Mind the gap: Transesophageal echocardiography aids detection of pseudo-coarctation during thoracoabdominal surgery

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Video clip is available online.

CLINICAL SUMMARY

A 49-year-old woman with Marfan syndrome was referred for surgical repair of a thoracoabdominal aortic aneurysm with expanding diameters secondary to a chronic DeBakey III aortic dissection diagnosed 16 years earlier, reaching a maximum diameter of 7.5 cm at the distal thoracic aorta (DTA) (see Figures 1-3). Prior written informed consent was obtained from the patient for the use of anonymized material for teaching purposes.

Exposure was gained via a left thoraco-phrenicotomy along sixth intercostal space and midabdominal line down to level of the umbilicus. After mild heparinization (target activated clotting time, 250-300 seconds), left heart bypass (LHB) was established with the inflow cannula...
in the left inferior pulmonary vein and the outflow cannula in the infrarenal aorta. The operation was conducted under mild hypothermia (34°C) and sequential aortic crossclamping from proximal to distal aortic segments and visceral protection with selective perfusion of cold blood via the celiac and superior mesenteric arteries and intermittent administration of cold Custodiol HTK Solution (Essential Pharmaceutical Corp, Pomona, Calif) via the renal arteries. The ischemic times were as follow: celiac 40 minutes, superior mesenteric arteries 54 minutes, renal arteries 94 minutes, and iliac arteries 17 minutes, with a total LHB time of 286 minutes.

Once the proximal clamps were applied immediately after the origin of the LSA and the mid-DTA, a chronic thick dissection flap was identified between the true and the false aortic lumens immediately after the proximal clamp. The flap was resected until the proximal clamp area and the proximal aortic anastomosis was constructed. The aortic repair was conducted per our standard technique described elsewhere.1-3

Once the LHB was discontinued, a large pressure gradient (72 mm Hg) was noticed between the right radial and femoral arterial lines (Figure 4). The distal aortic graft pressure was measured directly inserting an 18-gauge needle connected to a manometer line into the Dacron (DuPont, Wilmington, Del) graft at the mid-descending thoracic level, confirming the pressure gradient. TEE revealed the presence of a residual thick dissection flap in the native aorta proximal to the anastomosis. Color Doppler in the area revealed marked flow acceleration and continuous wave Doppler confirmed a high systolic instantaneous peak pressure gradient of 62.37 mm Hg (Figure 5). The continuous wave Doppler waveform (Figure 5) also demonstrated persistence of the pressure gradient into diastole. These findings are compatible with a significant coarctation effect.4

LHB was re-established. The aortic arch was clamped proximal to the origin of the LSA that was temporarily
occluded. The aortic graft was opened 2 cm distal to the previous anastomosis and the surgical fenestration was extended, retrograde, toward the aortic arch. Once LHB was weaned again, the pressure gradient had resolved. No further discrepancy between arterial lines was noticed. The patient made an uneventful recovery and the postoperative computed tomography scan showed complete resection of the dissection flap (Figure 6).

DISCUSSION

Intraoperative TEE use is recommended for procedures involving the thoracic aorta to confirm preoperative diagnosis, assess surgical results, and detect unexpected findings or complications. The literature describes the role of TEE in diagnosis of dissection complications such as aortic regurgitation and arterial vessel involvement. As such, TEE has been incorporated into the clinical practice recommendations of the European Association of Echocardiography.

In this case, the TEE was rapidly utilized to identify the morphology and location of an unusual complication; namely, a pseudo-coarctation due to incomplete surgical fenestration of the dissection flap beyond the proximal clamp area by illuminating the residual flap within the distal arch. This case is an example of how improvements in patient outcome may be achieved by appropriately timed echocardiography-guided surgery.

In cases of chronic aortic dissection, it is important to perform a surgical fenestration consisting of surgical resection of the thick septum to prevent malperfusion or selective pressurization of 1 of the lumens. Among the risks of leaving a dissection flap at the site of the anastomosis, as we experienced, is insufficient expansion of the true lumen to allow adequate flow with resultant high proximal pressure. Although feasible based on the preoperative computed tomography scan, it is not always possible to guarantee the surgical result with complete expansion of the true lumen because application of the proximal clamp might distort the anatomy and make the anastomosis challenging.

Clamping distal to the LSA poses some benefits that will increase risk of respiratory complications, such as preserving its contribution to spinal cord blood flow and avoiding the trajectory of the left recurrent laryngeal nerve. The presence of a large distal arch aneurysm, mandates clamping the arch, which also increases the risk of iatrogenic retrograde type A aortic dissection related to a sudden increase in the proximal blood pressure.

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Another potential complication of the proximal clamp and transection of the aorta at the proximal and mid-DTA level is a lesion in the esophageal wall, which would be devastating.\(^1,3\)

Other intraoperative methods to detect this complication are epiaortic ultrasound and direct pressure measurement with a gauge needle and pressure line inserted in the proximal and distal segments. Postoperatively, this complication would have been detected by the computed tomography scan or on an invasive aortogram (Video 1).

**LESSONS LEARNED**

Suspicion of this complication should arise in patients with large aneurysms with reduced space for the application of the crossclamp. In these scenarios, the anatomy is easily distorted and careful identification of the 2 lumens before constructing the anastomosis is essential to allowing resection of any residual flap and/or avoiding exclusion of 1 of the lumens while constructing the anastomosis. Improvements in patient outcome may be achieved by appropriately timed echocardiography-guided surgery.

**References**

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