Systematic review and meta-analysis of the risk of bowel ischemia after ruptured abdominal aortic aneurysm repair

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ABSTRACT

Objective: Outcomes after repair of ruptured abdominal aortic aneurysm (RAAA) have improved in the last decade. It is unknown whether this has resulted in a reduction of postoperative bowel ischemia (BI). The primary objective was to determine BI prevalence after RAAA repair. Secondary objectives were to determine its major sequelae and differences between open repair (OR) and endovascular aneurysm repair (EVAR).

Methods: This systematic review (PROSPERO CRD42017055920) followed Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and Meta-analysis Of Observational Studies in Epidemiology (MOOSE) guidelines. MEDLINE and Embase were searched for studies published from 2005 until 2018. The methodologic quality of observational studies was assessed with the Methodological Index for Non-Randomized Studies (MINORS) tool. The quality of the randomized controlled trials (RCTs) was assessed with the Cochrane Collaboration's tool for assessing risk of bias. BI prevalence and rates of BI as cause of death, reoperation, and bowel resection were estimated with meta-analyses with a random-effects model. Differences between OR and EVAR were estimated with pooled risk ratios with 95% confidence intervals (CIs). Changes over time were assessed with Spearman rank test (ρ). Publication bias was assessed with a funnel plot analysis.

Results: A total of 101 studies with 52,670 patients were included; 72 studies were retrospective cohort studies, 14 studies were prospective cohort studies, 12 studies were retrospective administrative database studies, and 3 studies were RCTs. The overall methodologic quality of the RCTs was high, but that of observational studies was low. The pooled prevalence of BI ranged from of 0.08 (95% CI, 0.07-0.09) in database studies to 0.10 (95% CI, 0.08-0.12) in cohort studies. The risk of BI was higher after OR than after EVAR (risk ratio, 1.79; 95% CI, 1.25-2.57). The pooled rate of BI as cause of death was 0.04 (95% CI, 0.03-0.05), and that of BI as cause of reoperation and bowel resection ranged between 0.05 and 0.07. BI prevalence did not change over time (ρ, −0.01; P = .93). The funnel plot analysis was highly suggestive of publication bias.

Conclusions: The prevalence of clinically relevant BI after RAAA repair is approximately 10%. Approximately 5% of patients undergoing RAAA repair suffer from severe consequences of BI. BI is less prevalent after EVAR than after OR. (J Vasc Surg 2018;■:1-16.)

Keywords: Abdominal aortic aneurysm; Bowel ischemia; Endovascular aneurysm repair; Postoperative complication

Bowel ischemia (BI) is a major complication after repair of ruptured abdominal aortic aneurysm (RAAA).[1] BI can range from mild mucosal ischemia to severe transmural ischemia. BI can have a mild course that does not require treatment, whereas untreated transmural BI can lead to sepsis or bowel perforation with potentially life-threatening consequences. The only effective treatment of transmural ischemia is surgical resection of affected bowel segments. Surgery for BI generally consists of sigmoid resection or left hemicolectomy, depending on the extent of ischemia, and colostomy placement.

Care for patients with RAAA repair has improved in the last decade, with a significant decrease in postoperative mortality both after open repair (OR) and after endovascular aneurysm repair (EVAR).[1,2] It is unclear whether this improvement—and the introduction of EVAR—has also resulted in a reduction of BI. Some studies have indeed shown a reduction of BI after EVAR compared with OR, but it is unknown whether this has led to a general decrease of BI after RAAA repair.[3-5]

The primary objective of this systematic review was to determine the best available estimate of the prevalence of BI after RAAA repair. Secondary objectives were to determine rates of BI after OR and EVAR, as cause of death, reoperation, and bowel resection, and to assess possible changes in prevalence in the course of time.

