Zagazig University Medical Journal
www.zumj.journals.ekb.eg
https://doi.org/10.21608/zumj.2022.143306.2581 Volume 30, Issue 2, March 2024
Manuscript ID ZUMJ-2206-2581
DOI 10.21608/ZUMJ.2022.143306.2581

ORIGINAL ARTICLE

Drug coated versus non-compliant balloon angioplasty in a failing native arteriovenous access

Mohamed H. Zidan a*, Ahmed M. Tawfik a, Hosam A. Tawfek a, Amro M. Elboushi a,b
Department of Vascular Surgery, Faculty of Medicine, Zagazig University, Egypt a.
Department of Vascular Surgery, University Hospitals, Birmingham, United Kingdom b.

***Corresponding Author:**
Mohamed Hamed Zidan

Email: mzeidan1981@gmail.com

Submit Date **2022-06-08**
Accept Date **2022-06-20**

ABSTRACT

Background: Stenosis due to neointimal hyperplasia is the main reason of failing arteriovenous fistula (AVF). Percutaneous endovascular procedures are widely applied for treatment of failing dialysis circuit. Both drug-coated balloon (DCB) and non-compliant balloon (NCD) angioplasty can be employed to treat hemodialysis access dysfunction.

Aim of the work: The goal of this trial is to assess the additional value of using DCB over NCB for the management of failing native AVF.

Methods: This is a single-centre randomized clinical study, 53 patients presented with failing dialysis access are assessed for eligibility. The study was conducted at Vascular Surgery Department, Zagazig University Hospitals-Egypt from January 2017 to December 2020. A total of 27 patients presented with failing AVF, are randomized to 13 patients are treated with DCB and 14 patient are treated with NCB angioplasty. The primary endpoint of the study is anatomical success (less than 30% residual stenosis of the target lesion). Secondary endpoints include duplex assessment of dialysis circuit flow rate, complications (minor and major), target lesion primary patency (TLPP), target lesion assisted primary patency (TLAPP), target lesion secondary patency (TLSP), cumulative primary and assisted primary patency, as well as intervention free survival during 12 months follow up.

Results: In DCB group, the mean age of 55.1 years; while the mean age in NCB group is 54.6 years. There are no preoperative differences in patient risk factors between both groups. Anatomical success rate is achieved in 100% of both groups. TLPP between DCB and NCB groups at 12 months (61.5% vs 57.1%) are comparable (P = 0.81), as well as TLAPP at 12 months (61.5% vs 64.3%; P = 0.88). TLSP between DCB and NCB at 12 months (69.2% vs 64.3%) are also comparable (P = 0.78). Successful endovascular angioplasty for all circuit restenosis are performed in one DCB patient and three NCB patients. Rates of overall fistula restenosis are higher in NCB than DCB group without significance difference.

Conclusion: DCB is promising alternative for failing AVF treatment, as it clinically improves short term access patency, and reduces target lesion restenosis rate but this remains statistically insignificant.

Keywords: Arteriovenous fistula, Angioplasty, paclitaxel. Drug coated balloon, high pressure balloon**,** failing access.

INTRODUCTION

Haemodialysis arteriovenous (AV) dysfunction continues to be a considerable cause of morbidity, hospitalization and increase of health care cost. [1-3]

Intervention to correct / improve AV dysfunction continues to be a frequent in patients undergoing hemodialysis. [4]

Percutaneous transluminal angioplasty (PTA) has been used regularly as a standard method to treat AV stenosis and prolong the life of both AVF and arteriovenous grafts. [1, 5, 6]. PTA has a high rate of technical success but suffers from poor long-term patency rates mainly caused by neointimal hyperplasia. This necessitates the need for recurrent/several interventions to improve and preserve patency and decrease AV dysfunction. [7-

9]. Some studies showed that an average of 3.1-3.5 interventions was performed in the life span of an arteriovenous access till it is functionless. [5, 6, 10-12] with up to 50 percent of endovascular intervention requiring a redo intervention in less than 6 months. [13-15]

PTA success rates in resistant venous stenosis have increased since the introduction of NCB, producing higher inflation pressures than conventional balloon that mechanically destroy the dense fibrous tissue at the stenotic segment. [16]

Paclitaxel coated balloons have been used effectively in treating arterial stenotic lesions demonstrated in randomized controlled trials, systematic reviews, and meta-analysis. [17-21]

Publications studying the use of paclitaxel coated balloons in salvaging failing/ dysfunctional arteriovenous access have showed variable results with heterogeneous study groups/devices, small sample sizes and short follow up. [3, 22-27]

Our study is designed to assess the additional value of using DCB over NCB as regard to the primary patency rate and target lesion restenosis in de novo stenosis in native AVF.

PATIENTS AND METHODS

Study design

This was a single centre (Vascular Surgery Department, Zagazig University Hospitals), randomized controlled trial in the period from January 2017 to December 2020. The study protocol was approved by the local ethical committee of Zagazig Faculty of Medicine, and all patients gave informed consent before participation in the study.

The study's inclusion and exclusion criteria are listed in **Table 1**.

All patients underwent history taking, physical examination, and laboratory investigations. Doppler ultrasound for flow measurement before and after the procedure is performed.

