In 2010, the American College of Cardiology Foundation (ACCF) and the American Heart Association (AHA) together with the Society of Thoracic Surgeons (STS), American Association of Thoracic Surgeons (AATS), the Society of Cardiovascular Anesthesiologists (SCA), and 5 other national medical societies published the first set of guidelines for the management of thoracic aortic diseases (TAD)(1). The objective of these consensus guidelines was to provide detailed, assessable expert recommendations for the detection, diagnosis, and management of patients with thoracic aortic diseases. Although thoracic aortic diseases are predominantly surgical problems and successful operative repair is considered a definitive treatment, medical decision-making in the management of patients with thoracic aortic diseases remains challenging for the following reasons: a) most patients with thoracic aortic diseases are asymptomatic, b) the progression of thoracic aortic diseases to catastrophic life-threatening thoracic aortic syndromes is acute and unpredictable, c) elective surgical repair is preferable, but associated with significant risk, d) a wide variety of surgical and anesthetic techniques are employed for the management of patients undergoing thoracic aortic repair and e) the quality of medical evidence to support specific recommendations is limited and based primarily on institutional experience, case series, and expert opinion (Level C). This lecture will attempt to address several controversial aspects of the consensus guidelines that may be encountered in the routine management of patients with thoracic aortic diseases. Several examples of recommendations with aspects that are controversial or raise additional important questions for clinical decision-making are listed below.

**Bicuspid Aortic Valve and Ascending Aortic Aneurysm**

The following Class I recommendations (procedure or treatment SHOULD be performed) that apply to patients with bicuspid aortic valves generate the following clinical questions.

**Class I Recommendations**

1. First-degree relatives of patients with a bicuspid aortic valve, premature onset of thoracic aortic disease with minimal risk factors, and/or a familial form of thoracic aortic aneurysm and dissection should be evaluated for the presence of a bicuspid aortic valve and asymptomatic thoracic aortic disease. (Level of Evidence: C)

2. All patients with a bicuspid aortic valve should have both the aortic root and ascending thoracic aorta evaluated for evidence of aortic dilatation. (Level of Evidence: B)

3. Patients with Marfan syndrome or other genetically mediated disorders (vascular Ehlers-Danlos syndrome, Turner syndrome, bicuspid aortic valve, or familial thoracic aortic aneurysm and dissection) should undergo elective operation at smaller diameters.
(4.0 to 5.0 cm depending on the condition; see Section 5) to avoid acute dissection or rupture. (Level of Evidence: C)

4. Patients undergoing aortic valve repair or replacement and who have an ascending aorta or aortic root of greater than 4.5 cm should be considered for concomitant repair of the aortic root or replacement of the ascending aorta. (Level of Evidence: C)

Clinical questions:

1. What imaging modalities and imaging conventions apply to the use of aortic diameter for prognostic purposes?
2. What are criteria for aortic valve replacement or repair in a patient with a bicuspid aortic valve and ascending aortic aneurysm?
3. What operation should be performed in a patient undergoing aortic valve replacement with dilation of the aortic root or ascending aorta?

Initial Management of Acute Aortic Dissection

The following recommendations from the TAD guidelines clearly favor the initial use of beta-blockers to control heart rate for the initial management of acute aortic dissection, but evidence to support the efficacy of beta-blocker therapy over vasodilator therapy for the initial treatment of acute aortic dissection is lacking and beta-blocker therapy has potential serious adverse effects. Furthermore, the Class III recommendation (Risk exceeds benefit and Procedure or treatment should NOT be performed because it may be harmful) that vasodilator therapy should not be initiated prior to rate control has not been substantiated.

Class I

1. Initial management of thoracic aortic dissection should be directed at decreasing aortic wall stress by controlling heart rate and blood pressure as follows:
   a. In the absence of contraindications, intravenous beta blockade should be initiated and titrated to a target heart rate of 60 beats per minute or less. (Level of Evidence: C)
   b. In patients with clear contraindications to beta blockade, nondihydropyridine calcium channel–blocking agents should be utilized as an alternative for rate control. (Level of Evidence: C)
   c. If systolic blood pressures remain greater than 120 mm Hg after adequate heart rate control has been obtained, then angiotensin-converting enzyme inhibitors and/or other vasodilators should be administered intravenously to further reduce blood pressure that maintains adequate end-organ perfusion. (Level of Evidence: C)
   d. Beta blockers should be used cautiously in the setting of acute aortic regurgitation because they will block the compensatory tachycardia. (Level of Evidence: C)

