Journal of the American Heart Association

EDITORIAL

Vascular Closure Devices after Femoral Arteriotomy: Insight in High-Risk Patients

Ravi Thakker, MD; Jose C. Iturrizaga, MD; Tareq Abu Sharifeh, MD

Femoral arteriotomy has been appreciated to be one of the most commonly used access sites for cardiac catheterization.[1] Although transradial arterial access use is increasing and becoming the predominant access site, femoral arterial access is still needed for large-bore access procedures.[2] Complications associated with femoral arteriotomy include groin hematomas, pseudoaneurysms, arteriovenous fistulas, cholesterol plaque embolization, and infection.[3] Femoral artery access is also associated with an increased risk of bleeding compared with radial artery access.[4] Proposed ways to overcome these access site complications have included the use of ultrasound access, which allows for visualization of landmarks in addition to fluoroscopy,[5] as well as, micropuncture technique.[6] Although manual compression is appreciated as the main stay of hemostasis after femoral arteriotomy, vascular closure devices (VCD) have been noted to be a tool in the interventionalist armament. VCDs have been shown to decrease bed rest time and decrease time to hemostasis.[7]

See Article by Povsic et al.

It is in this context that the study by Marquis-Gravel et al[8] in this issue of the *Journal of the American Heart Association* (*JAHA*) should be viewed. The authors are to be commended on their post hoc study of 1580 patients from the REGULATE-PCI (A Study to Determine the Efficacy and Safety of REG1 Compared to Bivalirudin in Patients Undergoing PCI [Percutaneous Coronary Intervention]) trial,[9] which occurred across 225 sites in North America and Europe from 2013 to 2014. In the original trial, Lincoff et al[9] compared REG1 versus bivalirudin in patients undergoing PCI. The primary efficacy end point was the composite of all-cause death, myocardial infarction, stroke, and unplanned target lesion revascularization by day 3. The safety end point was bleeding. The study was stopped prematurely because of medication allergy. In this analysis[8] the authors evaluated the efficacy of VCDs in reducing bleeding after transfemoral PCI. The patient population compared were those undergoing VCD versus manual compression. Patients presenting with ST-segment–elevation myocardial infarction within 48 hours, clinical instability, inability to tolerate anticoagulation, recent use of bivalirudin, fibrinolysis, or glycoprotein IIb/IIIa inhibitors were excluded. The primary efficacy end point was type 2, 3, or 5 Bleeding Academic Research Consortium (BARC) access site bleeding on day 3. There are several baseline characteristics to appreciate from this study, although they may not all be statistically significant:

1. Women accounted for approximately 30% of the patient population in the VCD group and 25% in the manual compression group (P=0.05).
2. A creatine clearance of <60 mL/min was present in 14.2% of the VCD group and 13.4% of the manual compression group (P=0.63).

Key Words: Editorials ■ femoral arteriotomy ■ femoral artery access site complications ■ vascular closure devices

The opinions expressed in this article are not necessarily those of the editors or of the American Heart Association.

Correspondence to: Ravi Thakker, MD, Division of Cardiovascular Disease, University of Texas Medical Branch, Galveston, TX 77555. Email: ravi.a.thakker@gmail.com

For Disclosures, see page 2.

JAHA is available at: www.ahajournals.org/journal/jaha

3. Clopidogrel was used in 57.8% of the VCD group and 51.6% of the manual compression group (*P*=0.02). Ticagrelor was used in 7.7% of the VCD group and 8.5% of the manual compression group (*P*=0.55). Prasugrel was used in 9.9% of the VCD group and 9.5% of the manual compression group (*P*=0.84).
4. Peripheral artery disease was present in 21.7% of the VCD group and 11.3% of the manual compression group (*P*=<0.01).

The authors reported the following findings:

1. Bleeding Academic Research Consortium 2, 3, or 5 bleeding through day 3 was present in 6.4% of the VCD group and 6.6% of the manual compression group. This was not statistically significant (*P*=0.89). At day 3 through day 30 there was no Bleeding Academic Research Consortium 3 or 5 bleeding. Ultimately, multivariate analysis showed no difference in the primary end point of bleeding (*P*=0.79).
2. Median time to hemostasis (*P*<0.01) and ambulation (*P*<0.01) were shorter in the VCD group compared with the manual compression group.
3. Secondary bleeding end points were not significantly different between either group (*P*>0.05).
4. Interestingly, the authors found lower bleeding rates in patients with high-risk features such as female sex (*P*=0.005), chronic kidney disease (*P*=0.0004), and on ticagrelor or prasugrel who underwent VCD (*P*=0.038).

