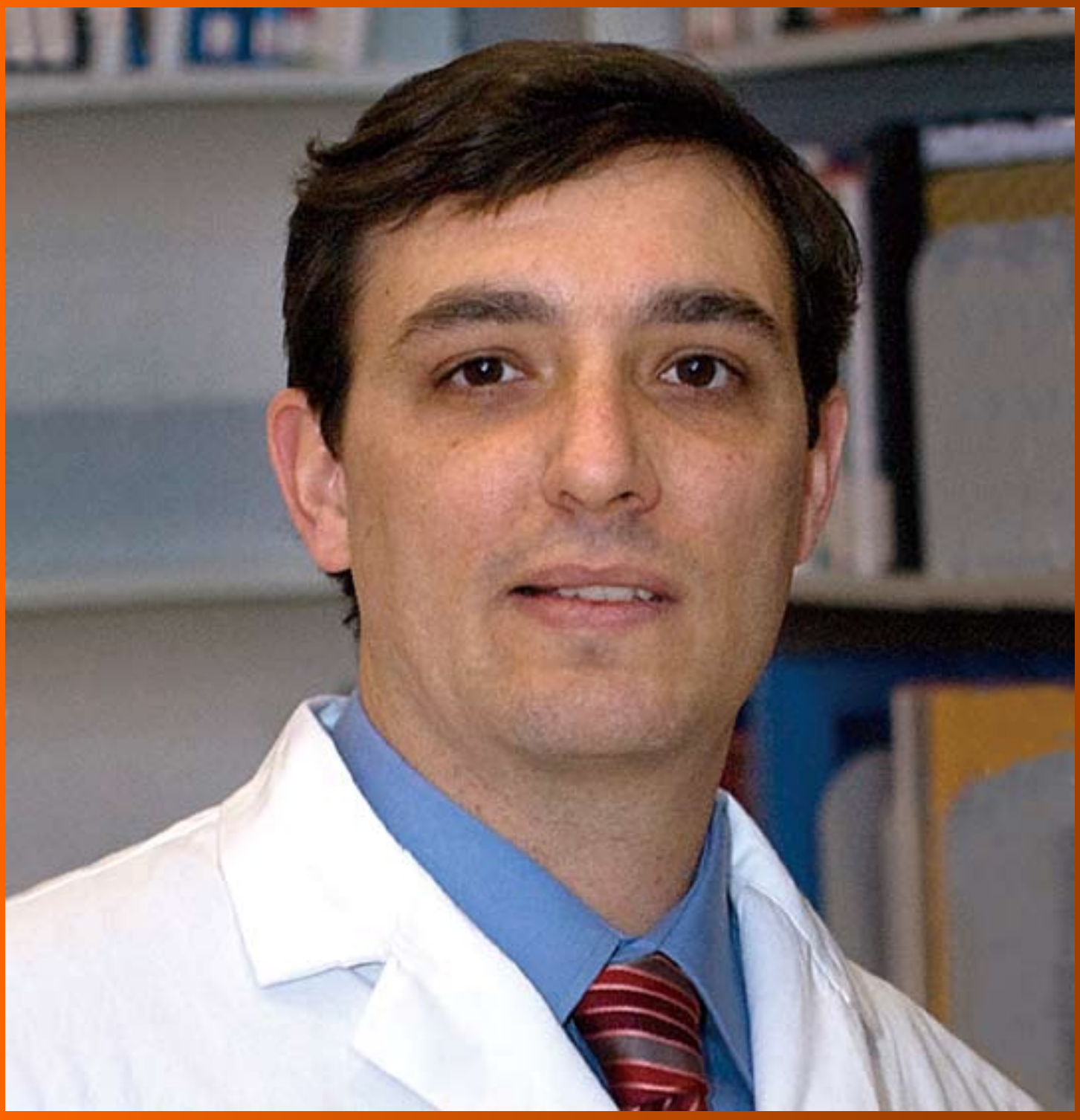
ISSN 1949-8462 (online)