Intervention: The target lesion (TL) is defined as stenosis in the arteriovenous anastomosis, juxta-anastomotic and extra-anastomotic venous segment. No central vein stenosis is included. After ultrasonographic and/or angiographic confirmation of significant stenosis, the AVF is accessed from an arterial or venous puncture. An appropriate-size vascular sheath (4–7 F) is inserted and 5000 IU heparin is routinely administered.

A digital subtraction angiography is performed to visualize the entire access circuit, and identification of the site of stenosis. By a 0.035-in hydrophilic guidewire (Terumo Guidewire; Terumo Medical, Tokyo, Japan) and catheter, the target lesion is crossed.

All lesions are initially treated with an NCB [Mustang (Boston scientific, Marlborough, MA 01752, USA) or Covidien Fortrex (Medtronic, Minneapolis, MN, USA)], inflated for 2 minutes and the procedure is repeated if necessary, until good technical success result has been achieved (residual stenosis <30% and an absence of perforation).

Randomization is performed by a research nurse after successful dilation with NCB participants are enrolled and randomly assigned to DCB or NCB group in a 1:1 ratio.

The lesion of DCB group is then only treated again with DCB by the same size of previously used NCB according to randomization for 120s. DCB used in this trial has a paclitaxel dose of 3.5µg/mm2 and used urea as excipient (Medtronic IN. PACT, Medtronic, Minneapolis, MN, USA).

A new angiography is performed after a second PTA to confirm the final angiographic result. After removing the introducer sheath, puncture site hemostasis is achieved by compression.

All patients are started on dual antiplatelet therapy (DAPT) postoperatively: acetylsalicylic acid (ASA) 100mg+clopidogrel 75mg.

Follow-up: Follow-up assessments occur at one week, one month, 3 months, 6 and 12 months. Clinical and duplex follow up is done to evaluate dialysis circuit flow rate.

Study Endpoints and Outcome Measures:

The primary endpoint of the study is anatomical success (less than 30% residual stenosis of TL). Secondary endpoints include duplex assessment of dialysis circuit flow rate, complications (minor and major), target lesion primary patency (TLPP), target lesion assisted primary patency (TLAPP), target lesion secondary patency (TLSP), cumulative primary and assisted primary patency as well as intervention free survival for 12 months follow up.

Anatomical success is defined as less than 30% residual diameter stenosis of the target lesion measured immediately after PTA by the operating physician at the time of the procedure.

TLPP is defined as uninterrupted patent and functional dialysis circuit till repeating surgical and/or percutaneous procedures during a given period. TLAPP is defined as a patent and functional dialysis circuit after repeating percutaneous revision of procedure during a given time period. TLSP is defined as a patent and functional dialysis circuit regardless of the number of repeating surgical,

percutaneous procedures and/ or surgically abandoned during a given period.

Cumulative primary patency is defined as the total time the dialysis circuit remains patent, till repeating surgical and/or percutaneous procedures during a given time period. Cumulative assisted primary patency is defined as the total time the dialysis circuit remains patent, after repeating percutaneous revision of procedure during a given time period. Intervention free survival is defined as the total time the dialysis circuit remains patent, regardless of the number of repeating surgical, percutaneous procedures surgically abandoned during a given time period.

Randomization: Simple randomization and concealment is achieved using computer-generated random numbers and the sealed envelope technique. Envelopes are opened in the operating room after confirmation of successful TL dilatation. Enrolled patients are allocated to the studied groups in 1:1 ratio. Randomization, allocation, and concealment are supervised by an independent researcher who is not aware of the nature of the study.

Statistical Analysis:

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures are coded, entered and analyzed using Microsoft Excel software. Data are then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. Qualitative data are represented as numbers and percentages, while quantitative ones are continues represented by mean and SD. Difference and association of qualitative variables are tested by Chi square test. (X2). While differences between quantitative independent groups are tested by t test. P value is set at <0.05 for significant results & <0.001 for highly significant results.

RESULTS

Patient Demographics

Table 2 shows demographic data and risk factors; **Table 3** shows dialysis access and procedural data. The CONSORT chart to demonstrate the study protocol is delivered in **Figure 1**, of 53 patients screened, 39 are recruited and proceeded to fistulography and angioplasty, 4 (10% of those undergoing angioplasty) were ruled out due to unsuccessful dilation that needed stent insertion.

One patient was lost to follow-up at each group, in addition to one patient died in DCB group and two patients in NCB group. Also, one patient in DCB group and two patients in NCB group were ruled out due to voluntary withdrawal. Only 27 patients completed the study (13 in DCB group and 14 in NCB group) until the end of follow up period after 12 months.

The mean age for DCB group is 55.1 years and that of NCB group is 54.6 years. There are no significant differences in demographics or risk factors and TL characteristics between the DCB and NCB groups. Most common risk factors, include diabetes (61.5% &64.3%), hypertension (76.9% & 64.3%) in DCB and NCB groups respectively. **(Table 2).**

Study outcome

Procedural outcomes in DCB and NCB groups are shown in **Tables 4-6**. Anatomical success is achieved in 100% (13/13) of DCB group and 100% (14/14) of NCB group.

