Teaching operative cardiac surgery in the era of increasing patient complexity: Can it still be done?

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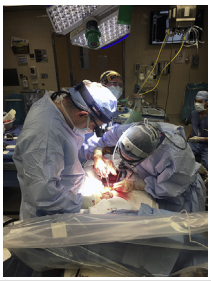
ABSTRACT

Objective: Teaching the next generation operative cardiac surgery while maintaining the highest level of patient care is an ever-increasing challenge given the growing proportion of patients with multiple comorbidities, the loss of more straightforward cases to percutaneous interventions, and the pressure of public reporting. No study to date has compared the outcomes of similar cases performed entirely (''skin-to-skin'') by the resident with those performed entirely by the staff to confirm the safety of this practice.

Methods: A total of 100 consecutive cardiac cases performed skin-to-skin by the resident (group R) were matched by procedure 1:1 to nonconsecutive cases performed by a single attending surgeon (group A). Patients were excluded from the analysis if there was overlap in any portion of the procedure by the trainee or the attending.

Results: Patients in group A were similar to those in group R with respect to age, gender, body mass index, American Society of Anesthesiologists classification, left ventricular ejection fraction, and diabetes mellitus. Mean operative times were longer in group R (4.6 vs 2.7 hours, $P < .001$), as were cardiopulmonary bypass times (96 vs 50 minutes, $P < .001$) and aortic crossclamp times (78 vs 39 minutes, $P < .001$). There were no significant differences in red blood cell transfusions, reexplorations, stroke, length of stay, or wound infections. There were no in-hospital or 30-day deaths.

Conclusions: Our data indicate that trainees can be educated in operative surgery under the current paradigm, despite longer operative times, without sacrificing outcome quality. It is reasonable to expect academic programs to continue providing trainees significant experience as primary operating surgeons. (J Thorac Cardiovasc Surg 2018;■:1-8)



Dr Tolis and a cardiac surgery resident at Massachusetts General Hospital.

Central Message

An organized approach to cardiac surgical training can safely produce well-trained surgeons in the current era. Academic programs should continue providing trainees experience as primary surgeons.

Perspective

Increased patient complexity combined with resident work hour regulations and public reporting of outcomes and complications has compromised the training experience of cardiac surgical residents. This study shows that with a carefully planned approach to surgical education, residents can be appropriately trained while patients can continue receiving excellent medical care.

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EDU

Despite the introduction and acceptance of less-invasive access techniques such as transcatheter aortic valve replacement (AVR) and mitral clip procedures over the past few years, cardiac surgery has largely remained a traditional ''open'' surgical specialty. The majority of cardiac operations are still performed through a median sternotomy or a right thoracotomy requiring advanced open surgical skills. Surgical staples and anastomotic devices have found limited applicability in adult cardiac surgery and have

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Abbreviations and Acronyms
ACC = aortic crossclamp
AVR = aortic valve replacement
CABG = coronary artery bypass grafting
CPB = cardiopulmonary bypass
MVR = mitral valve replacement
STS = Society of Thoracic Surgeons

been largely abandoned. At the same time, other surgical specialties such as general and vascular surgery have moved toward laparoscopic and endovascular platforms, respectively. As a result of this, in combination with duty hour restrictions, many graduates seek additional training for open operations by means of postgraduate fellowships, while those continuing with cardiac fellowships enter their training with a limited set of open skills.[1]

Although most open cardiac operations performed today were first described and popularized more than 4 decades ago, the complexity of those operations has increased because more elderly patients with multiple comorbidities are routinely referred for surgery compared with years past. This has temporally coincided with the introduction of extensive outcomes data collection and public reporting, with plans to use these data as a determinant for physician and hospital financial compensation. Complications are heavily scrutinized, and their financial cost is shifted more toward the medical institutions and less toward the insurance companies. Meanwhile, many best-selling publications and national mainstream media outlets appear more eager to cover unsubstantiated stories of inadequate resident supervision coupled with concurrent surgery practices and have arbitrarily linked these practices to poor outcomes for the patients on the basis of individual case reports. As a result, many academic surgeons are reluctant to provide their trainees with the extent of operative experience and autonomy that they received during their own years of training.[2] Finally, many medical students and general surgery residents choose not to pursue a career in cardiothoracic surgery given the negative image created around the field and the training process in particular.[1,3,4]

Several studies have demonstrated the safety of providing trainees with an adequate operative experience.[5-7] Although some of these studies have looked at specific types of operations such as off-pump revascularization or have documented the progress of resident learning as demonstrated by a decrease in the time it takes a trainee to perform a certain task, none of them have routinely provided robust data about the degree of trainee independence.[8-10] The majority of these studies do not comment on attending/resident overlap and have not systematically examined many preoperative, perioperative, and postoperative parameters.[11-13] The purpose of this study was to compare postoperative outcomes of 2 similar surgical patient cohorts whose operations were performed entirely by an attending surgeon or by a physician in training. By doing so, we hoped to determine if the inefficiencies associated with resident training affect clinical outcomes and to further drill down on appropriate patient selection for resident training. We think that observing residents operating skin-to-skin is the ultimate assessment of competency and readiness for surgical practice (Video 1).

MATERIALS AND METHODS

Patient Selection and Data Collection

This study was approved by the Partners Human Research Committee's Institutional Review Board for human research to meet ethical and legal requirements. From July 2014 to December 2016, Dr Tolis completed a total of 642 pump cases, either as teaching surgeon or primary surgeon. The breakdown of these cases is as follows: isolated coronary artery bypass grafting (CABG) (321), isolated AVR (84), isolated mitral valve replacement (MVR) (8), AVR/CABG (64), MVR/CABG (3), AVR/MVR (4), mitral valve repair (12), mitral valve repair/CABG (17), and other (129). A prospective longitudinal database was created capturing comprehensive data for all patients undergoing cardiac operations by Dr Tolis at our institution. Consecutive cases done skin-to-skin by the resident surgeon during the study period with attending supervision were matched by specific operative procedure 1:1 with cases done skin-to-skin by the same attending surgeon. A 1:1 matching was achieved once the resident cases reached a total of 100. Because we collected our data prospectively, in almost all categories there were fewer attending alone cases, necessitating the attending to perform several cases in each category himself to achieve equal numbers in all categories and eventually achieve 1:1 matching with the resident alone cases. All cases were performed at the Massachusetts General Hospital main campus.

Training

The cardiothoracic training program at the Massachusetts General Hospital consists of both rotating general surgery residents and full-time cardiothoracic residents who have completed general surgery training. All cases done skin-to-skin by resident surgeons were done so by the 8 full-time cardiothoracic residents who rotated with Dr Tolis during the study period. Of the 8 residents, 4 performed skin-to-skin cases during both full years of their training, whereas the other 4 only performed skin-to-skin cases during the second year of their training.

Before being allowed to perform an operation skin-to-skin, the residents had displayed competency in performing each individual step of the operation during the earlier part of their training (eg, opening, harvesting conduits, cannulating, constructing distal and proximal anastomoses). This had been significantly enhanced after adoption of the "apprenticeship model," which we implemented in our program in 2013, where a resident would be assigned to a specific attending for a 2- to 3-month block to increase the level of responsibility allowed to the resident and enhance the resident's experience.

Definitions

Cases were considered skin-to-skin if the operating surgeon completed each of the following steps of the operation from the right side of the operating table:

Common steps.
1. Opening of skin, soft tissues, sternum, and pericardium.
2. Cannulation for cardiopulmonary bypass (CPB).
3. Placement of aortic crossclamp (ACC).