World Journal of *Cardiology*

World J Cardiol 2018 November 26; 10(11): 191-249



Published by Baishideng Publishing Group Inc

World Journal of Cardiology

Contents

Monthly Volume 10 Number 11 November 26, 2018

EDITORIAL

191 Thin and crush: The new mantra in left main stenting?

Rigatelli G, Zuin M, Dash D

196 Revisiting endovascular treatment in below-the-knee disease. Are drug-eluting stents the best option?

Spiliopoulos S, Kitrou PM, Brountzos EN

201 Coronary spasm: It's common, but it's still unsolved

Teragawa H, Oshita C, Ueda T

REVIEW

210 Clinical applications of feature-tracking cardiac magnetic resonance imaging

Muser D, Castro SA, Santangeli P, Nucifora G

ORIGINAL ARTICLE

Clinical Trials Study

222 Safety and efficacy of frequency-domain optical coherence tomography in evaluating and treating intermediate coronary lesions

Khurwolah MR, Meng HY, Wang YS, Wang LS, Kong XQ

Observational Study

234 Incidence and risk factors for potentially suboptimal serum concentrations of vancomycin during cardiac surgery

Cotogni P, Barbero C, Rinaldi M

META-ANALYSIS

242 Surgical left atrial appendage occlusion during cardiac surgery: A systematic review and meta-analysis

Atti V, Anantha-Narayanan M, Turagam MT, Koerber S, Rao S, Viles-Gonzalez JF, Suri RM, Velagapudi P, Lakkireddy D, Benditt DG

ABOUT COVER

AIM AND SCOPE

World Journal of Cardiology (*World J Cardiol*, *WJC*, online ISSN 1949-8462, DOI: 10.4330) is a peer-reviewed open access journal that aims to guide clinical practice and improve diagnostic and therapeutic skills of clinicians.

WJC covers topics concerning arrhythmia, heart failure, vascular disease, stroke, hypertension, prevention and epidemiology, dyslipidemia and metabolic disorders, cardiac imaging, pediatrics, nursing, and health promotion. Priority publication will be given to articles concerning diagnosis and treatment of cardiology diseases. The following aspects are covered: Clinical diagnosis, laboratory diagnosis, differential diagnosis, imaging tests, pathological diagnosis, molecular biological diagnosis, immunological diagnosis, genetic diagnosis, functional diagnostics, and physical diagnosis; and comprehensive therapy, drug therapy, surgical therapy, interventional treatment, minimally invasive therapy, and robot-assisted therapy.

We encourage authors to submit their manuscripts to *WJC*. We will give priority to manuscripts that are supported by major national and international foundations and those that are of great basic and clinical significance.

INDEXING/ABSTRACTING

World Journal of Cardiology (*WJC*) is now abstracted and indexed in Emerging Sources Citation Index (Web of Science), PubMed, PubMed Central, Scopus, China National Knowledge Infrastructure (CNKI), and Superstar Journals Database.

EDITORS FOR THIS ISSUE

NAME OF JOURNAL
World Journal of Cardiology

ISSN
ISSN 1949-8462 (online)

LAUNCH DATE
December 31, 2009

FREQUENCY
Monthly

EDITORIAL BOARD MEMBERS
All editorial board members resources online at http://www.wjgnet.com/1949-8462/editorialboard.htm

EDITORIAL OFFICE
Jin-Lei Wang, Director
World Journal of Cardiology
Baishideng Publishing Group Inc
7901 Stoneridge Drive, Suite 501, Pleasanton, CA 94588, USA
Telephone: +1-925-2238242
Fax: +1-925-2238243
E-mail: editorialoffice@wjgnet.com
Help Desk: http://www.f6publishing.com/helpdesk
http://www.wjgnet.com

PUBLISHER
Baishideng Publishing Group Inc
7901 Stoneridge Drive, Suite 501,
Pleasanton, CA 94588, USA
Telephone: +1-925-2238242
Fax: +1-925-2238243
E-mail: bpgoffice@wjgnet.com
Help Desk: http://www.f6publishing.com/helpdesk
http://www.wjgnet.com

PUBLICATION DATE
November 26, 2018

INSTRUCTIONS TO AUTHORS
http://www.wjgnet.com/bpg/gerinfo/204

ONLINE SUBMISSION
http://www.f6publishing.com

World Journal of Cardiology

Submit a Manuscript: http://www.f6publishing.com

World J Cardiol 2018 November 26; 10(11): 196-200

DOI: 10.4330/wjc.v10.i11.196

ISSN 1949-8462 (online)

EDITORIAL

Revisiting endovascular treatment in below-the-knee disease. Are drug-eluting stents the best option?

