

Outcomes of 3309 thoracoabdominal aortic aneurysm repairs

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ABSTRACT

Objective: Since the pioneering era of E. Stanley Crawford, our multimodal strategy for thoracoabdominal aortic aneurysm repair has evolved. We describe our approximately 3-decade single-practice experience regarding 3309 thoracoabdominal aortic aneurysm repairs and identify predictors of early death and other adverse postoperative outcomes.

Methods: We analyzed retrospective (1986-2006) and prospective data (2006-2014) obtained from patients (2043 male; median age, 67 [59-73] years) who underwent 914 Crawford extent I, 1066 extent II, 660 extent III, and 669 extent IV thoracoabdominal aortic aneurysm repairs, of which 723 (21.8%) were urgent or emergency. Repairs were performed to treat degenerative aneurysm (64.2%) or aortic dissection (35.8%). The outcomes examined included operative death (ie, 30-day or in-hospital death) and permanent stroke, paraplegia, paraparesis, and renal failure necessitating dialysis, as well as adverse event, a composite of these outcomes.

Results: There were 249 operative deaths (7.5%). Permanent paraplegia and paraparesis occurred after 97 (2.9%) and 81 (2.4%) repairs, respectively. Of 189 patients (5.7%) with permanent renal failure, 107 died in the hospital. Permanent stroke was relatively uncommon (n = 74; 2.2%). The rate of the composite adverse event (n = 478; 14.4%) was highest after extent II repair (n = 203; 19.0%) and lowest after extent IV repair (n = 67; 10.2%; $P < .0001$). Estimated postoperative survival was 83.5% ± 0.7% at 1 year, 63.6% ± 0.9% at 5 years, 36.8% ± 1.0% at 10 years, and 18.3% ± 0.9% at 15 years.

Conclusions: Repairing thoracoabdominal aortic aneurysms poses substantial risks, particularly when the entire thoracoabdominal aorta (extent II) is replaced. Nonetheless, our data suggest that thoracoabdominal aortic aneurysm repair, when performed at an experienced center, can produce respectable outcomes. (*J Thorac Cardiovasc Surg* 2016;151:1323-38)

Thoracoabdominal aortic aneurysm (TAAA) repair was first performed in the 1950s¹⁻³ and soon became a signature repair under Michael E. DeBakey's tutelage at Baylor

College of Medicine⁴—the premier aortic center of this pioneering era. Into the 1970s and beyond, E. Stanley Crawford refined TAAA repair by invoking many surgical concepts that remain in use today: endoaortic graft inclusion, expeditious repair, reattachment of intercostal and lumbar arteries, and patch reattachment of visceral vessels, to name a few.⁵ Through the efforts of Drs DeBakey, Denton A. Cooley, and Crawford and their

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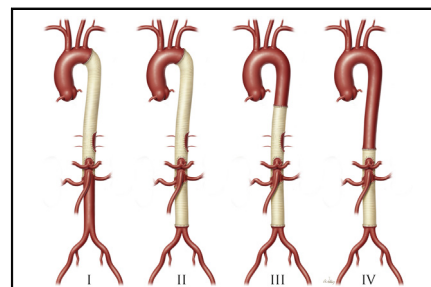
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Outcomes of TAAA repair differ by Crawford extent.

Central Message

Open TAAA repair produces respectable outcomes, but there is clearly room for improvement. Outcome differs by repair extent.

Perspective

We present the results of 3309 open TAAA repairs to elucidate operative risk. These repairs require interrupting blood flow to vital organs, which incurs the risk of postoperative paraplegia, renal failure, and other complications. Our data suggest that open TAAA repair performed at an experienced center can produce respectable outcomes, but further improvement is needed.

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Abbreviations and Acronyms

eTAAR	= endovascular thoracoabdominal aortic repair
HCA	= hypothermic circulatory arrest
MOF	= multisystem organ failure
RRR	= relative risk ratio
TAAA	= thoracoabdominal aortic aneurysm
TEVAR	= thoracic endovascular aortic repair

colleagues, Baylor College of Medicine developed into a global, tertiary-care aortic center that continues to treat many patients with highly complex TAAA pathology who are in acute need. Even after his untimely death, Crawford continued to guide TAAA repair through the many surgeons he had mentored, the widespread use of his namesake classification system (the Crawford extents of TAAA repair⁶) (Figure 1), and information gleaned from his published experience of 1509 TAAA repairs.⁷ As we assess postoperative outcomes during our approximately 3-decade single-practice experience regarding 3309 TAAA repairs, we honor the legendary men that laid the foundation of modern TAAA repair.

