Creative Options for Large Sheath Access during Aortic Endografting

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Access-related limitations, namely small-caliber vessels and tortuous or calcified stenotic vessels, are often encountered during endovascular aneurysm repair (EVAR) and thoracic EVAR (TEVAR). Overcoming these limitations often requires the creation of a conduit through which the endovascular devices can be delivered. If these limitations are not recognized and respected preoperatively, significant morbidity and mortality may ensue because access-related complications are often addressed in emergent and chaotic situations. There are a variety of conduits described in the literature, each with their own advantages and disadvantages. The present report explores the use of conduits during EVAR and TEVAR by discussing the current literature, and the authors also describe a preferred method to address unfavorable iliac anatomy through the use of endoconduits.

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Abbreviations: EVAR = endovascular aneurysm repair, TEVAR = thoracic endovascular aneurysm repair

AS creative ways to address aortic pathologic processes with endovascular interventions continue to evolve, one of the constant obstacles encountered in endovascular aneurysm repair (EVAR) and thoracic EVAR (TEVAR) is the issue of remote arterial access. It is likely that the most common reason for procedure-related death in the setting of endovascular aortic interventions is directly related to iliac artery rupture in patients with small or diffusely diseased access vessels. Not surprisingly, iliac artery rupture is associated with a cascade of events that necessitate urgent intervention and often lead to poor outcomes. Conduits may be created in attempts to circumvent this devastating complication and improve patient outcomes during EVAR and TEVAR when femoral access is suboptimal.

In an international survey (1) and the phase II multicenter trial of the only Food and Drug Administration–approved thoracic endoprosthesis (2), conduits were used in approximately 15% of cases during TEVAR. In this latter study (2), inadequate arterial access was responsible for the only initial treatment failures. Likewise, the EUROSTAR registry (3) reported access-related complications in 13% of patients undergoing EVAR, with access-related issues being one of the most common reasons for conversion to an open surgical procedure. One group (4), investigating the reasons why certain patients are not candidates for EVAR, found that 50% of patients ineligible for EVAR are deemed so because of unfavorable iliac artery anatomy. Since that time, most physicians advocate the liberal use of conduits, but it should be stressed that procedural planning begins with appropriate preoperative and intraoperative imaging.

PREOPERATIVE AND INTRAOPERATIVE IMAGING

Computed tomographic (CT) angiography is the gold-standard imaging modality used for preoperative planning before EVAR and TEVAR (5,6). Not only does CT angiography allow for accurate aortic measurements for device sizing, but it also allows for accurate assessment of the iliac arteries in determining whether some type of conduit is required. Sheath size requirements are largely based on the device measurements taken preoperatively, and developing a plan that takes into account iliac artery diameter and sheath size is paramount. Additionally, it is imperative that, when common femoral artery access is considered (especially for percutaneous interventions with large sheaths), CT angiography images are obtained through the femoral heads to determine the presence of extensive calcification and the exact location of the common femoral artery.

Intraoperative imaging at the time of EVAR or TEVAR further helps delineate pelvic anatomy and the need

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for the use of a conduit. Although diameter measurements of the common and external iliac arteries can largely be determined from preoperative CT angiography, length measurements, the status of hypogastric artery flow, and the response of tortuosity of the iliac system to stiff guide wires is often better appreciated with pelvic arteriography. The use of information gathered from preoperative imaging and intraoperative angiography at the time of the procedure largely determines whether a conduit will be necessary to help facilitate device delivery, and—equally as important—where it should be placed. If there is significant concern about whether the iliac arteries can accommodate passage of the appropriately sized sheath needed for the planned aortic intervention, it is best to proceed with the creation of a conduit preemptively rather than dealing with an iliac artery complication on a more emergent basis.

OPEN SURGICAL CONDUITS

Open surgical conduits fashioned to the common iliac artery or directly to the aorta have been the mainstay for dealing with unfavorable iliac anatomy during EVAR and TEVAR during the past decade and a half. Much experience with their use has been gathered since the advent of endovascular aortic procedures, and several key points deserve emphasis. Lessons learned from our own experience and highlights from a recently published 10-year experience with the use of iliac conduits (7) form the basis for much of our approach to open surgical conduits.