Stavros Spiliopoulos, Panagiotis M Kitrou, Elias N Brountzos

Stavros Spiliopoulos, Elias N Brountzos, 2nd Radiology Department, Interventional Radiology Unit, University of Athens, Attikon University General Hospital, Athens 12461, Greece

Panagiotis M Kitrou, Department of Interventional Radiology, Patras University Hospital, Patras 26500, Greece

ORCID number: Stavros Spiliopoulos (0000-0003-1860-0568); Panagiotis M Kitrou (0000-0001-7631-2068); Elias N Brountzos (0000-0002-7504-2016).

Author contributions: Spiliopoulos S conceived the study and made critical revisions to its content; Kitrou PM drafted the manuscript and made critical revisions to its content; Brountzos EN drafted the manuscript and made critical revisions to its content; All authors approved the final version of the article.

Conflict-of-interest statement: The authors have no conflict of interest to declare.

Manuscript source: Invited Manuscript

Corresponding author to: Stavros Spiliopoulos, MD, PhD, Assistant Professor, 2nd Department of Radiology, Division of Interventional Radiology, National and Kapodistrian University of Athens, School of Medicine, Attikon University General Hospital, Athens 12461, Greece. stavspiliop@med.uoa.gr
Telephone: +30-693-7403468

Received: July 12, 2018
Peer-review started: July 12, 2018
First decision: August 2, 2018
Revised: August 14, 2018
Accepted: October 11, 2018
Article in press: October 12, 2018

Published online: November 26, 2018

Abstract

Patients with below-the-knee arterial disease are primarily individuals suffering from critical limb ischemia (CLI), while a large percentage of these patients are also suffering from diabetes or chronic renal failure or both. Available data from randomized controlled trials and their meta-analysis demonstrated that the use of infrapopliteal drug-eluting stents (DES), in short- to medium- length lesions, obtains significantly better results compared to plain balloon angioplasty and bare metal stenting with regards to vascular restenosis, target lesion revascularization, wound healing and amputations. Nonetheless, the use of this technology in every-day clinical practice remains limited mainly due to concerns regarding the deployment of a permanent metallic scaffold and the possibility of valid future therapeutic perspectives. However, in the majority of the cases, these concerns are not scientifically justified. Large-scale, multicenter randomized controlled trials, investigating a significantly larger number of patients than those already published, would provide more solid evidence and consolidate the use of infrapopliteal DES in CLI patients. Moreover, there is still little evidence on whether this technology can be as effective for longer below-the-knee lesions, where a considerable number of DES is required. The development and investigation of new, longer balloon-expanding or perhaps self-expanding DES could be the answer to this problem.

Key words: Critical limb ischemia; Infrapopliteal arterial disease; Drug-eluting stents; Peripheral arterial disease; Balloon angioplasty

Core tip: The use of infrapopliteal drug-eluting stents

(DES) remains limited in clinical practice mainly due to concerns regarding the deployment of a permanent metallic scaffold and the possibility of valid future therapeutic perspectives. However, these concerns are not scientifically justified. Large-scale, multicenter randomized controlled trials investigating a significantly larger number of patients would consolidate the use of infrapopliteal DES in critical limb ischemia patients. Moreover, there is still little evidence on whether this technology can be as effective for longer lesions, where a considerable number of DES is required. The development and investigation of longer balloon-expanding or self-expanding DES could solve this problem.

Spiliopoulos S, Kitrou PM, Brountzos EN. Revisiting endovascular treatment in below-the-knee disease. Are drug-eluting stents the best option? *World J Cardiol* 2018; 10(11): 196-200 Available from: URL: http://www.wjgnet.com/1949-8462/full/v10/i11/196.htm DOI: http://dx.doi.org/10.4330/wjc.v10.i11.196

INTRODUCTION

Patients with below-the-knee (BTK) arterial disease are mainly suffering from critical limb ischemia (CLI), the malignant expression of peripheral arterial disease[1]. Additionally, a large percentage of CLI patients with BTK disease are suffering from diabetes or chronic renal failure or both[2]. Specifically, patients with diabetes and CLI should undergo prompt revascularization, as the 5-year survival rate in such patients has been reported to be as low as 25%, while diabetes has been correlated with increased risk of limb amputation and repeat revascularization procedures[2]. These fundamental characteristics of BTK disease demarcate the therapeutic approach. More specifically, CLI sets the goal of treatment, which is limb salvage, rather than increasing walking distance, as in cases of intermittent claudication. Limb salvage is strongly related to direct, immediate and acute flow restoration to the foot, also described as immediate lumen gain.

