Transvenous devices for inferior vena cava interruption

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Inferior vena cava interruption to prevent pulmonary embolism has undergone major evolutionary changes over the past 2 decades. Direct approaches to the vena cava with ligation or compartmentalization with extrinsically applied devices through transperitoneal or retroperitoneal incisions have given way to transvenous devices placed under fluoroscopic control and introduced through the jugular or femoral vein.

A number of transvenous devices have been developed and fall into two basic categories: those that totally occlude and those that compartmentalize the inferior vena cava. Although a variety of devices have been designed and tested, the most widely used are the Hunter-Sessions balloon for total vena cava occlusion and the Greenfield filter for compartmentalization. Both are effective in preventing pulmonary embolism, and each has its own advantages and disadvantages. The major difference between the occlusion and the compartmentalization devices is their effect on long-term vena cava patency and the incidence of lower extremity edema and chronic venous insufficiency.

In a recent issue of this journal Dr. James A. Hunter reported his 18-year experience with 191 cases of vena cava occlusion using the Hunter-Sessions balloon and demonstrated the effectiveness of this device in preventing major pulmonary embolism. No patient died of a pulmonary embolus, although four patients had small pulmonary emboli, underscoring the fact that no device can uniformly prevent all pulmonary emboli, which at times may arise from sites other than the lower extremities. The high mortality rate found in this group of patients reflected the underlying disease processes, which prompted placement of the balloon device and was not the result of vena cava occlusion. A similar high mortality rate is a feature of other clinical series with nonoccluding devices.

The important question of whether vena cava occlusion had an adverse effect on long-term lower extremity edema and venous insufficiency could not be resolved from Dr. Hunter’s article since nearly half of the patients had died, and the presence or absence of edema was reported not in absolute terms but as a percent of patients at the last follow-up examination. Although it is well recognized that it is possible to occlude the inferior vena cava without the development of chronic edema, it is also clear that maintaining patency of the vena cava in patients with thromboembolic disease results in a lower long-term incidence of edema and venous insufficiency.

A significant problem in the placement of transvenous vena cava interruption devices is malpositioning and misplacement of the devices. Dr. Hunter and his colleagues have been very successful in avoiding such complications by placing the devices in the angiography suite where imaging equipment is optimal and, if needed, radiologists can assist in proper identification of landmarks. Proper imaging is important in all transvenous device placements, since most misplacements can be attributed to lack of proper definition of the anatomy. The Greenfield filter, which engages the vena cava with hooks, frequently “perforates” the wall of the vena cava but rarely causes an adverse clinical effect. Although refinement of the anchoring mechanism of new transvenous devices may eliminate this problem in the future, at the current time the advantage of improved vena cava patency outweighs the occasional incident of retroperitoneal bleeding. Migration of transvenous devices has been known to occur with both the Mobin-Uddin and Greenfield filter. No migration has occurred with the Hunter-Sessions balloon in Dr. Hunter’s hands, indicating its stability when properly positioned. However, there is no reason to suspect that migration could not occur with this device when it is used by less skilled or less experienced users.

Newer transvenous devices and technologies are currently being developed. Major improvements include the ability to place these devices percutaneously under angiographic control. This facilitates use of the superior imaging capabilities of the angiography suite and may reduce problems of misplacement.
However, other problems have been reported such as local venous thrombosis and hemorrhage at the site of insertion. The safety and effectiveness of these new transvenous devices needs to be compared to currently available devices so that their role may properly be evaluated. In this regard it is important to note the long-term evaluation provided by Dr. Hunter and his colleagues. Similar careful follow-up must be obtained in patients receiving other types of devices.

No transvenous vena cava interruption device is free of drawbacks, and strict indications and criteria must be applied whenever these devices are used. All are faced with potential problems of vena cava thrombosis, venous perforation, and migration. The possibility of recurrent pulmonary embolism will always remain, particularly from sites other than the lower extremity. Since acute thromboembolism is most often encountered in patients who are critically ill and hospitalized, it is inevitable that further refinements of transvenous vena cava interruption focus on devices that are removeable once the hazard of pulmonary embolism or the risk of hemorrhage from anticoagulation is no longer present. Such removeable, percutaneous filters may eliminate the need for most permanently placed vena cava interruption devices.

REFERENCES