

Open repair of thoracoabdominal aortic aneurysms in experienced centers



Konstantinos G. Moulakakis, MD,^a Georgios Karaolanis, MD,^b Constantine N. Antonopoulos, MD,^a John Kakisis, MD,^a Christos Klonaris, MD,^b Ourania Preventza, MD, FACS,^{c,d,e} Joseph S. Coselli, MD,^{c,d,e} and George Geroulakos, MD,^a Athens, Greece; and Houston, Tex

ABSTRACT

Objective: We performed a systematic review and meta-analysis aiming to assess the mortality and morbidity of all published case series on thoracoabdominal aortic aneurysms (TAAAs) in experienced centers treated with open repair.

Methods: A systematic search of the literature published until April 2017 was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. Separate meta-analyses were conducted for overall in-hospital mortality for TAAA, mortality according to the type of TAAA, spinal cord ischemia, paraplegia and paraparesis, cardiac events, stroke, acute kidney failure, and bowel ischemia. A metaregression analysis was performed with volume of the center, percentage of ruptured cases among the series, length of in-hospital stay, and publication year as covariates.

Results: A total of 30 articles were included in the meta-analysis, corresponding to a total of 9963 patients who underwent open repair for TAAAs (543 ruptured). The pooled mortality rate among all studies was 11.26% (95% confidence interval [CI], 9.56-13.09). Mortality was 6.97% (95% CI, 3.75-10.90), 10.32% (95% CI, 7.39-13.63), 8.02% (95% CI, 6.37-9.81), and 7.20% (95% CI, 4.19-10.84) for Crawford types I, II, III, and IV, respectively. Pooled spinal cord ischemia rate was estimated at 8.26% (95% CI, 6.95-9.67), whereas paraparesis and paraplegia rates were 3.61% (95% CI, 2.25-5.25) and 5% (95% CI, 4.36-5.68), respectively. We estimated a pooled cardiac event rate of 4.41% (95% CI, 1.84-7.95) and a stroke rate of 3.11% (95% CI, 2.36-3.94), whereas the need for permanent dialysis rate was 7.92% (95% CI, 5.34-10.92). Respiratory complications after surgery were as high as 23.01% (95% CI, 14.73-32.49). Metaregression analysis evidenced a statistically significant inverse association between mortality and the volume of cases performed in the vascular center ($t = -2.00$; $P = .005$). Interestingly, a more recent year of study publication tended to be associated with decreased in-hospital mortality ($t = -1.35$; $P = .19$).

Conclusions: Our study showed that despite the advances in open surgical techniques, the morbidity and mortality of the technique continue to remain considerable. Despite the focus on mortality and spinal cord ischemia, respiratory complications, permanent postoperative renal dialysis, stroke rate, and cardiac events also affect the outcome. The estimated trend of lower mortality in high-volume centers suggests that perhaps this type of service should be provided in a few reference centers that have an established record and experience in the management of these patients. (J Vasc Surg 2018;68:634-45.)

Keywords: Open repair; Surgery; Thoracoabdominal

Open repair of a thoracoabdominal aortic aneurysm (TAAA) represents a complex task and possibly the most challenging operative technique for cardiac and vascular surgeons. In 1955, Etheredge et al¹ reported a successful repair of a TAAA in the United States, and in

the same year, Charles Rob,² an English surgeon, described his experience of the repair of six abdominal aortic aneurysms requiring thoracic aortic clamping that were treated through a thoracoabdominal incision. Two years earlier, Michael De Bakey and Denton Cooley³ successfully repaired an aneurysm located in the terminal descending thoracic and proximal abdominal aorta with a homograft using the clamp and sew technique. The homograft was harvested by them 6 days previously from a young man who died of acute injuries. Since 1955, despite the advances in open surgical techniques, the morbidity and mortality of the technique continue to remain considerably high.⁴

Mortality ranges between 2.3%⁵ and 32.7%,⁶ with high-volume centers reporting lower mortality.^{4,7-10} One of the largest current series with 3309 patients published by Coselli et al⁴ reported a 7.5% mortality rate. It has been proposed that this variability in outcomes is due to the surgeon's team and its familiarity with the procedure but also to the institution's experience in managing the perioperative care of these challenging cases.¹¹ However, in reviewing the current outcomes of open

From the Department of Vascular Surgery, "Attikon" University Hospital,^a and Vascular Unit, First Department of Surgery, "Laiko" General Hospital,^b Medical School, National and Kapodistrian University of Athens, Athens; the Division of Cardiothoracic Surgery, Michael E. DeBakey Department of Surgery, Baylor College of Medicine, Houston^c; the Department of Cardiovascular Surgery, Texas Heart Institute, Houston^d; the CHI St. Luke's Health-Baylor St. Luke's Medical Center, Houston.^e

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Correspondence: Konstantinos G. Moulakakis, MD, PhD, MSc, FEBVS, Consultant Vascular Surgeon, Department of Vascular Surgery, National and Kapodistrian University of Athens, Attikon Hospital, Greece Rimini 1 Str, Haidari, Athens, 12462 Greece (e-mail: konmoulakakis@yahoo.gr).

