JEVTM

Journal of ENDOVASCULAR RESUSCITATION and Trauma Management

Volume 8, Issue 2, Autumn 2024, ISSN: 2002-7567

Issue Highlights

Endovascular treatment of ruptured hepatocellular carcinoma

Thromboembolic complications after carotid artery stenting

Failing coils during embolization of intracranial aneurysms

Complications rate for partial REBOA

And more...

Official publication of the Society of Endovascular Resuscitation and Trauma Management

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Journal of Endovascular Resuscitation and Trauma Management

Volume 8
Issue 2
Autumn 2024

ISSN: 2002-7567
https://publicera.kb.se/jevtm

This is the *Journal of Endovascular Resuscitation and Trauma Management*. We want to provide a truly Open Access platform for the dissemination of knowledge and peer-reviewed research in the field of endovascular and hybrid hemorrhage control.

To achieve this, we do not wish to be bound by medical discipline, country, resource or even the conventional rules of medical publishing. To achieve this goal, we have assembled an Editorial Board of clinicians and scientists who are experts within the field. This project is generously supported by a grant from the Department of Cardiothoracic and Vascular Surgery, Örebro University Hospital, Sweden.

We are keen to receive manuscript submissions that present new original findings, review important topics or educate our readers on any aspect of hemorrhage control, where an endovascular technique has been employed. This can either be in isolation or in combination with open surgical techniques (hybrid surgery). For further information for authors, please see *https://publicera.kb.se/jevtm*.

As the subject of hemorrhage and resuscitation is a common problem across many medical disciplines, we encourage submissions from all specialties: vascular, trauma, acute care, obstetrics, emergency medicine, to mention a few.

The Journal will publish 3 times a year with additional special issues on specific topics, and will be truly Open Access. There will be no article processing charges or publishing fees. All articles will be published online and indexed using a digital object identifier. The Archives can be found on https://publicera.kb.se/jevtm under journals and are there with no time or access limitations.

The Journal is an EBSCO and CrossRef Member and indexed in SCOPUS, Web Of Science, Clarivate, Sherpa Romeo, Google Scholar, EMBASE, and other indexing services. We are registered with DOAJ (Directory of Open Access Journals) and use Turnitin services.

Official publication of the Society of Endovascular Resuscitation and Trauma Management (EVTM)
In cooperation with Örebro University Hospital and Örebro University, Sweden.

Region Örebro County
Örebro University Hospital

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EVTM Program
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National Library of Sweden

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Author Guidelines

GUIDELINES FOR SUBMISSION

A manuscript submitted to the Journal must constitute a unique piece of work that is not previously published or under consideration for publication, in part or whole, elsewhere.

Submissions should preferably be produced using Microsoft Word, although other formats will be considered. Submissions should be anonymized.

The submission process requires three discreet documents:

1. Cover Letter
2. Title Page
3. Manuscript (including Abstract, Tables and Figures)

Please ensure that the names and contact details of **all** authors are entered on the online submission system.

Cover Letter

This should be written by the corresponding author and must contain the following:

1. The type of manuscript submission (Original Article, Review Article, etc).
2. A sentence or two on the subject of the study.
3. Confirmation that the study is not under consideration for publication by another journal.
4. Confirmation that all of the authors have made a substantial contribution to the manuscript and that they have seen and approved the submission draft.
5. A conflict-of-interest statement regarding the authors. Where there is none, this should be clearly stated. More information about the Journal's publication ethics can be found on the journal webpage https://publicera.kb.se/jevtm/policies.
6. A clear statement that the authors follow the ethical guidelines as stated on the Journal webpage.

Title Page

This should consist of the following:

- Title: This should be concise and reflect the type and purpose of the study.
- Authors: These should be listed in order for publication, with first name, initials and surname.
- Affiliations: The institution(s) that the authors are affiliated with should be listed. Ensure that sufficient information is included to identify the authors (full addresses are not required).
- Corresponding Author: This individual should be clearly identified, along with one full institutional address and email address.
- Presentation: The meeting where any of the submitted data was presented should be listed.
- Disclosure: To disclose any official information.
- Acknowledgements (Optional): Any acknowledgements that you would like to include.
- Conflicts of Interest (Compulsory): A conflict-of-interest statement regarding the authors. Where there is none, this should be clearly stated.
- Funding Declaration (Compulsory): Any grant funding should be listed or it should be noted if no grant funds were used.
- Author Contributions (Optional): All authors are expected to have substantially contributed to the study and manuscript writing (see https://publicera.kb.se/jevtm/policies).

Main Body

This should consist of text in 12 pts, double spaced with a justified margin, written in US English. While each article type has specified headings, the use of sub-headings is encouraged to aid clarity. These should be formatted as follows:

Main Heading **BOLD, FULL CAPITALS**
Sub-Heading ***Bold and Italicized, Title Case***
Sub-sub-heading *Italicized, sentence case*

Abstract
The abstract should be a maximum of 250 words and consist of the following headings (but see specific manuscript types below for exceptions):

- Background
- Methods
- Results
- Conclusions

Keywords
Three to six appropriate keywords should be included.

References

References should follow the Vancouver Style and should be noted in the text numerically in sequence within the text, using square brackets, e.g.: [1] or [1,2] or [1–3].

Example references:

Stannard W, Rutman A, Wallis C, O'Callaghan C. Central microtubular agenesis causing primary ciliary dyskinesia. Am J Respir Crit Care Med. 2004;169:634–7.

Tang AL, Diven C, Zangbar B, et al. The elimination of anastomosis in open trauma vascular reconstruction. J Trauma Acute Care Surg. 2015; *In Press*. doi: XXXXXXXXXX.

Rasmussen TE, Tai NRM. Rich's Vascular Trauma. 3rd ed. Philidelphia: Elsevier; 2015.

Thamm DH. Miscellaneous tumors. In: Withrow S, Vail D, editors. Small Animal Clinical Oncology. 5th ed. St. Louis: Elsevier; 2013. pp. 679–88.

Where there are more than six authors, the first three should be included followed by et al.

Figures/Tables

All figures/tables must be cited within the text, presented as Figure 1, Figure 2*a*,*b*, Figures 1 and 2, and Table 1.

Figure captions should be styled as follows.

Figure 1 Title of figure.
Details of figure described below. (**a**) First sub item. (**b**) Second sub-item.

Table captions are styled similarly.

Supplementary Digital Content

Where manuscripts would benefit from additional content (datasets, images, video) that does not necessarily need to be included in the published article, supplementary digital content (SDC) can be hosted. This includes, but is not limited to, tables, figures, or video. Authors should include in their cover letter a description of this content and its purpose.

TYPES OF ARTICLES

All of the following article types are peer reviewed.

Original Articles

This is a report of a formal basic science or clinical research study. Manuscripts reporting unique scientific studies should be no longer than 5000 words. They should consist of the following sections:

- *Introduction*: This should concisely present the background to the problem that the study hopes to answer. A hypothesis should be clearly stated.
- *Methods*: This section should be suitably detailed to permit replication of the study. The regulatory permissions for the study should also be detailed, e.g. Institutional Review Board, ethical committee etc, including a protocol/registration number. Where animal research has been undertaken, the institutional animal care and use guidelines that have been followed should be clearly stated.
- *Results*: These should involve the reporting of the salient positive and negative findings of the study in clear language. The use of images, figures and tables are encouraged, of which the data should not be duplicated in the prose. There is no maximum number of figures or tables, but these should be appropriate to the study. Numerical results and *P* values should be reported to three decimal places.
- *Discussion*: This should place the reported study findings in the context of the literature. Limitations and future direction should also be discussed. Authors must be careful to ensure that conclusions are not overstated and are supported by data.

They should contain a structured abstract with a maximum of 250 words.

Editorials

Short, focused Editorials on an important aspect of endovascular hemorrhage control are welcomed. These should endeavor to bring attention to an important topic, or accompany an article published within the Journal. The latter will be invited by the Editor. Submitted manuscripts should be no longer than 1500 words. Abstracts are not included.

Narrative Reviews

This style of article can afford the author considerable latitude in examining a pertinent topic in endovascular hemorrhage control. The literature should be examined objectively and presented to the reader in the context of current understanding. The author should be able to synthesize a narrative, which leaves the reader with a good understanding of an emerging or controversial topic. The author is welcome (and encouraged) to express an opinion, but where this is the case, it should be clearly stated.

The submitted manuscript should be no longer than 5000 words. There is no formal structure; however, the use of logical headings/sub-headings is important to enable readers to follow the article easily. The abstract should also be unstructured and be a maximum of 150 words.

Systemic Reviews and Meta-Analyses

Where there is a topic within the subject area of endovascular hemorrhage control that has a substantial evidence base, a Systematic Review with/without a Meta-Analysis is considered more appropriate than a narrative review article. These articles should follow the methodology established by PRISMA. The overall aim is to provide a pooled analysis that enables firm conclusions to be drawn on a particular subject.

Submitted manuscripts should be no longer than 5000 words, and authors should include a PRISMA checklist in their submission. The abstract should be no longer than 250 words.

Tips and Techniques

In the evolving world of endovascular hemorrhage control, the advice and opinion of actively practicing clinicians is of great importance. Both solicited and unsolicited submissions are reviewed, both on major and minor components of endovascular techniques. This can be presented in the context of "evidence" or just as an opinion. The use of quality images and diagrams is encouraged. This type of article permits the author to write from experience, rather than from the published literature. Articles explaining how to approach certain problems or how to accomplish certain maneuvers are welcomed.

The submitted manuscript should be no longer than 1500 words. The abstract should be unstructured and be a maximum of 150 words.

Images of Interest

The Journal accepts images of interest accompanied by a short commentary. The aim of this section is to demonstrate and illustrate an educational message, rather than just to demonstrate dramatic pathology. Images can be submitted as a multi-panel with a series of scans/photographs in order to support the message presented in the narrative.

The submitted manuscript should be no longer than 250 words. Abstracts are not included.

Case Reports

These are short case reports including current literature reviews.

The submitted manuscript should be no longer than 1500 words. An abstract can be included (under 150 words) but is not compulsory.

Letters to the Editor

Letters to the Editor that comment on anything within the Journal can be submitted for publication. Abstracts are not included.

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EVTM-ST Section

The EVTM-ST Section will be a section of each JEVTM edition geared towards residents/fellows and education. The editors will invite one trainee to submit an interesting case report, and invite a reviewer to review and add a brief editorial. The editors should not be authors nor reviewers. The components of the section will include a standard case report presentation with figures of CT or angio or anything interesting and pertinent. The discussion should finish with a "what I learned" summary/bullet points for education purposes. The brief editorial by the reviewer is the final paragraph.

The submissions should be a maximum of 1500 words. An abstract can be included (under 150 words) but is not compulsory.

Conference Proceedings

Where a conference is affiliated to the Journal, the proceedings will be published as agreed by the Editorial Board.

SUPPORT FOR LANGUAGE AND ARTICLE CONTENT

The aim of the Journal, in addition to the dissemination of peer-reviewed evidence, is to support English-second-language authors and early career scientists. Provided that a submitted manuscript has good scientific merit, the Journal is able to provide a free language editing service. Furthermore, where article content would benefit from high-quality figures, artwork can be commissioned to support the publication.

AFTER ACCEPTANCE

Once your article has been accepted and undergone peer review, it will be processed and you will receive the proofs.

COPYRIGHT AND LICENSING

Authors contributing to the JEVTM agree to publish their articles under a Creative Commons CC BY 4.0 License, allowing third parties to read and download, and to copy and disseminate for non-commercial purposes. Articles will be published immediately after the final corrections of the master proof have been made. Authors retain copyright of their work and grant first publication rights to the JEVTM.

PROOFREADING

The purpose of the proof is to check for typesetting or conversion errors and the completeness and accuracy of the text, tables and figures. Substantial changes in content, e.g., new results, corrected values, title, and authorship, are not allowed without the approval of the Editor-in-chief.

After online publication, further changes can only be made in the form of an Erratum, which will be hyperlinked to the article.

ONLINE FIRST

The article will be published online after receipt of the corrected proofs. This is the official first publication citable with the DOI. After release of the printed version, the paper can also be cited by issue and page numbers.

ACCESS

All articles in the JEVTM are open access and upon acceptance are immediately and permanently free for everyone to read and download.

ETHICS AND POLICIES

The JEVTM follows guidelines and best practices published by professional organizations, including Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals by ICMJE, and Principles of Transparency and Best Practice in Scholarly Publishing (joint statement by COPE, DOAJ, WAME, and OASPA). The Journal also follows the guidelines for medical scientific publications (Vancouver, Uniform Requirements for Manuscripts Submitted to Biomedical Journals - URM - and The International Committee of Medical Journal Editors - ICMJE - regulations).

The Journal is committed to maintaining the highest level of integrity in the content published. The Journal has a conflict of interest policy in place and complies with international, national and/or institutional standards on research involving human and animal participants and informed consent. The Journal follows the Committee on Publication Ethics (COPE) regulations and subscribes to its principles on how to deal with acts of misconduct, thereby committing to investigate allegations of misconduct in order to ensure the integrity of research. The Journal is part of Similarity Check, a service that uses software tools to screen submitted manuscripts for text overlap. If plagiarism is identified, the COPE guidelines on plagiarism will be followed.

Content published in the Journal is peer reviewed (double blind review process). Detailed information follows in the text below.

Authorship Criteria

All the authors named as such in the manuscript must have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.

Each author, and any co-authors, must also meet the following criteria:

1. All must have made a significant contribution to the design of the study, the collection of data, or the analysis and interpretation of data and
2. All must, either by writing or by helping to edit the manuscript, have contributed to the design of its intellectual content to a significant degree.

Each author must also be able to take responsibility for part of the article's content and be able to identify which co-authors are responsible for the remaining parts.

The above text comes from the CODEX guidelines for research publications.

Peer Review Policy

- Authors of manuscripts and reviewers of the same manuscript must not be close colleagues, family members, work on the same research project, or otherwise have a close collaboration.
- Reviewers should only accept to assess manuscripts that fall within their own subject area.

- Reviewers should respond to invitations without delay and submit completed reviews within a reasonable time.
- Reviewers' comments must not be influenced by the author's nationality, religious or political beliefs, gender or commercial interests.
- Reviewers' comments must not contain hostile or provocative language and must not include personal attacks, slander or other derogatory comments.

Author Self-Archiving

Article authors have the right to self-archive the submitted ("preprint") version of the manuscript and the published version without any embargo period.

Submitted manuscripts and published versions of articles can, for example, be archived on:

- the author's personal website
- the author's employer's website and/or institutional repository or archive
- non-profit preprint servers or subject-based archives

Preprint Policy

The Journal's editors allow authors to upload earlier drafts of manuscripts/articles on the condition that authors agree to the following:

- Authors retain all rights to any previously published version and are permitted to submit their updated manuscript to the Journal.
- Authors accept that the Journal's editors cannot guarantee full anonymity in the review process, even if the author anonymizes the manuscript when earlier versions of the manuscript are made available.

If the manuscript is published in the Journal, the author is expected to cross-link, with DOI link, the different versions of the manuscript/article.

Orcid

The Journal's editors strongly recommend that authors submitting manuscripts register an "Open Researcher and Contributor Identifier" or ORCID.

This registration provides a unique and stable digital author identity that ensures that the article is attributed to the correct person and improves the searchability of all the author's publications. This helps to ensure that the author receives recognition for their work. As a person's ORCiD remains the same as long as the account exists, any name changes, change of employment, department affiliation or research field do not affect the searchability of previous publications. This facilitates correspondence between research colleagues.

The Journal's editors encourage all authors to include ORCiD along with other author information when the manuscript is registered in the system. If the article is accepted, this will be published with the article.

Open Data

As research funders' and universities' demands for open research data become increasingly common, some authors may be obliged to make their collected empirical material open and available to everyone.

In cases where this applies to the Journal's authors, the Journal's editors encourage that the material be made available according to the FAIR principles (Findable, Accessible, Interoperable, Reusable).

The material thus made available must be linked to within the submitted manuscript under a special heading. Research data should then be made public when the article is published. Empirical material obtained from other researchers must be referenced in the same way as other scientific sources. For further questions about guidelines for handling open data and guidelines about how data should be handled and published, please contact your university.

