Developing a curriculum for cardiothoracic surgical critical care: Impetus and goals

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"The future is already here. It is just not yet widely distributed"

— William Gibson

The past 2 decades have ushered several significant changes affecting the practice of cardiothoracic surgery (CTS). An increasing number of older patients with more complex disease processes and higher acuity are presenting for surgical management. The rapid evolution in the applications of virtual reality, informatics, imaging, and devices has led to novel procedures and treatment modalities, including minimally invasive and hybrid procedures. Medical knowledge is continually expanding, providing better understanding of the natural history of diseases and the effect of various treatment modalities, through advanced monitoring technology. The practice of CTS is continually evolving to involve more active interdisciplinary collaboration among surgeons, cardiologists, radiologists, and various other clinicians. This collaboration has included novel ways of supportive measures of CTS cases in the perioperative period.¹

This growing multidisciplinary collaboration has expanded beyond North America to the global CTS community at large (Joel Dunning, MD, personal communication, July 12, 2011). In addition, intersocietal and mutual recognition by the governing bodies of the specialty is fostering the creation of a truly global CTS scientific and professional community.

However, other factors during this time have had a negative impact on this goal, such as the reduction of resident work hours, a steady decline in the number of thoracic surgery applicants, and more surgeons retiring or choosing other specialties. Meanwhile, advances in the science of safety, new health care legislations, and regulatory measures have increased the focus on improved outcomes and reducing errors and cost, with significant financial reimbursement implications.²⁻⁴

This decade has also seen the emergence and rapid growth of cardiothoracic surgical critical care (CTSCC) as a robust and distinct new subspecialty with a unique scope of practice. It has gained recognition by the American Board of Thoracic Surgery in 2008⁵⁻⁷ and endorsement by the 2 parent organizations of CTS, the American Association for Thoracic Surgery and the Society of Thoracic Surgeons, who continue to sponsor its Symposia, postgraduate courses, and conferences organized by its dedicated organization (the Foundation for the Advancement of Cardiothoracic Surgical Critical Care). This endorsement and support continue with the American Board of Thoracic Surgery and the American Board of Surgery collaborating to create training pathways for certification in CTSCC (Valerie Rusch, MD, personal communication, May 14, 2011).

IMPETUS FOR A SPECIFIC CARDIOTHORACIC SURGICAL CRITICAL CARE CURRICULUM

The Institute of Medicine's "Crossing the Quality Chasm"⁸ report includes the following among its "10 Rules for Redesign of the Healthcare System":

- Knowledge is shared and information flows freely.
- Decision making is evidence-based.
- Safety is a system property.
- Needs are anticipated.
- Waste is continuously decreased.

This increased focus on improved outcomes in CTS can be translated into a safer, more predictable, evidence-based, cost-effective practice with less errors.

Several performance improvement strategies have emphasized the importance of the clear definition of the team function and the task to be addressed. Thus, the focus of training has shifted from the completion of a certain program to achieving competency in the knowledge base, skills, and judgment relevant to the specified areas.^{9,10}

It has also been established that efficiently engineered systems have the least number of errors, waste the least amount of energy and resources, and produce the best outcomes in a shorter period of time. Efficiency can sometimes be described as "the right operator, with the right information, making the right decision to use the right tool to perform the right task at the right time in the right manner." In clinical terms, the promotion of a more efficient CTSCC surgical discipline means the

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Abbreviations and Acronyms

- CTS = cardiothoracic surgery
CTSCC = cardiothoracic surgical critical care

appropriately educated and trained surgeon, equipped with the best available evidence-based information, formulating and leading the implementation of the correct management plan within the specific, relevant environment of CTSCC.