The traditional endovascular treatment algorithm suggests the use of balloon angioplasty or bare metal stenting (BMS) as a bail-out option in cases of residual stenosis or flow-limiting dissection. However, diabetes and chronic renal failure contribute to the formation of an aggressive, hard, atherosclerotic plaque with marked calcifications that are resistant to balloon dilation, reducing the possibility of achieving an adequate acute luminal gain with the use of plain balloon angioplasty[2]. Therefore, in this specific population, the use of stents is, in many occasions, mandatory to obtain an acceptable immediate outcome. As outcomes of BMS in infrapopliteal arteries have been similar to those attained by balloon angioplasty and because short-term patency was not warranted, several studies, including multicenter randomized controlled trials (RCTs), investigated the use of infrapopliteal drug-eluting stents (DES) and the evidence in favor of this technology, which is widely used in coronary disease, began to accumulate[3,4].

Table 1 Endovascular devices for infrapopliteal arterial disease

Balloon angioplasty
Bare metal stents (balloon- or self-expandable)
Drug-eluting stents
Bioabsorbable stents
Bioabsorbable drug-eluting stents
Drug-coated balloons
Drug-infusion devices
Atherectomy devices
Lithotripsy

As a result, a significant volume of high-level evidence supporting the safety and effectiveness of infrapopliteal DES has emerged in the literature, motivating the Trans-Atlantic Society Consensus Ⅱ update to endorse the use of DES in the treatment algorithm of CLI and establish endovascular treatment as a valid and successful alternative to surgery. Notably, the specific consensus document supports the use of DES in short-length infrapopliteal lesions[1]. The endovascular devices currently available for the treatment of infrapopliteal arterial disease are summarized in Table 1.

In a 2013 meta-analysis of five RCTs (611 patients), Fusaro *et al*[5] found that infrapopliteal DES use significantly decreased major amputations and reinterventions compared to plain balloon angioplasty or BMS.

In a recent network meta-analysis of 16 RCTs (1805 patients), Katsanos *et al*[6] demonstrated that both DES and drug-coated balloons (DCBs) had significantly better results compared to plain balloon angioplasty and BMS with regards to vascular restenosis, target lesion revascularization and wound healing. Moreover, DES had also significantly better results when compared with DCB for the most important, strong clinical endpoint of amputations. The Infrapopliteal Drug-Eluting Angioplasty Versus Stenting (commonly known as IDEAS) trial by Siablis *et al*[7] is the only study so far that directly compares these state-of-the-art technologies in BTK disease. Despite the fact that DES demonstrated significantly less binary restenosis at six months follow-up, late lumen loss was similar between the two technologies. An in-depth analysis revealed that this was attributed to the superior acute luminal gain obtained by DES compared to balloon dilation. In the case of small-caliber BTK arteries, even a few millimeters of initial gain are significant, as a larger initial vessel diameter requires superior volume of hyperplasia to reach the critical point of clinically significant restenosis. Therefore, the current data demonstrate the superiority of DES technology for the management of BTK disease (Table 2). Nonetheless, the penetration of this technology in everyday clinical practice has been poorer than expected, due to several issues that remain to be addressed.