Archiving Policy

The Journal's current and future content, beginning when the Journal joins Publicera, is made available via Publicera and stored long-term on a secure and central server at the National Library of Sweden.

The Journal's owner and the National Library of Sweden aim for the journal's archive to be transferred and made available via Publicera, and thus the archive will also be stored long-term on a secure and central server at the National Library of Sweden.

In the event that the Journal ceases operations, the Journal's content on Publicera will remain archived at the National Library of Sweden.

Correction And Retraction Policies

The conditions of publication with persistent identifiers such as DOIs include that the object published is final and not changed without readers being clearly informed of such changes.

Articles published in the Journal cannot therefore be changed without a) an erratum or b) a change notice being published and linked to the original article.

If a factual error in an article is discovered, this should be reported to the Editor-in-chief, who decides on possible actions and possible corrections.

The Journal encourages post-publication discussion through Letters to the Editor or on an externally moderated website for review and post-publication discussion of research, such as PubPeer.

In order to maintain the highest scientific standards, the Journal follows strict quality standards:

Upon request, authors should be prepared to send relevant documentation or data in order to verify the validity of the results presented. This could be in the form of raw data, samples, records, etc. Sensitive information in the form of confidential or proprietary data is excluded.

If there is suspicion of misbehavior or alleged fraud, the Journal and/or Publisher will carry out an investigation following COPE guidelines. If, after investigation, there are valid concerns, the author(s) concerned will be contacted via their given email address and given an opportunity to address the issue. Depending on the situation, this may result in the Journal's and/or Publisher's implementation of the following measures, including, but not limited to:

- If the manuscript is still under consideration, it may be rejected and returned to the author.

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(*Continued*)

- If the article has already been published online, depending on the nature and severity of the infraction:
  an erratum/correction may be placed with the article
  an expression of concern may be placed with the article
  or in severe cases retraction of the article may occur.

The reason will be given in the published erratum/correction, expression of concern, or retraction note. Please note that retraction means that the article is maintained on the platform, watermarked "retracted", and the explanation for the retraction is provided in a note linked to the watermarked article.

Authors have an obligation to correct mistakes once they discover a significant error or inaccuracy in their published article. The author(s) is/are requested to contact the Journal and explain in what sense the error is impacting the article. A decision on how to correct the literature will depend on the nature of the error. This may be a correction or retraction. The retraction note should provide transparency as to which parts of the article are impacted by the error.

Complaints and Appeals Policy

In the case of formal complaints, disputes, or appeals, authors should contact the Editor-in-chief, who is responsible for ensuring that a fair, deliberative, and thorough investigation is conducted.

Policy For Ethical Oversight

The journal follows the ethical guidelines and best practices set forth by the Committee on Publication Ethics (COPE). All cases of ethical misconduct will be dealt with in accordance with COPE's recommendations and guidelines.

Authors' Responsibilities

A submitted manuscript cannot be under consideration for publication in other journals. All authors are obliged to provide retractions or corrections of mistakes after the review process. The final responsibility for the scientific accuracy and validity of published manuscripts rests with the authors, not with the Journal, its editors, or the publisher (Örebro University Hospital).

All published material will include the following Ethics Statement:

Ethics Statement

- All the authors named as such in the manuscript have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.
- The authors declare that they have read and abided by the JEVTM statement of ethical standards including rules of informed consent and ethical committee approval as stated in the article.

Detailed Ethical Guidelines
Maintaining the integrity of the research and its presentation is helped by following the rules of good scientific practice, which are outlined here:

- The manuscript should not be submitted to more than one journal for simultaneous consideration.
- The submitted work should be an original work. Please provide transparency on the re-use of material to avoid the concerns about text-recycling ("self-plagiarism").
- A single study should not be split up into several parts to increase the quantity of submissions and submitted to various journals or to one journal over time (i.e. "salami-slicing/publishing").
- Concurrent or secondary publication is sometimes justifiable, provided certain conditions are met. Examples include translations or a manuscript that is intended for a different group of readers.
- Results should be presented clearly, honestly, and without fabrication, falsification, or inappropriate data manipulation (including image based manipulation). Authors should adhere to discipline-specific rules for acquiring, selecting, and processing data.
- No data, text, or theories by others should be presented as if they were the author's own ("plagiarism"). Proper acknowledgements to other works must be given (this includes material that is closely copied (near verbatim), summarized and/or paraphrased), quotation marks (to indicate words taken from another source) must be used for verbatim copying of material, and permissions secured for material that is copyrighted.
- Authors should avoid untrue statements about an entity (which can be an individual person or a company) or descriptions of their behavior or actions that could potentially be seen as personal attacks or allegations about that person.
- Authors are strongly advised to ensure the author group, the Corresponding Author, and the order of authors are all correct at submission. Adding and/or deleting authors during the revision stages is generally not permitted, but in some cases may be warranted. Reasons for changes in authorship should be explained in detail. Please note that changes to authorship cannot be made after acceptance of a manuscript.

Financial conflicts of interest
Authors need to consistently disclose financial conflicts of interest.

Editors' Responsibilities

The Editors of the JEVTM have responsibilities toward the authors who provide the content of the Journal, the peer reviewers who comment on the suitability of manuscripts for publication, the Journal's readers and the scientific community, the owners/publishers of the Journal, and the public as a whole.

Reviewers' Responsibilities

Peer review assists editors in making editorial decisions and, through editorial communications with authors, may assist authors in improving their manuscripts. Peer review is an essential component of formal scholarly communication and lies at the heart of scientific endeavor.

Any invited referee who feels unqualified to review the research reported in a manuscript or knows that its prompt review will be impossible should immediately notify the editors and decline the invitation to review so that alternative reviewers can be contacted.

Any manuscripts received for review are confidential documents and must be treated as such; they must not be shown to or discussed with others except if authorized by the Editor-in-Chief (who would only do so under exceptional and specific circumstances). This applies also to invited reviewers who decline the review invitation.

Reviews should be conducted objectively and observations formulated clearly with supporting arguments so that authors can use them for improving the manuscript. Personal criticism of the authors is inappropriate. Reviewers should identify relevant published work that has not been cited by the authors. Any statement that is an observation, derivation or argument that has been reported in previous publications should be accompanied by the relevant citation. A reviewer should also notify the editors of any substantial similarity or overlap between the manuscript under consideration and any other manuscript (published or unpublished) of which they have personal knowledge.

Any invited referee who has conflicts of interest resulting from competitive, collaborative, or other relationships or connections with any of the authors, companies or institutions connected to the manuscript and the work described therein should immediately notify the editors to declare their conflicts of interest and decline the invitation to review so that alternative reviewers can be contacted.

Unpublished material disclosed in a submitted manuscript must not be used in a reviewer's own research without the express written consent of the authors. Privileged information or ideas obtained through peer review must be kept confidential and not used for the reviewer's personal advantage. This applies also to invited reviewers who decline the review invitation.

The scientific editorial technical team has been created in order to support the authors, the editors and the Editorial Board in quality control of all submissions. The team review all submissions and check for scientific problems, errors/bias and quality. Their work is also aimed at checking the ethical issues of all submissions to the JEVTM.

In an effort to standardize the review process for the Journal of Endovascular Resuscitation and Trauma Management, we ask all reviewers to use our checklist when reviewing a manuscript.

Patient Anonymity and Informed Consent Policy

It is the authors' responsibility to ensure that a patient's anonymity is protected, to verify that any experimental investigation with human subjects reported in the manuscript was performed with informed consent and follows all the guidelines for experimental investigation with human subjects required by the institution(s) with which all the authors are affiliated and/or ethical committee processing. Authors are asked to comply with the general guidelines for integrity protection, as listed by the health ministries in the EU, the EU commission, and US Department of Health (see, for example, https://www.hhs.gov/hipaa/for-professionals/special-topics/research/index.html). Authors should mask patient's eyes and as well as genital organs, as far as possible, and always remove patient names from figures.

Protection of Human Subjects and Animals in Research

For original articles in the Journal that report research involving animals, the corresponding author must confirm that all experiments were performed in accordance with relevant guidelines and regulations (i.e. IACUC guidelines and federal regulations, or EU guidelines for animal research). One recommended document for animal studies is the ARRIVE reporting guidelines (PLoS Bio. 2010; 8(6), https://doi.org/10.1371/journal.pbio.1000412). We encourage authors to follow the RRR principles of animal studies in medicine (https://www.feam.eu/wp-content/uploads/FEAM-Forum_Round-table-animals_Report_Final.pdf).

All studies of human subjects must contain a statement within the Methods section indicating approval of the study by an institutional review body (i.e. Institutional Review Board or ethical committee), and, if appropriate, a statement confirming that informed consent was obtained from all subjects if possible. If no legally informed consent can be obtained, such as in research carried out with human subjects receiving emergency treatment, authors should indicate when possible if a waiver of regulatory requirements for obtaining and documenting informed consent applies.

Ethical Approval and Informed Consent

Authors should include information about ethical approval and informed consent, such as "Ethical approval to report these cases was given by XXXXX. Written informed consent was obtained from xxxx."

Or, in cases where approval and consent were not provided, "Ethical approval was not required. Informed consent was not possible because XXXX and the information has been anonymized or informed consent was not required."

All submissions are screened for inappropriate image manipulation, plagiarism, duplicate publication, and other issues that violate research ethics. Depending on the outcome of these investigations, the Journal may decide to publish errata, or, in cases of serious scientific misconduct, ask authors to retract their paper or to impose retraction on them.

General Statement

Patients have a right to privacy that should not be infringed without informed consent. Identifying information, including patients' names, initials, or hospital numbers, should not be published in written descriptions, photographs, and pedigrees unless the information is essential for scientific purposes and the patient (or parent or guardian) gives written informed consent for publication. Informed consent for this purpose requires that a patient who is identifiable be shown the manuscript to be published.

Identifying details should be omitted if they are not essential. Complete anonymity is difficult to achieve, however, and informed consent should be obtained if there is any doubt. For example, masking the eye region in photographs of patients is inadequate protection of anonymity. If identifying characteristics are altered to protect anonymity, such as in genetic pedigrees, authors should provide assurance that alterations do not distort scientific meaning and editors should so note.

EVTM Society

Join the Endovascular Resuscitation Platform

The EVTM Society is a non profit organization that aims to share information on advanced methods for bleeding control and endovascular resuscitation, exchange of data, and cooperation and education. It is also designed to serve as a professional platform for the multidisciplinary approach.

By joining the EVTM Society you will be part of this global development.

To join, please visit jevtm.com/evtm-society.

The Membership fee is 50 USD biannually (25 USD per year).
Contact information for payment: lotta@mkon.se

Vision and Mission:
Our mission is to promote optimal treatment and new methods for bleeding control in trauma and non-trauma patients, and state-of-the-art endovascular resuscitation. This will be achieved by a joint international body that will support the following:

- A web-based free platform for EVTM issues (jevtm.com).
- JEVTM – the Journal of Endoascular Resuscitation and Trauma Management, an open access peer-reviewed journal.
- The EVTM round table symposium, a platform for continuous debate and data exchange.
- Educational opportunities in the form of manuals (Top Stent), courses, workshops, and web seminars.
- Promoting open dialogue and cooperation between societies, organizations and the industry.
- Promoting new guidelines and recommendations for EVTM-related issues and protocols.
- Promoting research in EVTM-related areas, both human and animal.
- Promoting PR for EVTM issues, grants, and collaboration with industry.
- Encouraging residents and young colleagues to carry out research on EVTM issues.
- Promoting cooperation and data exchange with other medical instances.

Structure:
The EVTM council, led by the society chair, will change membership periodically (i.e., after two years). The council aims to have one or two representatives from each participating country and discipline.

The EVTM Society is supported at this stage by Örebro University Hospital in all financial respects (as part of EVTM research group support). This support has been granted for the forthcoming five years.

The main task of the council is to pave the way for the EVTM venture, and promote the JEVTM/EVTM symposium, EVTM-related courses, cooperation, and free exchange of information.

Members will obtain free access to all JEVTM information and discussions as well as regular updates on EVTM-related activities, education, and developments. Members will also be offered a reduced fee for the EVTM round table symposium.

The EVTM Society is registered in Sweden, and is managed in collaboration with the EVTM program at Örebro University Hospital, the JEVTM journal and web platform, and other institutes.

Since the society is registered in Sweden, it will follow the rules and guidelines of the Swedish government and the EU. Expansion to other countries is welcome, but should follow our ethical guidelines and the EVTM Society should be named in all documents appropriately.

Call for collaboration: We call out to physicians with an interest in endovascular resuscitation, trauma and bleeding management. We need the contributions of the medical professionals who want to be a part of our venture.

Please consider joining by filling out the form at:
http://www.jevtm.com/evtm-society

9th EVTM Symposium

October 17th-19th 2024 in Örebro, Sweden

HOT TOPICS in EndoVascular resuscitation and Trauma Management

ENDOVASCULAR RESUSCITATION and TRAUMA MANAGEMENT

Contents

Editorial

Vol. 8, No. 2; 2024; pp 27–28
DOI: https://doi.org/10.26676/jevtm.26305

EndoVascular Resuscitation and Trauma Management (EVTM) – Where do we go?

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Endovascular solutions for both elective and acute vascular surgery continue to develop, with a significant shift in the volumes of endovascular versus open surgery as solutions for common vascular diseases (Swedvasc National Swedish Vascular Registry Data 2024, https://www.ucr.uu.se/swedvasc/om-swedvasc/om-swedvasc). One example of this trend is in the treatment of aortic aneurysm, where there has been a clear shift towards endovascular solutions with beneficial results and guideline recommendations both for acute and elective surgery [1]. Furthermore, there is evidence that an endovascular or minimally invasive approach for bleeding (and some vessel occlusions) might be a favorable first-hand solution for different situations [2,3,4]. The results are dramatic in the context of ruptured Abdominal Aortic Aneurysm (rAAA), descending aortic blunt trauma and dissections, as well as pelvic bleeding treatment. We can today treat all rAAA with endovascular and hybrid techniques with low exclusion rate as reported by our center in Sweden [5,6]. A multidisciplinary approach and collaboration are important factors in this work. The methods used for rAAA can be used in traumatic and non-traumatic bleeders, avoiding the need to open new cavities or to perform major surgery on fragile patients, and are an essential part of the EVTM concept [7]. The benefits become obvious when we look at embolization or endografts versus major surgery for gastrointestinal, pelvic, gynecological bleeders or iatrogenic vascular surgery [2]. This is also true for the treatment of iatrogenic vascular injuries. We have noticed that over the last 10 years we have rarely needed open surgery for injuries of the femoral or iliac artery, and we can solve most problems with a local anesthetic endovascular procedure or hybrid surgery. There were no femoral/iliac artery endograft occlusions in our center (data not yet published). This use of endovascular and hybrid methods might be a game changer for iatrogenic vascular injuries. It helps patients in need of fast, relatively simple methods, preventing morbidity and mortality, as well as decreasing patient suffering and costs, not to mention intensive care resources [8]. EVTM is not limited to trauma or bleeders but provides a platform for different endovascular and hybrid solutions for resuscitation [7].

There is much to do in the field of EVTM. Even if experience as mentioned on rAAA and thoracic blunt trauma or pelvic bleeders supports the use of endo methods, we need clear data on other traumatic and non-traumatic injuries, and further evidence of what are the best solutions for these patients. There is also much to learn and develop in endovascular methods for non-bleeding resuscitation. One example is the field of out-of-hospital cardiogenic circulatory collapse, where the survival rate is extremely low and the morbidity high. Endovascular methods have the potential to decrease mortality in these situations.

The JEVTM will continue working on the collection of evidence for the correct use of endovascular and hybrid methods for bleeding control and resuscitation. Clinicians and researchers in the field of trauma, surgery, anesthesia/intensivists, vascular surgery, interventional radiology, emergency medicine, orthopedics, and gynecology, as well as military personnel and pre-hospital medical teams, are encouraged to contribute their data to the development of EVTM.

Ethics Statement

(1) All the authors mentioned in the manuscript have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.
(2) The authors declare that they have read and abided by the JEVTM statement of ethical standards including rules of informed consent and ethical committee approval as stated in the article.