A total of 14 reinterventions are performed during the study period, 8 in NCB and 6 in DCB group. Successful endovascular angioplasty for all circuit restenosis are performed in one DCB patient and three NCB patients. Rates of overall fistula restenosis are higher in NCB than DCB group without significance difference. **(Table 6).**

Thrombectomy is performed for the access thrombosis in five patients in each group, being failed and abandonment in all patients from each group. **(Table 6).** There are no minor, major or other procedure-related complications reported in either treatment group.

Mean access flow data shows a significant elevation between preoperative and postoperative values in both groups (P <0.001). Preoperative flow rates for patients undergoing DCB or NCB are comparable (285.66+30.18 vs 290.66+36.82 ml/min respectively; P= 0.701). However, mean postoperative access flow rates are higher in the DCB group than in the NCB, but statistically insignificant (685.66+142.7 vs 616.25+91.7 ml/min respectively; P=0.157; **Table 5).**

Target Lesion Patency rates

TLPP rates between DCB and NCB at 6 months (69.2% vs 57.1%) and 12 months (61.5% vs 57.1%) are comparable (P = 0.51 and 0.81 respectively), as well as TLAPP at 6 months (76.9% vs 71.4%) and 12 months (61.2% vs 64.3% ; P = 0.74 and 0.88 respectively). TLSP rates between DCB and NCB at 6 months (76.9% vs 71.4%) and 12 months (69.2% vs 64.3%) are also comparable (P = 0.74 and 0.78 respectively; **Table 4**).

Kaplan-Meier survival analysis shows no statistically significant differences between the studied groups regarding cumulative primary and assisted primary patency as well as intervention free survival during 12 months follow up. **(Figures 2-4).**

Table 1: Inclusion and exclusion criteria

Inclusion Criteria
Patient is ≥18 years of age with a life expectancy of ≥12 months.
Patient has an upper limb native AVF, created ≥60 days prior to the primary intervention.
Patient underwent successful dialysis for at least 8 of 12 sessions during a four-week period from AVF.
Patient has a new stenotic lesion located between the arteriovenous anastomosis and cephalic arch/brachioaxillary vein junction with ≥50% stenosis.
Clinical criteria of dysfunctional fistula, as prolonged bleeding after access needle withdrawal, abnormal pulsations and weak thrill
Native vessel 4-7 mm in diameter (corresponding to the size of available DCBs)
Patient underwent successful dilatation of TL (<30% residual stenosis) with NCB.
Patient has consented to participate in the trial and has agreed to attend all follow-up schedule.
Exclusion Criteria
Patients younger < 18 years of age.
Patients who had previous intervention on the same AVF or ipsilateral central vein.
Patients who have Arteriovenous grafts.
Patients who have aneurysms, pseudo- aneurysms.
Patients who have steal syndrome.
Patients with current or previous thrombosis of AVF.
Patient with concomitant central venous stenosis.
Patient with extra anastomotic arterial inflow lesion (> 2cm from anastomosis).
Patients with infection local /systemic.
Patients needing concomitant surgical intervention.
Pregnant or breast-feeding female patients.
Patients expected to undergo a kidney transplant within 6 months.
Patients on immunosuppressive medications.
Patients with contraindications for dual antiplatelet therapy.
Patients allergic to paclitaxel / contrast
Patients who are deemed unlikely to be non-complaint with follow up

Table 2: Demographic data distribution between studied groups

			NCB	DCB	t/ X^2	P
Age			**54.66±8.51**	**55.13±7.94**	**0.147**	**0.884**
BMI			**28.66±3.65**	**31.0±4.35**	**0.683**	**0.545**
Sex	**Female**	**N**	**4**	**8**		
		%	**28.6%**	**61.5%**		
	Male	**N**	**10**	**5**	**0.29**	**0.58**
		%	**71.4%**	**38.5%**		
Diabetes mellitus (DM)	**-VE**	**N**	**5**	**5**		
		%	**35.7%**	**38.5%**		
	+VE	**N**	**9**	**8**	**0.02**	**0.88**
		%	**64.3%**	**61.5%**		
Hypertention	**-VE**	**N**	**5**	**3**		
		%	**35.7%**	**23.1%**		
	+VE	**N**	**9**	**10**	**0.51**	**0.47**
		%	**64.3%**	**76.9%**		
Coronary artery disease (CAD)	**-VE**	**N**	**10**	**7**		
		%	**71.4%**	**53.8%**		
	+VE	**N**	**4**	**6**	**0.44**	**0.64**
		%	**28.6%**	**46.2%**		
Smoking	**-VE**	**N**	**10**	**10**		
		%	**71.4%**	**76.9%**		
	+VE	**N**	**4**	**3**	**0.10**	**0.74**

			NCB	DCB	t/ X^2	P
		%	**28.6%**	**23.1%**		
Total		N	**14**	**13**		
		%	**100.0%**	**100.0%**		

