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REVIEW

Systematic Review and Meta-analysis of Factors Influencing Survival Following Abdominal Aortic Aneurysm Repair

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WHAT THIS PAPER ADDS?

Predicting late survival before elective abdominal aortic aneurysm (AAA) repair remains the Achilles heel of AAA management. Models predicting 30 day mortality are well established but determining late survival is not fully understood. This systematic review reports the determinants of late survival following open and endovascular AAA repair and suggests significant factors that influence late survival. The need for standardisation in current reporting of AAA survival data has been highlighted. Knowledge and quantification of such factors may assist in clinical decision making when assessment surrounding AAA management is made.

Background: Predicting long-term survival following repair is essential to clinical decision making when offering abdominal aortic aneurysm (AAA) treatment. A systematic review and a meta-analysis of pre-operative non-modifiable prognostic risk factors influencing patient survival following elective open AAA repair (OAR) and endovascular aneurysm repair (EVAR) was performed.

Methods: MEDLINE, Embase and Cochrane electronic databases were searched to identify all relevant articles reporting risk factors influencing long-term survival ($\geq$1 year) following OAR and EVAR, published up to April 2015. Studies with $<$100 patients and those involving primarily ruptured AAA, complex repairs (supra celiac/renal clamp), and high risk patients were excluded. Primary risk factors were increasing age, sex, American Society of Anaesthesiologist (ASA) score, and comorbidities such as ischaemic heart disease (IHD), cardiac failure, hypertension, chronic obstructive pulmonary disease (COPD), renal impairment, cerebrovascular disease, peripheral vascular disease (PVD), and diabetes. Estimated risks were expressed as hazard ratio (HR).

Results: A total of 5,749 study titles/abstracts were retrieved and 304 studies were thought to be relevant. The systematic review included 51 articles and the meta-analysis 45. End stage renal disease and COPD requiring supplementary oxygen had the worst long-term survival, HR 3.15 (95% CI 2.45–4.04) and HR 3.05 (95% CI 1.93–4.80) respectively. An increase in age was associated with HR of 1.05 (95% CI 1.04–1.06) for every one year increase and females had a worse survival than men HR 1.15 (95% CI 1.07–1.27). An increase in ASA score and the presence of IHD, cardiac failure, hypertension, COPD, renal impairment, cerebrovascular disease, PVD, and diabetes were also factors associated with poor long-term survival.

Conclusion: The result of this meta-analysis summarises and quantifies unmodifiable risk factors that influence late survival following AAA repair from the best available published evidence. The presence of these factors might assist in clinical decision making during discussion with patients regarding repair.

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INTRODUCTION

Determinants of a patient's late survival following AAA repair mostly depend on pre-existing co-morbidities rather than the AAA repair method chosen. The results of a meta-analysis that included four randomised controlled trials (RCT) comparing open AAA repair (OAR) with endovascular aneurysm repair (EVAR) showed that the modality chosen for AAA repair does not influence survival at 4 years (OR 0.92, 95% CI 0.75—1.12).[1] When the results from three propensity score matched studies were included in the meta-analysis, the main conclusion did not change (HR 0.97, 95% CI 0.9—1.04).[2]

Prognostic demographic and clinical variables associated with poor late survival following AAA repair have been well described but are often reported as single outcomes in multiple studies. The aim of this study was to perform a systematic review and meta-analysis of prognostic factors on individual outcomes against one another for their associated impact on late survival following AAA repair.

METHODS

This was a systematic review performed according to the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA)[3] and the meta-analysis and systematic reviews of observational studies in epidemiology (MOOSE),[4] guidelines as most of the anticipated studies included were of an observational design. Two researchers (M.K. and J.R.) independently conducted the study selection, data extraction, and assessment of methodological quality. This topic was defined in the PICOT[5,6] format as the Population is patients undergoing elective AAA repair (via either OAR or EVAR); Intervention and comparison: presence/absence or magnitude of non-modifiable clinical pre-operative risk factors, Outcome: all cause mortality and Time: greater than or equal to 1 year.

Search strategy

Medline, EMBASE, and the Cochrane Library Database were searched via the OVID SP database. With the assistance of a clinical librarian, "exploded" medical subject headings (MeSh) terms for MEDLINE and Cochrane, and EMTREE terms for EMBASE were used to broaden the key word search: "abdominal aortic aneurysm", "risk factors", "long term survival" and "survival rate" along with their synonyms. Two independent researchers conducted the search and when disagreement arose the reviewers met to resolve any issues.

There were no date restrictions and no limitations on publication language or study type applied to the search. The first search was conducted in May 2014 and updated in April 2015. A manual search of additional articles was conducted using references from relevant articles and review papers. The journals *Annals of Vascular Surgery*, *European Journal of Endovascular and Vascular Surgery*, *Journal of Endovascular Therapy*, *Journal of Vascular Surgery and Vascular* were searched for any relevant articles published "online first". Abstracts of conference proceedings were searched for full text publication. Eligible titles or abstracts where imported into Endnote X7 (Thomson Reuters) library and full text articles were obtained.

Inclusion and exclusion selection criteria

Two independent reviewers adhered to the following inclusion criteria: any studies reporting survival data and information about non-modifiable factors that may influence survival following elective AAA repair (OAR or EVAR), with at least 1 year follow up with the primary outcome endpoint being all cause mortality; studies with greater than a 100 patients; studies including symptomatic or rupture AAA in the analysis were included if the total number of symptomatic/rupture AAA was less than 20% of study participants. Studies containing up to a small proportion of patients (<40%) undergoing complex open (suprarenal clamping/visceral debranching) or fenestrated EVAR were included. Studies that included AAA repair and other vascular operations were included if the analysis was done separately for each type of surgery. However, the other vascular operations were not included. The exclusion criteria included studies that were limited to small AAA (<5 cm), high risk patients, octogenarians, and studies reporting intra- or post-operative factors rather than pre-operative factors, and non-patient related factors such as hospital/surgeon volume status.

Study selection

When studies from large registries or known databases were included, the most recent study or the paper that contained the largest number of patients and relevant data was used. Data from national databases were also checked to ensure data from individuals were not duplicated in other published series. If two articles presented data from the same database, but different variables were reported, then both studies were included for the two variables. Study authors were contacted when clarification was required.

Data extraction and quality assessment

Data extraction from studies meeting the inclusion criteria were entered into a Microsoft Excel spreadsheet. This review presents the unmodifiable demographic factors and clinical determinants that may influence long-term survival: age, sex, and clinical assessment information represented by the American Society of Anaesthesiologist (ASA) score, and information about the presence of potentially important co-morbidities: ischaemic heart disease (IHD), cardiac failure, hypertension, chronic obstructive pulmonary disease (COPD), renal impairment, cerebrovascular disease, peripheral vascular disease (PVD), and diabetes.