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Conflicts of Interest

The author declares that they have no conflicts of interest.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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Systematic Reviews and Meta-Analyses

Vol. 8, No. 2; 2024; pp 29–41
DOI: https://doi.org/10.26676/jevtm.25894

Comparison of Thromboembolic Complications After Carotid Artery Stenting with and without Using Protection Devices: A Systematic Review and Meta-Analysis Study

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Background: This study compared the rate of thromboembolic events during carotid angioplasty and stenting (CAS) with and without embolic protection devices (EPDs). We reviewed literature to find studies comparing embolic event rates during CAS with and without EPDs and conducted a meta-analysis to determine the safer approach.
Methods: The Embase, PubMed, and Web of Science databases were thoroughly searched following PRISMA guidelines. Each estimation was executed using random-effects models. The I^2 index was used to assess the heterogeneity among the studies. Egger and Begg's tests were applied to evaluate publication bias. Stata version 14.2 was used for statistical analysis.
Results: For 25% of patients, an EPD was used during CAS, and for 75% it was not. Of the patients undergoing CAS, the prevalences of hypertension, diabetes mellitus, coronary artery disease, and cigarette smoking were 81%, 37%, 39% and 43%, respectively. In total, of the patients included 52% were symptomatic and 48% were asymptomatic. The mortality rate reduced from 2% in the no-EPD subgroup to 1% in the EPD subgroup. The occurrence of all other complications was also reportedly higher in patients who did not receive an EPD, including major stroke and myocardial infarction, except for minor events, which were reported to be almost the same in both subgroups.
Conclusions: We found that the use of an EPD can help reduce the occurrence of thromboembolic complications of CAS, including myocardial infarction, major stroke, and death. Altogether, our results suggest that the benefits of using an EPD during CAS outweigh its risks.

Keywords: *Carotid Angioplasty; Carotid Artery Stenting; Protection Devices; Thromboembolic*

Received: 12 July 2024; Accepted: 31 August 2024

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INTRODUCTION

Stroke is a prominent cause of mortality and hospitalization in the United States [1]. Also, in developed countries, after cancer and cardiac-related fatalities, it is the third most significant cause of mortality [2]. Ischemic and hemorrhagic strokes are the most common types. According to population-based studies, internal carotid artery stenosis due to atherosclerosis is responsible for 15% to 20% of ischemic strokes [3,4]. In the United States, almost 500,000 new strokes occur each year; 20% to 30% of these occurrences are

caused by carotid artery disease [5]. The severity and symptomatic/asymptomatic nature of internal carotid artery atherosclerosis contribute to yearly stroke risk. Patients with asymptomatic stenosis (60–99%) had a 2–2.5% annual stroke risk, while symptomatic carotid stenosis (more than 70%) raises the chance of stroke by 10–15% per year [6–9].

Medical therapy is used to treat individuals with carotid artery disease to minimize emboli formation and regulate the progression of atherosclerosis. Revascularization should be considered in more severe cases [10,11]. In recent years, carotid artery angioplasty and carotid artery stenting have been developed as effective, minimally invasive methods for treating carotid stenosis. Carotid angioplasty and stenting (CAS) is a possible treatment in individuals with significant comorbidities for whom endarterectomy would be a high-risk procedure [5]. Regardless of advancements in stenting procedures and medical antiplatelet therapy, embolic neurologic events during CAS procedures are unavoidable [12,13]. The carotid artery's friable, ulcerated, and thrombotic material may embolize during the surgery [14–16].

Several protective methods are available to reduce the risk of thromboembolic complications [17]. Several cerebral protective devices have been manufactured to minimize the risk of pre-procedural problems [18]. Distal filters, proximal embolic protection devices (EPDs), particularly proximal balloon occlusion, and flow reversal devices are some of them [19–21]. The popularity of these gadgets has recently soared and they are now widely used in therapeutic settings [18]. Although cerebral protection devices minimize the risk of overt perioperative stroke during CAS, the chance of silent cerebral embolism is still considerable, and the risk varies depending on the type of protection utilized [22].

Much previous research has found no significant differences in embolic problems in CAS patients who received EPDs versus those who did not [23–25]. Some studies have shown that endovascular treatment of carotid artery stenosis without EPDs can yield acceptable outcomes in terms of safety and efficacy [5,18,26,27]. On the other hand, using EPDs during CAS has been shown in some studies to minimize embolic consequences [28,29]. Yusuf Inanc et al. reported that complication rates associated with embolization were as much as 5% lower when a protective device was used during stenting [30]. In the multicenter study by Scheinert et al. involving 120 patients, the combined 30-day endpoint of death and stroke was 2.5%, indicating that using an EPD during CAS may reduce the rate of embolic complications [31].

CAS has emerged as a highly effective treatment for carotid stenosis, but the risk of thromboembolic complications during this procedure remains a significant challenge. EPDs have been developed to address this issue, although the evidence supporting their efficacy has been inconsistent across studies. Given the critical need to minimize perioperative complications, our study takes a pivotal step in systematically reviewing the literature to evaluate the impact of EPDs on the rate of embolic events during CAS. Through a comprehensive meta-analysis, we aim to clarify whether the use of EPDs effectively reduces the incidence of serious complications such as myocardial infarction (MI), major stroke, and death. This analysis is crucial for guiding clinical decision-making and optimizing patient outcomes in carotid stenting procedures.

METHODS

Search Strategy

Systematic literature searches were thoroughly conducted in the PubMed, Scopus, Web of Science, Embase, and Google Scholar databases, following PRISMA guidelines. The keywords, keyword combinations, and mesh terms used in these databases were as follows: carotid artery stenting, CAS, carotid artery stenting with devices, embolic protection devices, embolic events, and stenting without protection. An independent investigator performed the search, and then, after removing duplicate articles, two other authors screened the articles based on title and abstract, and unrelated articles were excluded. Then they reviewed the remaining articles based on full text and included related articles in the study, and a third investigator resolved discrepancies. The literature lists of included studies were also manually reviewed to identify additional eligible articles.

Selection Criteria

This meta-analysis includes studies that met one or more of the following predefined criteria:

(1) randomized controlled trials (RCTs) or retrospective observational studies that compared embolic complications during carotid stenting with and without protective devices;
(2) studies published in English;
(3) studies that compare the EPD group with the control group;
(4) studies that evaluate embolic events during CAS.

Also, the exclusion criteria for our study are as follows:

(1) studies in which the data are not clearly and accurately presented and that have no control groups;
(2) studies where authors could not provide additional quantitative data;
(3) incomplete data or unclear distinction between unprotected and protected CAS;
(4) high-risk bias studies or studies that reported irrelevant results.

Data Extraction

Two independent reviewers extracted the relevant data from the eligible studies. All disagreements were discussed, and the final decision was made through consensus with the third party. Then data extraction was carried out for the predefined variables listed below:

(First author, year of publication, country, sample size, patient characteristics (age, gender, smoking history, coronary artery disease, diabetes, hypertension, stenting with and without embolic protection, percentage of symptomatic and asymptomatic patients, number of minor embolic events, number of strokes, number of deaths (total and stroke-related), number of MI and follow-up duration)).

The ethics code of this study is IR.SBMU.RETECH.REC.1403.225.

Quality Assessment

The Newcastle–Ottawa Scale (NOS) was used in the present study to assess the quality of all selected articles [32]. This scale comprises eight elements for evaluating the quality of studies, such as "comparability," "outcome," and "selection." In addition, the Ottawa checklist was employed for cross-sectional studies. According to the standard of scoring in the NOS, cross-sectional studies can be classified as follows: low risk of bias (7–10), intermediate risk of bias (5–6), and high risk of bias (1–4) (Table 1).

Statistical Analysis

Stata version 14.2 (Stata Corp, College Station, TX, USA) was used to perform a meta-analysis (with metaprop command) and assess the pooled prevalence, along with the associated 95% confidence interval (CI) for the main complications in patients experiencing CAS with or without EPD. The heterogeneity of the included articles in this meta-analysis was measured by the heterogeneity index (I^2). If the heterogeneity was statistically significant ($P < 0.05$ and $I^2 > 50\%$), the random effects model was utilized to perform a meta-analysis; otherwise, the fixed-effect model was used. Meta-regression analyses were performed to assess the impact of the potential variables on discovering the source of heterogeneity. Moreover, Egger's test and Begg's funnel plot were used to evaluate the publication bias. A significant publication bias is considered to occur when $P < 0.05$.

RESULTS

Study Selection

In our initial search in the mentioned databases, 1,377 studies were identified. After removing 459 duplicate studies, we excluded 791 for irrelevant titles and abstracts. By reviewing the full text of the remaining 127 articles, 111 articles were excluded due to a lack of relevant information. Finally, 16 studies published from March 2002 until December 2021 met the eligibility criteria for final analysis (Figure 1).

Table 1 Newcastle–Ottawa quality assessment results for included studies.

	Selection				*Comparability*	*Outcome*			
Author	*1*	*2*	*3*	*4*	*1*	*1*	*2*	*Total Score*	*Risk of Bias*
Yabalak et al. [23]	*			**		**	*	6	Intermediate risk of bias
Dayama et al. [24]	*	*		**		**	*	7	Low risk of bias
Deharo et al. [33]	*	*		**		**		6	Intermediate risk of bias
Inanc et al. [30]	*	*		**		**		6	Intermediate risk of bias
Nazari et al. [34]	*	*	*	**	**	**	*	10	Low risk of bias
Garriboli et al. [26]	*	*		**		**		6	Intermediate risk of bias
Cremonesi et al. [35]	*	*		**		**		6	Intermediate risk of bias
Gray et al. [36]	*	*		**		**	*	7	Low risk of bias
Al mobarak et al. [37]	*	*		**		**		6	Intermediate risk of bias
Bastug et al. [3]	*	*		**		**		6	Intermediate risk of bias
Scheinert et al. [31]	*	*		**	**	**	*	9	Low risk of bias
Ghafari et al. [27]	*			**		**	*	6	Intermediate risk of bias
Mansour et al. [28]	*	*		**		**	*	7	Low risk of bias
Pandey et al. [5]	*			**		**	*	6	Intermediate risk of bias
Reimers et al. [29]	*	*		**		**	*	7	Low risk of bias
El-Sudany et al. [18]	*			**		**		5	Intermediate risk of bias

The overall score for the quality assessments for each study is represented by stars, with each star indicating the quality rating for the corresponding parameter.

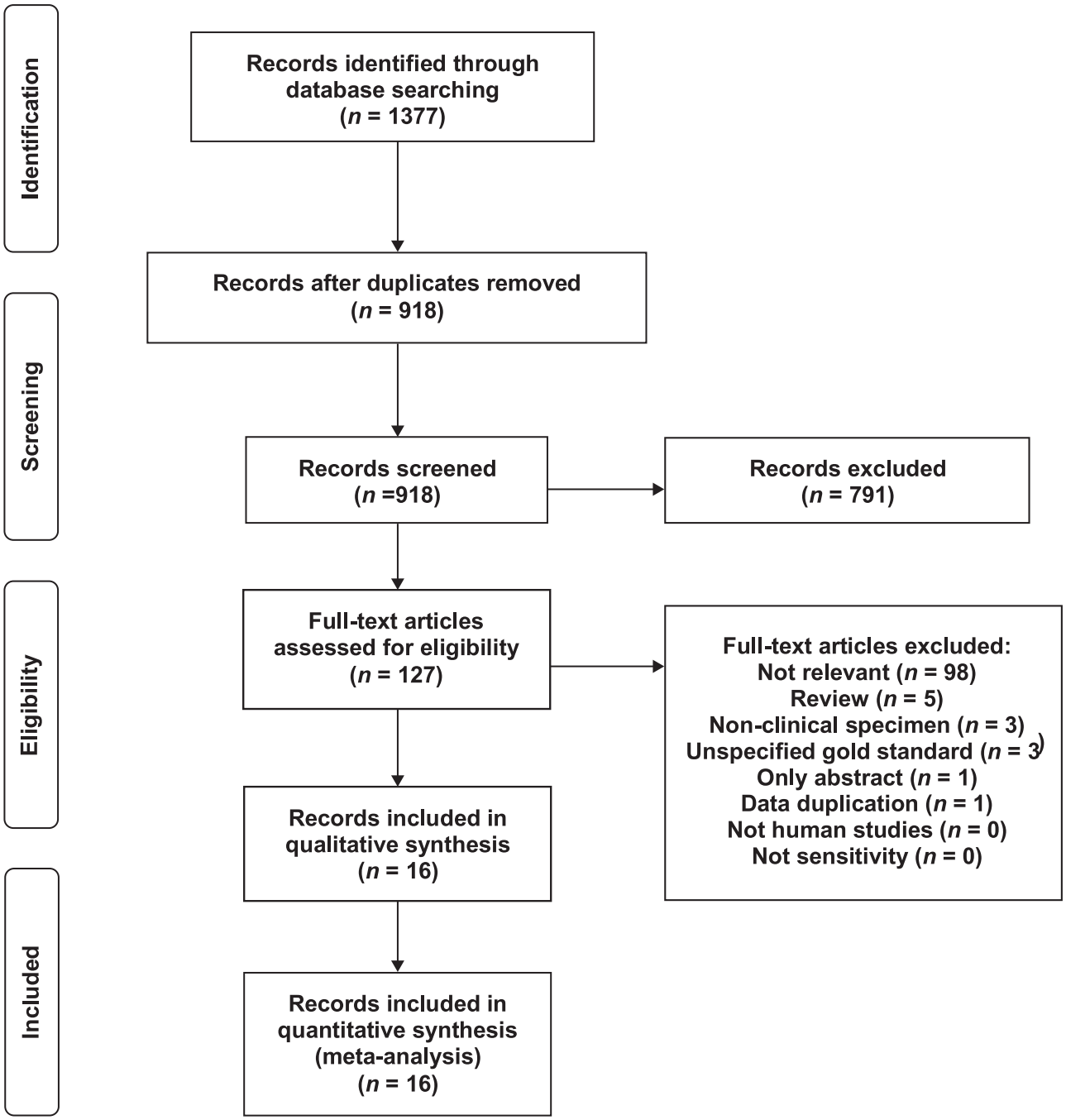

Figure 1 The process of study selection.

Demographic Characteristics of Included Studies

After merging all the extracted data, our study covered 3,875 patients, 1,171 (30%) female (95% CI: 26–34; I^2 = 85.0%) [3,5,18,23,24,26–31,33–37]. Of the participants, for 2,923 EPDs were used during CAS and for 952 they were not. Based on the average age reported in the articles, the mean age of patients was 70.05 (95% CI: 68.55–71.54; I^2 = 93.7%). Furthermore, the full-text reviewed studies were primarily conducted in Europe (*N* = 13) (Table 2).

Risk Factors, Complications, and Outcomes

Based on the primary analysis, the assessment of risk factors revealed hypertension, diabetes mellitus, coronary artery disease, and cigarette smoking with 81% (95% CI: 0.76–0.86; I^2 = 89.83%), 37% (95% CI: 0.31–0.43; I^2 = 89.90%), 39% (95% CI: 0.28–0.50; I^2 = 94.65%), and 43% (95% CI: 0.30–0.57; I^2 = 96.69%) prevalences, respectively (Figure 2). Among the patients who underwent CAS, the total death rate was measured to be 1% (95% CI: 0.01–0.01; I^2 = 0.00%) (Figure 3). After

Table 2 Baseline characteristics of the included studies. The articles have been examined and compared from the point of view of demographics, comorbidities, complications and outcomes.

