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EDITORIAL COMMENT

Another Meiosis in the Specialty of Cardiovascular and Thoracic Surgery

Birth of the Purebred "Thoracic Aortic Surgeon"?*

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The carefully analyzed data and well-written paper by Andersen et al. (1) in this issue of the *Journal* carry an important message for clinicians as well as health-policy planners and payers with respect to acute type A aortic dissection. All facets of cardiovascular medicine and surgery over the last 20 to 30 years have witnessed an seemingly inexorable trend towards subspecialization and further sub-subspecialization. Although a few U.S. institutions have developed special expertise and a large experience in caring for patients with disorders of the thoracic aorta that has translated into superior surgical outcomes, acute type A aortic dissection has remained a life-threatening clinical catastrophe that continues to challenge and humble all of us, with an in-hospital mortality risk (for those who reach a tertiary referral hospital alive) still exceeding 19% to 28% (2,3). In the United States, an earlier report using the Nationwide Inpatient Sample (NIS) of 3,013 patients showed the mortality rate to be 26% (some acute type B dissections included) between 1995 and 2003; an inverse relationship between hospital procedure volume and operative mortality was identified, but the independent significant predictors of operative mortality were increasing age and operation at a non-teaching hospital (4). A subsequent NIS analysis of 5,184 patients with an acute type A aortic dissection treated between 2003 and 2008 reported an overall operative mortality rate of 21.6%, which fell slightly to 19.1% from 2005 to 2008 (5). Further, patients undergoing emergency surgical repair by lower-volume surgeons and centers had about double the risk-adjusted operative mortality operative rate compared with the highest volume surgeons and centers (5).

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At Duke, 2 cardiovascular surgeons who received specialized subspecialty training in thoracic aortic surgery created a dedicated multidisciplinary team approach called the "thoracic aortic surgery program" (TASP) in 2005 that built up a large clinical volume of thoracic aortic cases and developed a standardized protocol for treatment of patients with acute type A dissection. One key element of this multidisciplinary team was to limit the number of physicians involved to a small number of dedicated cardiovascular surgeons, cardiac anesthesiologists, cardiovascular intensivists, cardiologists, cardiovascular radiologists, and perfusionists. These investigators retrospectively compared their outcomes in patients with acute type A aortic dissection before (1999 to 2005) and after (2005 to 2011) introduction of TASP. During the pre-TASP era, an average of 9 operations were performed annually by 11 different surgeons; after TASP, this case load increased slightly to 12 procedures annually, but 97% were performed by 1 of the 2 dedicated TASP surgeons. This analysis convincingly demonstrates markedly superior early results, including an 8-fold reduction in the observed-to-expected (O/E) 30-day/in-hospital mortality ratio (1.26 to 0.15). This improvement in survival persisted out to 4 to 5 years.

Reading this report from Duke, however, vividly reminded me of a mistake my colleagues and I made many decades ago. In 1978, several young aggressive attendings joined the Stanford cardiovascular surgical staff, including myself, Bruce Reitz, and then Scott Mitchell. The annual volume of emergency operations for acute type A aortic dissection was high, and we set out to prove to Doctors Shumway, Stinson, and Griepp that they had trained us well. We were initially immensely proud of ourselves to report that the operative mortality rate for patients with acute type A aortic dissection at Stanford had fallen from 38% (1963 to 1976) to 7% (1977 to 1982) (6), only to admit sheepishly 11 years later that this "honeymoon period" had probably been due to chance! After 1982, the mortality rate rose again (7). We could not detect a change over time in patient substrate or dissection-related complications to explain this finding, but we postulated that the introduction of LifeFlight helicopter acute care patient transport systems may have resulted in larger numbers of more gravely ill patients surviving long enough to get to Stanford (7). As Dr. Shumway used to say: "It's always better to be lucky than smart." This brings up the question of patient selection, referral bias, and selection bias possibly accounting for the improved results at Duke in the TASP era (1). The authors used historical controls as their reference clinical

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performance standard, and the 2 cohorts were dissimilar. The more recent TASP patients were younger, and fewer had hypotension, shock, tamponade, and myocardial infarction; therefore, the predicted International Registry of Acute Aortic Dissection (IRAD) mortality score was 18.2% versus 26% for the pre-TASP patients. Using O/E mortality ratios adjusted for some of this more favorable results in the TASP era, but unknown and imponderable patient selection and patient referral bias may have existed. Experience, practice, and seasoned surgical judgment are all essential elements. Because of the limited number of patients, a formal propensity score analysis could not be supported. The authors admitted that the study was small and inadequately powered to detect small differences in outcomes and could be subject to type II errors.

