

Radial artery cardiac catheterization: Changing the convincing data/ /work to change (CD/WC) ratio

Christopher Cove

Cardiac Catheterization Laboratory, University of Rochester Medical Center, Rochester, NY, USA

Article p. 332

Cardiac catheterization is one of the commonest procedures done worldwide. Although the risks of the procedure are small, it is plagued by patient dissatisfaction due to the prolonged bed rest after the procedure and groin bleeding related to the femoral artery puncture site. There have been many attempts to decrease or eliminate the bed rest post-procedure, including the development of numerous percutaneous vascular closure devices, using smaller catheters and hemostatic patches. Although these devices in general achieve faster ambulation time, none have been shown to decrease bleeding complications and they all add cost to the procedure [1–4].

Radial artery catheterization offers the unique combination of less bleeding, better patient satisfaction and early ambulation without an increased cost to the system [5–7]. Despite these advantages, radial access has been very slowly adopted. Interventionalists have quickly adopted many new techniques that were shown to benefit patients, so why not the radial approach to cardiac catheterization?

The best answer may be the convincing data/work to change (CD/WC) ratio. I would propose this as a novel barometer of predicting when there will be a shift in medical practice. Physicians will rarely change their way of doing things until the CD/WC ratio is significantly greater than 1. If we look at recent new techniques in interventional cardiology, we can see how the CD/WC ratio affects practices. One the quickest changes that occurred in interven-

tional cardiology was the adoption of drug eluting stents (DES). The randomized data for the prevention of re-stenosis was overwhelming [8] and the techniques needed to adapt to this change were no different than using bare metal stents. This gave DES a CD/WC ratio much greater than one. On the opposite side is the use of rotational and directional atherectomy. Here there is limited data in randomized trials of any patient benefit [9] and these procedures require a significant amount of training and new techniques to be successful. So the CD/WC ratio is less than one with atherectomy; therefore a cardiologist's use of these devices is limited.

So what is the CD/WC ratio of radial artery catheterization? At this point it is approaching 1 but not close enough for interventionalists worldwide to change their approach in large numbers. Decreasing the work to change (WC) is the first barrier that has to be overcome. Because of the radial artery's small size, vascular anomalies and its tendency to spasm reaching the central aorta can be difficult. But with appropriate training and experience, success rates with the radial technique can approach the rates with femoral cases, even in complex patients [10, 11]. In addition to better training, better equipment is also making the technique less difficult. With new sheaths for radial access, better catheters for guide support and lower profile balloons and stents, never before has radial access been easier. The more operators adopt the radial technique, the more the medical device industry will improve the tools we use.

Despite these advances it is unlikely that there will be a large decrease in the WC, so if the CD/WC ratio is going to be greater than 1, there needs

to be a large increase in the amount of convincing data (CD). The article by Chodór et al. [12] in this month's edition of "Cardiology Journal" helps increase the CD for radial artery catheterizations. The amount of data needed to change physicians' practices is difficult to assess. The quality of the data may be more important than the quantity. Data that comes from high quality studies is more likely to be accepted as true by the cardiology community.

There is growing evidence that bleeding in patients with acute coronary syndromes is associated with increased mortality [13–17]. The etiology is unclear but may be related to anemia causing increased ischemic events, impaired renal function and platelet activation. In addition, blood transfusions can lead to activation of the inflammatory process and progression of atherosclerosis [18]. So, given this information, it is not surprising that a meta-analysis of nearly 39,000 procedures done in British Columbia found that the use of radial artery catheterizations halved the transfusion rate and was associated with a significant reduction in the 30 day and 1 year mortality rate; odds ratio = 0.71 and 0.83 respectively with a p value < 0.001 [19].

This data is consistent with the RIVIERA study, a large prospective, international registry which reported a decrease in bleeding complications and a reduction in percutaneous coronary intervention related mortality [20]. Similarly in the 'real world' study PREVAIL, which was a prospective look at 1,000 consecutive patients undergoing percutaneous procedures via arterial access, radial artery access was associated with less bleeding and lower in-hospital mortality [21]. The difficulty with all of these studies is that they are observational and it is difficult to control all the possible confounders. Since they are not randomized, there is a possible selection bias that cannot be controlled. The impact on the CD will be blunted because of this. Until there is a large randomized trial of radial versus femoral arterial access, it is unlikely that the CD/WC ratio will be significantly greater than 1. There was one prospective, randomized clinical trial that did show benefit to radial access with less bleeding, but because of the higher access site failures and because it was more than 10 years ago, its effect was minimal [6].

The article by Chodór et al. [12] in this issue of "Cardiology Journal" is unique in two regards. It is one of the few prospective, randomized trials of radial access and it also shows that the use of radials in acute myocardial infarction is possible. Because of this, it significantly adds to the CD and pushes the CD/WC ratio closer to 1. There is limited

data for the use of radials in acute myocardial infarction, as Chodór points out. Although this present trial is small, it clearly shows that radial artery improved the time to ambulation with no increase in the overall time of procedure, fluoroscopy time or volume of contrast. The study was not powered to look for complications but it is encouraging that there was a trend toward a decreased transfusion rate ($p = 0.08$). The major criticism of this study is the increase in door to balloon time in the radial access arm. Chodór's data shows this is due to sheath positioning and guide catheter placement. Any increase in door to balloon time in primary angioplasty has the potential to increase the mortality rate of acute myocardial infarction patients. If radial artery is to be used commonly in primary angioplasty there should be no difference in door to balloon time between radial and femoral arterial access. This can be done with more experience and better tools (decreasing the WC). At the University of Rochester Medical Center, the door to balloon times are similar between radial and femoral operators [22]. This has only been achieved through experience and training.