					Demographics			*Comorbidities*				*Complications and Outcomes*			
Author	*Country*	*Year*	*Embolic Protection Devices*	*Sample Size (N)*	*Mean Age (SD)*	*Female (%)*	*Symptomatic (%)*	*Hypertension (%)*	*Coronary Artery Disease (%)*	*Diabetes mellitus (%)*	*Smoking (%)*	*Major Stroke (%)*	*Minor Events (%)*	*MI (%)*	*Total death (%)*
Al mobarak et al. [37]	Ireland	2002	EPD	162	68 (8)	13	48	80	54	31		0	1.2	0	1.2
Cremonesi et al. [35]	Italy	2003	EPD	442	73 (8)	21	57					0.2	0.9	0	0
Reimers et al. [29]	Italy	2004	EPD	753	70 (8)	36	28	77.2	62.9	20.8		0.8	2	0.4	0.5
Pandey et al. [5]	USA	2007	No-EPD	94	68 (10)	45	63	68.9	33	31	32.9	1.9		1.9	1.9
Mansour et al. [28]	Germany	2011	No-EPD	133	71 (10)	23	68	72.1	21.8	24.8		2.2	0.7	0	4.5
Dayama et al. [24]	Germany	2017	EPD	200	68 (11)	23	0					3.5		1.5	0.5
Dayama et al. [24]	Germany	2017	No-EPD	57	69 (9)	35	0					7		1.8	1.8
Scheinert et al. [31]	Germany	2017	EPD	120	75 (8)	28	12	88.3	43.3	34.2	47.5	2	0	0.8	0
Gray et al. [36]	USA	2017	EPD	250	75 (10)	30	15	94.4		34.8	72.4	0.4	2.4	0.4	0.8
Inanc et al. [30]	Turkey	2018	No-EPD	171	67 (14)	36		65.4	33.9	38.5	56	0	5.8	0	0
De Haro et al. [33]	Spain	2018	EPD	21	73 (7)	23	100	0.01	33.3	66.7	43	0	0	0	4.7
Garriboli et al. [26]	Italy	2018	No-EPD	77	77	22	0	61	20	22		1.3	0	0	0
Ghaffari et al. [27]	Iran	2020	No-EPD	36	65 (11)	44	75	61.1	11.1	13.9	8.3	5.6	0	0	2.8
El-Sudany et al. [18]	Egypt	2021	No-EPD	91	63 (10)	37	100	82.4	25.3	65.9	37.4	0	1	0	0
Yabalak et al. [23]	Turkey	2021	EPD	35	69 (9)	23	86	65.7	37.1	57.7		2.9	0	2.9	2.9
Yabalak et al. [23]	Turkey	2021	No-EPD	16	70 (9)	25	81	0.01	56.3	50		0	12	0	0
Nazari et al. [34]	USA	2021	No-EPD	277		31	51	80.5		33.9	28.5	6.5		2.5	2.2
Nazari et al. [34]	USA	2021	EPD	923		33	46	84.4		34.3	27.2	2.1		2.1	1.1
Bastug et al. [3]	Turkey	2021	EPD	17	76 (7)	24	100	0.01	88.2	82.3	88.2	5.8	0	0	0

Embolic protection device (EPD); myocardial infraction (MI).

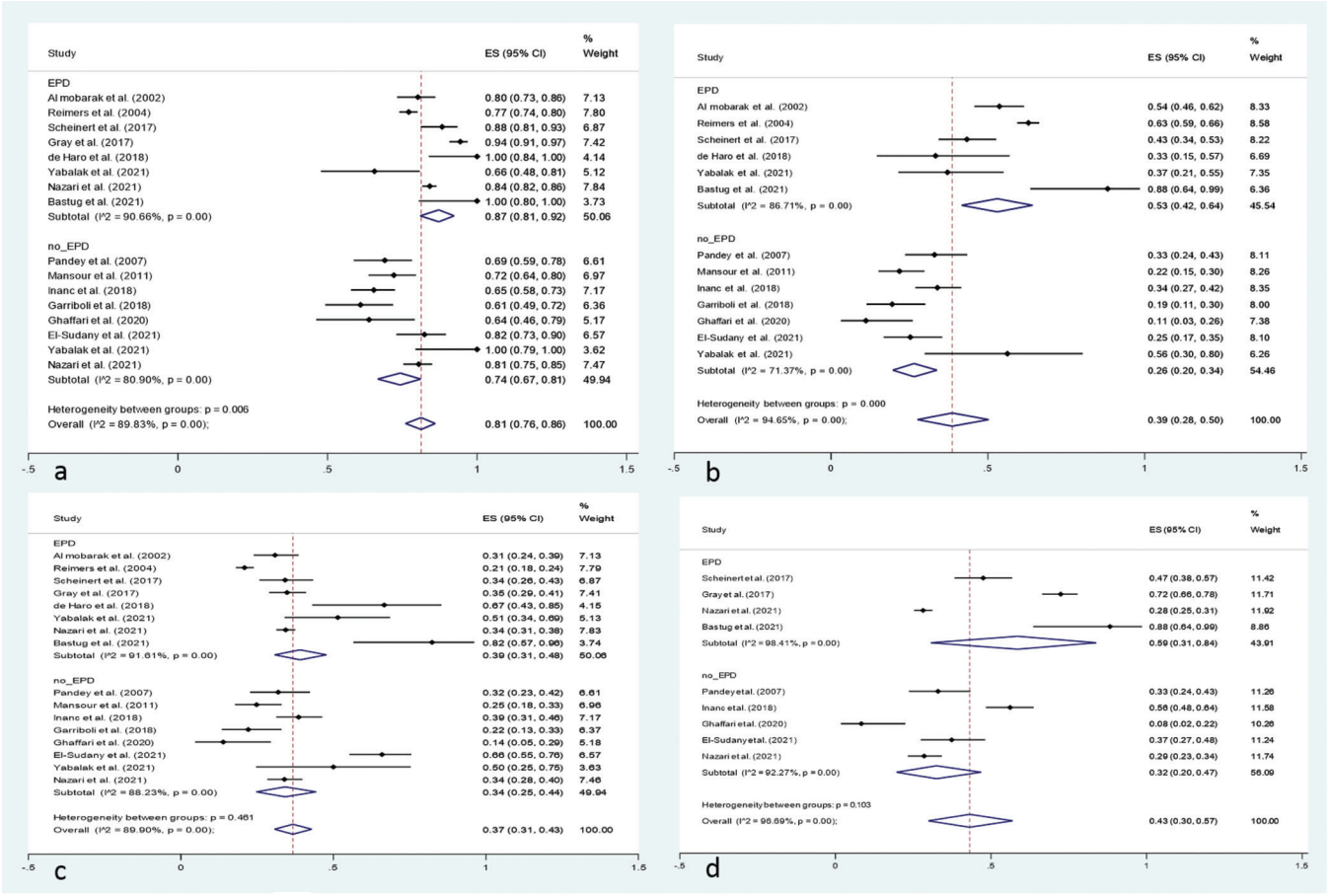

Figure 2 The prevalence of risk factors. Forest plot of the prevalence of hypertension (**a**), coronary artery disease (**b**), diabetes mellitus (**c**), and cigarette smoking (**d**) in patients who underwent carotid angioplasty and stenting (CAS). Each square shows the effect estimate of individual studies with their 95% CI. The size of the squares is proportional to the weight of each study in the meta-analysis. In this plot, studies are shown in the order of publication date and first author's names (based on a random-effects model). Effect size (ES).

eliminating three studies, 52% of included patients were symptomatic (95% CI: 0.41–0.64; I^2 = 98.0%), and by eliminating six studies, 48% of patients were asymptomatic (95% CI: 0.36–0.60; I^2 = 98%) (Figure 4). The prevalence of minor events in the study population of the articles included was about 2% (95% CI: 0.01–0.03; I^2 = 52.83%). Moreover, the prevalence of MI and major stroke was 1% (95% CI: 0.00–0.02; I^2 = 56.68%) and 2% (95% CI: 0.01–0.03; I^2 = 73.44%), respectively (Figure 5).

Meta-Regression

Since the heterogeneity in assessing the effects of using EPD in CAS was high, we used a meta-regression to determine the potential sources of heterogeneity. The results of the meta-regression analyses indicate that the association of death with either mean age or comorbidities, duration, smoking, being female, and symptoms of recently experienced cerebral vascular accidents was not statistically significant. Moreover, major adverse cardiovascular and cerebral events were not significantly related to the mentioned content in both groups. However, there was an exception, where we found that the prevalence of coronary artery disease as a risk factor was correlated with a higher mortality rate.

Subgroup Analysis

The results of subgroup analysis showed that the patients who received EPD during CAS were mostly asymptomatic [symptomatic: 41% (95% CI: 27–55; I^2 = 98.4%); asymptomatic: 59% (95% CI: 45–73; I^2 = 98.4%)], whereas in patients with no-EPD it was the opposite [symptomatic: 68% (95% CI: 56–80; I^2 = 86.1%); asymptomatic: 32% (95% CI: 21–44; I^2 = 85.0%)]. The mortality rate reduced from 2% (95% CI: 0.01–0.04; I^2 = 0.00%) in the no-EPD subgroup to 1% (95% CI: 0.00–0.01; I^2 = 0.00%) among the EPD subgroup. The occurrence of all other complications was also reportedly higher in patients who did not receive EPD, including major stroke [EPD subgroup: 1% (95% CI: 0.00–0.02; I^2 = 65.23%); no-EPD subgroup: 4% (95%CI:

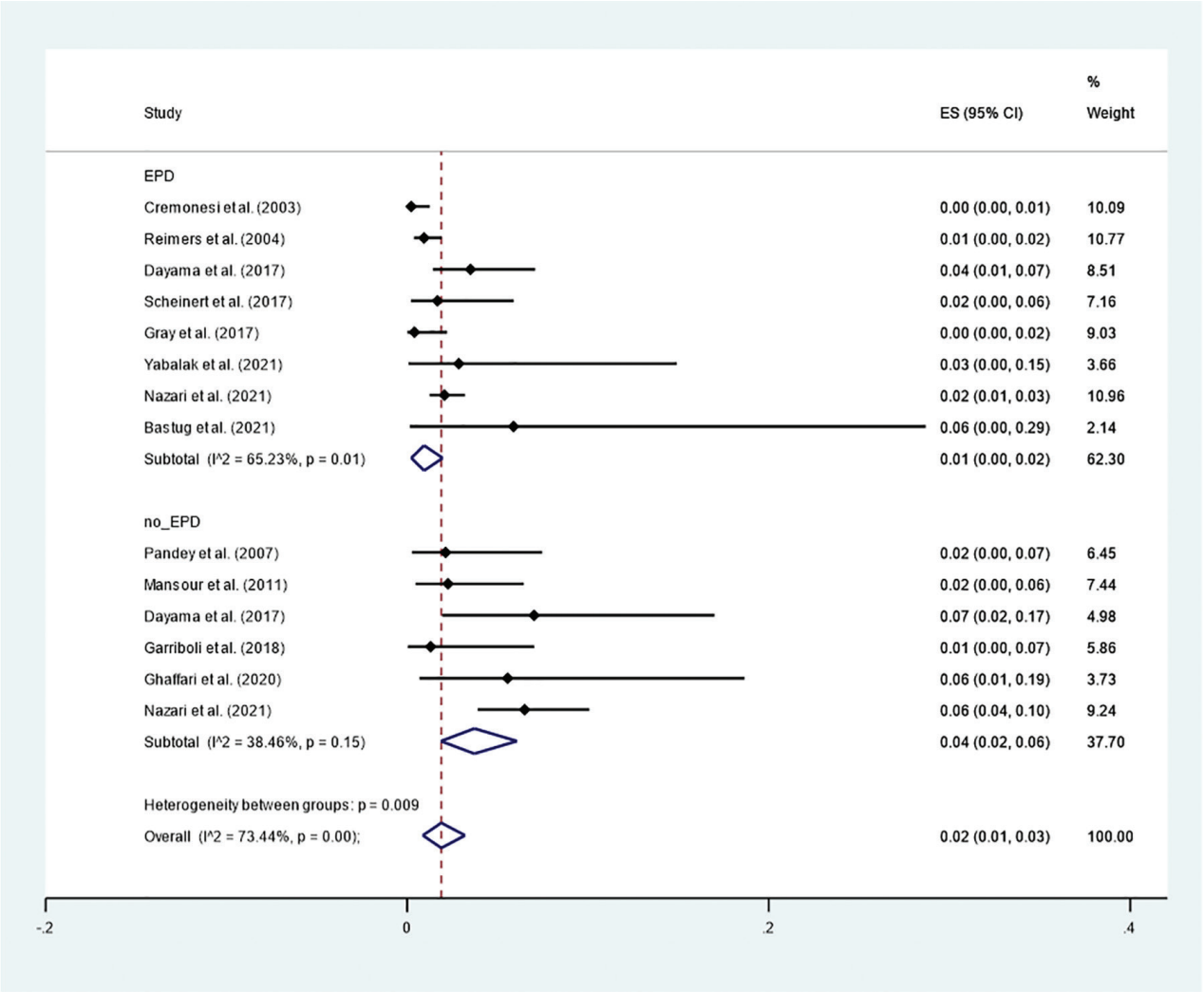

Figure 3 Forest plot of the prevalence of total death in patients who underwent CAS. Each square shows effect estimates of individual studies with their 95% CI. The size of the squares is proportional to the weight of each study in the meta-analysis. In this plot, studies are shown in the order of publication date and first author's names (based on a fixed-effects model). Effect size (ES).

0.02–0.06; I^2 = 38.46%)] and MI [EPD subgroup: 1% (95% CI: 0.00–0.02; I^2 = 62.16%); no-EPD subgroup: 2% (95% CI: 0.01–0.04; I^2 = 0.00%)], except for minor events [EPD subgroup: 2% (95% CI: 0.01–0.03; I^2 = 21.12%); no-EPD subgroup: 2% (95% CI: 0.01–0.03; I^2 = 0.00%)], which were reported to be almost identical in both subgroups (Table 3).

Publication Bias

Figure 6 demonstrates Begg's and Egger's funnel plots for relevant studies. Considering that there were no significant symmetries in Begg's (P = 0.047) and Egger's (P = 0.003) test results, it can be concluded that there was publication bias among the included studies. Also the risk of bias assessment was based on several criteria, including selection bias, comparability of study groups, and outcome reporting. Out of the total studies, six were classified as having a low risk of bias, indicated by higher total scores (7 to 10), suggesting a more robust methodological quality. Conversely, studies with intermediate risk of bias, scoring between 5 and 6, may have potential limitations that could influence the reliability of their findings. This distribution highlights the importance of considering bias when interpreting the study outcomes and their implications for broader application.

DISCUSSION

This systematic review and meta-analysis compared the rate of probable embolic events during CAS with and without EPD. We found that the application of an EPD

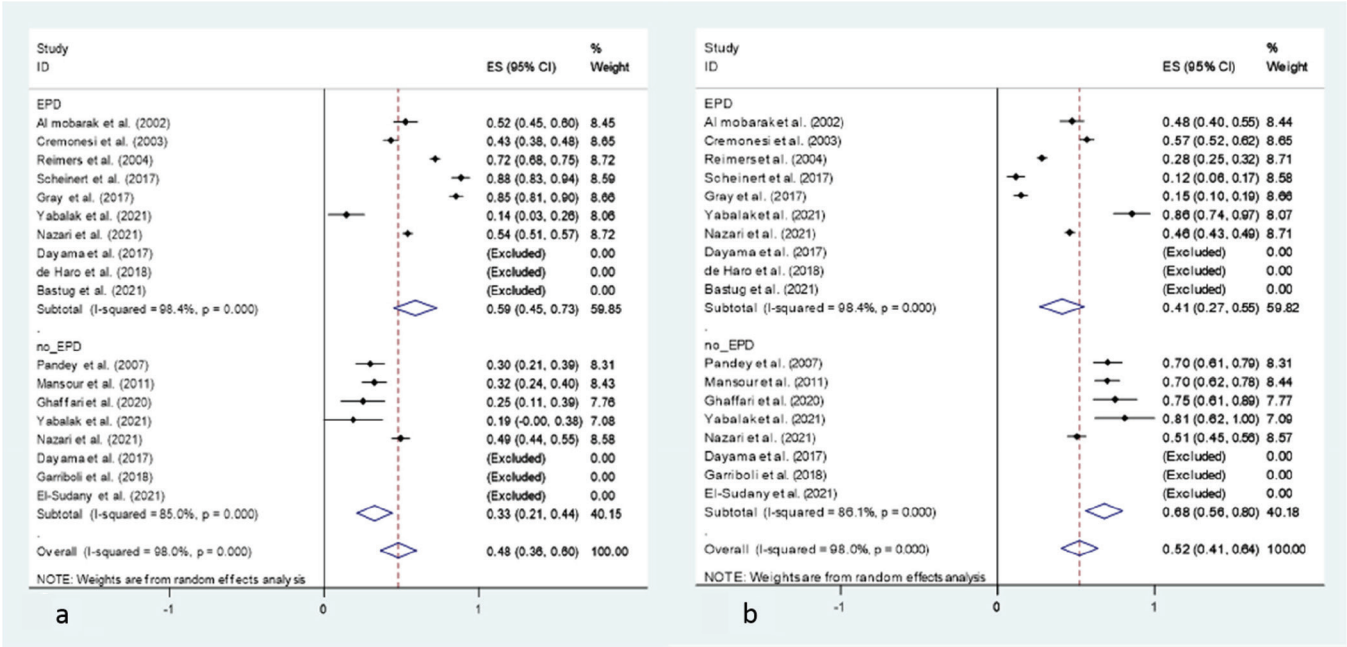

Figure 4 Prevalence of asymptomatic and symptomatic patients undergoing CAS. Forest plot of the prevalence of asymptomatic patients (**a**) and symptomatic (**b**) patients who underwent CAS. Each square shows the effect estimate of individual studies with their 95% CI. The size of the squares is proportional to the weight of each study in the meta-analysis. In this plot, studies are shown in the order of publication date and first author's names (based on a random-effects model). Effect size (ES).

during CAS can help with reducing the occurrence of thromboembolic complications of CAS, including MI, major stroke, and death.