First of all, the implementation of a permanent metallic scaffold in such small-caliber vessels as the

Table 2 Randomized controlled trials for infrapopliteal drug-eluting technologies

Study	Yr of publication
Falkowski *et al*[22]	2009
BELOW. Tepe *et al*[23]	2010
ACHILLES. Scheinert *et al*[24]	2012
YUKON-BTX Rastan *et al*[25]	2012
DESTINY Bosiers *et al*[26]	2012
DEBATE-BTK. Liistro *et al*[27]	2013
IN.PACT DEEP. Zeller *et al*[28]	2014
IDEAS. Siablis *et al*[7]	2014
BIOLUX P-II. Zeller *et al*[29]	2015
PADI. Spreen *et al*[30]	2017

tibial arteries raises the issue of whether an occlusion would be re-accessible. Spiliopoulos *et al*[8] performed a retrospective analysis on the recanalization of occluded DES in BTK vessels. Within a period of seven years, a total 367 patients were treated with infrapopliteal DES and the re-occlusion rate was 11.4%. Notably, the success rate of endovascular recanalization of DES occlusions was 90.7% (49/54 cases), while endovascular recanalization was rarely technically demanding. Failure to recanalize the occluded stent(s) was associated with tandem popliteal stent occlusion and stent fractures. This concern of fracture or deformation that compromises patency and re-intervention options has been addressed in another retrospective analysis by Karnabatidis *et al*[9] in which the incidence and clinical implications of DES fracture was evaluated. In 63 CLI patients and 191 lesions, 369 stents were deployed. The follow-up period was 15 ± 11 mo. Only one (0.3%) severe stent fracture and eleven (3.0%) stent compressions were noted. The authors concluded that stent fracture or severe compression is rare and occurs in specific anatomical locations, mainly the distal anterior tibial artery. The authors recommended avoiding stenting in the specific anatomical location, as fractures lead to patency loss and inability to recanalize the occlusion[9]. The cost-effectiveness of DES was also a concern considering their higher price compared to plain balloon angioplasty and their short length, which leads to the deployment of a significant number of stents for the treatment of the characteristically long BTK lesions. This was also addressed in a cost-effectiveness study by Katsanos *et al*[10], where they concluded that the higher DES direct cost is counter-balanced by the smaller number of re-interventions required for limb salvage. Considering that the price of DES has decreased, longer stents could further diminish the direct cost and optimize the cost-effectiveness of infrapopliteal DES use. Finally, some physicians advocate that the deployment of infrapopliteal DES could compromise future surgical options. According to the authors' opinion, stenosed or occluded BTK arterial segments are not a suitable target for surgical reconstruction. Nevertheless, stent placement should always be performed with a view to future treatment options and should certainly respect non-diseased arterial segments that could be used for bypass surgery.

DCBs have been successfully used for the treatment of superficial femoral artery lesions and granted themselves an established role in the treatment algorithm, while there is already increasing evidence for their role in the treatment of dysfunctional dialysis access[11-16]. The use of this technology transformed treatment into a two-step procedure, with an initial step of mechanical treatment required to treat the immediate problem of vascular stenosis, while DCBs are implemented to slow down the process of restenosis using the cytotoxic drug paclitaxel. Several up-to-date tools are available in both the superficial femoral artery and dialysis access to perform vessel preparation[17,18]. However, in BTK vascular disease, the evidence supporting the use of DCB is rather controversial, as two large multicenter RCTs studies have failed to demonstrate the superiority of these devices over standard percutaneous transluminal angioplasty[19]. It is the authors' opinion that this disadvantage in BTK vessels is due to the deficient initial treatment vessel preparation step, which is not required when using balloon-expandable DES. Hence, it remains to be tested whether new technologies dedicated to vessel preparation and minimization of dissection will improve outcomes of infrapopliteal DCB angioplasty.

To conclude, although available data support the use of infrapopliteal DES for short- to medium-length lesions, the use of this technology in everyday clinical practice remains limited, mainly due to concerns regarding the deployment of a permanent metallic scaffold and the possibility of valid future therapeutic perspectives. However, in the majority of the cases, these concerns are not scientifically justified. Large-scale, multicenter RCTs investigating a significantly larger number of patients than those already published would provide solid evidence and would strengthen the use of infrapopliteal DES in CLI patients. Moreover, there is still little evidence on whether this technology can be as effective for longer BTK lesions, where a considerable number of DES is required[20,21]. The development and investigation of new, longer balloon-expanding or perhaps self-expanding DES could be the answer to this problem.

