Prospective, randomized controlled study of paclitaxel-coated versus plain balloon angioplasty for the treatment of failing dialysis access

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Disclosure

Speaker name: .................................................................

I have the following potential conflicts of interest to report:

☐ Consulting
☐ Employment in industry
☐ Stockholder of a healthcare company
☐ Owner of a healthcare company
☐ Other(s)

☒ I do not have any potential conflict of interest
Incidence of ESRD has been escalating over the last years.

The creation of hemodialysis access (the so-called “lifeline” for dialysis patients) in the form of either an autologous arteriovenous fistula (AVF) or prosthetic arteriovenousous graft (AVG).

The autogenous arteriovenous fistula is considered as the optimum access.

When the access has matured, it results in higher patency rates and lower complication rates than the other dialysis options as the prosthetic grafts and cuffed, tunneled dialysis catheters.

However, juxtaanastomotic venous stenosis is a major concern associated with AVFs, which is mainly as a result of neointimal hyperplasia.

The presence of this occlusive neointimal hyperplasia at the anastomosis and/or the outflow veins, which may be accelerated by chronic kidney disease, has been considered to be the leading cause of AVF failure.

An established method of preserving failing dialysis access is plain balloon angioplasty (BA) of significantly stenotic lesions occurring in the dialysis circuit of failing arteriovenous shunts.

Although BA remains the cornerstone treatment for vascular access stenosis because of its minimally invasive percutaneous nature and widespread availability, the combination of venous anatomy and physiology, with the pre-existing endothelial dysfunction of uremic patients, generally leads to poor mid- and long-term results, necessitating multiple repeat angioplasty sessions in the same circuit.

In an attempt to improve immediate technical success and long-term vascular patency, several methods have been applied in the past, with bare metal stents having been most widely tested, albeit with controversial outcomes.

Several devices and techniques:

- Cutting balloons
- Cryoplasty

have been used in an attempt to improve patency outcomes of conventional percutaneous transluminal angioplasty in failing dialysis vascular access.

• One such approach could be the use of angioplasty with paclitaxel-coated balloons (PCBs), which are already known to effectively inhibit neointimal hyperplasia and reduce vascular restenosis after angioplasty of the superficial femoral artery for leg ischemia.

• PCB provides rapid delivery of the antiproliferative drug to the local vessel wall and inhibition of neointimal hyperplasia as compared with PBA.

Aim of this study
Is to compare:

**Primary patency rates (PPR)** and **target lesion revascularization (TLR)** of paclitaxel-coated balloon (PCB) vs. plain balloon angioplasty (PBA) to preserve the patency of the vascular access circuit in patients undergoing hemodialysis after one year of follow-up.
From 1st January 2015 to 31st December 2016

Three tertiary hospitals in Egypt & Saudi Arabia
Patients have been assigned into two groups:

Group A: included 48 patients underwent PCB.

Group B: included 48 patients underwent PBA.

Randomization has been done using the Sealed Envelope Services.
http://www.sealedenvelope.com
96 Patients

54

42
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<thead>
<tr>
<th><strong>Inclusion criteria</strong></th>
<th><strong>Exclusion criteria</strong></th>
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<tr>
<td>• Age 18 – 90 years.</td>
<td>• Patient unable to provide informed consent.</td>
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<tr>
<td>• Autogenous arteriovenous fistula or prosthetic arteriovenous graft in the upper limb.</td>
<td>• Patient unable to abide with study follow-up protocol.</td>
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<td>• Vascular access actively used for hemodialysis (at least 1 successful session).</td>
<td>• Patient participating in other relevant or conflicting studies.</td>
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<td>• Clinical signs of failing access due to presence of significant anatomic stenosis as detection of elevated venous pressure during dialysis &amp;/or decreased blood flow.</td>
<td>• Vascular access circuit placed in the lower extremities.</td>
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<td>• Angiographically proven venous outflow stenosis &gt;50% as compared to proximal segment of the reference vein diameter. Aneurysmal venous segments were avoided.</td>
<td>• Bare metal stent or stent-graft placed previously.</td>
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<td>• Reference diameter of proximal outflow vein &lt;7mm*</td>
<td>• Metastatic cancer or other terminal medical condition.</td>
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<td>• Hemodynamically significant stenosis of the central venous system.</td>
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<td>• Limited life expectancy (&lt;6 months).</td>
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<td>• Blood coagulation disorders.</td>
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<td>• Sepsis or active infection.</td>
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<td>• Recent arm superficial thrombophlebitis (&lt;6 months).</td>
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• Patients & Methods

- Prospective, randomized study.
- Informed consent was taken from every patient as agreed by ethical committee.
- Careful clinical and radiological evaluation of every patient.
Study devices