Table 3: Dialysis access and procedure data distribution between studied groups

			NCB	DCB	t/ X^2	P
Dialysis access data						
Dialysis duration (months)			**13.66±4.36**	**10.46±3.63**	**0.463**	**0.659**
Lesion length (cm)			**5.81±1.03**	**6.02±1.35**	**0.430**	**0.671**
Stenosis percentage (%)			**69.16±9.0**	**68.0±10.82**	**0.299**	**0.767**
Dialysis access side	**Lt**	**N**	**10**	**5**		
		%	**71.4%**	**38.5%**		
	Rt	**N**	**4**	**8**	**0.29**	**0.58**
		%	**28.6%**	**61.5%**		
Dialysis access type	**BB**	**N**	**3**	**2**		
		%	**21.4%**	**15.4%**		
	BC	**N**	**7**	**7**	**0.16**	**0.92**
		%	**50.0%**	**53.8%**		
	RC	**N**	**4**	**4**		
		%	**28.6%**	**30.8%**		
Target lesion location	**Anastomotic**	**N**	**5**	**4**		
		%	**35.7%**	**30.8%**		
	Cannulation zone	**N**	**4**	**4**	**0.96**	**0.81**
		%	**28.6%**	**30.8%**		
	Juxta anastomotic	**N**	**5**	**5**		
		%	**35.7%**	**38.5%**		
Abnormal thrill	**No**	**N**	**6**	**5**		
		%	**42.9%**	**38.5%**		
	Yes	**N**	**8**	**8**	**0.05**	**0.81**
		%	**57.1%**	**61.5%**		
Recirculation	**No**	**N**	**8**	**8**		
		%	**57.1%**	**61.5%**		
	Yes	**N**	**6**	**5**	**0.054**	**0.81**
		%	**42.9%**	**38.5%**		
Difficult puncture	**No**	**N**	**4**	**3**		
		%	**28.6%**	**23.1%**		
	Yes	**N**	**10**	**10**	**0.106**	**0.74**
		%	**71.4%**	**76.9%**		
Pulling clots	**No**	**N**	**8**	**10**		
		%	**57.1%**	**76.9%**		
	Yes	**N**	**6**	**3**	**1.18**	**0.27**
		%	**42.9%**	**23.1%**		
Procedure data						
Balloon diameter (mm)			**6.0±0.73**	**6.46±0.74**	**1.626**	**0.117**
Balloon length (cm)			**7.0±1.04**	**7.2±1.01**	**0.503**	**0.620**
Inflation duration (minute)			**2.0±0.0**	**2.0±0.0**	**0.00**	**1.00**

BB: Brachiobasalic **BC:** Bachiocephalic **RC:** Radiocephalic

Table 4: Post-operative outcomes and patency rates distribution between studied groups

			NCB	DCB	t/ X^2	P
Cumulative 1ry patency (days)			**226.75±75.1**	**288.2±95.36**	**1.274**	**0.214**
Intervention free survival (days)			**255.66±88.63**	**299.86±97.63**	**0.963**	**0.345**
TLPP 6/12	**-VE**	**N**	**6**	**4**		
		%	**42.9%**	**30.8%**		
	+VE	**N**	**8**	**9**	**0.42**	**0.51**
		%	**57.1%**	**69.2%**		
TLPP 12/12	**-VE**	**N**	**6**	**5**		
		%	**42.9%**	**38.5%**		
	+VE	**N**	**8**	**8**	**0.054**	**0.81**
		%	**57.1%**	**61.5%**		
TLAPP 6/12	**-VE**	**N**	**4**	**3**		
		%	**28.6%**	**23.1%**		
	+VE	**N**	**10**	**10**	**0.106**	**0.74**
		%	**71.4%**	**76.9%**		
TLAPP 12/12	**-VE**	**N**	**5**	**5**		
		%	**35.7%**	**38.5%**		
	+VE	**N**	**9**	**8**	**0.02**	**0..88**
		%	**64.3%**	**61.5%**		
TLSP 6/12	**-VE**	**N**	**4**	**3**		
		%	**28.6%**	**23.1%**		
	+VE	**N**	**10**	**10**	**0.106**	**0.74**
		%	**71.4%**	**76.9%**		
TLSP 12/12	**-VE**	**N**	**5**	**4**		
		%	**35.7%**	**30.8%**		
	+VE	**N**	**9**	**9**	**0.074**	**0.78**
		%	**64.3%**	**69.2%**		
Total		**N**	**14**	**13**		
		%	**100.0%**	**100.0%**		

Table 5: Changes of access volume rate between studied groups

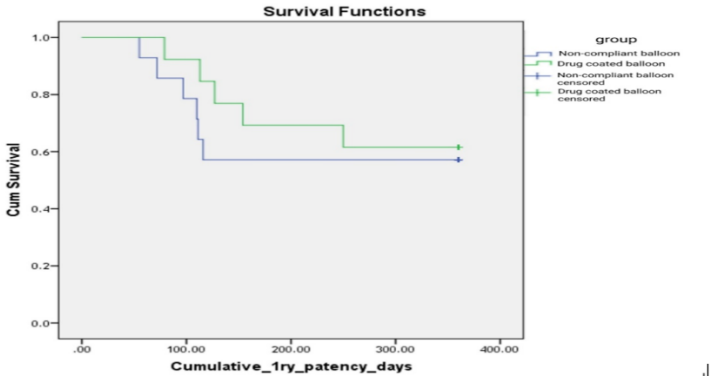
	NCB	DCB	t/ X^2	P
Pre-operative access volume flow (ml/min)	**290.66±36.82**	**285.66±30.18**	**0.388**	**0.701**
Post-operative access volume flow (ml/min)	**616.25±91.7**	**685.66±142.7**	**1.458**	**0.157**
P	**0.00****	**0.00****		