REFERENCES

1 **Jaff MR**, White CJ, Hiatt WR, Fowkes GR, Dormandy J, Razavi M, Reekers J, Norgren L. An update on methods for revascularization and expansion of the tasc lesion classification to include below-the-knee arteries: A supplement to the inter-society consensus for the management of peripheral arterial disease (TASC II): The TASC Steering Comittee. *Ann Vasc Dis* 2015; **8**: 343-357 [PMID: 26730266 DOI: 10.3400/avd.tasc.15-01000]

2 **Spiliopoulos S**, Theodosiadou V, Katsanos K, Kitrou P, Kagadis GC, Siablis D, Karnabatidis D. Long-term clinical outcomes of infrapopliteal drug-eluting stent placement for critical limb ischemia in diabetic patients. *J Vasc Interv Radiol* 2015; **26**: 1423-1430 [PMID: 26250856 DOI: 10.1016/j.jvir.2015.06.034]

3 **Katsanos K**, Spiliopoulos S, Diamantopoulos A, Karnabatidis D, Sabharwal T, Siablis D. Systematic review of infrapopliteal drug-eluting stents: a meta-analysis of randomized controlled trials.

Cardiovasc Intervent Radiol 2013; **36**: 645-658 [PMID: 23435741 DOI: 10.1007/s00270-013-0578-2]

4 **Katsanos K**, Spiliopoulos S, Diamantopoulos A, Siablis D, Karnabatidis D, Scheinert D. Wound healing outcomes and health-related quality-of-life changes in the achilles trial: 1-year results from a prospective randomized controlled trial of infrapopliteal balloon angioplasty versus sirolimus-eluting stenting in patients with ischemic peripheral arterial disease. *JACC Cardiovasc Interv* 2016; **9**: 259-267 [PMID: 26777329 DOI: 10.1016/j.jcin.2015.10.038]

5 **Fusaro M**, Cassese S, Ndrepepa G, Tepe G, King L, Ott I, Nerad M, Schunkert H, Kastrati A. Drug-eluting stents for revascularization of infrapopliteal arteries: updated meta-analysis of randomized trials. *JACC Cardiovasc Interv* 2013; **6**: 1284-1293 [PMID: 24355118 DOI: 10.1016/j.jcin.2013.08.007]

6 **Katsanos K**, Kitrou P, Spiliopoulos S, Diamantopoulos A, Karnabatidis D. Comparative effectiveness of plain balloon angioplasty, bare metal stents, drug-coated balloons, and drug-eluting stents for the treatment of infrapopliteal artery disease: Systematic review and bayesian network meta-analysis of randomized controlled trials. *J Endovasc Ther* 2016; **23**: 851-863 [PMID: 27708143 DOI: 10.1177/1526602816671740]

7 **Siablis D**, Kitrou PM, Spiliopoulos S, Katsanos K, Karnabatidis D. Paclitaxel-coated balloon angioplasty versus drug-eluting stenting for the treatment of infrapopliteal long-segment arterial occlusive disease: the IDEAS randomized controlled trial. *JACC Cardiovasc Interv* 2014; **7**: 1048-1056 [PMID: 25234679 DOI: 10.1016/j.jcin.2014.04.015]

8 **Spiliopoulos S**, Theodosiadou V, Fragkos G, Diamantopoulos A, Katsanos K, Siablis D, Karnabatidis D. Feasibility of endovascular recanalization of occluded infrapopliteal drug-eluting stents. *J Endovasc Ther* 2014; **21**: 392-399 [PMID: 24915587 DOI: 10.1583/13-4593MR.1]

9 **Karnabatidis D**, Katsanos K, Spiliopoulos S, Diamantopoulos A, Kagadis GC, Siablis D. Incidence, anatomical location, and clinical significance of compressions and fractures in infrapopliteal balloon-expandable metal stents. *J Endovasc Ther* 2009; **16**: 15-22 [PMID: 19281287 DOI: 10.1583/08-2530.1]

10 **Katsanos K**, Karnabatidis D, Diamantopoulos A, Spiliopoulos S, Siablis D. Cost-effectiveness analysis of infrapopliteal drug-eluting stents. *Cardiovasc Intervent Radiol* 2013; **36**: 90-97 [PMID: 22414987 DOI: 10.1007/s00270-012-0370-8]

