Femoral Artery Complications Associated with the Mynx Closure Device

J.D. Fields, K.C. Liu, D.S. Lee, S.J. Gonda, A. Dogan, S.H. Gultekin, G.M. Nesbit, B.D. Petersen and S.L. Barnwell

*AJNR Am J Neuroradiol* 2010, 31 (9) 1737-1740
doi: [https://doi.org/10.3174/ajnr.A2153](https://doi.org/10.3174/ajnr.A2153)
http://www.ajnr.org/content/31/9/1737
Multiple devices have been designed to close the femoral artery after access for interventional radiology and cardiology procedures. These closure devices were developed with the intention of decreasing the risk of bleeding from the artery and reducing the time of patient immobilization after catheter removal. Such devices include StarClose (Abbott, Chicago, Illinois), Perclose (Abbott), Angio-Seal (St. Jude Medical, Minnetonka, Minnesota), and, most recently, the Mynx vascular closure device (AccessClosure, Mountain View, California).

At our institution, for typical diagnostic or interventional procedures, we most frequently used the StarClose closure device. This device, while generally effective for hemostasis, frequently results in significant pain at the time of deployment. In a smaller number of patients, upper leg pain lasting weeks or longer has been noted. Finally, 1 patient (of >500 in whom the StarClose device was deployed) developed symptomatic femoral stenosis, which required surgical repair. This experience led us to try the Mynx vascular closure device, which was reported to be safe and effective and to result in very little pain at the time of deployment.1

To our knowledge, angiographic or sonographic evaluation of the femoral artery following deployment of the Mynx closure device has not been reported. In this article, we describe the results of follow-up femoral arteriography in the subset of patients in whom the femoral artery was visualized after initial closure with the Mynx device.

**Materials and Methods**

All patients in whom the Mynx vascular closure device was used for femoral artery closure were identified by hospital billing records. All follow-up vascular studies in which the femoral artery could be visualized (conventional angiography, CT angiography, and sonography) were then identified. Each follow-up study was subsequently reviewed retrospectively by an experienced radiologist to determine whether any vascular abnormalities of the femoral artery system were present.

The Mynx vascular closure device was deployed in the standard fashion as directed by the device manufacturer. Initially, the device was used almost exclusively during observation by the Mynx representative and was subsequently used exclusively by operators certified in the use of the Mynx device. A proctor from the company was present for most cases, even after certification. In addition, a more senior company representative observed the deployment of the device for 2 days at our institution to ensure that the proctor had provided reliable instruction in the use of the device. Throughout, our technique was judged to be adequate and no technical concerns were raised by the company proctor present for most of the device placements. Furthermore, the supervisor expressed no concerns regarding the instruction in the use of the device provided by the proctor.

**Results**

Between August 25, 2009, and October 19, 2009, 146 Mynx closure devices were used in 135 patients after femoral artery puncture. In 27/146 (18.5%) of cases, a follow-up vascular study visualizing the femoral artery was available. These studies were performed at a median follow-up time of 6 days (mean, 8.4 days) after the initial Mynx closure device was used.

In our practice, patients commonly undergo an initial diagnostic procedure and then return in approximately 1 week for a therapeutic intervention. Thus, most follow-up imaging studies (24/27, 89%) were femoral arteriograms performed at the conclusion of the interventional procedure before placement of a second closure device approximately 1 week after the deployment of a first closure device for the initial diagnostic angiogram. Three patients were evaluated by sonography...
rather than by femoral arteriography. One sonography examination was ordered for a patient with persistent severe groin pain (1/27, 4%). In addition, after concern regarding the Mynx device surfaced, surveillance sonographic examinations were performed on the 2 patients who still remained in the hospital (2/27; 7%).

In 26/27 cases with follow-up imaging, the Mynx device was deployed using a 5F sheath; none of these patients were anticoagulated for the procedure. In 1 patient, the Mynx device was deployed using a 6F sheath following an interventional procedure in which intraprocedural heparin was given.