The overall design of this study is well done. We know from prior trials such as the ISAR-CLOSURE (Instrumental Sealing of Arterial Puncture Site Closure Device Versus Manual Compression Trial)[10] and CLOSE-UP (Comparison of the FemoSeal Arterial Closure Device to Manual Compression After Coronary Angiography)[11] studies, as the authors point out, that VCD is noninferior to manual compression in terms of access site complications and hematoma formation. On the contrary, Tavris et al[12] in their analysis of the CathPCI Registry found VCDs to lower bleeding risk or vascular complications compared with manual compression alone. This analysis raises important questions such as the need for studies in high-risk groups that include women, patients with renal insufficiency, and those on P2Y12 inhibition therapy. In the Northern New England PCI Registry, Ahmed et al[13] noted that older age, poor renal function, cardiogenic shock, and use of large sheaths were all indicators for increased bleeding in women undergoing PCI. Aside from the aforementioned, lower body mass index, anatomy of the vessel such as smaller vessel size, in vivo platelet function, and pharmacodynamics of antiplatelet therapy have also been identified as female-specific factors relating to increase bleeding risk.[14] The diathesis for bleeding in patients with renal insufficiency is multifold and focused on anemia and nitric oxide production with a concern for poor platelet adhesion.[15] Owing to the variation in bleeding potential among various P2Y12 inhibitors, it is imperative that the right antiplatelet be chosen. Prasugrel has been associated with increased thrombolysis in myocardial infarction major and minor bleeding compared with clopidogrel and ticagrelor.[16]

This study[8] demonstrates 2 major important points that the interventionalist must keep in mind. VCDs may not reduce major bleeding but play an important role in time to hemostasis and ambulation, which we feel may help reduce patient down-time and time to discharge. Furthermore, in high-risk patients such as women, patients with history of chronic kidney disease, and those who are on antiplatelet therapy, VCDs should be considered as a primary method of hemostasis.

ARTICLE INFORMATION

Affiliation

Division of Cardiovascular Disease, University of Texas Medical Branch, Galveston, TX

Disclosures

None.

REFERENCES

1. Rao SV, Ou FS, Wang TY. Trends in the prevalence and outcomes of radial and femoral approaches to percutaneous coronary intervention: a report from the National Cardiovascular Data Registry. *JACC Cardiovasc Interv*. 2008;1:379–386. doi: 10.1016/j.jcin.2008.05.007
2. Sandoval Y, Burke MN, Lobo AS, Lips DL, Seto AH, Chavez I, Sorajja P, Abu-Fadel MS, Wang Y, Poulouse A, et al. Contemporary arterial access in the cardiac catheterization laboratory. *JACC Cardiovasc Interv*. 2017;10:2233–2241. doi: 10.1016/j.jcin.2017.08.058
3. Nasser TK, Mohler ER III, Wilensky RL, Hathaway DR. Peripheral vascular complications following coronary interventional procedures. *Clin Cardiol*. 1995;18:609–614. doi: 10.1002/clc.4960181105
4. Gargiulo G, Giacoppo D, Jolly SS, Cairns J, Le May M, Bernat I, Romagnoli E, Rao SV, van Leeuwen MAH, Mehta SR, et al. Effects on mortality and major bleeding of radial versus femoral artery access for coronary angiography or percutaneous coronary intervention: meta-analysis of individual patient data from 7 multicenter randomized clinical trials. *Circulation*. 2022;146:1329–1343. doi: 10.1161/CIRCULATIONAHA.122.061527
5. Fanaroff AC, Giri J. Fluoroscopic guidance for femoral artery access-pushing patients out of the plane without a parachute? *JAMA Cardiol*. 2022;7:1118–1120. doi: 10.1001/jamacardio.2022.3413
6. Ben-Dor I, Sharma A, Rogers T, Yerasi C, Case BC, Chezar-Azerrad C, Musallam A, Forrestal BJ, Zhang C, Hashim H, et al. Micropuncture technique for femoral access is associated with lower vascular complications compared to standard needle. *Catheter Cardiovasc Interv*. 2021;97:1379–1385. doi: 10.1002/ccd.29330
7. Patel MR, Jneid H, Derdeyn CP, Klein LW, Levine GN, Lookstein RA, White CJ, Yeghiazarians Y, Rosenfield K; American Heart Association Diagnostic and Interventional Cardiac Catheterization Committee of the Council on Clinical Cardiology, Council on Cardiovascular Radiology and Intervention, Council on Peripheral Vascular Disease, Council on Cardiovascular Surgery and Anesthesia, and Stroke Council.