Table 6: Complication distribution between studied groups

			Group		X^2	P
			NCB	**DCB**		
Recurrence	**-VE**	**N**	**11**	**12**		
		%	**78.6%**	**92.3%**		
	+VE	**N**	**3**	**1**	**0.76**	**0.29**
		%	**21.4%**	**7.7%**		
Access circuit thrombosis	**-VE**	**N**	**9**	**8**		
		%	**64.3%**	**61.5%**		
	+VE	**N**	**5**	**5**	**0.02**	**0.88**
		%	**35.7%**	**38.5%**		
Total		**N**	**14**	**13**		
		%	**100.0%**	**100.0%**		

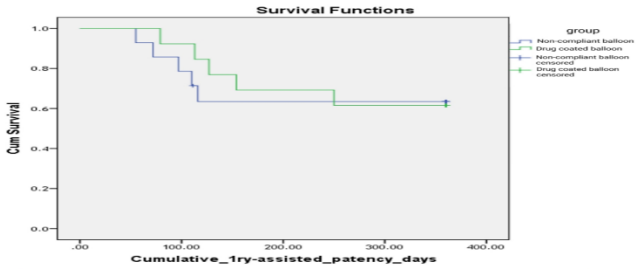
Figure 1: CONSORT (The Consolidated Standards of Reporting Trials) chart illustrating study protocol

Figure 2: Kaplan-Meier for primary patency survival



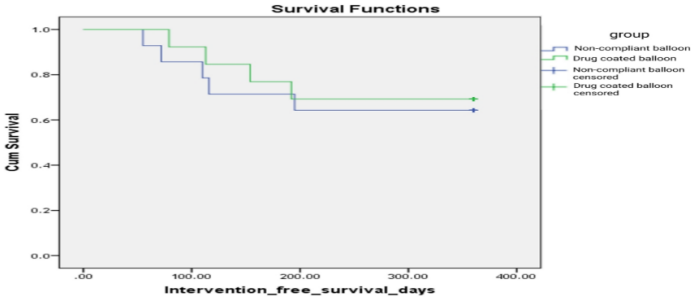
	Mean			
	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
NCB	**245.786**	**35.467**	**176.271**	**315.301**
DCB	**277.154**	**30.728**	**216.927**	**337.380**
Overall	**260.889**	**23.795**	**214.251**	**307.526**

Figure 3: Kaplan-Meier for primary assisted patency survival



group	Mean			
	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
NCB	**261.635**	**35.345**	**192.358**	**330.912**
DCB	**277.154**	**30.728**	**216.927**	**337.380**
Overall	**268.277**	**23.675**	**221.874**	**314.680**

Figure 4: Kaplan-Meier for Intervention free survival



Group	Mean			
	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
NCB	**270.571**	**32.986**	**205.918**	**335.224**
DCB	**290.615**	**29.597**	**232.604**	**348.626**
Overall	**280.222**	**22.346**	**236.424**	**324.020**

DISCUSSION

In a newly formed hemodialysis access, neointimal hyperplasia may occur at the anastomotic site among other sites leading to outflow stenosis. [29] Neointimal hyperplasia occurs as a combination of factors including initial trauma to the vessels at the time of vascular access surgery, elevated oxidative stress and shear stress across the dialysis circuit, access injury from dialysis needle punctures resulting in proliferation of the smooth muscle cells and attempts of angioplasties to prolong arterio-venous access. [30,31] Different modalities for salvage of failing dialysis access have been used including transluminal angioplasty, cutting balloons, stents, and stent grafts. [32]

In recent years, the use of DCB has been developed as a combination of the mechanical action of the angioplasty balloon and the pharmacological action of the substances that reduce cellular proliferation and neointimal hyperplasia. [3] The most widely used drug is the cytostatic agent paclitaxel. [33, 34]

Our results have shown that TLPP rates at 6 and 12 months are improved in DCB in comparison to NCB, but it remains statistically insignificant. TLSP rates at 6 months are again improved in DCB in comparison to NCB and comparable at 12 months and remains statistically insignificant. There are no minor, major, or other procedure-related complications reported in either treatment group. However, rates of overall fistula restenosis are higher in NCB than DCB group without significant difference.

On other hand, mean access flow data shows a significant elevation between preoperative and postoperative values in both groups; in addition to mean postoperative access flow rates are higher in DCB group than in NCB, but statistically insignificant.

Several clinical series and studies demonstrating the effectiveness of DCBs in the management of failing dialysis accesses, reported different results in terms of the time-to-reintervention and the patency rates.

