Current results of open total arch replacement versus hybrid thoracic endovascular aortic repair for aortic arch aneurysm: A meta-analysis of comparative studies

Umberto Benedetto, MD, PhD,^a Giovanni Melina, MD, PhD,^a Emiliano Angeloni, MD,^a Massimiliano Codispoti, MD, FRCS,^b and Riccardo Sinatra, MD,^a Rome, Italy, and Cambridge, UK

For aortic arch aneurysm, conventional open total aortic arch replacement (OTAAR) has long been considered the standard therapy. Despite improvement of surgical technology and strategy, however, OTAAR remains a procedure associated with some morbidity and mortality, particularly among high-risk patients.¹

In an attempt to reduce the complications associated with OTAAR, hybrid thoracic endovascular aortic repair (HTEAR), with aortic arch debranching and endovascular graft placement, has emerged as an attractive option for high-risk patients.² Randomized controlled trial comparing the strategies are not available, however, and potential advantages of the hybrid strategy relative to the conventional procedure remain to be demonstrated. To gain insights into the role of the hybrid approach in the management of aortic arch aneurysm, we conducted a meta-analysis of available comparative studies.

MATERIALS AND METHODS

All studies comparing the results of hybrid (HTEAR) and open (OTAAR) approaches for the repair of aortic arch aneurysm were identified by means of a 2-level search strategy. First, a public-domain database (MEDLINE) was searched by using a Web-based search engine (PubMed, Embase, Cochrane Library). Second, relevant studies were identified through a manual search of secondary sources, including references of initially identified articles and a search of reviews and commentaries. The MEDLINE database was searched from January 1966 through June 2012. Medical subjects heading key words included “aortic arch aneurysm,” “total open aortic arch replacement/repair,” and “hybrid endovascular aortic arch repair.”

Studies considered for inclusion met the following criteria: results of OTAAR and HTEAR for aortic arch aneurysm were compared, and at least 1 of the outcomes of interest was reported. Outcomes investigated were operative mortality, permanent neurologic deficit, late mortality, and need for reintervention. For each study, data regarding outcomes of interest were used to generate an odds ratio (<1 favoring HTEAR; >1 favoring OTAAR) and a rate ratio (<1 favoring HTEAR; >1 favoring OTAAR). The 95% confidence intervals (CIs) were based on the asymptotic normality of the combined estimates. To account for undetectable heterogeneity related to the observational design of the studies included, pooled estimates were calculated by means of a random effect model. Between-study heterogeneity was analyzed by means of I^2 , and a value >50% was considered to be indicative of heterogeneity. Publication bias was evaluated by means of the Begg-Mazumdar rank correlation test.

RESULTS

Our research identified 4 comparative observational studies²⁻⁵ that included a total of 378 patients (OTAAR, n = 269; HTEAR, n = 109). All studies reported data on operative mortality and permanent neurologic deficit, all but 1 study³ reported data on late mortality, and 2 studies^{3,4} reported on need for reintervention. Among studies

From the Department of Cardiac Surgery,^a Ospedale S. Andrea, La Sapienza, Università di Roma, Rome, Italy; and Department of Cardiac Surgery,^b Papworth Hospital NHS Foundation Trust, Cambridge, UK.

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Address for reprints: Umberto Benedetto, MD, PhD, Department of Cardiac Surgery, La Sapienza, Università di Roma, Ospedale Sant'Andrea, Via di Grottarossa 1035, 00189 Rome, Italy (E-mail: u2benedetto@libero.it).

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FIGURE 1. Meta-analysis for operative mortality of hybrid versus open approach. The odds ratios for death from each included study (squares) and from the pooled estimate (diamond) are plotted, each with 95% confidence interval (CI; line lengths and width of diamond). M-H, Mantel-Haenszel test.

FIGURE 2. Meta-analysis for permanent neurologic deficit associated with hybrid versus open approach. The odds ratios for neurologic deficit from each included study (*squares*) and from the pooled estimate (*diamond*) are plotted, each with 95% confidence interval (*CI*; line lengths and width of diamond). *M-H*, Mantel-Haenszel test.

reporting on late outcomes, follow-up ranged from 7 to 18.5 months.

Pooled analysis of operative outcomes showed that HTEAR did not significantly improve operative mortality (odds ratio, 0.67; 95% CI, 0.27-1.63; $P = .92$; Figure 1), whereas it was associated with a slight, nonsignificant increase in permanent neurologic deficits (odds ratio, 1.93; 95% CI, 0.86-4.37; $P = .1$; Figure 2). A nonsignificant trend toward increased late mortality was observed after HTEAR (rate ratio, 1.73; 95% CI, 0.9-3.3; $P = .10$), without any differences with regard to need for reintervention (rate ratio, 0.81; 95% CI, 0.32-2.07; $P = .66$). No heterogeneity was found among outcomes of interest ($I^2 = 0\%$ for all tests), and no publication bias was detected ($P = .69$).

DISCUSSION

Surgical complexity and frailty of patients make aortic arch aneurysms a challenging surgical indication.¹ Several studies have shown combined aortic debranching followed by endovascular repair to be an effective and feasible means of treating aortic arch aneurysms²⁻⁵; however, definitive conclusions regarding its superiority to the conventional open approach are still lacking.

This meta-analysis, which pooled data from available comparative reports on HTEAR versus OTAAR, showed no significant improvement with respect to operative and late mortality with HTEAR. Surprisingly, HTEAR was actually found to be associated with a slight increase in the incidence of permanent neurologic deficit, suggesting that the risk of embolism remains significant even with

HTEAR. As a consequence, careful manipulation and a short crossclamp time during debranching should be considered mandatory.

The main limitation of this meta-analysis was the observational design of the studies included, which makes the analysis prone to biases caused by, for example, selection of participants, different patient risk profiles, and unavailability for follow-up. When potential heterogeneity among studies was investigated, however, it was found to be nonsignificant for all outcomes of interest.

In conclusion, no definitive evidence supports the superiority of the HTEAR relative to OTAAR. Surgical strategy for aortic arch aneurysm should be chosen on the basis of the patient's characteristics, and OTAAR should be still considered the benchmark for alternative approach evaluation.

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