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TAAA repair between different studies in the literature, it is obvious that there is considerable variability between high-volume centers; in addition, good results have been reported from medium- and low-volume centers, reflecting the fact that the volume-outcome relationship is complex and multifactorial.^{5,12}

Because endovascular techniques have emerged as a demanding alternative for the treatment of TAAAs with some encouraging results, it is good timing to re-evaluate the safety of the open repair technique. We undertook a systematic review and meta-analysis with the aim of identifying all published reports on TAAA treated with open repair to assess the mortality and morbidity of this type of reconstruction.

METHODS

Data collection

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines were used for this meta-analysis. MEDLINE, Scopus, Embase, Google Scholar, Ovid, and the Cochrane Library were systematically searched, and thereafter we also performed an additional search in the reference lists of the eligible articles for additional titles.

Search methodology

A thorough search of the English-language literature published until April 2017 was performed to identify studies relative to TAAAs. The search strategy explored medical subject heading terms in all possible combinations: "thoracoabdominal" AND "thoraco-abdominal" OR "aortic aneurysms" OR "open repair" OR "ruptured." We investigated studies focusing on patients undergoing open surgery for TAAAs. The electronic search was supplemented and expanded using the "related articles" function of the search engine and a manual search of the relevant articles. Study selection and data extraction were performed by two investigators (G.K., C.N.A.), and the full texts of the studies were retrieved. Discrepancies were rechecked, and consensus was achieved by discussion. After 1260 abstracts were located and read online, relevant articles were printed to permit thorough reading.

Inclusion and exclusion criteria and data extraction

Studies were included in the review if they:

- kern.5em* Provided data on open repair of TAAAs;
- kern.5em* Presented data of the in-hospital mortality or the mortality rate according to the type of TAAA;
- kern.5em* Provided data related to the surgical techniques and the mechanisms used for protection of spinal cord function and visceral organ perfusion;
- kern.5em* Described ≥ 50 patients (the cutoff point of 50 patients was chosen as the threshold criterion with the reflection that experience from a center

with >50 patients treated with this technique merits consideration); and

- kern.5em* Were published in the English language.

Articles were excluded if they:

- kern.5em* Reported only ruptured TAAAs;
- kern.5em* Reported data for hybrid or endovascular reconstructions;
- kern.5em* Referred to treatment of infected TAAAs;
- kern.5em* Included data of thoracic aortic aneurysms (alone or in combination with TAAAs);
- kern.5em* Reported data only for type IV TAAA; and
- kern.5em* Described nationwide data that were not included in the meta-analysis in an attempt to avoid overlapping.

We also excluded duplicate or metachronous republication from the same surgical groups; in these cases, only the latest article or the article with the largest number of patients was included.

Only the data referring to the open approach were extracted and analyzed in these studies. Studies using the old technique of aortic reconstruction (anastomosis end to side to the aorta above and below the aneurysm, followed by ligation of the aneurysm) were also excluded as this technique has largely been replaced by more direct reconstructions.

Basic data extracted from the studies fulfilling the inclusion criteria included the first author's name, study year, type of study, total number of patients undergoing open surgical repair, mean age, and number of patients with ruptured TAAA on admission. The mean follow-up period and overall survival at last follow-up were also included.

We extracted mortality rates according to the type of TAAA, overall in-hospital mortality for all TAAA, spinal cord ischemia rate, paraplegia and paraparesis rates, cardiac event rate, stroke rate, acute kidney failure rate and the percentage of patients who needed dialysis, bowel ischemia rate, and reintervention rate.

Study definition

Any neurologic deficit potentially related to the abrupt interruption of vessels supplying blood to the spinal cord was defined as spinal cord ischemia. Permanent spinal cord deficits were defined as those present at hospital discharge and further classified according to their severity, paraplegia (inability to move legs) vs paraparesis (leg weakness).

Statistical analyses

Data synthesis and treatment effects. The outcome rates in patients with open repair for TAAA were estimated for each study and reported as the proportion of patients with the corresponding outcome among all patients treated. Values of the concomitant outcomes were subsequently calculated and expressed as

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