What about the IRAD mortality risk algorithm for patients with acute type A aortic dissection used in this analysis? The pre-operative IRAD risk prediction model reported by Rampoldi et al. (2) was derived retrospectively from 682 patients with acute type A aortic dissection seen between 1996 and 2003, and used simple demographics, history, symptoms, signs, and diagnostic methods. To the best of my knowledge, it has never been validated prospectively in other patients. Without validation, using just the same patients it was derived from amounts to a self-fulfilling prophecy. This analysis from Duke may be the first external calibration of the IRAD algorithm. Between 1999 and 2005 (pre-TASP), the early mortality O/E ratio at Duke was 1.3 in an era that overlapped the IRAD experience, indicating that the IRAD death prediction algorithm functioned fairly well then. Since 2005, however, the O/E mortality ratio at Duke fell to 0.15, indicating either spectacularly excellent results or, alternatively, that the IRAD formula calibration no longer is valid and overestimates operative risk in the contemporary era. Additional IRAD algorithm validation studies in other, larger acute type A dissection cohorts is necessary to determine whether it is still valid or needs to be recalibrated. Unfortunately, the national STS Adult Cardiac Surgery Database does not track acute dissection cases; hopefully, it will do so in the future, which will enable new risk algorithms to be developed in the United States and then validated in independent large samples.

The fact that a seemingly high proportion of patients (15%) did not receive any operation suggests stringent patient selection was carried out, which a cynic might say explains in part the better results after TASP was introduced. This probably is not the case because the authors undertook an exhaustive medical records search to uncover all patients with acute type A aortic dissection diagnosed at Duke during these 12 years. Many of these individuals were admitted to medical services where, because they had several life-threatening other diseases, were very elderly and debilitated, or refused consideration of operation, the cardiovascular surgery service was not even consulted. They point out that the fraction of patients not receiving operation in the IRAD studies was similar (in the 9.9% to 28% range [8,9]), but the IRAD sites were tertiary aortic centers, and the number of patients not transferred to them is unknown, which makes these fractions in IRAD underestimates. We will never know the number of patients in the Duke catchment basin who, for various reasons, were not considered for transfer; similarly, it is unknown how many did not survive transfer or the number of unstable patients clinically unsuitable for transfer who were operated upon in outlying hospitals. These denominators are elusive and probably will never be known with certainty short of conducting registry studies in large populations covered by single insurers.

Finally, an interesting observation in the Duke report was that fewer emergency procedures were started during "off hours": before TASP, 48% of operations commenced between 5 PM and 6 AM, but during the TASP era, this fell to 29%. The authors state that stable or unstable patients <48 h since the onset of symptoms are still taken directly to the operating room, but perhaps in the TASP era, they did not see as many patients who fell into this <48-h window. Those beyond 48 h from symptom onset who were stable were not rushed to the operating room at night. This parallels the recommendations recently promulgated by the European Association for Cardio-Thoracic Surgery reported by Bonser et al. (10), and makes good sense. Instead of the junior cardiovascular surgeon on-call rushing patients to the operating room in the middle of the night when the nursing, perfusion, and anesthesia teams may be fatigued and thinly staffed, waiting until more experienced surgeons with seasoned judgment have weighed in on the case and the operating room and anesthesia teams are fresh and at their best to proceed during daylight hours is prudent in most stable patients.

The bottom line message of this paper is that outcomes could be improved nationwide if the acute care and emergency surgical treatment of most patients with acute type A aortic dissection were regionalized and restricted to institutions with high-volume multidisciplinary thoracic aortic surgery programs. Will state or federal health-policy planning bodies, broad healthcare systems, health maintenance organizations, and other payers ever enforce such a dictum? It certainly will not occur soon in the United States, but its time has come, and implementation of such a concept should translate into higher quality, efficient care associated with more favorable cumulative long-term cost effectiveness. On the other hand, paralleling what has already transpired in the niche fields of heart transplantation, mechanical support for heart failure, and mitral valve surgery, the dawn of the superspecialized "thoracic aortic surgeon" with superspecialized expertise is upon us, thereby fragmenting the field of cardiovascular surgery even further. Hence, another meiosis has occurred in our field.

If such policy and payment regulation were to occur, the distribution and number of referent thoracic aortic surgical centers of special expertise is problematic. Would

the Canadian system of approximately 1 open heart surgery center per million inhabitants be optimal? Or would 1 per 5 million population be enough, meaning only 7 specialized centers for Canada? How about 1 per Canadian province, for a total of 10? In California, 1 center per million would mean about 38 centers, far fewer than the current number of hospitals doing open heart surgery (which probably exceeds 130); conversely, perhaps most patients in California with acute type A aortic dissection who can be stabilized are already flown to a few major institutions with active thoracic aortic surgery programs, but no state-wide data are available to answer this question. What would work adequately in the sparsely populated intermountain and other Western states? With rapid fixed-wing and helicopter Air-Evac transportation widely available across the United States, almost all patients should be able to reach a referent thoracic aortic center within 1 to 2 h. Recall that 71% and 76%, respectively, of the patients in this report before and after TASP were transferred to Duke from outlying hospitals, indicating that regionalization may already exist in North Carolina; it would be interesting to learn the distances these patients traveled to reach Durham. I conjecture that in the United States, 1 specialized thoracic aortic surgical program for every 5 to 10 million inhabitants would provide timely and efficient services, which should translate into better short-term and long-term outcomes.

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