Anesthetic Considerations for Left Heart Bypass During Aortic Repair Surgery

Kishan Dwarakanath, M.D. and Charles D. Collard, M.D.

Division of CV Anesthesiology, Texas Heart Institute, St. Luke’s Episcopal Hospital, Houston, TX

Although endovascular techniques are becoming increasingly common for managing pathology of the descending thoracic aorta (DTA), open surgical repair remains the gold standard (1, 2). During surgeries in which the DTA is being repaired or reconstructed, left heart bypass (LHB) may be used to provide perfusion to portions of the body distal to the area being repaired, such as the viscera and the lower extremities (3). A list of indications for LHB is given in Table 1.

<table>
<thead>
<tr>
<th>Table 1. Indications for Left Heart Bypass</th>
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<tbody>
<tr>
<td>Open repair of Crawford Extent I or II Thoracoabdominal Aortic Aneurysms</td>
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<tr>
<td>Open repair of DeBakey Type III Aortic Dissections</td>
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<tr>
<td>Repair of traumatic DTA injury</td>
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<td>Surgery on the DTA with anticipated clamp time &gt; 30 min</td>
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Although there are several options for implementation of LHB, they all have in common the goal of diverting a portion of saturated blood from the patient’s left atrium (LA) to a section of the arterial vasculature distal to the portion of the aorta that is being reconstructed (Figure 1). Prior to LHB cannulation, the patient is first heparinized (100-150 units/kg). The most common proximal cannulation site is the left inferior pulmonary vein, although the LA appendage, LV apex, ascending aorta, or subclavian artery may be used (3-5). Distal cannulation may be accomplished via the femoral artery (FA) or the distal aorta (DA). The choice of cannulation site rests with the surgical team and will be guided by surgeon preference and specific anatomy of the patient. If selective visceral perfusion is desired, a portion of the LHB blood flow may be re-routed to the visceral ostia via balloon perfusion catheters (6).

Once the proximal aorta is cross-clamped, the institution of LHB creates two parallel circulations, an upper and a lower. The “upper” consists of native flow from the LV and thence to the great vessels and heart. The “lower” consists of flow from the LA to the centrifugal pump, and then to the distal cannulation site (FA or DA) and/or any visceral vessels that have been selectively cannulated (Figure 1). Blood in the “lower” circulation will return to the right side of the heart primarily via the inferior vena cava (IVC).
Blood flow to the great vessels and heart (i.e., the upper circulation) is dependent on the patient’s own heart function. Blood flow to the lower circulation is dependent on LHB. Typical LHB flows are 1.5-2.5 L/min.

Primary monitors include upper extremity arterial pressure (typically the right radial artery) and a pulmonary artery catheter with real-time cardiac output and mixed venous oxygen saturation capabilities. Lower extremity pressure may be monitored, if desired, via a FA catheter.

Once instituted, the key concept regarding LHB management is to recognize that increased blood flow to the lower circulation removes blood from the LA, and thus decreases the amount of saturated blood available for LV loading. Without adequate LV loading, the patient’s heart cannot provide adequate blood flow to the brain, heart and upper extremities (i.e., the upper circulation). Assuming normal LV function, low flows in the upper circulation (manifested by arterial hypotension in an upper extremity) may be remedied by 1) volume loading the patient or 2) by decreasing flow to the lower circulation by reducing the rate of LHB flow (i.e., LHB flow to the lower circulation is inversely correlated with flow to the upper circulation). At our institution, we generally prefer to volume load the patient prior to the institution of LHB, and then maintain relatively constant LHB flows while manipulating LV preload through adjusting the rate at which shed blood is returned to the patient via a central venous catheter. However, should the mean arterial pressure to the brain and great vessels (i.e., the upper circulation) fall below the cerebral autoregulation curve, we then decrease the LHB flows to the lower circulation in order to raise the mean arterial pressure to the upper circulation.

REFERENCES


