

Mayo Clinic Proceedings

Walk This Way: Early Ambulation After Cardiac Catheterization— Good for the Patient and the Health Care System

Although the safety of diagnostic left heart catheterization from the femoral artery is well established, access complications remain an important concern to patients and practitioners.¹ The risk of major and minor complications, such as excessive bleeding, hematoma formation, retroperitoneal bleeding, pseudoaneurysm formation, and arteriovenous fistula formation, has been reported to be 1.6% to 19% in different case series.²⁻⁶ In addition to patient safety, factors such as patient comfort, hospital cost, and catheterization laboratory throughput have provided motivation for the establishment of protocols for achieving access site hemostasis after diagnostic cardiac catheterization.⁷

After sheath removal, access site hemostasis has historically been achieved by manual compression; however the recent advent of mechanical compression devices and arterial closure devices has led to debate regarding the most effective method to achieve hemostasis quickly and safely. The use of arterial closure devices has allowed for reductions in the duration of patient bed rest after heart catheterization⁸⁻¹¹; however, these devices contribute to increased health care costs, and it remains unclear whether closure devices reduce complication rates.¹² In fact, there is some concern that in cases of device failure, complications such as arterial occlusion or infection can be serious. Protocols for duration of manual or mechanical compression, use of arterial closure devices, and time to ambulation after sheath removal vary widely across catheterization centers. Data are insufficient to construct universal guidelines to minimize vascular complications and patient discomfort while improving efficiency in the catheterization laboratory and potentially reducing costs.

In this issue of *Mayo Clinic Proceedings*, Doyle et al¹³ report a well-done and clinically relevant study of 1005

patients (1009 procedures) undergoing left heart catheterization via femoral access in which 5F catheter systems were used. After 10 to 15 minutes of manual pressure to achieve hemostasis, a protocol consisting of 1 hour of bed rest was followed after the procedure, allowing for ambulation as early as 1 hour after catheterization in the absence of complications. In this protocol, a patient was observed while walking 100 feet and then assessed by a nurse. If the patient had no problems and the access site remained stable, the patient walked another 100 feet.

[See also
page 1537](#)

After successful ambulation, patients were observed for an additional 60 minutes before dismissal from the hospital. In addition, a contact telephone number was provided to patients for use in the event of complications occurring after hospital discharge. Overall procedural success, defined as achieving successful hemostasis, patient ambulation within 60 minutes, and dismissal from the hospital without complications, was achieved in 975 procedures (97%). The authors report a remarkably low incidence of major (0.1%) and minor (3.3%) complications with the use of this protocol. The single major complication consisted of a patient who was noted to have a large (5 cm) hematoma at the access site approximately 1 hour after initial ambulation. Most minor complications consisted of small (<4 cm) hematoma formation at the access site (1.4%) or rebleeding (1.9%). Most cases of rebleeding occurred during bed rest (0.6%) or during ambulation (1.1%), and only 2 patients (0.2%) had evidence of rebleeding during the observation period after ambulation. No patients in this study required blood transfusion or surgical repair of the arterial access site, and no instances of retroperitoneal bleeding, arteriovenous fistula, pseudoaneurysm, arterial occlusion, or infection were observed.

It is important to address several issues that may affect the applicability of the protocol used at Mayo Clinic to other catheterization centers. Of note, the execution of a protocol such as that described by Doyle et al is largely dependent on the skill and training of the catheterization

Address correspondence to Deepak L. Bhatt, MD, Department of Cardiovascular Medicine, Cleveland Clinic Foundation, 9500 Euclid Ave, Desk F25, Cleveland, OH 44195 (e-mail: bhattdd@ccf.org).

© 2006 Mayo Foundation for Medical Education and Research

laboratory nursing staff and ancillary personnel. The success of this protocol at Mayo Clinic speaks to the exceptional level of nursing at that institution, and caution should be used in generalizing these data to other catheterization centers. The availability of nursing resources and the ability of the catheterization laboratory staff to undergo effective training in achieving hemostasis with manual compression may be important factors in allowing other centers to use a similar protocol. In addition to the in-hospital care, the provision of a telephone contact for patients to report complications represents another staffing issue. It was unclear from the article how many study patients experienced delayed complications resulting in contact through the telephone hotline; however, it should be noted that all centers may not have the resources to establish such a protocol. One factor that has increased the use of mechanical compression devices and arterial closure devices has been the shortage in trained nursing staff at many centers. If adequate personnel are available, the procedure room may be “turned over” while 1 person holds manual pressure; however, at centers with nursing shortages, it may not be feasible for nurses or technicians to maintain manual pressure after procedures because this may delay room turnover and decrease catheterization laboratory throughput.