In most cases, a standard retroperitoneal approach through a lower-quadrant oblique incision provides adequate access to the common iliac artery (**Fig 1**) or distal aorta. This is typically performed under general anesthesia. Exact determination of where the conduit will be placed can commonly be made from preoperative imaging studies. When aortic bifurcation disease is present, the more proximal infrarenal aorta may serve as the site for conduit placement. Unless concomitant open infrarenal aneurysm repair is planned at the same time as TEVAR or exploratory laparotomy is undertaken for another reason, such as addressing solid organ injuries often seen in the setting of blunt traumatic thoracic aortic transections, these exposures used for conduit placement are usually approached in a retroperitoneal fashion.

The material used to create the conduit is largely determined by surgeon preference, but the vast majority are made from polyester grafts. Use of a 10-mm graft allows for the introduction of large delivery sheaths needed for EVAR or TEVAR and ancillary 5-F sheaths adjacent to these for placement of diagnostic angiography catheters. This eliminates the need for bilateral access during TEVAR. The large sheaths can be placed through the end of the conduit with hemostasis maintained by vessel loops or, preferably, the sidewall of the conduit can be accessed with the end of the graft closed by a suture or clip.

The anastomosis from the graft to the common iliac artery or aorta is performed in an end-to-side fashion. This anastomosis can be reinforced with a cuff fashioned from the prosthetic graft to help reduced blood loss during passage of the delivery sheaths (8). In an effort to further reduce suture line disruption of this newly created anastomosis, the anastomosis can be held manually to provide support as large delivery sheaths are advanced into the native vessel (7). Additionally, we place a radiopaque marker at the anastomosis, pass the delivery sheath beyond this marker under fluoroscopic guidance, and avoid repetitive exchanges across this site.

In an effort to prevent entry into the native vessel at a steep angle, the conduit is tunneled to the groin parallel to the iliac artery. It can be brought out through a separate stab incision on the abdominal wall, or alternatively, if the iliac artery is significantly diseased or damaged, the conduit can be used as a bypass to the femoral artery on completion of the procedure. If iliofemoral bypass is not required, at the end of the endovascular portion of the procedure, the conduit is transected and oversewn, leaving a small cuff of prosthetic material attached to the native vessel.

Although the placement of a conduit is technically successful in most cases, significant morbidity can accompany a retroperitoneal dissection. This dissection has accounted for a significant amount of the morbidity seen during TEVAR and EVAR. In fact, one study (9) demonstrated a 1.5 day longer hospital length of stay, 82% longer procedure time, 2.6-fold greater blood loss, and 1.8-fold higher rate of perioperative complications when retroperitoneal procedures were used instead of femoral access during EVAR. In addition, the creation of an open surgical conduit can be exceptionally difficult in morbidly obese patients. In recognition of the increased morbidity associated with retroperitoneal dissections, a variety of techniques have been developed to allow for remote femoral artery access during EVAR and TEVAR.

CREATIVE ALTERNATIVES TO OPEN SURGICAL CONDUITS

Efforts to limit the degree of retroperitoneal dissection when faced with unfavorable iliac anatomy in the setting of EVAR and TEVAR led some groups to advocate limited retroperitoneal exposures followed by direct aortoiliac access (10,11). In addition to avoiding extensive dissection and increased morbidity, as well as arterial cross-clamping and potential vessel injury, direct iliac artery access avoids leaving behind a small stump of prosthetic material. This stump of prosthetic material is a theoretical nidus for embolic material or infection and can cause confusion on postoperative imaging (7). Access sites that use this direct puncture technique are closed by cinching adventitial purse-string sutures that had been placed before arterial puncture (10). Although theoretically less morbid than the use of prosthetic conduits, a retroperitoneal approach is still required with this direct aortoiliac puncture technique.

Several techniques aim to avoid the retroperitoneal dissection altogether, and one of the simplest ways to deal with stenotic iliac vessels during aortic endografting is with balloon angioplasty from a femoral approach (12). Stents can be placed selectively after completion of the aortic endografting, but more commonly it is performed in all cases after withdrawal of the delivery sheaths. While this may permit EVAR and TEVAR from the groins in a small subset of patients who would otherwise require an open surgical