Although recent studies have demonstrated the improved outcomes when CTS-trained surgeons assume a leadership position in the practice of CTSCC,^{11,12} there remains a number of significant issues affecting this goal:

- The decreasing number of cardiothoracic surgeons.
- The decreased attractiveness of CTSCC as a specialty because of the reluctance to pursue a role as an “intensivist” with no operative duties. Cardiothoracic surgeons in training consider CTSCC as a small part of their education, less important than technical prowess.
- The lack of uniform, evidence-based, specialty-specific practice guidelines for CTSCC among different institutions and practitioners, in contrast with general critical care.
- The lack of a comprehensive, encompassing set of guidelines for clinical practice in the various areas of CTS, for example, general thoracic, combined cardiothoracic, adult cardiovascular, or heart failure surgery.
- The paucity of dedicated, specialty-specific staff: In academic centers, the responsibility for CTSCC cases usually falls on CTS/heart failure surgery/transplant residents or fellows, “visiting fellows,” or general surgery residents rotating on the CTS service. Because of the restrictions on work hours, nurse practitioners and physician assistants have also been involved in this area of practice. In addition, the presence of residents and fellows is seen as a “temporary” staffing option, with minimal or no likelihood of pursuing a career in this field. In nonacademic centers, on the other hand, the attending cardiothoracic surgeon is primarily the main decision-maker for CTSCC cases. General critical care specialists (“intensivists”), nurse practitioners, and physician assistants often are shouldering a major part of this responsibility.
- The above-mentioned factors apply not only to surgeons but also to other clinicians in CTSCC, such as critical care nurses, clinical nurse specialists, and nurse practitioners. These practitioners have an essential role in the specialty and face the same challenges and issues as surgeons, which often drive them away from the specialty to seek other careers. It has been a consistent goal of the Foundation for the Advancement of Cardiothoracic

Surgical Critical Care organization to engage these groups of clinicians in the emerging specialty, because it matures into a true multidisciplinary team-based clinical area (Nevin Katz, MD, personal communication, September 30, 2010).

PRINCIPLES OF THE CURRICULUM

CTS can be defined as the discipline involved in the surgical management of cardiac or pulmonary dysfunction or failure, specifically, correction of anatomic abnormalities, amelioration of functional abnormalities, and replacement of the failing organ.

The following topics represent the basic principles of CTSCC management and the basic framework for didactic education training and qualification for the cardiothoracic critical care surgeon:

1. Initial recovery from surgery: A significant experience in managing critically ill surgical patients is thus required, especially in areas common to both general surgical critical care and CTSCC. A required period of training in general surgery, as recognized by such organizations as the American Board of Surgery, the American or Royal College of surgeons, or their equivalents, can thus be one of the requirements for eligibility for the certification examination.
2. Stable/optimal native cardiovascular or pulmonary system performance: This is the heart of the management process in the CTSCC environment. The surgeon must be thoroughly knowledgeable, competent, and highly skilled in understanding the anatomic, developmental, physiologic, pathophysiologic basis for cardiac, vascular, and pulmonary disease processes. Also of paramount importance is a demonstration of a comprehensive understanding and adequate hands-on experience in the operative management of such diseases.

This particular knowledge base must also include the understanding of the preoperative status of the target organ systems, that is, the cardiovascular and pulmonary system, the effect of the disease on the other organ systems, the planned or expected impact of the surgical procedure on the course of the disease and the patient as a whole, and the expected risks and complications in the postoperative period and their impact on the longevity and quality of life of the patient.

A period of specialized CTS training (residency or fellowship) with exposure to different disciplines of CTS practice as recognized by the CTS parent organizations (American Board of Thoracic Surgery, American Association for Thoracic Surgery, Society of Thoracic Surgeons, European Association for Cardiothoracic Surgery, or their equivalents) thus becomes one of the requirements for eligibility for the certification examination.

TABLE 1. Examples of core competency areas in the management of cardiothoracic surgical critical care patients

