

# *Introduction*

## Minimally Invasive Vascular Surgery

MICHAEL L. MARIN, M.D.<sup>1</sup>, HAROLD A. MITTY, M.D.<sup>2</sup>, LARRY H. HOLLIER, M.D.<sup>1</sup>, AND VALENTIN FUSTER, M.D.<sup>3</sup>

MINIMALLY INVASIVE VASCULAR SURGERY, or endovascular therapy, comprises a series of techniques which employ specialized tools to alter vascular pathology from the luminal surface of the vessel. These techniques include the ability to treat the affected, diseased artery from a remote, easily accessible peripheral vessel. The development of endovascular therapy has a rich history, which has been closely entwined with the development of diagnostic angiographic techniques.

Angiography of cadavers rapidly followed Roentgen's initial discovery of x-ray imaging of bones in 1895. The medical implementation of clinical diagnostic angiography was delayed because of the lack of a suitable non-toxic contrast agent. In 1927 this problem was partially resolved by Moniz, who was the first to use a 22% sodium iodide solution to image the cerebral circulation (1).

Moniz's concepts were rapidly expanded by Dos Santos and associates, who applied these techniques to the peripheral circulation, thus developing arteriography and aortography (2). Dos Santos' group was the first to clearly delineate atherosclerotic lesions, arterial aneurysms and patterns of arterial collateralization. The dramatic foundation of cardiac arteriography also occurred during this time period with the work of Werner Forssmann, who was then a surgical intern in Berlin. Defying his superiors, who refused to allow him to conduct cardiac

catheterization experiments, he catheterized himself in 1929, advancing a urethral catheter from his basilar vein into his right ventricle under fluoroscopic guidance. It was not until 1941, when Andre Cournand performed his important studies on cardiopulmonary physiology, that the true potential of cardiac catheterization became apparent (3). Cournand, Forssmann and D.W. Richards shared the Nobel Prize in Physiology and Medicine in 1956, for these important accomplishments.

Improvements in diagnostic arteriography evolved rapidly in the 1950's with the better access techniques of Seldinger (4), the coronary angiographic techniques of Sones (5), and the specialized guidewires of Amplatz (6). These improvements in diagnostic imaging techniques made possible the development and eventual implementation of therapeutic endovascular procedures.

One of the first minimally invasive catheter-based therapies to be introduced was by Fogarty, who used a balloon catheter to remotely extract intravascular thrombi (7). This approach to arterial embolectomy completely circumvented the need for standard extensive arterial revascularization procedures, which were associated at the time with significant morbidity and perioperative mortality. The application of catheter-based therapy to chronic atherosclerotic occlusive lesions of vessels was subsequently initiated by Dotter in 1964, with the percutaneous insertion of Teflon catheters over a guidewire to "dilate" a stenotic lesion (8). Technical modification of Dotter's technique by Grüntzig and others led to the development of the angioplasty balloons and their eventual application to coronary stenosis (9).

Improved therapeutic devices for endovascular therapy continue to be developed, while advances in diagnostic imaging occur. High resolution, digital subtraction arteriography, ad-

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From the Departments of <sup>1</sup>Surgery, <sup>2</sup>Radiology, and <sup>3</sup>Cardiology, Mount Sinai School of Medicine, New York, NY.

Address all correspondence to Michael L. Marin, M.D., Henry Kaufmann Professor of Vascular Surgery, Chief, Division of Vascular Surgery, Box 1273, Mount Sinai School of Medicine, 1 East 100th Street, New York, NY 10029; E-mail: michael.marin@msnyuhealth.org

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vanced CT angiography, detailed duplex ultrasonic imaging, magnetic resonance angiography have all evolved to advance the limits of endovascular therapy. Data from these specialized techniques are already directing vascular therapy in new and exciting ways. The ability to characterize atherosclerotic plaque or analyze the integrity of the vascular wall are a few of the areas that are actually guiding treatments today (10). High resolution CT images combined with finite element analysis also holds the promise of aiding in the prediction of which aortic aneurysms are at immediate risk of rupture, mandating immediate repair (11). It is becoming increasingly clear that the fusion of imaging and therapeutic intervention will continue to assist us in providing the highest quality of care to the vascular disease patient. The history of this field is rich and continues to bear fruit of extraordinary value. This theme issue of *The Mount Sinai Journal of Medicine* explores the cutting edge of diagnostic and therapeutic endovascular therapy, setting the standard for the present and future care of patients with vascular disease.

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