch JB, Geisler BP, Manda B, Misra S, Lyden SP, Pflederer TA, Lookstein RA. IN. PACT AV access trial: economic evaluation of drug-coated balloon treatment for dysfunctional arteriovenous fistulae based on 12-month clinical outcomes. Journal of Vascular and Interventional Radiology. 2022 Aug 1;33(8):895-902.

Caveats

- The 1-year data estimated cost differences based on an estimate of re-intervention at 3 years
- The actual data is not as severe but
- There are a lot of censored patients
- 89 v. 60 at 1 yr & 28 v. 16 at 3 yr.

Other endpoints				
Any target lesion revascularization	62.5% (84)	79.3% (106)	0.555 (0.417–0.740)	<.001
Total number of interventions required to maintain target lesion patency‡	254	289	% reduction −17.3%	NA
Incidence rate of target lesion revascularization per arteriovenous fistula year§	0.74 (254/343.0)	0.95 (289/303.7)	0.78 (0.66–0.92)	.004
Participants with at least 1 target lesion intervention	49.4% (84/170)	66.3% (106/160)	−16.8% (−27.3% to −6.3%)	.002
Total number of interventions required to maintain access circuit patency‖	307	345	% reduction −16.3%	NA
Incidence rate of access circuit revascularizations per arteriovenous fistula year§	0.90 (307/343.0)	1.14 (345/303.7)	0.79 (0.68–0.92)	.002
Participants with at least 1 access circuit intervention	57.1% (97/170)	70.6% (113/160)	−13.6% (−23.8% to −3.3%)	.010
Access circuit primary patency, freedom from:	26.4% (100)	16.6% (114)	0.628 (0.479–0.822)	<.001
Reintervention in access circuit	71.9% (97)	83.1% (113)	0.605 (0.461–0.794)	<.001
Access circuit thrombosis	8.2% (10)	18.3% (19)	0.457 (0.212–0.983)	.04

Table 1. Analysis Inputs

Variable	Definition	Source
Clinical parameters		
Age (y)	65.6 ± 13.3	Studies by Lookstein et al (12) or Holden et al (13)
Sex (% male)	64.5%	Studies by Lookstein et al (12) or Holden et al (13)
Mortality HR of persons with ESRD on hemodialysis, relative to general population mortality	6.75	Calibrated on the basis of the pooled mortality estimate at 12 mo as reported in the study by Falk et al (9).
Effectiveness: access circuit reintervention events		
PTA, at 6 mo	0.65 ± 0.8	Study by Lookstein et al (12).
DCB, at 6 mo	0.32 ± 0.7	Study by Lookstein et al (12).
Difference in access circuit reintervention events at 6 mo	−0.33 ($P < .001$)	Study by Lookstein et al (12).
PTA, at 12 mo	1.05 ± 1.18	Study by Holden et al (13).
DCB, at 12 mo	0.65 ± 1.05	Study by Holden et al (13).
Difference in access circuit reintervention events at 12 mo	−0.40 ($P < .001$)	Study by Holden et al (13).
Effectiveness: access circuit primary patency		
PTA, 12 mo	32.4%	Study by Holden et al (13).
DCB, 12 mo	53.8%	Study by Holden et al (13).
Difference in access circuit primary patency at 12 mo	21.4%. ($P < .001$)	Study by Holden et al (13).
Use of devices per respective reintervention procedure (full details in Tables E1 and E2)		
DCB	1.23	Use in the IN.PACT AV Access trial, post hoc analysis.
BMS (used in 10% of reinterventions)	1.0	Use in the IN.PACT AV Access trial, post hoc analysis.
Cost parameters: first (main) analysis		
Medicare fee schedule amounts, weighted average		
PTA procedure cost	$3,332	Weighted average of Medicare calendar year 2020 payments, considering the following site-of-service mix: 51%, physician office; 26%, hospital outpatient; 19%, ambulatory surgery center; and 4%, hospital inpatient. Respective site-of-service amounts reflect national average payment (details shown in Supplemental Materials).
DCB procedure cost	$3,332 (+DCB additional payment where explored)	Same as PTA procedure cost (base case), plus additional DCB costs (scenario analyses).
Reintervention cost	$4,113	Weighted average payments as described earlier, assuming 85% PTA, 10% stent placement, and 5% thrombectomies and surgical interventions as observed in the trial (details shown in Supplemental Materials).
Cost parameters: second analysis		
Vascular access cost in year 1 for patients who maintained access circuit primary patency at 12 mo after AVF creation	$7,561	Study by Abdel-Kader et al (5), inflated from 2013 to 2019 U.S. dollars using the medical consumer price index.
Vascular access cost in year 1 for patients who lost primary patency at 12 mo after AVF creation	$17,617	Study by Abdel-Kader et al (5), inflated from 2013 to 2019 U.S. dollars using the medical consumer price index.
Vascular access cost over 2.5 years for patients who maintained primary patency at 12 mo after AVF creation	$16,315	Calculated on the basis of the annualized cost reported in the study by Abdel-Kader et al (5), inflated from 2013 to 2019 U.S. dollars using the medical consumer price index.
Vascular access cost over 2.5 years for patients who lost access circuit primary patency at 12 mo after AVF creation	$34,511	Calculated on the basis of the annualized cost reported in the study by Abdel-Kader et al (5), inflated from 2013 to 2019 U.S. dollars using the medical consumer price index.
Discounting		
Discount rate on costs, p.a.	3.0%	Recommendations of the Panel on Cost-Effectiveness analysis (15).

AVF = arteriovenous fistula; BMS = bare-metal stent; DCB = drug-coated balloon; ESRD = end-stage renal disease; HR = hazard ratio; p.a. = annually; PTA = percutaneous transluminal angioplasty.

Summary

