The best of both worlds—repair of acute Stanford type A aortic dissections in the hybrid operating room?

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Received: 04 October 2017; Accepted: 25 January 2018; Published: 09 February 2018.

doi: 10.21037/jovs.2018.01.22

View this article at: http://dx.doi.org/10.21037/jovs.2018.01.22

Acute type A aortic dissection is a fatal disease without prompt surgical intervention. Optimal surgical technique, particularly with respect to arch management, has undergone significant evolution over the last decade and has resulted in significant improvements in operative outcome. One clinical factor, however, which continues to have the greatest negative impact on postoperative mortality is organ malperfusion occurring in over 25–33% of patients with an acute type A dissection (1,2). A recent report from the International Registry of Acute dissection (IRAD) detailed a 63% mortality rate for patients presenting with mesenteric malperfusion as a result of an acute type A dissection (3). Limb ischemia associated with type A dissection is more common than mesenteric ischemia, occurring in nearly 20% of patients (4). Often, limb ischemia resolves following ascending aorta and aortic arch reconstruction alone. When the ischemia persists, salvage revascularization is usually successful for limb salvage, although complications such as rhabdomyolysis and renal failure may occur as a result of the ischemic injury and subsequent limb reperfusion. Other types of malperfusion may require active intervention in addition to aortic repair. One such example is coronary malperfusion, which occurs more frequently than mesenteric malperfusion and often requires additional intervention for complete correction (1).

The optimal technique for treating organ malperfusion both during and after repair of an acute type A aortic dissection continues to evolve. Many of the surgical adjuncts aimed at correcting malperfusion in this patient population often require advanced imaging and due this need, an ideal location for treating patients with acute type A dissection is most likely a hybrid operating room (OR). The hybrid OR is often equipped with multiple imaging modalities for precise definition of pathologic anatomy and may include on-table computed tomography, intravascular ultrasound, and multiplanar angiography. The availability of such sophisticated technology in one central location represents the optimal setting in which to perform advanced imaging studies and subsequent intervention in these acutely ill patients.

One such example of a surgical technique which has benefitted from being performed in a hybrid OR is the frozen elephant trunk (FET) procedure. The FET technique entails either antegrade or retrograde placement of a thoracic endovascular stent graft in the proximal descending thoracic aorta and is currently one of the more commonly utilized adjuncts outside of conventional ascending aortic and aortic arch reconstruction. The theoretical benefits of FET are re-approximation of the dissected layers, coverage of any downstream reentry tears in the distal aorta and optimizing late remodeling to prevent the need for future intervention. The FET technique can be performed in a retrograde fashion through the common femoral artery prior to commencing proximal aortic repair and would require the technology which exists in a hybrid OR including intravascular ultrasound and fluoroscopy to determine sizing as well as precise determination of proximal and distal landing zones.

With respect to specific malperfusion syndromes, mesenteric malperfusion in the setting of an acute type a dissection is usually a lethal event when the proximal aortic repair is performed as an isolated procedure prior to mesenteric revascularization. The poor outcomes associated with this surgical strategy has led to the development of new treatment paradigms which are aimed at performing mesenteric revascularization prior to proximal aortic repair.

The "TEVAR-first" approach proposes an initial retrograde TEVAR in order to promote true lumen re-expansion and improved mesenteric blood flow (5). Given the imaging resolution limitations of portable fluoroscopy and because of the additional need for concomitant procedures at the time of initial TEVAR, the hybrid OR may represent the ideal location to care for this specific cohort of acute type A dissection patients. A single location, where the needs for both conventional open aortic reconstruction and endovascular therapy can be addressed, represents a significant advantage toward optimal patient care in terms of expeditious care and risk of patient transport to multiple locations. A hybrid OR suite carries such an advantage and may be more ideal compared to transporting a patient to multiple locations such as a traditional OR and a cardiac catheterization lab.

Other malperfusion syndromes associated with type A dissection may also be better managed in a hybrid OR suite. Lower extremity malperfusion is the most frequently occurring malperfusion syndrome, affecting over 10% of all patients with an acute type A dissection (1). Lower extremity malperfusion requires intervention approximately 40% of the time, and, most commonly, these interventions are open extra-anatomic bypasses. However, lower extremity peripheral operations are often necessary in elderly patients with more chronic disease, and these cases often require peripheral angiography with lower extremity runoff. Completion ultrasonography and intraoperative intravascular ultrasound are often necessary, and these imaging modalities may be better utilized in a hybrid OR setting.

Operative repair of any type A dissection with or without a malperfusion syndrome are complex procedures. These cases may often require additional pieces of equipment which may not be utilized in elective procedures and invariably require more physical space than an average cardiac operation, thus revealing yet another benefit of the hybrid OR. Most modern hybrid rooms are in excess of 1,000 square feet and are constructed so as to make as much use of the available space as possible. The physical makeup of a hybrid OR suite may facilitate type A dissection repair and the associated equipment space necessary to accomplish adjunctive procedures.

The disadvantages of a hybrid OR may ultimately center around nonsurgical issues. These suites are expensive to construct, and, as such, most hospitals emphasize utilization by multiple specialties. This fact makes availability for emergency cases an ongoing issue. Priority should always be placed on survival following surgical repair for a type A dissection, so availability issues may hinder utilization for these often complex cases. Some hybrid ORs were added on to an existing OR footprint and can be located remote from cardiac surgical rooms and the necessary cardiopulmonary bypass supplies. This distance can create an unsafe environment for complex patient care and access. While hybrid suites are nearly ubiquitous in urban settings, rural hospitals may not have access to hybrid ORs. Hospital-to-hospital transfers should likely not occur based on availability of hybrid OR's alone for patients with type A dissections.

In conclusion, the hybrid OR suite for the performance of acute surgery for the repair of acute type A dissection has multiple advantages. The evolution of surgical treatment and its potential solutions will likely include a combination of both open and endovascular therapy. The hybrid OR allows these differing strategies to be performed in a seamless manner, making this setting the ideal space for repair of these complex disease processes.

Acknowledgements

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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doi: 10.21037/jovs.2018.01.22
Cite this article as: Keeling B, Chen E. The best of both worlds—repair of acute Stanford type A aortic dissections in the hybrid operating room? J Vis Surg 2018;4:33.