Thoracic and Cardiovascular Surgery

Anesthesia and Neurocerebral Monitoring for Aortic Dissection

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Patients presenting to the operating room for repair of aortic dissection are challenging in all aspects of their care. Without exception, they require a multidisciplinary team approach. This article will review some of the specific challenges faced by anesthesiologists and neurologists when confronted with such a diagnosis. Specifically, we will discuss the myriad anesthetic issues that present in the preoperative stage and continue into the postoperative period. Neurologic complications during dissection repair result in increased morbidity and mortality. A variety of neurophysiologic monitoring techniques exist that may reduce this risk and will be discussed in detail. Finally, we will present some "controversies in care," emphasizing that our respective fields continue to grow, learn, and improve what information we have on the morbidity and mortality of aortic dissection.

KEYWORDS aortic, dissection, anesthesia, neurophysiologic monitoring

Cardiothoracic surgical procedures require a multidisciplinary team approach to manage these complex patients, as typified by acute aortic syndromes. Often, these hemodynamically unstable patients present to the operating room with minimal preoperative evaluation and only a suspicion of dissection. Communication among the surgeon, anesthesiologist, perfusionist, and neurologist is critical. In addition to their primary responsibility to maintain the patient in an appropriately anesthesized state, anesthesiologists often coordinate care, order blood, titrate hemodynamics, and perform transesophageal echocardiography (TEE). The risk of injury to the central nervous system during aortic dissection repair has now made the role of the neurophysiologist, and neurocerebral monitoring, an integral part of the procedure.

There are certain factors common among all anesthetics (*i.e.*, standard monitors, amnesia, analgesia, etc.). However, aortic dissection requires an exquisite understanding of physiology, and it is crucial that the anesthesiologist does not fall into a "generic" anesthetic care plan. Table 1 lists some of the specific anesthetic considerations for aortic dissection. This list is not meant to be definitive, but rather to serve as a foundation on which to deliver an anesthetic that is appropriate for this unique patient population.

Furthermore, the purpose of this section is not to be inclusive of all aspects of cardiac anesthesia. The reader is referred to numerous texts on this subject.[1-3] Rather, this discussion will highlight some of the unique concerns that confront cardiac anesthesiologists each day when the surgeon calls and says, "I have a patient with an aortic dissection . . ."

Formulating a Plan

As soon as those eight words are spoken, the anesthesiologist must begin asking him/herself some crucial questions, the answers to which will have impact on guiding perioperative care.

Question 1. Are there additional personnel available to assist in evaluating the patient, drawing blood for laboratory evaulation, placing invasive lines, obtaining blood products, etc.?

Question 2. What is the urgency of the procedure and what are the patient's presenting hemodynamics?

Question 3. Is aortic pathology present and to what extent—how was this diagnosed and does this explain the present hemodynamic condition?

Question 4. What is the nature of cardiac involvement (*i.e.*, aortic insufficiency, cardiac tamponade, and cardiac ischemia)?

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Table 1 General Anesthetic Considerations for Aortic Dissection

Preoperative Anesthetic Evaluation
Urgency (elective/urgent/emergent)
Diagnosis (suspected vs. known)
Review of radiographs
Comorbidities
Past Medical/Surgical/Anesthetic history
Laboratory data
Medications
Allergies
Physical examination
Discussion with surgical team
Blood availability
Preoperative Medications
Inotropes
Vasodilators
β-blockade
Narcotics
Benzodiazapines
Intraoperative Considerations
Positioning (median sternotomy vs. left thoracotomy)
Lung Isolation
Monitoring
Fluid management
Antibiotic prophylaxis
Antifibrinolytics
Neuroprotection
Topical cerebral cooling
Glycemic control
Acid/base management (α-stat vs pH-stat)
Optimal hematocrit
Postoperative Considerations
Blood pressure control
Glycemic control
Pain management
Neurological evaluation
Ventilatory/Weaning strategies

Question 5. Are there any other sequelae (*i.e.*, cerebral malperfusion syndrome, mesenteric ischemia, etc.)?

Question 6. Are there techniques available that may reduce the patient's perioperative risk (*i.e.*, neurophysiologic monitoring, cerebrospinal fluid drainage (CSF), etc.)?

The answers to these questions affect the comprehensiveness of the preoperative history, physical examination, choice of invasive monitoring, strategy for induction, and maintenance of anesthesia and anticipation of blood product requirements. In other words, to the cardiac anesthesiologist, the case starts long before the patient arrives in the operating room. If an organized plan has not been formulated, the outcome can be compromised and disastrous.

Preoperative Assessment

By prioritizing the most essential factors into an algorithm, one can avoid subtle oversights (Fig. 1). From an anesthetic standpoint there is only one thing more crucial than the urgency of the procedure and that is the availability of assistance. The anesthesiologist is a key person to mobilize and organize other health care professionals, directing transportation to the operating room and managing hemodynamics. The anesthesiologist must prepare a team consisting of other anesthesia providers, perfusionists, neurologists, nursing staff, and/or technicians, and assign specific tasks. Communication with all of these teams regarding the diagnosis, operative, and anesthetic plan is essential.

The urgency of the procedure dictates the availability of time to obtain past medical history and preoperative workup. Frequently, urgent or emergent cases will not allow for a comprehensive past medical or anesthetic history. At the very least, the anesthesiologist must evaluate the status of the airway, conduct a focused neurological examination, assess hemodynamics, and determine the need for the use of vasodilators or inotropes, as well as determine intravenous/arterial access. The preoperative interview should focus on relevant portions of the patient's history and physical examination, as listed in Table 2. This information, in addition to the patient's present medical status will significantly influence the choice of induction agents and anesthetic maintenance.

When the patient enters the operating room, blood pressure in both upper extremities should be measured to rule out dissection involving the aortic arch vessels. If the patient is awake, it is imperative that a thorough neurological examination be performed both for prognostic purposes as well as to provide a baseline for postoperative comparison. In 104 patients who underwent type A dissection repair at the University of Pennsylvania, the total in-hospital mortality was 9%, but in patients presenting with a CVA (who subsequently had a successful type A dissection repair) the death rate was 45%.[4]

Before anesthetic induction, large bore intravenous access should be obtained in addition to arterial monitoring. The decision of where to place the arterial line is, in part, determined by the presence of a blood pressure discrepancy between the left and right arms. A difference may represent malperfusion secondary to the dissection extending into an artery or a dissection flap occluding one of the branching vessels. At the same time, another team member should be ordering blood products and sending an arterial blood gas to rule out a significant acidosis (suggesting malperfusion), hypoxemia, and to allow estimation of a dilutional hematocrit in anticipation of cardiopulmonary bypass.

The physical examination should be focused on three primary systems: airway, cardiopulmonary, neurological. If the patient's airway accessibility is tenuous or at all questionable, backup devices should be readily available to aid in intubation (*i.e.*, fiber-optic scope, laryngeal mask airway, lightwand, etc.). From a cardiopulmonary perspective, note should be made of any diastolic murmur (consistent with aortic insufficiency), dampened heart sounds (consistent with pericardial effusion), crackles/rales (consistent with congestive heart failure), or wheezes (consistent with chronic obstructive pulmonary disease). Any of these will have impact on the upcoming anesthetic induction.

Safety must not be compromised. All appropriate monitors should be placed before induction of anesthesia, regardless of whether the patient presents emergently. While central mon-