Monitoring and diagnostics	Hemodynamic monitoring	Arterial lines	
		Central venous catheters	
	Physiologic monitoring	Swan-Ganz catheter	
		Direct intracardiac lines	
		Pulse oximetry	
		Urinary catheter	
		Intracavitary temperature probe	
		Cerebral oximetry	
		Transcranial Doppler	
		Evoked response potential sensors	
		Electrocardiogram	
		Electroencephalogram	
	Imaging modalities	Radiography	
		Transthoracic echocardiography/transesophageal echocardiography	
		Computed tomography	
		Magnetic resonance imaging	
	Systems management	Neurologic	Level of consciousness
			Short- and long-term sedation
			Agitation/restraints
			Focal deficits, mental state
			Psychologic/psychiatric state
		Cardiovascular	Determinants of cardiac performance: Rhythm/dysrhythmia management, rate/pacing, preload/filling pressures
			Afterload/SVR/PVR/vasopressors/vasodilators
			Contractility/inotropes/chronotropes
			Tiered plan for low cardiac output syndrome
			Need for MCS/IABP, ECMO/ECLS/other MCS
			Tamponade (pericardial/sternal)
Bleeding/cardiothoracic drainage/take-back/open situation			
Code Blue/BLS/ACLS, CPS			
Vascular access			
Pulmonary			Central lines/arterial lines/SG catheter/introducers, sheaths/PICC lines
		Capacity for spontaneous respiration, weaning parameters, extubation/oxygen supplement/weaning/CPAP and BiPAP	
		Pulmonary congestion/edema	
		Additional or long vent support: risks/precautions/reintubation/tracheostomy	
		Ventilatory strategy: types/selection/management	
		ECMO consideration/criteria/management	
		Pleural space: air leaks/pneumothorax/pleural effusions/thoracentesis/chest tube placement	
Gastrointestinal		Capacity for independent feeding: level of consciousness, aspiration risk, swallowing integrity	
		Motility issues: acute gastric dilatation/constipation/ileus/obstruction/intestinal ischemia	
		Feeding strategy: diet types/feeding routes: NGT/PEG/TPN/PPN	
		UOP/oliguria/ATN/acute renal failure	
Renal		Electrolyte balance, acid-base balance	
		Fluid balance/diuresis	
Endocrinology	Dialysis: HD/CVVHD/SLEDD/ultrafiltration		
	Glucose management/adrenal insufficiency/thyroid replacement/other issues		
Infection control	Prophylaxis, surveillance: sterility/infection precautions/catheter and lines/cultures		
	Therapeutic: empiric/culture-guided		
	Resistance/isolation: MRSA, VRE, neutropenic		
Hematology	Coagulopathy, DIC, transfusion strategy		
	Hypercoagulable state		
	HIT, HITT, warfarin (Coumadin, Bristol-Myers Squibb Co, Princeton, NJ), alternate anticoagulation		

(Continued)

TABLE 1. Continued

Preventive measures	DVT prophylaxis, VAP prophylaxis, decubitus prophylaxis, CTS critical care fall precautions, ulcer/GI bleeding prophylaxis, bleeding precautions, and wound care
Ethical and social issues	Decision-making, spokesperson, living will/advance directives, code status, DNR tiers and options, and end-of-life issues Quality of life
Process issues	Science of safety Error causation and prevention Teamwork and leadership

ACLS, Advanced Cardiac Life Support; *ATTN*, acute tubular necrosis; *BiPAP*, bilevel positive airway pressure; *BLS*, basic life support; *CPAP*, continuous positive airway pressure; *CPS*, cardiopulmonary support; *CTS*, cardiothoracic surgery; *CVVHD*, continuous veno-venous hemodialysis; *DIC*, disseminated intravascular coagulopathy; *DNR*, do not resuscitate; *DVT*, deep venous thrombosis; *ECLS*, extra-corporeal life support; *ECMO*, extracorporeal membrane oxygenation; *GI*, gastrointestinal; *HD*, hemodialysis; *HIT*, heparin-induced thrombocytopenia; *HITT*, heparin-induced thrombocytopenia and thrombosis; *IABP*, intraaortic balloon pump; *MCS*, mechanical circulatory support; *MRSA*, methicillin-resistant *Staphylococcus aureus*; *NGT*, nasogastric tube; *PEG*, percutaneous endoscopic gastrostomy; *PICC*, peripherally inserted central catheter; *PPN*, peripheral parenteral nutrition; *PVR*, pulmonary vascular resistance; *SLEDD*, sustained low-efficiency daily dialysis; *SG*, Swan-Ganz; *SVR*, systemic vascular resistance; *TPN*, total parenteral nutrition; *UOP*, urine output; *VAP*, ventilator-associated pneumonia; *VRE*, vancomycin-resistant enterococci.