Class III

1. Vasodilator therapy should not be initiated prior to rate control so as to avoid
associated reflex tachycardia that may increase aortic wall stress, leading to propagation or expansion of a thoracic aortic dissection. (Level of Evidence: C)

**End-Organ Protection during Thoracic Aortic Repair**

The TAD guidelines recommended that brain and end-organ protection strategies are key elements in the surgical, anesthetic and perfusion management of patients undergoing thoracic aortic repair, list a variety of techniques that are used for organ protection but hesitate to provide specific details on the clinical applications of the techniques. For example, the guidelines refer to institutional experience as an important factor determining whether deep hypothermic circulatory arrest (DHCA) or selective antegrade cerebral perfusion (ACP) should be employed for brain protection for ascending aorta or aortic arch operations. Furthermore, although the recommendations stated that perioperative brain hyperthermia should be avoided, an optimal temperature for DHCA or ACP was not provided. The TAD guidelines assigned a Class I recommendation for cerebral spinal fluid drainage for spinal cord protection for patients at risk for spinal cord ischemia, but the recommendation relied on clinical judgment to determine which patients are at risk for spinal cord ischemia. Finally, Class III recommendations (should NOT be performed) were issued regarding the use of regional anesthetic techniques and the replacement of double-lumen endotracheal tubes in patients undergoing descending thoracic aortic repairs. These Class III recommendations were based on Level C evidence and very little clinical evidence and may constrain the management and therapeutic options available to individual patients.

**Class I**

1. A brain protection strategy to prevent stroke and preserve cognitive function should be a key element of the surgical, anesthetic, and perfusion techniques used to accomplish repairs of the ascending aorta and transverse aortic arch. (Level of Evidence: B)

**Class IIa**

1. Deep hypothermic circulatory arrest, selective antegrade brain perfusion, and retrograde brain perfusion are techniques that alone or in combination are reasonable to minimize brain injury during surgical repairs of the ascending aorta and transverse aortic arch. Institutional experience is an important factor in selecting these techniques. (Level of Evidence: B)

**Class III**

1. Perioperative brain hyperthermia is not recommended in repairs of the ascending aortic and transverse aortic arch as it is probably injurious to the brain. (Level of Evidence: B)

**Class I**

1. Cerebrospinal fluid drainage is recommended as a spinal cord protective strategy in open and endovascular thoracic aortic repair for patients at high risk of spinal cord ischemic injury. (Level of Evidence: B)

**Class IIa**
1. Spinal cord perfusion pressure optimization using techniques, such as proximal aortic pressure maintenance and distal aortic perfusion, is reasonable as an integral part of the surgical, anesthetic, and perfusion strategy in open and endovascular thoracic aortic repair patients at high risk of spinal cord ischemic injury. Institutional experience is an important factor in selecting these techniques. (Level of Evidence: B)

2. Moderate systemic hypothermia is reasonable for protection of the spinal cord during open repairs of the descending thoracic aorta. (Level of Evidence: B)

Class IIb
1. Adjunctive techniques to increase the tolerance of the spinal cord to impaired perfusion may be considered during open and endovascular thoracic aortic repair for patients at high risk of spinal cord injury. These include distal perfusion, epidural irrigation with hypothermic solutions, high-dose systemic glucocorticoids, osmotic diuresis with mannitol, intrathecal papaverine, and cellular metabolic suppression with anesthetic agents. (Level of Evidence: B)

2. Neurophysiological monitoring of the spinal cord (somatosensory evoked potentials or motor evoked potentials) may be considered as a strategy to detect spinal cord ischemia and to guide reimplantation of intercostal arteries and/or hemodynamic optimization to prevent or treat spinal cord ischemia. (Level of Evidence: B)

Class III
1. Regional anesthetic techniques are not recommended in patients at risk of neuraxial hematoma formation due to thienopyridine antiplatelet therapy, low-molecular-weight heparins, or clinically significant anticoagulation. (Level of Evidence: C)

2. Routinely changing double-lumen endotracheal (endobronchial) tubes to single-lumen tubes at the end of surgical procedures complicated by significant upper airway edema or hemorrhage is not recommended. (Level of Evidence: C)

References