11 **Kitrou P**, Karnabatidis D, Katsanos K. Drug-coated balloons are replacing the need for nitinol stents in the superficial femoral artery. *J Cardiovasc Surg (Torino)* 2016; **57**: 569-577 [PMID: 27128105]

12 **Kitrou PM**, Papadimatos P, Spiliopoulos S, Katsanos K, Christeas N, Brountzos E, Karnabatidis D. Paclitaxel-coated balloons for the treatment of symptomatic central venous stenosis in dialysis access: Results from a randomized controlled trial. *J Vasc Interv Radiol* 2017; **28**: 811-817 [PMID: 28434662 DOI: 10.1016/j.jvir.2017.03.007]

13 **Kitrou PM**, Spiliopoulos S, Papadimatos P, Christeas N, Petsas T, Katsanos K, Karnabatidis D. Paclitaxel-coated balloons for the treatment of dysfunctional dialysis access. results from a single-center, retrospective analysis. *Cardiovasc Intervent Radiol* 2017; **40**: 50-54 [PMID: 27738819 DOI: 10.1007/s00270-016-1479-y]

14 **Kitrou PM**, Katsanos K, Spiliopoulos S, Karnabatidis D, Siablis D. Drug-eluting versus plain balloon angioplasty for the treatment of failing dialysis access: final results and cost-effectiveness analysis from a prospective randomized controlled trial (NCT01174472). *Eur J Radiol* 2015; **84**: 418-423 [PMID: 25575743 DOI: 10.1016/j.ejrad.2014.11.037]

15 **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**: 348-354 [PMID: 25542635 DOI: 10.1016/j.jvir.2014.11.003]

16 **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**: 356-370 [PMID: 26823485 DOI: 10.1177/1526602815626557]

17 **Katsanos K**, Spiliopoulos S, Reppas L, Karnabatidis D. Debulking atherectomy in the peripheral arteries: Is there a role and what is the evidence? *Cardiovasc Intervent Radiol* 2017; **40**: 964-977 [PMID: 28451812 DOI: 10.1007/s00270-017-1649-6]

18 **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**: 1119-1126 [PMID: 27791450 DOI: 10.1080/17434440.2016.1254548]

19 **Barkat M**, Torella F, Antoniou GA. Drug-eluting balloon catheters for lower limb peripheral arterial disease: the evidence to date. *Vasc Health Risk Manag* 2016; **12**: 199-208 [PMID: 27274265 DOI: 10.2147/VHRM.S62370]

20 **Karnabatidis D**, Spiliopoulos S, Diamantopoulos A, Katsanos K, Kagadis GC, Kakkos S, Siablis D. Primary everolimus-eluting stenting versus balloon angioplasty with bailout bare metal stenting of long infrapopliteal lesions for treatment of critical limb ischemia. *J Endovasc Ther* 2011; **18**: 1-12 [PMID: 21314342 DOI: 10.1583/10-3242.1]

21 **Hammad TA**, Prasad A. The contemporary role of stents and angioplasty for the treatment of infrapopliteal disease in critical limb ischemia. *Curr Cardiol Rep* 2017; **19**: 58 [PMID: 28508349 DOI: 10.1007/s11886-017-0871-9]

22 **Falkowski A**, Poncyljusz W, Wilk G, Szczerbo-Trojanowska M. The evaluation of primary stenting of sirolimus-eluting versus bare-metal stents in the treatment of atherosclerotic lesions of crural arteries. *Eur Radiol* 2009; **19**: 966-974 [PMID: 19034460 DOI: 10.1007/s00330-008-1225-1]

23 **Tepe G**, Schmehl J, Heller S, Brechtel K, Heuschmid M, Fenchel M, Kramer U, Miller S, Claussen CD. Drug eluting stents versus PTA with GP IIb/IIIa blockade below the knee in patients with current ulcers--The BELOW Study. *J Cardiovasc Surg (Torino)* 2010; **51**: 203-212 [PMID: 20354490]

24 **Scheinert D**, Katsanos K, Zeller T, Koppensteiner R, Commeau P, Bosiers M, Krankenberg H, Baumgartner I, Siablis D, Lammer J, Van Ransbeeck M, Qureshi AC, Stoll HP; ACHILLES Investigators. A prospective randomized multicenter comparison of balloon angioplasty and infrapopliteal stenting with the sirolimus-eluting stent in patients with ischemic peripheral arterial disease: 1-year results from the ACHILLES trial. *J Am Coll Cardiol* 2012; **60**: 2290-2295 [PMID: 23194941 DOI: 10.1016/j.jacc.2012.08.989]