- The IN.PACT over-the-wire balloon paclitaxel-eluting, dilatation catheters (Invatec-Medtronic, Brescia, Italy) PCB group.
- Balloons were available at a maximum diameter of 7 mm and a maximum length of 80 mm, while the dose of paclitaxel on the balloon’s surface was 3 μg/mm².
- A variety of high-pressure balloon catheters in PBA group
Patients & Methods

Post procedural

- Patients were prescribed daily antiplatelet therapy with clopidogrel (75 mg) postprocedural in both groups.
- Clinical follow up was performed during regular dialysis sessions, and DSA follow-up was scheduled every 2 months or earlier if deemed necessary.
Study Endpoints and Outcome Measures

• The primary endpoint was primary patency of the treated lesion and of the treated circuit at 6 months.
Study Endpoints and Outcome Measures

- **Secondary endpoints** included:
  
  (1) Overall dialysis circuit survival, defined as a patent and functional vascular access regardless of the number of repeat surgical and/or percutaneous procedures in the interim.

  (2) Major and minor complications, classified according to published international reporting standards.
a. The arterial anastomotic stenosis of forearm loop graft has already dilated using PCB with significant residual restenosis >50%.

b. Final fistulogram showing subsequent further successful redilatation using HPB.
Tight stenosis of radiocephalic fistula vein (A) was dilated with 4/20mm PCB (B) with successful result as shown in the postdilatation venography (C).
Dilatation of the juxtaanastomotic cephalic vein segment stenosis (A) using paclitaxel-coated balloon 4mm*70mm (B) with successful postdilatation venography (C).
Results
Results

• There were no significant differences in age of the treated vascular access circuit (2.31 ± 1.62 years in PCB group vs. 2.63 ± 1.94 years in PBA group, \( p = 0.483 \)), nor in the overall length of the treated target vein lesion (5.2 ± 1.4 cm in PCB group vs. 5.4 ± 1.6 cm in PBA group, \( p = 0.641 \)).
Results

- All patients enrolled in the study have been completed the 1-year follow-up period.

- Device success rates were 100% in the PBA group and 39.6% in the PCB group, as further dilation with PBA was needed in 29 of 48 cases (60.4%) in the PCB group to achieve acceptable immediate postprocedural residual stenosis less than 30% ($p = <0.001$).
Among the limiting factors of our study were the **limited diameter availability** of PCBs (maximum of 7 mm) and **low-pressure** (12 atm) inflation force which influenced device success outcomes and the fact that different balloons with different maximum pressures were used in the PBA group constitutes an additional limitation of the study.
Results

- Anatomic and clinical success rates were 100% in both groups.

- No minor or major procedure-related complications occurred in either group.

- TLR-free survival was significantly superior in the PCB group according to the Kaplan–Meier survival analysis curve (PCB, 316 days; PBA, 172 days; \( p = 0.041 \)).

- Access circuit primary patency results were also significantly in favor of PCB angioplasty (PCB, 287 days; PBA, 156 days; \( p = 0.04 \)).
Kaplan-Meier survival plots of **dialysis circuit primary patency**. Vertical line with asterisk (*) represents 1-year time point. Subjects at risk are presented for intervals of 100, 200, 300, & 400 days.
Kaplan-Meier survival plots of TLR-free survival. Vertical line with asterisk (*) represents 1-year time point. Subjects at risk are also presented.
Discussion

• Controlled trial compared the effectiveness of traditional BA with that of BA followed by the insertion of a self-expanding stent-graft at the stenosed venous anastomotic site of the AVG. Of interest, 6-month primary patency rates of both the treatment area and the entire treated access circuit were significantly superior.

Discussion

• Theoretically, the absence of any source of chronic inflammation, such as the metal stent, avoids an exaggerated vessel reparative process responsible for the phenomenon of restenosis and acute late thrombosis.

• To date, positive results have been obtained with the application of PCB angioplasty for the treatment of leg ischemia due to peripheral artery disease and recurrent coronary obstructions due to in-stent stenosis.

Discussion

• In the randomized trial of Katsanos et al, the 6-month lesion primary patency rate was 70% in the group of dialysis recipients in whom PCBs were used, whereas it was 25% in the group treated with HPBs (P < .001).

• The difference was significantly in favor of PCBs in the recent pilot study by Lai et al, which included only patients with an AVF (70% vs 0% at 6 months; P < .01).

Discussion

• In our study, PCBs significantly improved dialysis access circuit primary patency
• the treated stenotic segments within the failing dialysis access circuit required fewer interventions when treated with angioplasty using a PCB than with BPA.
Conclusion
• Each arteriovenous access is considered precious.
• Paclitaxel-coated balloon angioplasty results in improved vessel patency and is superior to plain balloon in the treatment of failing native or prosthetic arteriovenous shunts used for dialysis access.
Thank You!
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