Despite the overall success of the described protocol, some limitations must be acknowledged. Given that most patients in the study did not undergo anticoagulation at the time of the procedure, the results should not be applied to patients undergoing percutaneous coronary intervention treated with high-dose anticoagulation or patients undergoing anticoagulation for other indications. Furthermore, these data should not be applied to patients undergoing left heart catheterization with larger sheath sizes, which might increase the risk of bleeding complications. Caution must be used in other groups of patients who are otherwise at high risk for bleeding, including those with peripheral arterial disease in whom the femoral artery may be less easily compressed¹⁴ and those with uncontrolled hypertension. Finally, as routine ultrasound examination of the arterial access site was not required as a part of this protocol, it is possible that the reported incidence of pseudoaneurysm and arteriovenous fistula formation was slightly underestimated.

In summary, the article by Doyle et al represents an important contribution to the existing data regarding early patient ambulation after diagnostic left heart catheterization from the femoral artery. The authors describe a protocol for manual compression after sheath removal and ambulation after 1 hour of bed rest in the absence of complications. The authors report an extremely low incidence of vascular complications with the use of this protocol, and the potential benefits in patient comfort, hospital cost, and catheterization laboratory throughput are substantial. In-

terestingly, one wonders if this protocol could safely be made even shorter by decreasing the duration of the observation period after ambulation, given the extremely low incidence of rebleeding complications during that time (0.2%). Further prospective studies are necessary to establish the safety of such a protocol in a community setting as well as in patients with a higher risk of bleeding, such as those undergoing percutaneous coronary intervention. As a consequence of the study by Doyle et al, future randomized trials of vascular closure devices now have a new benchmark—one that will not be easy to achieve. Potentially, a protocol using smaller sheath sizes, close observation, and early ambulation after manual compression of the femoral artery represents a viable method for ensuring patient safety while improving patient comfort, reducing costs, and improving efficiency in the cardiac catheterization laboratory.

Adnan K. Chhatriwalla, MD
Deepak L. Bhatt, MD
Department of Cardiovascular Medicine
Cleveland Clinic Foundation
Cleveland, Ohio

1. Babu SC, Piccorelli GO, Shah PM, Stein JH, Clauss RH. Incidence and results of arterial complications among 16,350 patients undergoing cardiac catheterization. *J Vasc Surg.* 1989;10:113-116.
2. Pollard SD, Munks K, Wales C, et al. Position and Mobilisation Post-Angiography Study (PAMPAS): a comparison of 4.5 hours and 2.5 hours bed rest [letter]. *Heart.* 2003;89:447-448.
3. Wood RA, Lewis BK, Harber DR, Kovack PJ, Bates ER, Stomel RJ. Early ambulation following 6 French diagnostic left heart catheterization: a prospective randomized trial. *Cathet Cardiovasc Diagn.* 1997;42:8-10.
4. Lim R, Anderson H, Walters MI, Kaye GC, Norell MS, Caplin JL. Femoral complications and bed rest duration after coronary arteriography. *Am J Cardiol.* 1997;80:222-223.
5. Knight CG, Healy DA, Thomas RL. Femoral artery pseudoaneurysms: risk factors, prevalence, and treatment options. *Ann Vasc Surg.* 2003 Sep;17:503-508. Epub 2003 Sep 29.
6. Gall S, Tarique A, Natarajan A, Zaman A. Rapid ambulation after coronary angiography via femoral artery access: a prospective study of 1,000 patients. *J Invasive Cardiol.* 2006;18:106-108.
7. Chhatriwalla AK, Bhatt DL. You can't keep a good man (or woman) down [editorial]. *J Invasive Cardiol.* 2006;18:109-110.
8. Baim DS, Knopf WD, Hinohara T, et al. Suture-mediated closure of the femoral access site after cardiac catheterization: results of the Suture To Ambulate and Discharge (STAND I and STAND II) trials. *Am J Cardiol.* 2000;85:864-869.
9. Kapadia SR, Raymond R, Knopf W, et al. The 6Fr Angio-Seal arterial closure device: results from a multitember prospective registry. *Am J Cardiol.* 2001;87:789-91.
10. SEAL Trial Study Team. Assessment of the safety and efficacy of the DUETT vascular hemostasis device: final results of the safe and effective vascular hemostasis (SEAL) trial. *Am Heart J.* 2002;143:612-619.
11. Bhatt DL, Raymond RE, Feldman T, et al. Successful “pre-closure” of 7Fr and 8Fr femoral arteriotomies with a 6Fr suture-based device (the Multicenter Interventional Closer Registry). *Am J Cardiol.* 2002;89:777-779.
12. Koreny M, Riedmüller E, Nikfardjam M, Siostrzonek P, Müllner M. Arterial puncture closing devices compared with standard manual compression after cardiac catheterization: systematic review and meta-analysis. *JAMA.* 2004;291:350-357.
13. Doyle BJ, Konz BA, Lennon RJ, Bresnahan JF, Rihal CS, Ting HH. Ambulation 1 hour after diagnostic cardiac catheterization: a prospective study of 1009 procedures. *Mayo Clin Proc.* 2006;81:1537-1540.
14. Bhatt DL. Peripheral arterial disease in the catheterization laboratory: an underdetected and undertreated risk factor [editorial]. *Mayo Clin Proc.* 2004; 79:1107-1109.