3. Stabilization/optimization of other major systems: Because the entire organism is dependent on the optimal function of the cardiopulmonary unit, disturbances of the function of other organs are frequent in the context of CTS. These system dysfunctions may have existed for a certain period of time preoperatively or develop anew after the surgical intervention or during the course of recovery. Table 1 provides some illustrative examples in specific areas in the CTSCC curriculum that require sufficient experience in identifying, monitoring, and managing disorders of these systems, as well as leading and coordinating a multidisciplinary approach with other specialists involved in the care of the CTS patient.
4. Promotion of independence from invasive measures and preparation for rehabilitation.
5. Prevention and management of complications. On the basis of the comprehensive understanding of all aspects of the conditions affecting the CTS patient population at hand, strategic planning and management of an integral pathway toward recovery and return to a meaningful, dignified quality of life are necessary.

GOALS AND DIRECTIONS

The concept of CTS practice as a “service line” process has been established.¹⁴ The core mission of the specialty is to provide excellent surgical care to CTS cases across the continuum of surgical management.¹³ Thus, the 21st century cardiothoracic surgeon¹⁵ is no longer just an operating room technician but also a leader of the multidisciplinary team and well versed in all aspects of the process, with the responsibility and accountability for the patient’s welfare that has characterized CTS throughout its history.¹⁶

In the face of the rapidly changing environment of CTS practice and the increasing competition from other specialties areas that are core CTS practice areas (eg, cardiac pacing, aortic repair, valve repair), CTS specialty and its parent organizations should rise to the challenge and ensure that our practitioners maintain an active interest and are well equipped to be competitive in all areas of practice, traditional or novel.¹⁷⁻¹⁹

On the basis of the documented improved outcomes when cardiothoracic surgeons assume responsibility for the peri-operative period, CTSCC should be promoted as an exclusive new practice “niche” within the CTS specialty:

- The surgeon’s involvement in all aspects of the process should be emphasized, as opposed to traditional focus on the technical duty alone.
- The importance of CTSCC in the process should be highlighted. It should not be delegated to non-surgeons, as is currently practiced. CTSCC and operative duties are not mutually exclusive areas of practice.
- The surgeon as a leader of a multidisciplinary team should be emphasized, as opposed to a clinical “turf war.”
- Easy and clear pathways for certification and credentialing as “CTSCC surgeons” should be provided. The proposed curriculum can be integrated in the formal training and education of cardiothoracic residents and fellows, and thus they can be eligible to take the qualifying examination after completion of their program. Cardiothoracic surgeons already out of training can attend a focused, structured training course to become eligible for certification.
- This specific training and certification as condition for recruitment and practice in CTSCC should be required, instead of hiring a generic “intensivist.” This will serve

as the foundation for improved compensation and reimbursement in this capacity.

CONCLUSIONS

CTSCC has been established as a distinct subspecialty, gaining recognition from the specialty board and the parent organizations of thoracic surgery. The timing is perfect for the emergence of the robust, enlightened, and visionary leadership to steer this surgical discipline into the future and to bridge the knowledge gap that exists today in CTSCC. One of the essential requirements for such a successful leadership is to establish a comprehensive, adaptable, flexible state-of-the-art curriculum as a foundation for the didactic skill and practice knowledge base for cardiothoracic surgeons in leadership roles in CTSCC with a primary focus on knowledge and competency as opposed to time spent in training. Determining the eligibility to enroll in a training program for CTSCC and for credentialing and certification for cardiothoracic surgeons already in practice in this particular specialty becomes of paramount importance in attracting surgeons to this specialty, thus creating a critical mass for its members (Nevin Katz, MD, personal communication, May 8, 2011). Because of the unique nature of the specialty, currently established guidelines of other surgical societies for education, training, credentialing, and certification may be insufficient or inapplicable.

Furthermore, developing clear guidelines for training and certification will eventually have an impact on the performance and quality metrics of surgeons, as well as other clinicians, which may affect their compensation and reimbursement.

By taking a visionary leadership position in developing such a curriculum, the parent organizations and sponsors of CTSCC will further enhance the growth of a robust, modern, global, and independent subspecialty to meet the societal, scientific, and technologic challenges and demands of a new era.

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