CAS is a less invasive treatment method than carotid endarterectomy (CEA) and is usually recommended for surgical candidates with worse conditions [38]. In a meta-analysis, Sardar et al. showed that minor intraoperative stroke rates during CAS are higher than CEA [39]. Therefore, this increased risk of stroke in patients undergoing endovascular interventions for carotid artery disorders necessitates the use of a protective device during surgery. However, patients are not entirely protected by EPDs against these thromboembolic complications. Also, the placement of such devices is inherently risky. One possible risk is the long operation duration, which increases the chance of thromboembolism.

Previous studies have provided reasons and probable mechanisms for why EPDs fail to prevent the dislodgement of microemboli. In a survey conducted in the Netherlands, Vos et al. determined the presence of macro emboli, isolated microemboli, micro embolic showers, and distal thrombus with the transcranial Doppler ultrasound in two groups of patients who underwent CAS with and without EPD [40]. In their study, the number of microemboli in the group with an EPD was higher than in the group without an EPD. They explained that by capturing macro emboli, the EPD filter causes macro embolies to disintegrate and generate more microemboli. Moreover, according to the laboratory data they reported, there is still a potential space for embolic particles between the device and the vascular wall after EPD deployment. The results of a study by Pandey et al. [5] in the United States showed that there is no additional risk associated with placing an EPD during CAS, which is in line with the results of other studies, including those of Coward et al. [41], Cremonesi et al. [35], Gray et al. [42], Mas et al. [43], and White et al. [44].

In a meta-analysis by Cho et al. in 2018, including 25 articles, using an EPD was significantly associated with a lower occurrence of stroke after CAS ($P = 0.001$). The prevalence of cerebrovascular events in protected and unprotected CAS was 2.0% and 3.4%, respectively [45]. Our results are almost similar to their findings. At the same time, we also included the latest studies (over 70% of studies are after 2017), a larger sample size, subgroup analysis, and more complications (major stroke, minor events, MI, and total death) and comorbidities (hypertension, coronary artery disease, diabetes mellitus, and smoking).

Garg et al. compared the total incidence of stroke within 30 postoperative days between protected and unprotected CAS by pooling the data from 24 studies. Their findings indicated that protected CAS reduced stroke with a relative risk of 0.59 (95% CI: 0.47–0.73) compared with unprotected CAS [46]. A 4.7% (95% CI: 4.1–5.2) reduction in the risk of stroke after CAS was also reported by Touzé et al. [47]. By comparing long-term side effects between symptomatic and asymptomatic patients who underwent

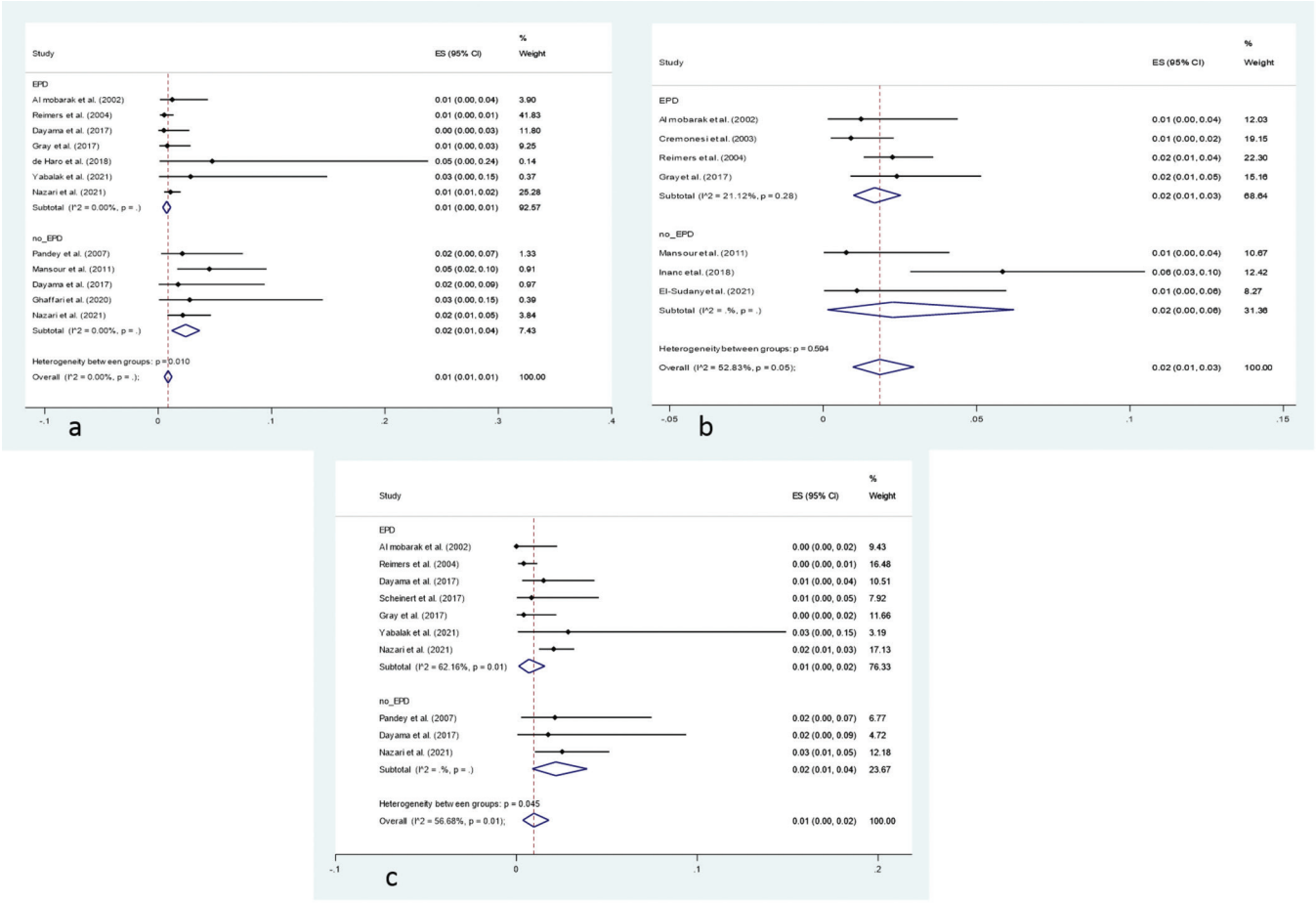

Figure 5 Prevalence of major stroke, minor events, and MI in patients undergoing CAS. Forest plot of the prevalence of major stroke (**a**), minor events (**b**), and MI (**c**) in patients who underwent CAS. Each square shows the effect estimate of individual studies with their 95% CI. The size of the squares is proportional to the weight of each study in the meta-analysis. In this plot, studies are shown in the order of publication date and first author's names (based on a random-effects model). Effect size (ES).

CAS, Kosowski et al. concluded that there was no statistically significant difference in stroke and death between the groups [48].

The filter deployed through the lesion during the procedure is at a higher risk of causing embolic events than other methods, such as proximal occlusion or flow reversal systems. This increased risk occurs because the filter may capture debris that dislodges from the lesion itself. Therefore, a proximal EPD can be more effective in preventing strokes during CAS, as it reduces the likelihood of embolic material travelling to the brain. Giri et al. compared the clinical outcome of events between distal and proximal protective devices during CAS, but the results were not significant based on the type of device (P = 0.07). However, proximal protective devices had higher rates of symptomatic lesion status [49]. Moreover, Zhan et al. revealed that stroke or death was not statistically different between groups that used filter (1.8%) and distal occlusion (2.3%) EPDs (odds ratio 1.04, P = 0.958) [50]. Furthermore, prospective trials are needed to compare the specificity and efficacy of the protective device with larger sample sizes and generalizable information.

Our analysis showed no significant association between cardiovascular risk factors and long-term complications. This can be attributed to the small sample size of the included studies, the shorter follow-up period, or the longer follow-up not being reported. However, according to our meta-regression analysis, the higher prevalence of cardiovascular disease was correlated with a higher mortality rate. This result can be justified by higher base-rate mortality in these patients and their higher susceptibility to endothelial injuries [51,52].

The study of the Paraskevas KI, referred to as The Carotid Revascularization Endarterectomy versus Stenting Trial (CREST), has been used to support the equivalence of CAS and CEA in the treatment of carotid stenosis in patients with symptoms or without symptoms. According to CREST data, there was no difference in outcome between CAS and CEA. However, subsequent subgroup analyses showed that CAS was associated with higher rates of stroke and mortality in symptomatic

Table 3 Statistical analysis of the reviewed studies. The studies were analyzed in terms of risk factors and, finally, in terms of the rate of major stroke, minor events, MI, and total death.

Data	*Variable*	*Number of Studies*	*Embolic Protection Device*	*Number of Patients*	*ES (95% CI)*	*I^2 (%)*
Demographic data	Mean age	13	EPD		71.80 (70.01–73.58)	94.7
			No-EPD		67.59 (65.38–69.80)	84.2
	Female	16	EPD	860	27% (22–33)	90.3
			No-EPD	311	33% (27–38)	64.3
	Symptomatic	15	EPD	1,086	41% (27–55)	98.4
			No-EPD	430	68% (56–80)	86.1
Comorbidities	Hypertension	14	EPD	1,891	87% (81–92)	90.66
			No-EPD	657	74% (67–81)	80.90
	Coronary artery disease	12	EPD	648	53% (42–64)	86.71
			No-EPD	169	26% (20–34)	71.37
	Diabetes mellitus	14	EPD	698	39% (31–48)	91.61
			No-EPD	313	34% (25–44)	88.23
	Smoking	9	EPD	513	59% (31–84)	98.41
			No-EPD	243	32% (20–47)	96.69
Complications and outcomes	Major stroke	16	EPD	38	1% (0–2)	65.23
			No-EPD	30	4% (2–6)	38.46
	Minor events	12	EPD	29	2% (1–3)	21.12
			No-EPD	12	2% (1–3)	0.0
	MI	14	EPD	28	1% (0–2)	62.16
			No-EPD	10	2% (1–4)	0.0
	Total death	16	EPD	21	1% (0–1)	0.0
			No-EPD	16	2% (1–4)	0.0

Embolic protection device (EPD); myocardial infraction (MI); effect size (ES).

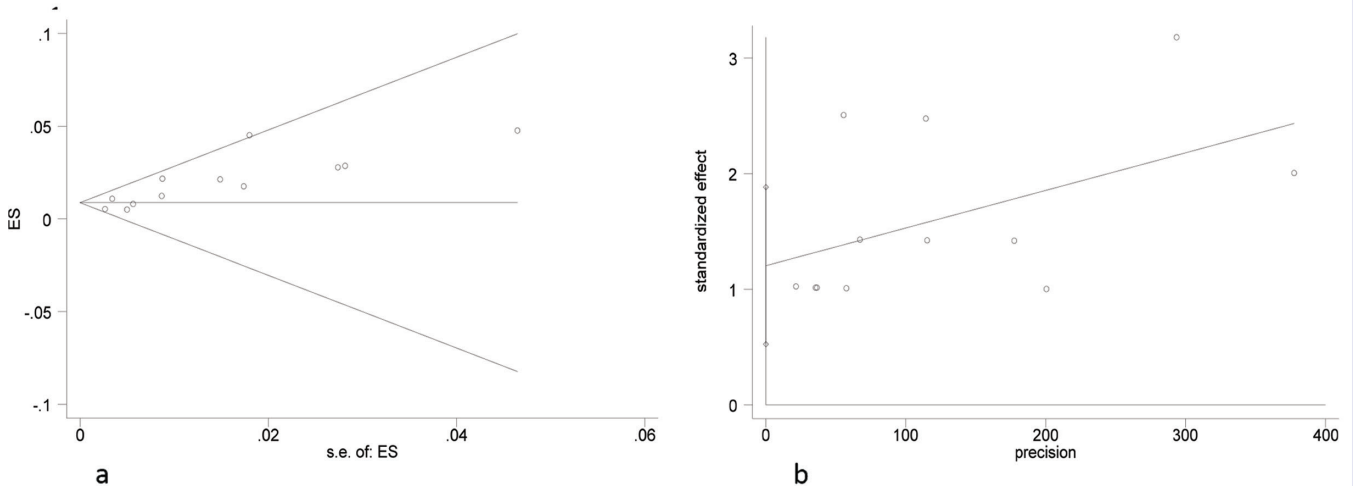

Figure 6 Publication bias. Begg's (**a**) and Egger's (**b**) funnel plots.

patients, women, and patients over 65 years of age compared with CEA. Thus, these data show that CEA and CAS are not equivalent, and CAS, until now, has a higher risk of stroke and death rates compared with CEA. Of course, it is worth mentioning that CREST used CAS technology and indications that are now expired [53].

This study had some limitations. A few studies reported data on other variables that a meta-analysis could not be performed on due to the small number of studies. Also, some studies had a high risk of bias. These factors can lead to limitations on the scope of research or the sample size. Also, some studies compare different types of devices, which leads to heterogeneity in our analysis, and non-English studies could not be included in our study.

Future research will expand the sample size, incorporate long-term outcomes, and evaluate emerging technologies in carotid artery stenting. Additionally,

cost-effectiveness and subgroup analyses, along with a potential randomized controlled trial, will be prioritized to enhance evidence quality and clinical practice.

CONCLUSION

In this systematic review and meta-analysis, we compared the rate of probable embolic events during CAS with and without using EPD. We found that the use of an EPD can help reduce the occurrence of perioperative complications of CAS, including MI, major stroke, and death. According to our meta-regression analysis, the prevalence of coronary artery disease as a risk factor was correlated with a higher mortality rate. Our results also showed that the patients who received an EPD during CAS were mostly asymptomatic, while in patients with no EPD usage, it was the opposite. Altogether, our results suggest that the benefits of using an EPD during CAS outweigh the risks of CAS.

Acknowledgement

The authors would like to thank the Clinical Research Development Unit (CRDU) of Loghman Hakim Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran for their support, cooperation, and assistance throughout the period of study (grant number: 43011345).

Conflict of Interest

The authors declare that they have no conflicts of interest.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Availability of data, code and other materials

The datasets, analysis code, and any additional materials used in this study are available from the corresponding author upon reasonable request. Any proprietary software or data not freely available will be provided under appropriate agreements or licenses.

Registration and Protocol Information

No formal protocol was prepared prior to the study. As such, there were no amendments to any registration or protocol information. All procedures and methodologies were developed in accordance with standard systematic review practices.

Ethics Statement

(1) All the authors mentioned in the manuscript have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.
(2) The authors declare that they have read and abided by the JEVTM statement of ethical standards including rules of informed consent and ethical committee approval as stated in the article.

