

Alloy With 'Memory' May Help Prevent Pulmonary Embolism

A SPACE-AGE METAL alloy capable of undergoing a programmed metamorphosis may provide a simple means of preventing pulmonary embolism, according to a Boston radiologist. It would enter the vena cava in the form of a straight wire, he explained, and then, once inside, would automatically change its shape into that of a blood filter.

The new alloy — kept on the government's highly classified list until recently — "can exist in one or another of two predetermined forms, depending on its temperature," according to Dr. Morris Simon, director of clinical radiology at Beth Israel Hospital and professor of radiology at Harvard Medical School.

For its application as a blood filter, he told a recent Science Writers Forum held by the American Heart Association in Tucson, it is designed to exist outside the body as a fine, straight wire about 15-20 cm long. Upon reaching the vena cava through an angiographic catheter it responds to the body heat by twisting itself into a complicated shape previously imprinted in its "memory." The resulting filter, Dr. Simon added, is designed to lock itself into position at the desired level of the vena cava.

A Simpler Approach

If the wire proves safe in humans — it has so far been tested successfully in dogs — it would represent a much simpler approach to preventing emboli from reaching the lungs than the traditional ligation or clipping of the vena cava or its obstruction with a Mobin-Uddin umbrella, he noted. The former procedure requires abdominal surgery, while the latter involves a cutdown in a jugular or femoral vein. "The 'memory' wire needs no other inlet than the angiographic catheter already introduced for diagnostic purposes," Dr. Simon said.

To prevent premature transformation during its passage through the catheter, the wire is bathed in a cool solution below its triggering temperature while it is being introduced. Once in place and in its filter form, it "effectively subdivides the cross section of the vena cava into a multitude of small openings that allow blood to pass through, but not emboli



In cool bath, wire remains straight; at body temperature it assumes filter shape (inset)

of any significant size," Dr. Simon observed. "Depending on its design, the openings can be about 2 to 4 mm in diameter."

The device would be used in patients in whom anticoagulants are precluded by the risk of internal bleeding — those who have suffered cerebral hemorrhages, undergone recent surgery, or sustained fractures or other injuries.

The underlying metallurgical breakthrough was achieved at the U.S. Naval Ordnance Laboratory as a result of work by Dr. William Buehler on nickel/titanium alloys (Nitinol) in the mid-1960's. The alloys were originally intended for use in space antennas. In addition to their unique shape memories, these alloys are nonmagnetic and are resistant to corrosion, oxidation and abrasion — all distinct advantages in biological applications.

In its straight-wire phase, the alloy used by Dr. Simon has to be kept at a temperature of about 50°F. Its transformation into the filter is completed at about 90°F, comfortably below body temperature.

The filter shape is programmed into the wire by winding it onto a jig at the lower temperature and annealing it in a furnace at about 1,020°F. The wire is then cooled and

straightened for introduction through the catheter.

"We have used clover leaf and spiral filter designs and are now moving on to a fine mesh produced by criss-crossing wire loops. The size of the mesh openings is only 2 mm square, small enough to block the passage of even tiny emboli," Dr. Simon reported.

Further animal experiments will be conducted to establish the alloy's efficiency, as well as its biologic effects on blood clotting, liver function and other bodily functions, he said. Tests on patients are foreseen in one to two years if the present research protocol continues to go well.

Collaborating with Dr. Simon on the metallurgical aspects of the filter is Professor Roy Klapow, of the Massachusetts Institute of Technology. His collaborators in clinical research are Drs. Edwin Salzman and David Freiman of Harvard.

"We believe," concluded Dr. Simon, "that the filter represents only the first of many in vivo applications of the remarkable thermal-memory alloys. There are other instruments of complex shape that could benefit from this method of easy insertion and emplacement, including devices for use in arteries, the heart, the bronchi, the skeleton, and the uterus."

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