PATIENTS AND METHODS**Study Enrollment and Patient Characteristics**

Baylor College of Medicine's institutional review board approved our clinical research protocol in 2006. For patients who underwent surgery after protocol approval, data were collected prospectively by dedicated staff, and informed consent was obtained whenever possible; waiver of consent was approved for patients who could not provide consent because of illness and whose family members were not available. For patients who underwent surgery before protocol approval, data were collected retrospectively from medical records, and consent was waived.

From October 1986 to December 2014, 3320 consecutive open TAAA repairs were performed on our service. We were unable to obtain consent from 11 patients with repairs performed after our protocol was approved; these patients were excluded from our analyses, and the remaining 3309 repairs form the basis of this report (Figure 2). Repairs included 914 Crawford extent I TAAA repairs, 1066 extent II repairs, 660 extent III repairs, and 669 extent IV repairs (Table 1). Of these, 142 repairs (4.3%) involved patients living outside the United States, in 28 different countries. Patients were characterized as symptomatic ($n = 2117$; 64.0%) if they had any symptom related to their aortic disease (eg, pain, hoarseness, dysphagia); in 729 (21.8%), repair was nonelective, with patients presenting in acute distress or being transferred to us for urgent or emergency care. Approximately two thirds of repairs were performed to treat degenerative aneurysms without dissection (64.2%); the other one third were performed to treat aortic dissection (35.8%), including the late aortic dilatation that is common in chronic dissection (30.8%). The distributions of several preoperative characteristics differed significantly by Crawford extent of repair (Table 1), including age, aortic dissection,

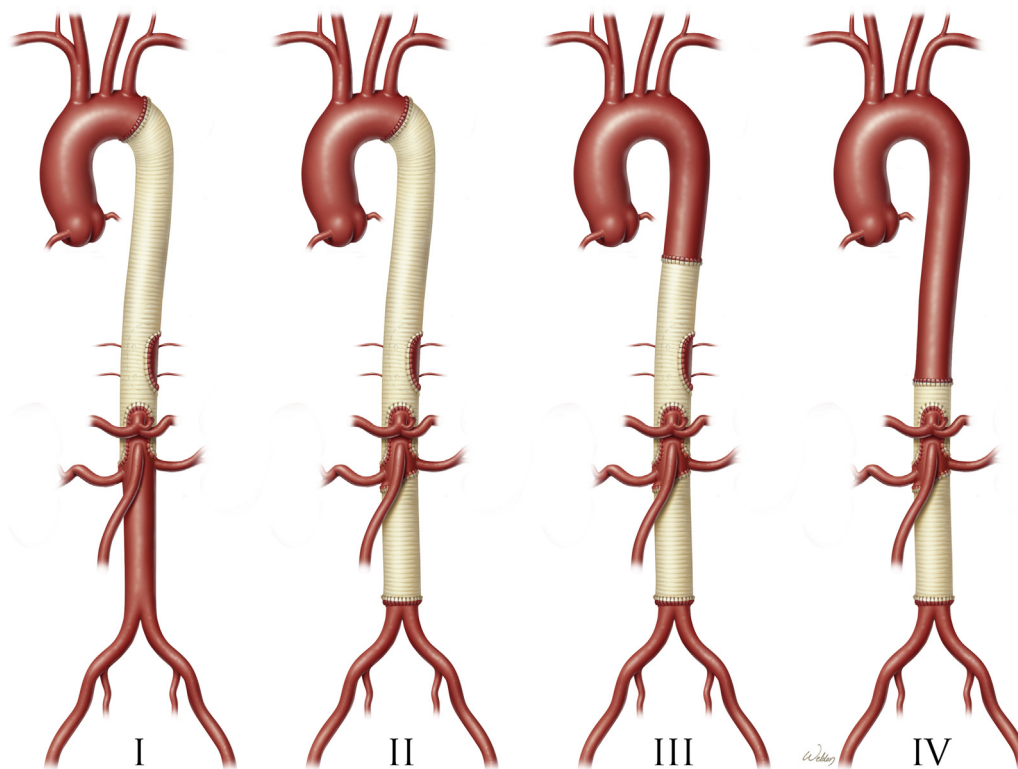


FIGURE 1. Drawing illustrating the Crawford extents of thoracoabdominal aortic aneurysm (TAAA) repair. Extent I repairs involve most or all of the descending thoracic aorta and the upper abdominal aorta. Extent II repairs involve the same segments as extent I repairs but also extend into the infrarenal abdominal aorta. Extent III repairs involve a combination of the distal half, or less, of the descending thoracic aorta (beginning below the sixth rib) and varying portions of the abdominal aorta. Extent IV repairs involve the abdominal aorta below the diaphragm. Used with permission of Baylor College of Medicine.

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