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Original Article

Vol. 8, No. 2; 2024; pp 42–48
DOI: https://doi.org/10.26676/jevtm.23392

Prevalence and Contraindications of Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA): A Comparative Study of Severe and Nonsevere Traumatic Brain Injury Patients

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Background: Traumatic brain injury (TBI) is the leading cause of poor neurological outcomes and multiple organ failure worldwide. The use of resuscitative endovascular balloon occlusion of the aorta (REBOA) has been proposed to increase proximal pressure above the balloon to proximal organs, particularly improving cerebral and cardiac perfusion. This study assessed the prevalence of REBOA candidates and absolute contraindications in major trauma patients with varying TBI severities.

Methods: A retrospective analysis was conducted on 1158 major trauma patients who were transported to a Level I trauma center in Bangkok, Thailand, between 2020 and 2021. After exclusions, we analyzed two groups: 258 patients with severe TBI and 293 with nonsevere TBI.

Results: REBOA candidacy was significantly greater in the nonsevere TBI group (65.5% vs. 37.2%, $p < 0.001$). This group also exhibited more severe bleeding in regions below the occlusion where bleeding control is critical: abdomen-to-groin (58.7% vs. 29.1%, $p < 0.001$), intra-abdominal sources (47.1% vs. 23.3%, $p < 0.001$), and unstable pelvic injuries (19.1% vs. 9.3%, $p = 0.002$). In addition, the nonsevere TBI group had a greater prevalence of REBOA contraindications: overall (44.0% vs. 1.9%, $p < 0.001$), aortic (30.4% vs. 1.2%, $p < 0.001$), and cardiac (18.1% vs. 1.2%, $p < 0.001$) injuries. Concomitant conditions were more frequent in the nonsevere TBI group (5.5% vs. 1.2%, $p = 0.012$).

Conclusions: The nonsevere TBI group demonstrated significantly more potential REBOA candidates, absolute contraindications, and concomitant conditions than the severe TBI group. These findings underscore the need for a comprehensive evaluation of the advantages of REBOA in unstable patients comparing severe and nonsevere TBI patients.

Keywords: *REBOA; Resuscitation; Resuscitative Endovascular Balloon Occlusion of the Aorta; Trauma; Traumatic Brain Injury*

Received: 24 April 2024; Accepted: 26 June 2024

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INTRODUCTION

Traumatic brain injury (TBI) and exsanguination, especially with noncompressible torso hemorrhage, are leading causes of death in trauma patients [1,2]. Recent advances in trauma resuscitation have enhanced the early detection and management of these conditions, improving survival rates significantly. This progress includes the broad application of endovascular resuscitation in trauma management (EVTM) techniques, including resuscitative endovascular balloon occlusion of the aorta (REBOA). This procedure has proven particularly effective in controlling severe hemorrhage in patients with noncompressible torso hemorrhage and

ensuring essential perfusion to critical organs such as the heart and brain. The use of REBOA has been integrated into numerous clinical guidelines for prehospital and inpatient settings [3–7]. Moreover, injury mechanisms such as hanging, major burns with shock, intoxication, and electric shock causing cardiac arrest, while less likely to cause severe bleeding, may still necessitate advanced resuscitative efforts. In such cases, the deployment of REBOA can be pivotal. By increasing proximal pressure to critical organs, REBOA enhances support during cardiopulmonary resuscitation and can act as a bridge to extracorporeal cardiopulmonary resuscitation, potentially improving survival outcomes.

TBI is closely associated with poor prognosis, primarily due to initial brain damage and subsequent clinical deterioration, which often precipitates multiorgan dysfunction. Numerous guidelines recommend multidisciplinary discussions to evaluate the prognosis of severe and catastrophic brain injuries, ensuring that care decisions, including the timing of care withdrawal, are well-informed and prevent premature cessation of support [8–14]. However, accurately assessing neurological status during initial trauma resuscitation is complex due to various confounding factors. Computed tomography (CT) is important for assessing TBI severity but is frequently impractical for unstable patients during initial management. Typically, these patients first receive essential resuscitative procedures or surgery, with a CT scan deferred until hemodynamic stability is assured. Recent studies have highlighted the benefits of REBOA in enhancing proximal arterial pressure to critical organs, particularly the brain. In addition, REBOA serves as a bridging intervention, allowing unstable patients to stabilize for necessary diagnostics and strategic planning, potentially including preparations for organ donation [15,16].

This study aimed to examine differences in the prevalence of potential candidates for REBOA in patients with severe versus nonsevere TBI. In addition, the study sought to identify the absolute contraindications to REBOA in these groups. This analysis will enable more precise and effective deployment of REBOA, optimizing the use of local resources in the management of these critical conditions.

METHODS

In this retrospective study, we evaluated adult patients older than 18 years who sustained major trauma and were transported to a Level I trauma center in Bangkok, Thailand, between 2020 and 2021. We modified the definition of major trauma from the 2011 Field Triage Decision Scheme [17] to suit our trauma unit's medical resources and capabilities. The Abbreviated Injury Scale (AIS) demonstrates the level of injury based on anatomical location and severity: AIS-head was characterized by CT scans or autopsy reports as an AIS of the head region of 3 or higher being defined as "severe TBI," which is associated with clinical progression and outcome. We excluded patients with lethal brain injuries (including pontomedullary or brainstem lacerations, exposed brain matter, and decapitation) and those with incomplete medical records.

The characteristics and parameters of patients were reviewed including the age, gender, and mechanism of injury. Data were collected from two groups which included patients with severe trauma who presented with unstable conditions such as systolic blood pressure below 90 mmHg and/or traumatic cardiac arrest with signs of life on arrival, individuals who were declared dead at the scene of major trauma and transported to the Department of Forensic Medicine, and those who were pronounced dead upon hospital arrival. Given the challenges in assessing patient status at major trauma scenes within Thailand's trauma system, our research is also interested in focusing on the group of patients that died at the scene. Emergency responses at the scene of major trauma typically involve volunteers and private ambulance services with widely varying levels of clinical expertise. This variability complicates the detection of subtle signs of life and accurate neurological assessment, especially in patients in profound shock or traumatic cardiac arrest with limited performance in our system. Our study thus sought to identify potential missed opportunities for resuscitation in these critical patients.

Referring to various clinical practice guidelines [4–6, 18,19], we selected the patients eligible for REBOA including those who experienced traumatic cardiac arrest and/or significant intra-abdominal bleeding. The eligibility criteria for significant intra-abdominal bleeding were as follows:

- AIS scores of 3 or higher for liver and spleen injuries, and scores of 4 or higher for kidney injuries; active hemorrhaging from the abdominal vasculature, the presence of unstable pelvic fractures, or injuries at groin junctions.

Due to the risk of exacerbating conditions following balloon inflation, the absolute contraindications for the use of REBOA were aortic injury and cardiac injuries, with or without cardiac tamponade.

Statistical Analysis

We summarized the demographic and clinical characteristics of the participants using descriptive statistics. Statistical analyses were performed with PASW Statistics, version 18 (SPSS Inc., Chicago, IL, USA). Categorical variables are presented as numbers and percentages, and continuous variables are presented as means ± standard deviations or medians and interquartile ranges. The distribution of all continuous data in

this study was normal. Categorical comparisons utilized the chi-square test or Fisher's exact test, as appropriate. Student's *t* test was applied to analyze normally distributed continuous data. A *p*-value of less than 0.05 was considered to indicate statistical significance for all tests.

Ethical Approval and Informed Consent

The Siriraj Institutional Review Board of the Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand, approved the study protocol (reference number Si-874/2023). Due to the retrospective and anonymity-preserving design of this study, written informed consent was not required from the participants.

RESULTS

This study evaluated 1158 major trauma patients who were transported to our center between 2020 and 2021. After applying the exclusion criteria, we analyzed two groups: 258 patients with severe TBI and 293 patients with nonsevere TBI (Table 1).

Both groups were predominantly male and the average age was approximately 40 years. Blunt injuries were significantly more common in the severe TBI group than in the nonsevere TBI group (93.0% vs. 81.9%, $p < 0.001$). Motorcycle accidents were the predominant cause of blunt injuries in both groups (60.9% in severe TBI and 56.3% in nonsevere TBI). In contrast, the incidence of penetrating injuries, stabbing, and other injuries was significantly greater in the nonsevere TBI group than in the severe TBI group (14.0% vs. 7.0%, $p = 0.012$; 9.6% vs. 0.4%, $p < 0.001$; and 4.1% vs. 0.4%, $p = 0.010$, respectively).

In this study, 65.5% of patients in the nonsevere TBI group were identified as potential candidates for REBOA. This proportion was significantly greater than the 37.2% observed in the severe TBI group ($p < 0.001$). Notably, the incidence of severe bleeding in the abdomen-to-groin region was higher in the nonsevere TBI group (58.7%) than in the severe TBI group (29.1%, $p < 0.001$). Similarly, 47.1% of the nonsevere TBI patients experienced intra-abdominal bleeding, which was significantly more than the 23.3% observed in the severe group ($p < 0.001$). In addition, unstable pelvic injuries were present in 19.1% of nonsevere TBI patients versus 9.3% of their severe counterparts ($p = 0.002$; Table 2).

Regarding REBOA contraindications, the nonsevere TBI group had a significantly higher overall incidence of contraindications (44.0% vs. 1.9%, $p < 0.001$), including aortic injuries (30.4% vs. 1.2%, $p < 0.001$), and significant cardiac injuries (18.1% vs. 1.2%, $p < 0.001$). In addition, concomitant conditions were more common in the nonsevere TBI group (5.5%) than in the severe TBI group (1.2%, $p = 0.012$; Table 2).

DISCUSSION

Advanced trauma resuscitation techniques are continually improving survival rates for the two leading causes of death in major trauma patients: TBI and exsanguination. The application of REBOA in TBI has two primary objectives. First, it enhances arterial pressure proximal to the balloon to boost cerebral and cardiac blood flow. Second, it controls hemorrhage to preserve hemoglobin and oxygen transport. These factors are critical for preventing secondary brain injury [20]. Translational research involving rodent polytrauma models has shown promising results, indicating that REBOA may

Table 1 Demographic and mechanism of injury profiles in major trauma patients in the severe TBI and nonsevere TBI groups.

Characteristics	*Severe TBI Group (n = 258)*	*Nonsevere TBI Group (n = 293)*	*p-value*
Age (years), mean±SD	40.2±18.2	40.4±16.9	0.894
Male sex, *n* (%)	214 (82.9%)	252 (86.0%)	0.383
Mechanism of injury, *n* (%)			
• Blunt	240 (93.0%)	240 (81.9%)	<0.001
– Motorcycle accident	157 (60.9%)	165 (56.3%)	0.322
– Motor vehicle collision	15 (5.8%)	21 (7.2%)	0.639
– Pedestrian struck	33 (12.8%)	22 (7.5%)	0.055
– Fall from height	22 (8.5%)	17 (5.8%)	0.282
– Fall from the same level	7 (2.7%)	13 (4.4%)	0.396
– Other blunt injury	6 (2.3%)	2 (0.7%)	0.210
• Penetrating	18 (7.0%)	41 (14.0%)	0.012
– Gunshot wound	17 (6.6%)	12 (4.1%)	0.264
– Stab wound	1 (0.4%)	28 (9.6%)	<0.001
– Other penetrating injury	0 (0.0%)	1 (0.3%)	>0.999
• Others[a]	1 (0.4%)	12 (4.1%)	0.010

TBI, traumatic brain injury.

[a]*Includes cases resulting from hanging, major burns with shock, intoxication, and electric shock causing cardiac arrest.*

Table 2 Suitability of REBOA in severe versus nonsevere traumatic brain injury groups.

	Severe TBI (n = 258)	*Nonsevere TBI (n = 293)*	*p-value*
Potential indications for REBOA, *n* (%)			
• Overall potential indication for REBOA (including the purpose of bleeding control and restoring circulation)	96 (37.2%)	192 (65.5%)	<0.001
• **Significant bleeding source(s) at the abdomen–groin**	75 (29.1%)	172 (58.7%)	<0.001
○ Major intra-abdominal bleeding	60 (23.3%)	138 (47.1%)	<0.001
○ Unstable pelvic injury	24 (9.3%)	56 (19.1%)	0.002
○ Junctional hemorrhage injury at the groin	1 (0.4%)	2 (0.7%)	0.920
Absolute contraindications for REBOA, *n* (%)			
• Overall	5 (1.9%)	129 (44.0%)	<0.001
• Aortic injury	3 (1.2%)	89 (30.4%)	<0.001
• Cardiac injury with or without cardiac tamponade	3 (1.2%)	53 (18.1%)	<0.001
Potential indications and contraindications for REBOA in the same case, *n* (%)	3 (1.2%)	16 (5.5%)	0.012

REBOA, resuscitative endovascular balloon occlusion of the aorta; TBI, traumatic brain injury.

improve cerebral perfusion by temporarily improving intracranial pressure and brain tissue oxygenation [21]. In addition, REBOA has been shown to maintain circulation effectively in potential organ donors, even in patients with severe TBI and a poor prognosis [16]. Our findings highlight a high prevalence of REBOA candidates, including those with severe or nonsurvivable TBI, with numbers exceeding those reported in some prior studies [22–27]. By distinguishing between these groups, our research sought to refine the approaches and effectiveness of resuscitation strategies, contributing to enhanced patient care protocols, especially the necessity for REBOA implementation in controlling significant bleeding sources.

Recent research on the use of REBOA in TBI patients has produced mixed results. Studies indicate that it either improves neurological outcomes or shows no difference. These outcomes are influenced by the physiological effects of aortic occlusion [20,28,29]. However, the application of REBOA warrants careful consideration. There are concerns that supraphysiological pressures generated above the balloon could increase intracranial pressure. This elevation may lead to brain edema and aggravate intracranial bleeding, risks that are highlighted as contraindications in several clinical guidelines [18,30].

Debate persists over the benefits of maintaining increased proximal pressure above the balloon for critical organs, particularly the brain and heart, even when there is no active bleeding beneath the REBOA placement. For example, one study compared hypotensive blunt trauma patients with TBI who were treated both with and without REBOA. It reported no significant differences in mortality rates or discharge Glasgow Coma Scale (GCS) scores [28]. Similarly, data from the American College of Surgeons Trauma Quality Improvement Program (ACS TQIP) database from 2015 to 2017 were collected from adult civilian blunt trauma patients, both with and without TBI, who underwent REBOA. Analysis revealed no notable differences in inpatient mortality or complications. Notably, TBI patients treated with REBOA presented with lower GCS scores, lower systolic blood pressure values, and greater injury severity scores [29]. Importantly, both studies excluded patients who died upon arrival at the hospital or who required immediate cardiopulmonary resuscitation.

A study by the Multi-Institutional Trials Committee of the American Association for the Surgery of Trauma examined extremely unstable TBI patients. The mortality odds were 3.1 times greater for resuscitative thoracotomy than for REBOA, suggesting a potential benefit of REBOA in reducing mortality. However, the study encompassed a broad range of TBI severities, from mild (27% of the study population) to severe. This diversity is critical because different severities of TBI naturally progress in varying ways [20]. Therefore, this variability highlights the need for cautious application of REBOA, considering that its perceived effectiveness might also be influenced by these inherent differences in the progression of TBI.

Future studies are expected to refine approaches for various scenarios and systems, thus enhancing our understanding of the risk–benefit balance associated with REBOA. A key factor in clinical decision-making is the feasibility of conducting thorough investigations, including necessary CT scans, which are vital for guiding treatment strategies in TBI patients. The complexity of clinical presentations, influenced by multiple factors, often complicates the accuracy of initial evaluations. The initial GCS score is generally insufficient for formulating early definitive plans because it can be affected by external factors not directly related to primary brain injury.