25 **Rastan A**, Brechtel K, Krankenberg H, Zahorsky R, Tepe G, Noory E, Schwarzwälder U, Macharzina R, Schwarz T, Bürgelin K, Sixt S, Tübler T, Neumann FJ, Zeller T. Sirolimus-eluting stents for treatment of infrapopliteal arteries reduce clinical event rate compared to bare-metal stents: long-term results from a randomized trial. *J Am Coll Cardiol* 2012; **60**: 587-591 [PMID: 22878166 DOI: 10.1016/j.jacc.2012.04.035]

26 **Bosiers M**, Scheinert D, Peeters P, Torsello G, Zeller T, Deloose K, Schmidt A, Tessarek J, Vinck E, Schwartz LB. Randomized comparison of everolimus-eluting versus bare-metal stents in patients with critical limb ischemia and infrapopliteal arterial occlusive disease. *J Vasc Surg* 2012; **55**: 390-398 [PMID: 22169682 DOI: 10.1016/j.jvs.2011.07.099]

27 **Liistro F**, Porto I, Angioli P, Grotti S, Ricci L, Ducci K, Falsini G, Ventoruzzo G, Turini F, Bellandi G, Bolognese L. Drug-eluting balloon in peripheral intervention for below the knee angioplasty evaluation (DEBATE-BTK): a randomized trial in diabetic patients with critical limb ischemia. *Circulation* 2013; **128**: 615-621 [PMID: 23797811 DOI: 10.1161/CIRCULATIONAHA.113.001811]

28 **Zeller T**, Baumgartner I, Scheinert D, Brodmann M, Bosiers M, Micari A, Peeters P, Vermassen F, Landini M, Snead DB, Kent KC, Rocha-Singh KJ; IN.PACT DEEP Trial Investigators. Drug-eluting balloon versus standard balloon angioplasty for infrapopliteal arterial revascularization in critical limb ischemia: 12-month results from the IN.PACT DEEP randomized trial. *J Am Coll Cardiol* 2014; **64**: 1568-1576 [PMID: 25301459 DOI: 10.1016/j.jacc.2014.06.1198]

29 **Zeller T**, Beschorner U, Pilger E, Bosiers M, Deloose K, Peeters P,

Scheinert D, Schulte KL, Rastan A, Brodmann M. Paclitaxel-Coated Balloon in Infrapopliteal Arteries: 12-Month Results From the BIOLUX P-II Randomized Trial (BIOTRONIK'S-First in Man study of the Passeo-18 LUX drug releasing PTA Balloon Catheter vs. the uncoated Passeo-18 PTA balloon catheter in subjects requiring revascularization of infrapopliteal arteries). *JACC Cardiovasc Interv* 2015; **8**: 1614-1622 [PMID: 26493253 DOI: 10.1016/j.jcin.2015.07.011]

30 **Spreen MI**, Martens JM, Knippenberg B, van Dijk LC, de Vries JPM, Vos JA, de Borst GJ, Vonken EPA, Bijlstra OD, Wever JJ, Statius van Eps RG, Mali WPTM, van Overhagen H. Long-Term Follow-up of the PADI Trial: Percutaneous Transluminal Angioplasty Versus Drug-Eluting Stents for Infrapopliteal Lesions in Critical Limb Ischemia. *J Am Heart Assoc* 2017; **6**: [PMID: 28411244 DOI: 10.1161/JAHA.116.004877]

P- Reviewer: Biondi-Zoccai G, Rostagno C **S- Editor**: Dou Y
L- Editor: Filipodia **E- Editor**: Wu YXJ

Published by **Baishideng Publishing Group Inc**
7901 Stoneridge Drive, Suite 501, Pleasanton, CA 94588, USA
Telephone: +1-925-223-8242
Fax: +1-925-223-8243
E-mail: bpgoffice@wjgnet.com
Help Desk: http://www.f6publishing.com/helpdesk
http://www.wjgnet.com