There were 5 definite (5/27, 18%) instances of filling defects detected by follow-up angiography (4 cases) or sonography (1 case), most likely representing intravascular Mynx sealant (Fig 1). All were asymptomatic and would not have been identified if follow-up angiography for an unrelated indication had not been performed. One of the 5 patients went to surgery for removal of foreign body (Fig 1) because of near occlusion of the superficial femoral artery, and 4 patients were observed and have remained asymptomatic. Pathologic examination of the sample obtained in the patient who underwent surgery confirmed that the filling defect was indeed intravascular Mynx sealant (Fig 2).

An additional 3 patients (3/27, 11%) had pseudoaneurysms (Fig 3), two requiring sonography-guided thrombin injection and 1 treated conservatively. Of the pseudoaneurysms, 1 was diagnosed due to persistent pain after closure and 2 were discovered incidentally on follow-up angiography.

Discussion

In 27 follow-up imaging studies after Mynx deployment, major femoral artery complications (intravascular Mynx sealant or pseudoaneurysm) were found in 29%; without follow-up vascular studies, however, only 1 of these complications would have been recognized (due to the presence of severe access-site pain). However, because follow-up examinations were obtained in less than 20% of patients, it is impossible to determine with precision the true incidence of adverse events associated with the device.

The Mynx device is designed to achieve femoral artery hemostasis by deploying a water-soluble biodegradable sealant in the femoral sheath tract while an intravascular balloon is...
positioned adjacent to the arteriotomy site. The apposition of the balloon to the arteriotomy site provides temporary hemostasis and theoretically prevents sealant from entering the artery. In addition to mechanical protection from the balloon, in theory, the column strength of the sealant is lost with contact to blood, resulting in horizontal spread rather than vertical spread into the blood vessel. This combination of safeguards has been reported to make it "virtually impossible to push [the sealant] forward into the artery." \(^1\)

The main publication reporting the results of the use of the current-generation Mynx vascular closure device is a prospective nonrandomized trial based in Europe. \(^1\) In this study of 190 patients, rapid hemostasis was achieved (mean, 1.3 minutes) with a success rate of 93%. Symptomatic complications were rare. A single symptomatic pseudoaneurysm was discovered (1/190), and another patient developed bleeding at the access site significant enough to require transfusion (1/190). This study did not, however, include angiographic or sonography follow-up. Thus, the frequency of asymptomatic intravascular sealant or pseudoaneurysms could not be determined. By comparison, without follow-up vascular imaging, the rate of symptomatic complications in our institutional experience would have been 1/146 devices deployed.

Despite the theoretic barriers preventing the sealant from entering the artery, cases reported from several sources suggest that this complication does occur. A case of symptomatic pseudoaneurysm was recently published. \(^2\) In addition, the US Food and Drug Administration—sponsored data base designed to track possible complications from the use of medical devices (MAUDE) contains >10 additional cases of possible or probable intravascular embolization. The MAUDE data base also contains reports of several pseudoaneurysms in patients in whom the device was used for closure and a number of instances of balloon detachment. \(^3\)

The means by which sealant may be introduced into the artery is well visualized with the plastic model developed to teach the use of the device (Fig 4). After the balloon is inflated and retracted against the arteriotomy site, an inadequate barrier results, and polyethylene sealant may be pushed into the intravascular space (gray arrow).
tery. Advancement of the white advanceur tube could push seal-
ant into the artery if insufficient hydration of the sealant oc-
curs and the sealant maintains column strength. This may oc-
cur either if the balloon is not adjacent to the arteriotomy or by displacement of the balloon (if the balloon is not held firmly enough against the vessel wall). On the other hand, pulling too hard on the balloon may result in tenting of the artery and pseudoaneurysm formation; consequently, opera-
tors are instructed to limit the degree of traction. The end result is that the design does not allow one to be completely certain that the balloon is held firmly enough against the arte-
rial wall to prevent intraluminal sealant deposition.

In our small study of patients who had follow-up exami-

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