One major obstacle to finalizing a diagnosis of TBI is the patient's unstable hemodynamic status. This instability can delay definitive diagnostic procedures in favor of more immediate life-saving interventions, such as damage control surgery or radiological measures. In these situations, REBOA can be strategically deployed as a bridging maneuver to maintain hemodynamic stability, thereby allowing for the timely completion of essential diagnostic assessments and the development of definitive treatment plans. Conversely, the inappropriate application of REBOA might occur if its use is not carefully tailored to the patient's injury severity. It may be overused in patients with predictably poor outcomes or underused in situations where it could benefit non-bleeding patients by enhancing cerebral blood supply. Accurate resolution of these complex issues is crucial for optimizing resource management and improving the standard of care for polytrauma patients. The necessity for treatment strategies that are precise and tailored to individual needs underscores the importance of continuously updating clinical protocols to align with emerging data and outcome analyses.

A noteworthy finding in our study was the reduced number of severe TBI patients identified as potential candidates for REBOA compared with those with nonsevere TBI (Table 2). This observation aligns with other research that reported fewer potential REBOA candidates among severe TBI patients [31]. Understanding this disparity is essential for integrating REBOA effectively into clinical practice, particularly within our healthcare system.

The primary injury mechanism in our region, motorcycle accidents, significantly contributes to life-threatening conditions in TBI patients. Unfortunately, detailed records on helmet usage were insufficient, but the correlation between motorcycle accidents and TBI was clear. In terms of hemorrhage control, our major trauma cohort had significantly more potential REBOA candidates in the nonsevere TBI group than in the severe TBI group. This finding suggests that there are different levels of physiological instability caused by life-threatening conditions between these groups.

Moreover, the findings underscore the need to develop strategies that expedite final diagnoses using CT imaging. Such strategies would enable timely and effective decision-making in our setting, where patients may lack substantial financial resources and some treatments are not covered by Thailand's Universal Coverage Scheme (a government health insurance program).

One guideline advocates for a whole-body CT scan before implementing REBOA when feasible [32]. However, given the significant number of patients at our hospital who are present with severe bleeding, prioritizing immediate surgical intervention or REBOA remains crucial to stabilize patients initially.

The application of REBOA in unstable patients demands a careful consideration of safety, particularly regarding contraindications. Although our study revealed a greater prevalence of potential REBOA candidates in the nonsevere TBI group, absolute contraindications and concurrent conditions must be assessed meticulously. This approach necessitates a detailed evaluation of both indications and contraindications during trauma resuscitation, tailored to the resources available at the medical facility.

How will our clinical practices evolve based on these findings? Recognizing the high frequency of bleeding sources in both severe and nonsevere TBI patients, where REBOA has shown potential benefits, we will consider implementing endovascular trauma management principles while simultaneously implementing early prevention of secondary brain injury, administration of tranexamic acid, and neurosurgical consultation which has been our practice following standard ATLS guidelines. In addition, our protocol will include securing early vascular access to expedite REBOA deployment, enhancing resuscitation monitoring, and ensuring swift preparation for immediate whole-body CT scans. Moreover, we will intensify our commitment to fulfilling surgical criteria and applying REBOA judiciously, with a balanced consideration of indications and contraindications.

This strategic enhancement aims to refine trauma resuscitation practices, ensuring that they are adaptable to the evolving needs and specific conditions of our patient population. We strive to optimize patient outcomes and use medical resources efficiently by integrating the study findings into our protocols.

Our study is limited by its retrospective design, single-center focus, and small sample size, which may affect the generalizability of the findings. Institutional policies on autopsies restricted detailed injury assessments: autopsies were limited to individuals with only severe injuries; minor wounds were not examined post-mortem. These limit our ability to compute comprehensive injury severity scores for patients who died at the scene and were transferred to the Department of Forensic Medicine. These constraints highlight the variability in trauma care systems and available resources, which differ significantly from those in other studies. Future research should expand to multicenter and international settings to address these disparities and enhance the reliability of REBOA assessments. This expansion would allow for a more diverse range of clinical experiences and patient demographics, aiding in refining guidelines and improving their practical application in varied healthcare environments.

CONCLUSIONS

This study has revealed a greater prevalence of potential REBOA candidates in the nonsevere TBI group, particularly for controlling bleeding sources. However, a higher incidence of absolute contraindications in the

same group necessitates careful risk assessment when considering REBOA for resuscitation and as a bridging intervention to facilitate timely CT diagnostics. These findings suggest that employing REBOA could significantly enhance trauma care efficiency, especially when REBOA is integrated into protocols designed for rapid and comprehensive early evaluations. Such integration is crucial in settings constrained by limited resources and the necessity for cost-effective approaches for trauma patients with severe TBI, potentially leading to improved patient outcomes and more efficient use of healthcare resources.

Acknowledgments

The authors extend their sincere thanks to Miss Julaporn Pooliam of the Research Department, Faculty of Medicine Siriraj Hospital, Mahidol University, for her invaluable assistance with the statistical analyses. We also thank Mr. David Park for his expert linguistic editing.

Ethics Statement

(1) All the authors mentioned in the manuscript have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.
(2) The authors declare that they have read and abided by the JEVTM statement of ethical standards including rules of informed consent and ethical committee approval as stated in the article.

Conflicts of Interest

The authors declare that there are no personal or professional conflicts of interest. There has been no financial support from companies that produce or distribute the drugs, devices, or materials discussed in this report.

Funding

This is an unfunded study.

Author Contributions

TS designed the study, collected and analyzed the data, and critically revised the manuscript. TW codesigned the study, conducted the literature search, collected and analyzed the data, and drafted and critically revised the manuscript. PP initiated the study concept, participated in data collection, and critically revised the manuscript. CS, PM, and NN also provided critical revisions to the manuscript. All authors have read and approved the final manuscript for submission.

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Original Article

Vol. 8, No. 2; 2024; pp 49–57
DOI: https://doi.org/10.26676/jevtm.25486

The Fog has not Lifted: No Reduction in Complications for Partial REBOA in the AAST AORTA Registry

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Background: Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) is a potentially lifesaving but polarizing therapy due to the associated morbidity and uncertainty of who might benefit. Techniques such as partial (p)REBOA that provide hemodynamic support while reducing distal ischemia are now captured in the Aortic Resuscitation in Trauma and Acute Care (AORTA) registry. We hypothesized that pREBOA would be associated with improved mortality and fewer adverse outcomes.

Methods: The AORTA registry was queried for adult patients who received complete (c)REBOA or pREBOA between 2020 and 2022. Patients were excluded if they had a head Abbreviated Injury Scale (AIS) ≥three or an AIS of six in any body region. Outcome measures were complications and mortality. Poisson regression analyses identified the independent effect of the type of approach on outcomes.

Results: 164 patients met the inclusion criteria, with pREBOA used in 36% of cases and no significant difference in patient demographics, injury characteristics, or injury severity between pREBOA and cREBOA. There was no difference in mortality rate (44.1% vs 45.7%). After adjusting for potential confounders, no statistically significant difference in complications was detected between the two approaches [adjusted IRR (95% CI): 1.11 (0.54–2.27), $p = 0.777$]. This association persisted after subgroup analysis of aortic Zone one vs Zone three deployment.

Conclusions: In this registry analysis, pREBOA did not reduce morbidity or mortality compared to cREBOA. Improving the granularity of clinical metrics in the AORTA registry is essential to understanding whether patients will benefit from pREBOA, and how to best implement this controversial resuscitation adjunct.

Keywords: *Resuscitative Endovascular Balloon Occlusion of the AORTA (REBOA); Partial REBOA (pREBOA); Complete REBOA (cREBOA); Hemorrhagic Shock; Resuscitation Adjunct*

Received: 17 June 2024; Accepted: 21 August 2024

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Presentation: This abstract was presented in the poster session at the American Association for the Surgery of Trauma Annual Meeting 2023 in Anaheim, CA.

INTRODUCTION

Severe hemorrhage remains a leading cause of preventable mortality in trauma patients. Approximately 40% of trauma-related deaths are due to hemorrhage or its related consequences [1,2]. Non-compressible truncal hemorrhage (NCTH) represents a unique clinical challenge as it is a condition characterized by severe bleeding from within the trunk of the body that is unable to be managed through traditional compression methods. NCTH has mortality rates as high as 85% in military settings and approaching 50% in civilian patients [3,4].

Multiple studies have shown that complete aortic occlusion with devices such as REBOA is a viable resuscitative adjunct for NCTH as it mitigates hemorrhage and enhances cerebral blood flow, thus acting as an interim measure before achieving definitive hemorrhage control [5–8]. While REBOA is effective in controlling bleeding, it induces ischemia downstream from the site of occlusion resulting in severe ischemia reperfusion injury and/or irreversible organ damage. To lessen the ischemic effects induced by full aortic occlusion, techniques such as partial REBOA have evolved, allowing for partial or variable occlusion of the aorta. Partial REBOA has the potential to maintain perfusion above the level of occlusion while simultaneously establishing a permissive state of regional hypoperfusion to areas of uncontrolled hemorrhage [9–11]. As such, these devices are hypothesized to have a more favorable complication profile but the clinical data has not yet answered this question. Intermittent REBOA (iREBOA) is an additional technique that involves periods of full occlusion and periods of deflation, while partial REBOA aims to maintain hemodynamics with reduced distal flow to help mitigate the supraphysiologic pressures created during times of full occlusion [6,12]. Ultimately, there are still many uncertainties about how to utilize these techniques, including the optimal timing, patient population, and titration strategy for achieving better overall outcomes.

In an effort to understand the relative benefits of alternative methods of balloon management for patients receiving REBOA, we compared the morbidity and mortality of partial REBOA and complete REBOA using the American Association for the Surgery of Trauma (AAST) AORTA Registry. We hypothesized that partial REBOA would be associated with better outcomes than complete REBOA.

METHODS

The study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines and the Declaration of Helsinki [13]. All collected data was retrieved from the Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery (AORTA) registry from 2020 to 2022. The AORTA Registry is a multi-institutional initiative designed to collect prospective data on adult patients (aged 18 or older) who undergo resuscitative aortic occlusion using both open and endovascular techniques during the acute phases of injury. This data is sourced from hospitals across the United States that are verified by the American College of Surgeons as Level I or Level II trauma centers. Designated registrars at each participating center are responsible for entering the data into the online portal developed by the AAST. This data includes patient demographics, clinical characteristics, intervention characteristics, and outcomes. All adult patients (18 years or older) registered in the database who received a complete or partial REBOA to aid in the management of a traumatic injury were considered for inclusion. Patients were excluded if they suffered a non-traumatic hemorrhage, underwent intermittent REBOA, had a head Abbreviated Injury Scale (AIS) ≥3, as the majority of these patients have a dismal prognosis or complications not related to REBOA, or an AIS of 6 in any region of the body, since these injuries are generally not considered survivable.

The primary outcome of interest was any complication (myocardial infarction, stroke, paraplegia, acute kidney injury requiring dialysis, acute lung injury/acute respiratory distress syndrome, distal embolism, need for amputation, bacteremia, pneumonia, sepsis, and multiorgan dysfunction). Secondary outcome measures included in-hospital mortality, discharge Glasgow Coma Scale (GCS), Glasgow Outcome Scale Extended (GOSE), intensive care unit (ICU) as well as hospital length of stay, and time to death. For the adjusted analyses, discharge GCS was dichotomized as ≤8 and >8 while discharge GOSE was dichotomized as ≤4 and >4. Distal pressure targets and balloon titration strategy were not included in the analysis as this data is not reported in the AAST AORTA Registry.

Statistical Analysis

Patients were divided into two groups based on the type of aortic occlusion: complete or partial. Continuous variables were summarized as medians and interquartile ranges. Categorical variables were presented as counts and percentages. The statistical significance of baseline differences between the cohorts was determined using the Mann–Whitney *U*-test or Fisher's exact test. In order to adjust for potential confounding, Poisson regression models with robust standard errors were employed to calculate the association between the type of aortic occlusion and the binary outcomes (complications, in-hospital mortality, discharge GCS, and discharge GOSE). For the continuous outcomes (ICU length of stay, hospital length of stay, and time to death) quantile regression models

were used instead. All analyses were adjusted for age, sex, type of injury, REBOA location, AIS in all regions, primary source of major hemorrhage, and Cardiopulmonary Resuscitation (CPR) being in progress on arrival. Results are presented as an adjusted incidence rate ratio (IRR) and corresponding 95% confidence interval (CI) for the Poisson regression models. The results of the quantile regression models are instead presented as the change in median length of stay and change in median time to death, along with corresponding 95% CIs.

A two-tailed *p*-value of less than 0.05 was considered statistically significant in all analyses. Missing data was managed using multiple imputation by chained equations. Analyses were performed using the statistical programming language R (R Foundation for Statistical Computing, Vienna, Austria) with the aid of the tidyverse, mice, quantreg, and sandwich packages (R Foundation for Statistical Computing, Vienna, Austria).

Ethical Approval and Informed Consent

Ethical approval was not required. Informed consent was not required.

RESULTS

After applying the inclusion and exclusion criteria, 164 patients were deemed suitable for further analysis (Figure 1). In total, 64% (*N* = 105) were managed using a complete aortic occlusion, while 36% (*N* = 59) were subjected to a partial aortic occlusion. Patients managed using a complete occlusion were older (40 vs 33 years, $p = 0.017$), had a higher presenting GCS (14 [8–15] vs 12 [3–14], $p = 0.025$), and were more likely to be hemorrhaging from the pelvis (18.1% vs 16.9%, $p = 0.030$) as well as less likely to be hemorrhaging from the head or neck (0% vs 8.5%, $p = 0.030$). Those who underwent complete occlusion were also less likely to be undergoing CPR on admission (6.7% vs 18.6%, $p = 0.035$) as well as more likely to be admitted to a level I trauma center (99% vs 91.5%, $p = 0.023$). There were no statistically significant differences in sex, injury severity, or admission vitals (Table 1).

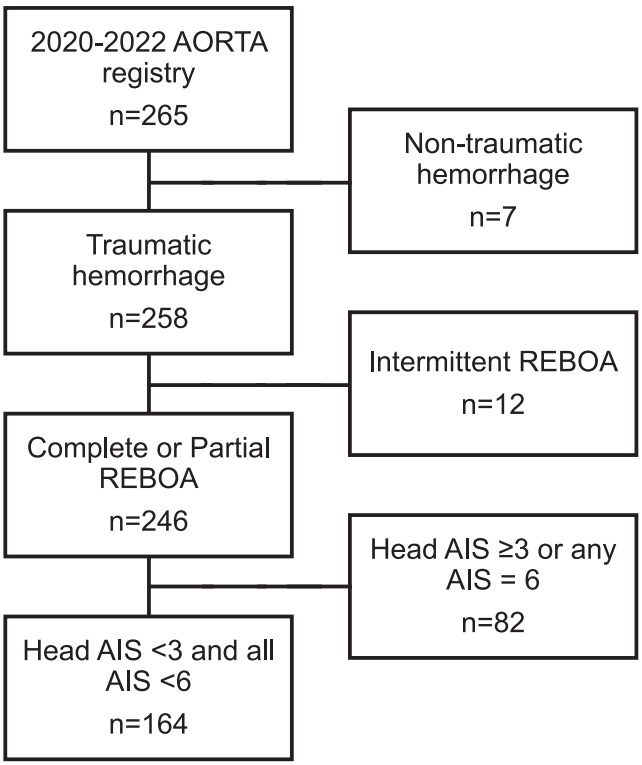

Figure 1 Inclusion and exclusion criteria flowchart.

For patients with Zone 3 placement, a greater percentage of them had complete REBOA (39% vs 18.6%, $p = 0.007$). Additionally, more patients who were treated with complete REBOA later received a pelvic external fixator (14.3% vs 3.4%, $p = 0.032$). There were no significant differences in technique for arterial access, final catheter sheath diameter, rate of successful arterial access, survival to removal of access sheath, hemodynamic stability, time to hemodynamic stability, or other interventions performed (Table 2).

In the univariate analysis, there were no statistically significant differences in the rate of complications, ICU or hospital length of stay, in-hospital mortality, or time to death (Table 3). There was a statistically significant difference in median discharge GCS (5.0 [3.0–15] vs 15 [6.0–15], $p = 0.011$) but no statistically significant difference in discharge GOSE (Table 3). After adjusting for potential confounding in the Poisson regression analysis, no statistically significant difference in complications was detected when comparing partial to complete REBOA [adjusted IRR (95% CI): 1.11 (0.54–2.27), $p = 0.777$]. This was also the case for all secondary outcomes (Table 4).

