Fenestrated and Branched Endografts

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The past 20 years have seen a gradual shift away from direct open surgery in favor of minimally invasive techniques. The treatment of vascular disease is no exception. Minimally invasive endovascular techniques of aneurysm repair substitute trans-femoral access for direct aortic exposure and stents for sutures. The new endovascular and conventional surgical methods of aneurysm repair share the same goals: to exclude the aneurysm from the arterial circulation, depressurize its walls, thereby preventing dilatation and rupture.

As one might expect, the minimally invasive approach reduces the pain, debility, morbidity and mortality of aortic aneurysm repair. Many studies have shown endovascular repair of an abdominal aortic aneurysm to be safe and effective, but only in patients who have the necessary anatomic stubstrate, consisting of a widely patent route of access through the iliac arteries and a non-dilated implantation site, or neck, between the aneurysm and the renal arteries. When the neck is too short blood can leak around the top of the stent graft into the aneurysm.

The problem is not really the lack of an implantation site; the pararenal aorta is usually a perfectly fine implantation site so long as the surgeon can find a way to maintain flow to the renal arteries. One solution involves small holes, or fenestrations, through the walls of the stent graft right over the renal orifices. The key to success lies in precise alignment of the fenestration and the renal artery orifice using a “bridging catheter” to guide the last phases of stent graft expansion, and a flared renal stent (bridging stent) to prevent subsequent migration. The technique is a little complicated, but surprisingly durable and effective. Although fenestrated stent grafts remain unapproved for use in the United States, this approach has been used successfully in thousands of patients around the world.

Regular fenestrated stent grafts fail to exclude pararenal and thoracoabdominal aortic aneurysms, because aortic dilatation at this level precludes direct apposition between the margin of the fenestration and the margin of the renal artery orifice. Under these circumstances, there are two endovascular alternatives: an all endovascular approach using branched stent grafts, and a hybrid approach using commercially

available stent grafts in combination with surgical bypass to the visceral arteries. The results of hybrid repair have been disappointing, because high-risk patients tolerate the surgical stress of visceral artery bypass poorly.

Simple fenestrations can be converted into branches by substituting covered stents for the usual uncovered bridging stents. At the University of California San Francisco we add a short sleeve to the margin of the fenestration to augment the inter-component connection. If the fenestrated stent graft is a muscle shirt, ours is a T-shirt. Since we are able to vary the exact position, orientation, length and diameter of the covered stents independently at the time of insertion, we are usually able to match a patient's anatomy using a small inventory of standard devices and techniques. To-date we have treated 44 thoracoabdominal and pararenal aneurysms using this approach and another 6 using variations of the fenestrated approach. Although the technique remains a work-in-progress, as evidenced ongoing reductions in the insertion times and complication rates, the overall mortality and morbidity results already compare well with the best reported results of conventional open surgery, especially in patients with extensive aneurysms and poor general health.

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