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Review Article

CARDIOVASCULAR

Cerebrospinal-fluid drain-related complications in patients undergoing open and endovascular repairs of thoracic and thoraco-abdominal aortic pathologies: a systematic review and meta-analysis

L. Q. Rong[1], M. K. Kamel[2], M. Rahouma[2], R. S. White[1], A. D. Lichtman[1], K. O. Pryor[1], L. N. Girardi[2] and M. Gaudino[2,*]

[1]Department of Anesthesiology and [2]Department of Cardiothoracic Surgery, Weill Cornell Medicine, New York, NY, USA

*Corresponding author. E-mail: mfg9004@med.cornell.edu

Abstract

Background: Cerebrospinal-fluid (CSF) drainage is recommended by current guidelines for spinal protection during open and endovascular repairs of thoracic and thoraco-abdominal aortic aneurysms. In the published literature, great variability exists in the rate of CSF-related complications and morbidity. Herein, we perform a systematic review and meta-analysis on the incidence of CSF drainage-related complications, and compare the complication rates between open and endovascular repairs.

Methods: The systematic review was conducted according to the Meta-Analysis of Observational Studies in Epidemiology guidelines. Thirty-four studies (4714 patients) were included in the quantitative analysis. The CSF drainage-related complications were categorised as mild, moderate, and severe. Pooled event rates for each complication category were estimated using a random-effect model. Random-effect uni- and multivariable meta-regression analyses were used to assess the effect of aortic-repair approach (open *vs* endovascular) and the CSF drainage criteria on CSF drainage-related complications.

Results: The pooled event rates were 6.5% [95% confidence interval (CI): 4.3–9.8%] for overall complications, 2% (95% CI: 1.1–3.4%) for minor complications, 3.7% (95% CI: 2.5–5.6%) for moderate complications, and 2.5% (95% CI: 1.6–3.8%) for severe complications. The drainage-related-mortality pooled event rate was 0.9% (95% CI: 0.6–1.4%). The uni- and multivariable meta-regression analyses showed no difference in complication rates between the open and endovascular approaches, or between the different CSF drainage protocols.

Conclusion: The complication rate for CSF drainage is not negligible. Our results help define a more accurate risk–benefit ratio for CSF drain placement at the time of repair of thoracic and thoraco-abdominal aneurysms.

Keywords: aortic aneurysm; complications; CSF drainage; thoracic; thoraco-abdominal

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Editor's key points

- Paraplegia remains one of the most devastating complications after open and endovascular repairs of descending thoracic or thoraco-abdominal aortic aneurysms.
- Although cerebrospinal-fluid (CSF) drainage has been shown to significantly decrease the incidence of spinal-cord ischaemia, the drain procedure itself is invasive and not without risks.
- This study estimates the pooled incidence of CSF drain-related complications. The pooled event rates of all complications were 6.5% with the rates of minor, moderate, and severe complications being 2%, 3.7%, and 2.5%, respectively.

Paraplegia remains one of the most feared complications after open and endovascular repairs of descending thoracic or thoraco-abdominal aortic aneurysms (DTA/TAAA).[1,2] Cerebrospinal-fluid (CSF) drainage is widely used in this setting for spinal-cord protection. Although CSF drainage has been shown to significantly decrease the incidence of spinal-cord ischaemia (SCI), the drain procedure itself is invasive and not without risks.[3–7]

To date, only isolated single-centre reports on CSF drainage have been published, and great variability exists in the reported incidence of CSF-related complications and morbidity. For this reason, a general and objective estimate of the risk associated with the procedure is difficult to ascertain.

In order to overcome this limitation, we performed a systematic review and meta-analysis on the incidence of CSF-related complications in thoracic and thoraco-abdominal aortic repairs. We used uniform definitions to classify the complications, and we compared complication rates for open and endovascular approaches.

Methods

This systematic review and meta-analysis was conducted in compliance with the Meta-Analysis of Observational Studies in Epidemiology (MOOSE) guidelines and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[8,9] Supplementary Table 1 illustrates the MOOSE guidelines checklist.

Study selection criteria

Randomised controlled trials (RCTs), prospective studies, and retrospective studies were included in this systemic review and meta-analysis (articles from 1990 to 2017). All articles reporting data on the intervention and outcomes of interest in human subjects were included. There were no date or language restrictions. Critical appraisal of eligible studies was assessed using the Newcastle–Ottawa Quality Assessment Scale for Cohort Studies (Supplementary Table 2). Studies with scores of 6 or more were included in our meta-analysis.

Participants, interventions, and outcomes

Patients undergoing DTA or TAAA repair who had perioperative CSF drainage were included.

Outcomes of interest included the development of CSF drainage-related postoperative morbidity and mortality, as reported in each article. The postoperative adverse events studied were categorised into severe complications [epidural haematoma, intracranial haemorrhage (ICH), subarachnoid haemorrhage, meningitis, and catheter/drainage-related neurological deficit], moderate complications [spinal headache, CSF leak requiring intervention (i.e. blood patch or suturing), and drain fracture requiring or not requiring surgical removal], and minor complications (puncture-site bleeding, bloody spinal fluid, CSF leak not requiring intervention, hypotension, drain fracture left in place, and occluded/dislodged catheters). If one patient had two or more complications of the same category, we counted them as one, and if the patient suffered from multiple complications of different categories, we counted the more severe one. The case fatality rate was defined as the proportion of CSF drainage-related deaths within patients undergoing CSF drainage for repair of thoracic or thoraco-abdominal aortic pathologies.

SCI was defined as any clinically evident neurological deficit.

Search strategy and data extraction

On March 21, 2017, two medically qualified reviewers conducted a systematic literature search that screened the titles and abstracts of studies identified by searching the electronic databases of PubMed and Scopus for articles published in all languages after 1990. Searches were performed using Medical Subject Headings (MeSH) used by the National Library of Medicine. The MeSH terms used to produce the search were {('aort*' [All Fields] AND spin* [All Fields]) AND 'drain*' [All Fields]}. A third independent reviewer (M.G.) confirmed adequate study selection based on the predefined inclusion and exclusion criteria. Moreover, references of selected articles, case reports, systematic reviews, and meta-analyses studying CSF drainage in patients undergoing aortic surgery were cross-checked and back referenced for additional relevant studies. Multiple publications studying the same patient population were identified, and studies with the most recent, complete data were included in the final analysis. Studies that did not report adequate information on a particular outcome were not included in that event analysis.

Strategy for data synthesis and statistical analysis

Risks of postoperative morbidity and mortality were pooled on a logarithmic scale using a random-effect model (inverse variance method).

The Cochran Q statistic and the I^2 test were used to assess the heterogeneity of the studies. If significant heterogeneity was detected (I^2>75%), a leave-one-out sensitivity analysis was performed to assess for a single-comparison-driven inference.

Univariable and multivariable meta-regression analyses (methods of moments) were performed to assess for potential causes of heterogeneity, and to assess for the effect of catheter size, targeted CSF pressure, rate of CSF drainage, drainage duration, amount of CSF drained, aneurysm type, and surgical approach on postoperative complications.

Funnel plots and the Egger regression test were used to assess for potential publication bias in the meta-analysis of overall complications. If publication bias is suspected, visual assessment of cumulative forest plot and classic and Orwin's fail-safe *N* tests were used for further assessment. If