Both target lesion and dialysis access primary patency rates did not differ between DCB and PTA at six months in a multicentre RCT of 285 patients with failing AVF. The DCB group, however, required fewer interventions to maintain target lesion patency at six months (0.31 versus 0.44 per patient, P = 0.03). [3] In contrast, DCBs were demonstrated to have a worse time-to-reintervention at 12 months in a single-centre RCT of 39 patients. [28]. A recent multicentre study enrolling 136 patients with failing fistulae and grafts who were allocated to DCB or NCB, found no significant difference in primary patency at six and 12 months. Both treatment arms had comparable safety profiles and death rates. [35]

Another meta-analysis of eight RCTs (PCB=327, PTA = 331) that focused on the causes of death as the primary endpoint, found no significant difference in short and mid-term death rate when DCBs were used versus PTA. [36]

Katsanos et al. [27] investigated 40 cases of dialysis fistula or AV graft angioplasty with DCBs to NCB angioplasty. At six months, the DCB group had 70% primary patency compared to 25% in the NCB group. Another study compared 20 lesions in ten patients and found that DCBs had significantly longer target lesion revascularization duration than PTA (25112 d vs. 103.2 d; P0.01). The DCB group had a significantly improved primary patency rate of the target lesion at six months, but this was statistically insignificant after 12 months, which is comparable to our findings. [26]

Kitrou et al. [23] assigned 40 patients to DCB or NCB angioplasty for the treatment of failing AVF. Two-thirds of the DCB group required further dilatation with an NCB to achieve anatomic success. Despite this, DCB significantly increased target lesion restenosis-free survival (DCB, 308 days vs. NCB, 161 days; P= 0.03). Primary dialysis access patency was significantly improved with the DCB angioplasty (PCB, 270 days vs. NCB, 161 days; P=0.04).

A current randomized study of 330 patients reported that DCB is significantly better than traditional balloon angioplasty in preserving six-month patency (82.2% vs. 59.5 %, P <0.0001). [37]

There is significant heterogeneity in the data published so far which can be explained by heterogeneous group of patients including patients with recurrent stenosis. Central vein stenosis /synthetic grafts. In our study we attempted to reduce the heterogeneity by focusing on de novo lesions in native fistulas with no central venous stenosis. Taking this into account our study suggests there is some short-term clinical advantage, but this remains statistically non-significant.

Although some of these treatments have reported promising results, up to date, no treatment modality for dialysis access has been documented in a large, homogenous, and focused meta-analysis.

Our study does have some limitations including small sample size and short follow up period. Recruitment was slow and the mortality risk demonstrated in katsanos and colleagues [22] meta-

analysis lead to more clinician's unwilling to offer this treatment to their patients.

CONCLUSION

DCB is a promising alternative for failing AVF treatment with non-significantly improved short term access patency and reduced target lesion restenosis rate. We recommend large-scale homogenous multicentre RCTs with long-term follow-up data to obtain results which may be statistically significant.

Conflict of interest: none

Financial disclosure: none

REFRENCES

1. National Kidney Foundation. KDOQI Clinical Practice Guideline for Hemodialysis Adequacy: 2015 update. Am J Kidney Dis. 2015 Nov; 66(5):884-930. doi: 10.1053/j.ajkd.2015.07.015. Erratum in: Am J Kidney Dis. 2016 Mar; 67(3):534. PMID: 26498416.