Arteriotomy closure devices for cardiovascular procedures: a scientific statement from the American Heart Association. *Circulation*. 2010;122:1882–1893. doi: 10.1161/CIR.0b013e3181f9b345
8. Marquis-Gravel G, Boivin Proulx L-A, Huang Z, Zelenkofske SL, Lincoff AM, Mehran R, Steg PG, Bode C, Alexander JH, Povsic TJ. Femoral vascular closure devices and bleeding, hemostasis, and ambulation following percutaneous coronary intervention. *J Am Heart Assoc*. 2022. doi: 10.1161/JAHA.122.025666
9. Lincoff AM, Mehran R, Povsic TJ, Zelenkofske SL, Huang Z, Armstrong PW, Steg PG, Bode C, Cohen MG, Buller C, et al. Effect of the REG1 anticoagulation system versus bivalirudin on outcomes after percutaneous coronary intervention (REGULATE-PCI): a randomised clinical trial. *Lancet*. 2016;387:349–356. doi: 10.1016/S0140-6736(15)00515-2
10. Schulz-Schüpke S, Helde S, Gewalt S, Ibrahim T, Linhardt M, Haas K, Hoppe K, Bottiger C, Groha P, Bradaric C, et al. Comparison of vascular closure devices vs manual compression after femoral artery puncture: the ISAR-CLOSURE randomized clinical trial. *JAMA*. 2014;312:1981–1987. doi: 10.1001/jama.2014.15305
11. Holm NR, Sindberg B, Schou M, Maeng M, Kaltoft A, Bottcher M, Krusell LR, Hjort J, Thuesen L, Terkelsen CJ, et al. Randomised comparison of manual compression and FemoSeal™vascular closure device for closure after femoral artery access coronary angiography: the CLOSuredEvices used in everyday practice (CLOSE-UP) study. *EuroIntervention*. 2014;10:183–190. doi: 10.4244/EIJV10I2A31
12. Tavris DR, Wang Y, Jacobs S, Gallauresi B, Curtis J, Messenger J, Resnic FS, Fitzgerald S. Bleeding and vascular complications at the femoral access site following percutaneous coronary intervention (PCI): an evaluation of hemostasis strategies. *J Invasive Cardiol*. 2012;24:328–334.
13. Ahmed B, Piper WD, Malenka D, VerLee P, Robb J, Ryan T, Herne M, Phillips W, Dauerman HL. Significantly improved vascular complications among women undergoing percutaneous coronary intervention: a report from the northern New England percutaneous coronary intervention registry. *Circ Cardiovasc Interv*. 2009;2:423–429. doi: 10.1161/CIRCINTERVENTIONS.109.860494
14. Ahmed B, Dauerman HL. Women, bleeding, and coronary intervention. *Circulation*. 2013;127:641–649. doi: 10.1161/CIRCULATIONAHA.112.108290 PMID: 23381962
15. Portolés J, Martín L, Broseta JJ, Cases A. Anemia in chronic kidney disease: from pathophysiology and current treatments, to future agents. *Front Med (Lausanne)*. 2021;8:642296. doi: 10.3389/fmed.2021.642296
16. Fei Y, Lam CK, Cheung BMY. Efficacy and safety of newer $P2Y_{12}$ inhibitors for acute coronary syndrome: a network meta-analysis. *Sci Rep*. 2020;10:16794. doi: 10.1038/s41598-020-73871-x