It is encouraging to see more data pushing the CD/WC ratio in favor of radial artery. As the evidence mounts and experience grows, we will be able to offer patients a better procedure that offers more comfort, decreased complications, and at a lower cost.

References

1. Hoffer EK, Bloch RD. Percutaneous arterial closure devices. *J Vasc Interv Radiol*, 2003; 14: 865–885.
2. Koreny M, Riedmuller E, Nikfardjam M et al. Arterial puncture closing devices compared with standard manual compression after cardiac catheterization: systematic review and meta-analysis. *JAMA*, 2004; 291: 350–357.
3. Nikolsky E, Mehran R, Halkinm A et al. Vascular complications associated with arteriotomy closure devices in patients undergoing percutaneous coronary procedures: a meta-analysis. *J Am Coll Cardiol*, 2004; 44: 1200–1209.
4. Tavis DR, Gallauresi BA, Lin B et al. Risk of local adverse events following cardiac catheterization by hemostasis device use and gender. *J Invasive Cardiol*, 2004; 16: 459–464.
5. Mann T, Cubeddu G, Bowen J et al. Stenting in acute coronary syndromes: A comparison of radial versus femoral access sites. *J Am Coll Cardiol*, 1998; 32: 572–576.
6. Kiemeneij F, Laarman GJ, Odekerken D et al. A randomized comparison of percutaneous transluminal coronary angioplasty by the radial, brachial and femoral approaches: The ACCESS study. *J Am Coll Cardiol*, 1997; 29: 1269–1275.
7. Cooper CJ, El-Shiekh RA, Cohen DJ et al. Effect of transradial access on quality of life and cost of cardiac catheterization: A randomized comparison. *Am Heart J*, 1999; 138 (3 Part 1): 430–436.

8. Stettler C, El-Shiekh RA, Cohen DJ et al. Drug eluting and bare metal stents in people with and without diabetes: Collaborative network meta-analysis. *BMJ*, 2008; 337: 1331.
9. Tran T, Brown M, Lasala J. An evidence-based approach to the use of rotational and directional coronary atherectomy in the era of drug-eluting stents: when does it make sense? *Catheter Cardiovasc Interv*, 2008; 72: 650–662.
10. Eccleshall SC, Banks M, Carroll R et al. Implementation of a diagnostic and interventional transradial programme: resource and organisational implications. *Heart*, 2003; 89: 561–562.
11. Lo TS, Buch AN, Hall IR, Hildick-Smith DJ, Nolan J. Percutaneous left and right heart catheterization in fully anticoagulated patients utilizing the radial artery and forearm vein: A two-center experience. *J Interv Cardiol*, 2006; 19: 258–263.
12. Chodór P, Krupa H, Kurek T et al. RADIAL versus femoral approach for percutaneous coronary interventions in patients with Acute Myocardial Infarction (RADIAMI): A prospective, randomized, single-center clinical trial. *Cardiol J*, 2009; 16: 332–340.
13. Steinhubl SR, Kastrati A, Berger PB. Variation in the definitions of bleeding in clinical trials of patients with acute coronary syndromes and undergoing percutaneous coronary interventions and its impact on the apparent safety of antithrombotic drugs. *Am Heart J*, 2007; 154: 3–11.
14. Anderson JL, Adams CD, Antman EM et al. ACC/AHA 2007 guidelines for the management of patients with unstable angina/non-ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 2002 Guidelines for the Management of Patients With Unstable Angina/Non-ST-Elevation Myocardial Infarction) developed in collaboration with the American College of Emergency Physicians, the Society for Cardiovascular Angiography and Interventions, and the Society of Thoracic Surgeons endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation and the Society for Academic Emergency Medicine. *J Am Coll Cardiol*, 2007; 50: e1–e157.
15. Rao SV, Jollis JG, Harrington RA et al. Relationship of blood transfusion and clinical outcomes in patients with acute coronary syndromes. *JAMA*, 2004; 292: 1555–1562.
16. Manoukian SV, Feit F, Mehran R et al. Impact of major bleeding on 30-day mortality and clinical outcomes in patients with acute coronary syndromes: An analysis from the ACUITY Trial. *J Am Coll Cardiol*, 2007; 49: 1362–1368.
17. Yusuf S, Mehta SR, Chrolavicius S et al. Comparison of fondaparinux and enoxaparin in acute coronary syndromes. *N Engl J Med*, 2006; 354: 1464–1476.
18. Yang X, Alexander KP, Chen AY et al. The implications of blood transfusions for patients with non-ST-segment elevation acute coronary syndromes: results from the CRUSADE National Quality Improvement Initiative. *J Am Coll Cardiol*, 2005; 46: 1490–1495.
19. Chase AJ, Fretz EB, Warburton WP et al. Association of the arterial access site at angioplasty with transfusion and mortality: The M.O.R.T.A.L study (Mortality benefit Of Reduced Transfusion after percutaneous coronary intervention via the Arm or Leg). *Heart*, 2008; 94: 1019–1025.
20. Montalescot G, Ongen Z, Guindy R et al. Predictors of outcome in patients undergoing PCI. Results of the RIVIERA study. *Int J Cardiol*, 2007 [Epub ahead of print].
21. Pristipino C, Trani C, Nazzaro MS et al. Major improvement of percutaneous cardiovascular procedure outcomes with radial artery catheterisation: results from the PREVAIL study. *Heart*, 2009; 95: 476–482.
22. Data from The URMIC Door to Balloon Time Data Base. Unpublished.