2. Johansen KL, Chertow GM, Foley RN, Gilbertson DT, Herzog CA, Ishani A, et al. US Renal Data System 2020 Annual Data Report: Epidemiology of Kidney Disease in the United States. Am J Kidney Dis. 2021 Apr; 77(4 Suppl 1):A7-A8. doi: 10.1053/j.ajkd.2021.01.002. PMID: 33752804; PMCID: PMC8148988.
3. Trerotola SO, Lawson J, Roy-Chaudhury P, Saad TF. Drug coated balloon angioplasty in failing AV fistulas: A randomized controlled trial. *Clin J Am Soc Nephrol*. 2018; 13(8):1215-1224. doi:10.2215/CJN.14231217
4. Clinical practice guidelines for vascular access. *Am J kidney Dis Off J Natl Kidney Found*. 2006; 48 Suppl 1:S176-247. doi:10.1053/j.ajkd.2006.04.029
5. Malka KT, Flahive J, Csizinscky A, et al. Results of repeated percutaneous interventions on failing arteriovenous fistulas and grafts and factors affecting outcomes. *J Vasc Surg*. 2016; 63(3):772-777. doi:https://doi.org/10.1016/j.jvs.2015.09.031
6. Suemitsu K, Shiraki T, Iida O, Kobayashi H, Matsuoka Y, Izumi M, et al. Impact of Lesion Morphology on Durability After Angioplasty of Failed Arteriovenous Fistulas in Hemodialysis Patients. J Endovasc Ther. 2018 Oct;25(5):649-654. doi: 10.1177/1526602817748316. Epub 2017 Dec 18. PMID: 29254461.
7. Turmel-Rodrigues L, Pengloan J, Baudin S, Testou D, Abaza M, Dahdah G, et al. Treatment of stenosis and thrombosis in haemodialysis fistulas and grafts by interventional radiology. Nephrol Dial Transplant. 2000 Dec; 15(12):2029-36. doi: 10.1093/ndt/15.12.2029. PMID: 11096150.
8. Viecelli AK, Mori TA, Roy-Chaudhury P, Polkinghorne KR, Hawley CM, Johnson DW, et al. The pathogenesis of hemodialysis vascular access failure and systemic therapies for its prevention: Optimism unfulfilled. Semin Dial. 2018 May; 31(3):244-257. doi: 10.1111/sdi.12658. Epub 2017 Nov 26. PMID: 29178510.
9. Brahmbhatt A, Remuzzi A, Franzoni M, Misra S. The molecular mechanisms of hemodialysis vascular access failure. *Kidney Int*. 2016; 89(2):303-316. doi:https://doi.org/10.1016/j.kint.2015.12.019
10. Heye S, Maleux G, Vaninbroukx J, Claes K, Kuypers D, Oyen R. Factors influencing technical success and outcome of percutaneous balloon angioplasty in de novo native hemodialysis arteriovenous fistulas. *Eur J Radiol*. 2012; 81(9):2298-2303.
11. Bountouris I, Kristmundsson T, Dias N, Zdanowski Z, Malina M. Is Repeat PTA of a Failing Hemodialysis Fistula Durable? Int J Vasc Med. 2014; 2014:369687. doi: 10.1155/2014/369687. Epub 2014 Jan 22. PMID: 24587906; PMCID: PMC3920629.
12. Balamuthusamy S, Reddi AL, Madhrira MH, Sankarapandian B, Nguyen P, Vallurupalli A, et al. Clinical predictors of recurrent stenosis and need for re-intervention in the cephalic arch in patients with brachiocephalic AV fistulas. J Vasc Access. 2017 Jul 14; 18(4):319-324. doi: 10.5301/jva.5000734. Epub 2017 Jun 23. PMID: 28665461.
13. Kennedy SA, Mafeld S, Baerlocher MO, Jaberi A, Rajan DK. Drug-coated balloon angioplasty in hemodialysis circuits: a systematic review and meta-analysis. *J Vasc Interv Radiol*. 2019; 30(4):483-494.
14. Agarwal SK, Nadkarni GN, Yacoub R, Patel AA, Jenkins JS, Collins TJ, et al. Comparison of Cutting Balloon Angioplasty and Percutaneous Balloon Angioplasty of Arteriovenous Fistula Stenosis: A Meta-Analysis and Systematic Review of Randomized Clinical Trials. J Interv Cardiol. 2015 Jun; 28(3):288-95. doi: 10.1111/joic.12202. Epub 2015 May 20. PMID: 25989717.
15. Kitrou P, Spiliopoulos S, Karnabatidis D, Katsanos K. Cutting balloons, covered stents and paclitaxel-coated balloons for the treatment of dysfunctional dialysis access. *Expert Rev Med Devices*. 2016; 13(12):1119-1126.
16. Aftab SA, Tay KH, Irani FG, Gong Lo RH, Gogna A, Haaland B, et al. Randomized clinical trial of cutting balloon angioplasty versus high-pressure balloon angioplasty in hemodialysis arteriovenous fistula stenoses resistant to conventional balloon