METHODS

A systematic review was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement and Meta-analysis Of

Observational Studies in Epidemiology (MOOSE) guidelines.[6,7] A review protocol was written in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) statement and was prospectively registered in the PROSPERO database (registration No. CRD42017055920).[8]

Eligibility criteria. Original studies reporting on BI after RAAA repair were included in this review. Sensitive eligibility criteria were used for the title and abstract screening because RAAA studies often report BI as one of the secondary end points and fail to mention BI in the abstract. Therefore, all studies that reported postoperative outcomes (defined as mortality, morbidity, or any complication) after RAAA repair were selected for full-text screening and were included in this review when they specifically reported BI prevalence or its sequelae. Conference papers and unpublished studies were not considered for inclusion. Furthermore, studies were not included when they had fewer than 20 patients or when RAAAs were analyzed in a cohort that also included other pathologic processes, such as thoracic or asymptomatic abdominal aortic aneurysms.

Database search. The online databases of MEDLINE and PubMed Central (through PubMed) and Embase (through Ovid) were searched for eligible articles published after January 1, 2005. The search comprised free text words and MeSH terms to search PubMed and subject headings to search Embase. No language restrictions were applied. The last search was carried out on January 1, 2018. The World Health Organization International Clinical Trials Registry Platform was searched for ongoing studies.

The search was carried out with the assistance of a clinical librarian experienced in surgical studies. The search followed the patient-intervention-comparison-outcome framework and combined three sets of search terms: abdominal aortic aneurysm, aneurysm repair, and postoperative outcomes (mortality, morbidity, or complications including BI). The Appendix (online only) includes the full electronic search. The reference lists of studies primarily reporting about BI after RAAA repair were searched for other potentially relevant articles.

Study selection. Fig 1 shows the literature review flow chart. Two reviewers (H.J., C.F.L) independently assessed all titles and abstracts for relevance according to the sensitive eligibility criteria. This was performed in Covidence.[9] Full-text screening was performed by the same two reviewers (H.J., C.F.L.) in accordance with the stricter eligibility criteria. Disagreements were solved by consulting a third reviewer (M.J.W.K.). Corresponding authors were contacted when full-text articles were not available.

Data extraction. Two reviewers (H.J., C.F.L.) independently extracted the data into a standardized file in SPSS Statistics (version 23.0; IBM Corp, Armonk, NY). Afterward, the data were merged in consensus. Corresponding authors were contacted when data were unclear or incomplete or when overlap between cohorts was suspected. When authors did not respond, the largest of overlapping cohorts was included. Additional information was received from authors of a randomized controlled trial (RCT) to enable an *as treated* meta-analysis of RCTs. When studies were written in a language that the review authors were not proficient in, persons with proficiency in the relevant language were consulted.

Extracted data included study characteristics; number, sex, and age of patients; method of RAAA repair; and mortality. Items related to BI included BI prevalence and the rate of BI as cause of death, reoperation, or bowel resection. BI was defined as colonic ischemia and did not include ischemia of the small bowel secondary to superior mesenteric artery complications. Outcomes occurring after the initial hospital stay or after 30 postoperative days were not registered.

Methodologic quality assessment. The risk of bias in observational studies was assessed independently by two reviewers (H.J., C.F.L.) with the Methodological Index for Non-Randomized Studies (MINORS) tool.[10] MINORS contains eight quality items that are scored as 0 (not reported), 1 (reported but inadequate), or 2 (reported and adequate). The item regarding loss to follow-up was not included because of the large amount of retrospective studies that included only patients with outcome data and the early occurrence of BI after RAAA repair, and most studies reported in-hospital or 30-day outcomes. As a result, the highest possible score for each study was 14. The risk of bias in RCTs was assessed with the Cochrane Collaboration's tool for assessing risk of bias.[11] Seven quality items were scored as low, high, or unclear risk of bias. Disagreements were resolved by reviewing the studies in consensus.

Data synthesis. The outcomes assessed for meta-analysis were the prevalence of BI and the rate of BI as a cause of death, reoperation, and bowel resection. The meta-analyses were carried out separately for RCTs, cohort studies, and studies using administrative databases and were performed only when two or more studies reported an outcome of interest. Pooled rates with 95% confidence intervals (CIs) were estimated in a meta-analysis with a random-effects model with an inverse variance method, using package meta in R (R Foundation for Statistical Computing, Vienna, Austria).[12] In addition, a comparative meta-analysis was carried out to determine differences in outcomes after OR and EVAR. Pooled risk ratios (RRs) with 95% CI were