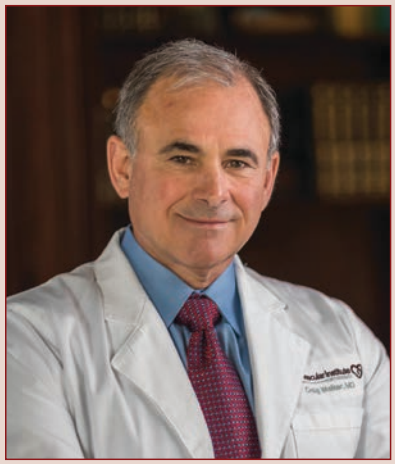
Single-Wall Arterial Puncture vs Dual-Wall Puncture: Does It Really Matter in Angiographic and Interventional Procedures?



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In this issue of *Vascular Disease Management,* there are multiple interesting articles and case reports. I have chosen to comment on Dr. Shoban Haridass and colleagues' article, "Traditional Seldinger Technique: A Disparity Between Reality and Belief."

This article debates whether Dr. Sven-Ivar Seldinger's 1953 article, "Catheter Replacement of the Needle in Percutaneous Arteriography," published in *Acta Radiologica*, describes a single-wall or double-wall arterial puncture in obtaining arterial access. While there may remain debate as to whether this commonly cited article on access did or did not refer to double-wall puncture or single-wall entry access, it affords the opportunity to discuss the importance of optimal arterial puncture techniques in angiographic and interventional procedures.

Every invasive arterial angiographic and interventional procedure begins with gaining arterial access and ends with management of the access site. Initially, access was obtained by direct surgical cutdown to the artery, allowing direct visualization and palpation of the vessel to be initially cannulated and then following the procedure the arteriotomy was sutured to close the arteriotomy site. Seldinger pioneered the process of gaining arterial access following administration of local anesthetic utilizing needle puncture of the artery guided by palpation or fluoroscopic visualization with subsequent vascular closure via manual compression. The vast majority of procedures performed today utilize the basic arterial puncture technique described by Seldinger rather than direct surgical cutdown.

Percutaneous access is associated with less risk of infection, typically less pain, and allows repeated future access via the same arterial site differentiating it from open surgical access, where scarring may preclude repeat access. Percutaneous access is associated with a shorter procedural time. Uncomplicated percutaneous arterial access may allow administration of prolonged thrombolytic treatment without the tissue bleeding that would occur with surgical access. Patients typically prefer this form of arterial access.

Seldinger's access technique, however, has disadvantages as well. Access must be below the inguinal ligament and ideally over the femoral head to allow effective compression and lessen the risk of retroperitoneal hematoma, with its potentially fatal outcome. Blind access may result in inadvertent puncture of the artery and vein with resultant fistula creation. Percutaneous access in its initial form did not allow direct arterial observation or surgical suture-mediated mechanical closure of the arterial access; therefore, there was greater risk of postprocedural bleeding and risk of pseudoaneurysm.

Direct surgical cutdown access allows operators to avoid accessing within highly diseased arterial segments where catheters may be occlusive, and further allow balloon embolectomy post procedure to ensure adequate postprocedural distal flow that can be angiographically confirmed at completion of the procedure. At the time of Seldinger's

original article, postprocedural anticoagulation posed less risk post surgical repair, as the artery was mechanically closed with sutures. Compression of the treated artery was typically not required following open surgical repair at the time of Seldinger's initial article, and thrombolytic therapy was not an available therapeutic option.

Contemporary utilization of percutaneous access and its challenges as well as potential solutions to the inherent drawbacks must be evaluated in the context of today's interventional practice. There are considerations that were not pertinent when Seldinger published his transformative article. Today's interventional techniques are often prolonged, require full anticoagulation during the entire procedure, and may employ very large bore access sheaths, which pose far greater risk of arterial obstruction and bleeding post procedure. Arterial puncture with a large bore needle like the ones utilized by Seldinger may penetrate not only the anterior but also the posterior wall of the intended access artery, resulting in bleeding during the procedure from the hole created in the posterior wall, which is not obstructed by the sheath or catheters during the procedure. This is of particular importance when there is aggressive anticoagulation or if fibrinolytic therapy is to be utilized. Posterior wall puncture has the potential to create large hematomas that occur during the procedure that may go unrecognized until the termination of the procedure or may become obvious during the procedure if there is pain, enlarging hematoma, or hypotension.

Although there is now a wide array of vascular closure tools that were not present when Seldinger reported his technique, these tools are designed only to close the anterior wall puncture site. These tools cannot close rents in the posterior arterial wall or rents caused by inadvertent sidewall arterial puncture. Utilization of smaller micropuncture needles can mitigate risks of inadvertent posterior or sidewall arterial puncture that could result in severe bleeding or pseudoaneurysm formation if larger holes in these areas are created by larger needles.

In today's world, the utilization of ultrasound-guided access allows an even greater margin of safety when utilizing percutaneous access, particularly when it is coupled with the use of smaller needles. Ultrasonic imaging allows the interventionist to avoid accessing areas of severe obstruction, carefully measure vessel size to ensure that sheaths are not occlusive during long procedures, lessen the risk of multiple failed needle puncture attempts or sidewall vascular puncture, and avoid posterior wall puncture. Ultrasound guidance drastically increases the likelihood of successful vascular closure if closure devices are intended by ensuring single wall access and access within a less diseased vessel segment. Ultrasonic vascular evaluation at the completion of a procedure can determine whether or not there is continued bleeding or pseudoaneurysm formation, and whether or not there is adequate distal flow. If there is continued bleeding, ultrasound-guided compression can help to direct effective compression to achieve hemostasis and confirm when bleeding has been controlled.

It is impossible to determine, in my opinion, whether Seldinger's technique was a single- or double-wall puncture. This visionary nonetheless revolutionized angiographic procedures with a technique that was considered controversial in 1953. His concept of percutaneous access under local anesthesia has been essential in the evolution of invasive arterial procedures. Although I greatly favor the concept of single-wall access, I am not certain that this can always be achieved with simple arterial palpation as a guide.

Every interventionist must understand where the potential risks associated with access originate at each of its steps if we are to eliminate or lessen those risks. If inadvertent posterior wall or sidewall puncture occurs, delaying administration of anticoagulants and manual pressure for a few minutes may greatly lessen subsequent bleeding risk. When manual pressure is the intended method of closure, reversing anticoagulant or waiting for the anticoagulant effect to lessen may improve closure. If closure devices are planned, they must be used appropriately. Access must be obtained within the optimal access zone below the inguinal ligament and ideally over the femoral head.

Access site complications are common. These complications are associated with decreased patient satisfaction, significant morbidity, increased costs, decreased short- and long-term patency, and increased mortality. Understanding each of the areas where risk occurs and instituting preventive measures at each step can help mitigate those risks. I believe that ultrasound-guided access and utilization of small-needle access can dramatically lessen risk of complications.

Access and closure techniques are of great importance in every invasive arterial procedure. We must afford more attention to access management. ■