angioplasty. J Vasc Interv Radiol. 2014 Feb;25(2):190-8. doi: 10.1016/j.jvir.2013.10.020. Epub 2013 Dec 5. PMID: 24315548Jia X, Zhang J, Zhuang B, Fu W, Wu D, Wang F, et al. Acotec Drug-Coated Balloon Catheter: Randomized, Multicenter, Controlled Clinical Study in Femoropopliteal Arteries: Evidence From the AcoArt I Trial. JACC Cardiovasc Interv. 2016 Sep 26; 9(18):1941-9. doi: 10.1016/j.jcin.2016.06.055. PMID: 27659572.

17. Jongsma H, Bekken JA, de Vries JPPM, Verhagen HJ, Fioole B. Drug-eluting balloon angioplasty versus uncoated balloon angioplasty in patients with femoropopliteal arterial occlusive disease. *J Vasc Surg*. 2016; 64(5):1503-1514.
18. Katsanos K, Spiliopoulos S, Paraskevopoulos I, Diamantopoulos A, Karnabatidis D. Systematic review and meta-analysis of randomized controlled trials of paclitaxel-coated balloon angioplasty in the femoropopliteal arteries: role of paclitaxel dose and bioavailability. *J Endovasc Ther*. 2016; 23(2):356-370.
19. Scheinert D, Duda S, Zeller T, Krankenberg H, Ricke J, Bosiers M, et al. The LEVANT I (Lutonix paclitaxel-coated balloon for the prevention of femoropopliteal restenosis) trial for femoropopliteal revascularization: first-in-human randomized trial of low-dose drug-coated balloon versus uncoated balloon angioplasty. JACC Cardiovasc Interv. 2014 Jan; 7(1):10-9. doi: 10.1016/j.jcin.2013.05.022. PMID: 24456716.
20. Tepe G, Schnorr B, Albrecht T, Brechtel K, Claussen CD, Scheller B, et al. Angioplasty of femoral-popliteal arteries with drug-coated balloons: 5-year follow-up of the THUNDER trial. JACC Cardiovasc Interv. 2015 Jan; 8(1 Pt A):102-8. doi: 10.1016/j.jcin.2014.07.023. PMID: 25616822.
21. Katsanos K, Spiliopoulos S, Kitrou P, Krokidis M, Karnabatidis D. Risk of death following application of paclitaxel-coated balloons and stents in the femoropopliteal artery of the leg: a systematic review and meta-analysis of randomized controlled trials. *J Am Heart Assoc*. 2018; 7(24):e011245.
22. Kitrou PM, Spiliopoulos S, Katsanos K, Papachristou E, Siablis D, Karnabatidis D. Paclitaxel-coated versus plain balloon angioplasty for dysfunctional arteriovenous fistulae: one-year results of a prospective randomized controlled trial. *J Vasc Interv Radiol*. 2015; 26(3):348-354.
23. Teo T, Tan BS, Yin W, Chan SX, Patel A, Tay K. ■ FEATURED ABSTRACT Prospective randomized trial comparing drug-eluting balloon versus conventional percutaneous transluminal angioplasty (DEBAPTA) for the treatment of hemodialysis arteriovenous fistula or arteriovenous graft stenoses-interim report of first 30 patients. *J Vasc Interv Radiol*. 2013; 24(4): S40-S41.
24. Swinnen JJ, Hitos K, Kairaitis L, Gruenewald S, Larcos G, Farlow D, et al. Multicentre, randomised, blinded, control trial of drug-eluting balloon vs Sham in recurrent native dialysis fistula stenoses. J Vasc Access. 2019 May; 20(3):260-269. doi: 10.1177/1129729818801556. Epub 2018 Sep 18. PMID: 30227772.
25. Lai CC, Fang HC, Tseng CJ, Liu CP, Mar GY. Percutaneous angioplasty using a paclitaxel-coated balloon improves target lesion restenosis on inflow lesions of autogenous radiocephalic fistulas: a pilot study. *J Vasc Interv Radiol*. 2014; 25(4):535-541.
26. Katsanos K, Karpabatidis D, Kitrou P, Spiliopoulos S, Christeas N, Siablis D. Paclitaxel-coated balloon angioplasty vs. plain balloon dilation for the treatment of failing dialysis access: 6-month interim results from a prospective randomized controlled trial. J Endovass Ther 2012; 19:263-72. www.clinicaltrials.gov:
27. Björkman P, Weselius EM, Kokkonen T, Rauta V, Albäck A, Venermo M. Drug-Coated Versus Plain Balloon Angioplasty In Arteriovenous Fistulas: A Randomized, Controlled Study With 1-Year Follow-Up (The Drecorest Ii-Study). *Scand J Surg*. 2019; 108(1):61-66. doi:10.1177/1457496918798206
28. Bitt! JA. Catheter interventions for hemodialy-sis fistulas and grafts. JACC Cardiovasc Intery. 2010; 3:1-11.
29. Roy-Chaudhury. P, Sukhatme VP, Cheung AK. Hemodialysis vascular access dysfunction: a cellular and molecular viewpoint. J Am Soc Nephrol. 2006; 17:1112-1127.
30. Liu BC, Li L, Gao M, Wang YL, Yu JR. Microinflammation is involved in the dysfunction of arteriovenous fistula in patients with maintenance hemodialysis. Chin Med J (Engl). 2008 Nov 5; 121(21):2157-61. PMID: 19080177.
31. Ibeas J, Roca-Tey. R, Vallespi 'n J, Moreno T, kMon ‘ux G, Martı '-Monro. 's A, et al. Spanish clinical guidelines on vascular access for haemodialysis. Nefrologia. 2017; 37(Suppl 1):1–193.
32. Karnabatidis D, Kitrou P. Drug eluting balloons for resistant arteriovenous dialysis access stenosis. J Vasc Access. 2017; 18(Suppl 1):88–91. https://doi.org/10.5301/jva.5000663.

33. Schorn I, Malinoff H, Anderson S, Lecy C, Wang J, Giorgianni JPG. The LUTONIX drug-coated balloon: a novel drug delivery technology for the treatment of vascular disease. Ady Drug Deliv Rev. 2017; 112:78–87. https://doi.org/10.1016/ j. addr.2017.05.015.
34. Moreno-Sánchez-T, Moreno-Ramirez M, Machancoses FH, Pardo-Moreno P, Navarro-Vergara PF. García-Revillo J. Efficacy of Paclitaxe! Balloon for Hemodialysis Stenosis Fistulae After One Year Compared to High-Pressure Balloons: A Controlled, Multicenter, Randomized Trial. Cardiovasc Intervent Radiol 2020; 43:382-90.
35. Dinh K, Limmer AM, Paravastu SCV, Thomas SD, Bennett MH, Holden A, et al. Mortality After Paclitaxel-Coated Device Use in Dialysis Access: A Systematic Review and Meta-Analysis. J Endovasc Ther. 2019 Oct; 26(5):600-612. doi: 10.1177/1526602819872154. Epub 2019 Aug 28. PMID: 31455140.
36. Lookstein RA, Haruguchi H, Ouriel K, Weinberg I, Lei L, Cihlar S, et al. IN.PACT AV Access Investigators. Drug-Coated Balloons for Dysfunctional Dialysis Arteriovenous Fistulas. N Engl J Med. 2020 Aug 20; 383(8):733-742. doi: 10.1056/NEJMoa1914617. PMID: 32813949.

To cite:

Zidan, M., Tawfik, A., Tawfeek, H., Elboushi, A. Drug coated versus non-compliant balloon angioplasty in failing native arteriovenous access. *Zagazig University Medical Journal*, 2024; (447-457): -. doi: 10.21608/zumj.2022.143306.2581