DISCUSSION

In our registry analysis, we found no statistically significant differences in any complications between patients who received partial REBOA and complete REBOA. This includes complications such as myocardial infarction, stroke, paraplegia, acute kidney injury requiring dialysis, distal embolism, need for amputation, and multi-organ dysfunction. There were also no statistical differences in ICU or hospital length of stay, discharge GCS or GOS, in-hospital mortality, or time to death.

These results were surprising given that several preclinical models have demonstrated that partial REBOA reduces ischemia-reperfusion injury and allows for longer balloon inflation time [14–16]. However, this study is subject to the inherent limitations of a retrospective multicenter registry of time-sensitive, life-saving interventions. One of the main limitations of this study is

Table 1 Demographics and clinical characteristics of REBOA patients.

	Complete Occlusion (N = 105)	*Partial Occlusion (N = 59)*	*p-Value*
Age, median [IQR]	40 [28–54]	33 [26–46]	0.017*
Missing, *n* (%)	1 (1.0)	0 (0.0)	
Sex, *n* (%)			0.544
Female	23 (21.9)	10 (16.9)	
Male	82 (78.1)	49 (83.1)	
Height (cm), median [IQR]	180 [170–180]	180 [170–180]	0.211
Missing, *n* (%)	28 (26.7)	8 (13.6)	
Weight (lbs), median [IQR]	180 [150–220]	180 [150–220]	0.686
Missing, *n* (%)	15 (14.3)	5 (8.5)	
Type of injury, *n* (%)			0.377
Blunt	70 (66.7)	44 (74.6)	
Penetrating	35 (33.3)	15 (25.4)	
Injury Severity Score, median [IQR]	29 [18–36]	26 [17–38]	0.923
Missing, *n* (%)	16 (15.2)	22 (37.3)	
Head AIS, *n* (%)			1.00
0	38 (36.2)	13 (22.0)	
1	4 (3.8)	1 (1.7)	
2	10 (9.5)	4 (6.8)	
Missing	53 (50.5)	41 (69.5)	
Thorax AIS, *n* (%)			0.361
0	20 (19.0)	6 (10.2)	
1	2 (1.9)	0 (0.0)	
2	8 (7.6)	5 (8.5)	
3	24 (22.9)	9 (15.3)	
4	11 (10.5)	8 (13.6)	
5	6 (5.7)	0 (0.0)	
Missing	34 (32.4)	31 (52.5)	
Abdomen AIS, *n* (%)			0.111
0	8 (7.6)	3 (5.1)	
1	2 (1.9)	0 (0.0)	
2	6 (5.7)	9 (15.3)	
3	24 (22.9)	11 (18.6)	
4	23 (21.9)	5 (8.5)	
5	16 (15.2)	8 (13.6)	
Missing	26 (24.8)	23 (39.0)	
Pelvic AIS, *n* (%)			0.414
0	20 (19.0)	5 (8.5)	
2	8 (7.6)	1 (1.7)	
3	7 (6.7)	5 (8.5)	
4	6 (5.7)	4 (6.8)	
5	8 (7.6)	3 (5.1)	
Missing	56 (53.3)	41 (69.5)	
Extremity AIS, *n* (%)			0.373
0	16 (15.2)	5 (8.5)	
1	13 (12.4)	8 (13.6)	
2	10 (9.5)	6 (10.2)	
3	20 (19.0)	8 (13.6)	
4	8 (7.6)	0 (0.0)	
5	7 (6.7)	4 (6.8)	
Missing	31 (29.5)	28 (47.5)	
Primary source of major hemorrhage, *n* (%)			0.030*
Head/neck (above clavicles)	0 (0.0)	5 (8.5)	
Chest (between clavicles and diaphragm)	12 (11.4)	3 (5.1)	
Abdomen	50 (47.6)	28 (47.5)	
Pelvis	19 (18.1)	10 (16.9)	
Extremities	9 (8.6)	5 (8.5)	
Missing	15 (14.3)	8 (13.6)	

(*Continued*)

	Complete Occlusion (N = 105)	*Partial Occlusion (N = 59)*	*p-Value*
First systolic blood pressure, median [IQR]	96 [76–120]	100 [86–130]	0.406
Missing, *n* (%)	25 (23.8)	16 (27.1)	
First heart rate, median [IQR]	110 [85–130]	120 [88–130]	0.773
Missing, *n* (%)	28 (26.7)	12 (20.3)	
First GCS, median [IQR]	14 [8.0–15]	12 [3.0–14]	0.025*
Missing, *n* (%)	32 (30.5)	10 (16.9)	
Prehospital CPR required, *n* (%)	9 (8.6)	10 (16.9)	0.126
Missing	0 (0.0)	1 (1.7)	
Admission systolic blood pressure, median [IQR]	81 [66–110]	90 [70–110]	0.168
Missing, *n* (%)	1 (1.0)	1 (1.7)	
Admission heart rate, median [IQR]	110 [88–130]	110 [81–130]	0.391
Missing, *n* (%)	2 (1.9)	1 (1.7)	
Admission GCS, median [IQR]	13 [3.0–15]	10 [3.0–14]	0.070
CPR in progress on arrival, *n* (%)	7 (6.7)	11 (18.6)	0.035*
Missing	1 (1.0)	0 (0.0)	
Trauma center level, *n* (%)			0.023*
I	104 (99.0)	54 (91.5)	
II	1 (1.0)	5 (8.5)	

The asterisk denotes statistical significance.
REBOA, resuscitative endovascular balloon occlusion of the aorta; IQR, interquartile range; AIS, abbreviated injury scale; GCS, Glasgow Coma Scale; CPR, cardiopulmonary resuscitation.

Table 2 Characteristics of interventions performed on REBOA patients.

	Complete Occlusion (N = 105)	*Partial Occlusion (N = 59)*	*p-Value*
REBOA indication, *n* (%)			0.079
Arrived in arrest/pulseless or arrested during emergency room evaluation	12 (11.4)	15 (25.4)	
Stabilization for transport to CT scan	23 (21.9)	17 (28.8)	
To stabilize the patient for transport to angiography or hybrid room for angiographic intervention	4 (3.8)	4 (6.8)	
To stabilize the patient for transport to the operating room	43 (41.0)	16 (27.1)	
To support bleeding control in planned surgical intervention	1 (1.0)	0 (0.0)	
Intraoperative REBOA placement in operating room for emergent surgery	18 (17.1)	7 (11.9)	
Missing	4 (3.8)	0 (0.0)	
Technique for arterial access, *n* (%)			0.627
Cut-down to facilitate direct visualization and access	8 (7.6)	6 (10.2)	
Fluoroscopic guided	1 (1.0)	0 (0.0)	
Percutaneous using external landmarks and palpation	26 (24.8)	17 (28.8)	
Ultrasound guided	70 (66.7)	32 (54.2)	
Missing	0 (0.0)	4 (6.8)	
REBOA location, *n* (%)			0.007*
Zone 1 (origin of left subclavian artery to the celiac artery)	63 (60.0)	48 (81.4)	
Zone 2 (celiac artery to the lowest renal artery)	1 (1.0)	0 (0.0)	
Zone 3 (lowest renal artery to the aortic bifurcation)	41 (39.0)	11 (18.6)	
Final catheter sheath diameter, *n* (%)			1.00
7 french	98 (93.3)	42 (71.2)	
8 french	2 (1.9)	0 (0.0)	
Missing	5 (4.8)	17 (28.8)	
Successful arterial access, *n* (%)	104 (99.0)	57 (96.6)	1.00
Missing	0 (0.0)	2 (3.4)	
Survival to removal of access sheath, *n* (%)	59 (56.2)	42 (71.2)	0.116
Missing	7 (6.7)	2 (3.4)	
Improved hemodynamics with aortic occlusion, *n* (%)	83 (79.0)	48 (81.4)	0.184
Missing	1 (1.0)	5 (8.5)	

(*Continued*)

Table 2 Characteristics of interventions performed on REBOA patients. (*Continued*)

	Complete Occlusion (N = 105)	*Partial Occlusion (N = 59)*	*p-Value*
Hemodynamic stability with aortic occlusion, *n* (%)	64 (61.0)	36 (61.0)	0.054
Missing	3 (2.9)	14 (23.7)	
Time from admission to hemodynamic stability (minutes), median [IQR]	32 [20–55]	30 [24–48]	0.821
Missing, *n* (%)	40 (38.1)	26 (44.1)	
Time from admission to definitive hemorrhage control (minutes), median [IQR]	74 [49–170]	60 [50–110]	0.222
Missing, *n* (%)	45 (42.9)	26 (44.1)	
Location after aortic occlusion, *n* (%)			0.882
CT scanner	20 (19.0)	14 (23.7)	
Intensive care unit	1 (1.0)	2 (3.4)	
Interventional radiology	3 (2.9)	2 (3.4)	
Operating room	47 (44.8)	27 (45.8)	
Patient did not survive beyond the emergency department	8 (7.6)	5 (8.5)	
Missing	26 (24.8)	9 (15.3)	
Additional interventions, *n* (%)			
Craniectomy or craniotomy	1 (1.0)	0 (0.0)	1.00
Thoracotomy	10 (9.5)	8 (13.6)	0.444
Exploratory laparotomy	67 (63.8)	37 (62.7)	1.00
Hepatic packing	15 (14.3)	12 (20.3)	0.381
Hepatic resection	2 (1.9)	1 (1.7)	1.00
Embolization of liver	3 (2.9)	3 (5.1)	0.668
Splenectomy	16 (15.2)	10 (16.9)	0.825
Bowel resection	23 (21.9)	13 (22.0)	1.00
Pelvic packing	25 (23.8)	9 (15.3)	0.232
Pelvic external fixation	15 (14.3)	2 (3.4)	0.032*

The asterisk denotes statistical significance.
REBOA, resuscitative endovascular balloon occlusion of the aorta; CT, computed tomography; IQR, interquartile range.

Table 3 Crude outcomes in REBOA patients.

	Complete Occlusion (N = 105)	*Partial Occlusion (N = 59)*	*p-Value*
Any complication, *n* (%)	32 (30.5)	13 (22.0)	0.327
Myocardial infarction, *n* (%)	1 (1.0)	1 (1.7)	1.00
Stroke, *n* (%)	0 (0.0)	1 (1.7)	0.360
Paraplegia, *n* (%)	3 (2.9)	0 (0.0)	0.554
Acute kidney injury requiring dialysis	11 (10.5)	7 (11.9)	1.00
Acute lung injury or ARDS	14 (13.3)	5 (8.5)	0.450
Distal embolism, *n* (%)	3 (2.9)	1 (1.7)	1.00
Need for amputation, *n* (%)	2 (1.9)	0 (0.0)	0.537
Bacteremia, *n* (%)	2 (1.9)	3 (5.1)	0.352
Pneumonia, *n* (%)	9 (8.6)	4 (6.8)	0.772
Infection requiring antibiotics only, *n* (%)	2 (1.9)	0 (0.0)	0.537
Infection requiring surgical intervention, *n* (%)	0 (0.0)	1 (1.7)	0.360
Sepsis, *n* (%)	6 (5.7)	2 (3.4)	0.712
Multiorgan dysfunction, *n* (%)	6 (5.7)	4 (6.8)	0.748
ICU length of stay (days), median [IQR]	2.5 [0.00–8.8]	3.0 [1.0–8.0]	0.249
Missing, *n* (%)	3 (2.9)	14 (23.7)	
Hospital length of stay (days), median [IQR]	9.0 [1.0–22]	8.0 [1.0–20]	0.986
Missing, *n* (%)	3 (2.9)	5 (8.5)	
Discharge GCS, median [IQR]	5.0 [3.0–15]	15 [6.0–15]	0.011*
Missing, *n* (%)	25 (23.8)	22 (37.3)	
Discharge GOSE, median [IQR]	1.0 [1.0–5.0]	2.0 [1.0–5.0]	0.430
Missing, *n* (%)	53 (50.5)	42 (71.2)	
In-hospital mortality, *n* (%)	48 (45.7)	26 (44.1)	1.00
Missing	1 (1.0)	4 (6.8)	

(*Continued*)

	Complete Occlusion (N = 105)	*Partial Occlusion (N = 59)*	*p-Value*
Time from admission to death (hours), median [IQR]	2.0 [1.0–4.0]	3.0 [2.0–4.0]	0.337
Mortality location, *n* (%)			0.320
Emergency room	8 (7.6)	6 (10.2)	
Operating room	22 (21.0)	7 (11.9)	
Ward	1 (1.0)	0 (0.0)	
ICU	17 (16.2)	13 (22.0)	
Missing	57 (54.3)	33 (55.9)	

The asterisk denotes statistical significance.
REBOA, resuscitative endovascular balloon occlusion of the aorta; ARDS, Acute Respiratory Distress Syndrome; IQR, interquartile range; ICU, intensive care unit; GCS, Glasgow Coma Scale; GOSE, Glasgow Outcome Scale Extended.

Table 4 Association between type of occlusion (partial vs complete) and adverse outcomes.

Outcome	*IRR (95% CI)*	*p-Value*
Complications	1.11 (0.54–2.27)	0.777
In-hospital mortality	0.86 (0.53–1.39)	0.532
GCS ≤8	0.83 (0.52–1.34)	0.455
GOSE ≤4	0.91 (0.64–1.30)	0.612
	Change in Median (95% CI)	
Hospital length of stay (days)	1.11 (–7.88–10.10)	0.809
ICU length of stay (days)	1.00 (–1.95–3.95)	0.506
Time to death (hours)	0.17 (–1.93–2.27)	0.874

IRRs are calculated using Poisson regression models with robust standard errors. Change in median is calculated using quantile regression models. All analyses are adjusted for age, sex, type of injury, REBOA location, Abbreviated Injury Scale in all regions, primary source of major hemorrhage, and cardiopulmonary resuscitation being in progress on arrival.
REBOA, resuscitative endovascular balloon occlusion of the aorta; IRR, incidence rate ratio; CI, confidence interval; GCS, Glasgow Coma Scale; GOSE, Glasgow Outcome Scale Extended; ICU, Intensive Care Unit.

that important clinical metrics including information on duration and type of partial REBOA were not fully characterized in the AAST AORTA registry. In addition, more than 40% of patient entries were missing time to definitive hemorrhage control data. Taken together, the omission of these key metrics and lack of granularity hinders investigators' ability to fully interpret and draw conclusions from the registry. This missing data is key for understanding clinical efficacy as it is well established that longer periods of occlusion are associated with increased complications [9,16]. The absence of complete and in-depth data poses additional challenges for researchers, as patient data points are missing from various, inconsistent areas, creating a highly heterogeneous database.

Despite several preclinical studies showing improved outcomes with partial REBOA, there is limited clinical data to advocate its use. In an analysis of the Aortic Balloon Occlusion (ABO) trauma registry, Paran et al. found no difference in mortality among patients who underwent partial vs complete occlusion of the aorta [17]. The results of our study support these findings in that there was no significant difference between partial and complete occlusion groups both for complications and mortality. Further clinical evidence is warranted to define the superiority of partial REBOA over complete REBOA.

Most notably, the aortic occlusion strategy was self-reported by the centers along with type of balloon used (i.e. Prytime ER-REBOA or p-REBOA PRO) and it lacks the granularity to determine how clinicians were implementing partial REBOA. This includes no information regarding their balloon volume titration strategy or distal pressure targets. Further, reported balloon placement was confirmed by plain film, albeit inconsistently, or in rare cases with computer tomography (CT) fluoroscopy. Understanding the method of partial REBOA titration is critical because small changes in balloon volume can cause large changes in flow downstream [18]. Depending on how the balloon is titrated, it is possible to induce an intermittent occlusion phenomenon in which downstream flow is either completely arrested or fully restored. This is in contrast to partial occlusion as is intended, with only 10–20% of downstream flow allowed. The differences between partial and intermittent REBOA can be subtle to the provider at the bedside, but can certainly impact hemodynamics and overall hemorrhage control. Without high-fidelity hemodynamic data, such differences are difficult to tease out.

The above referenced 10–20% of downstream flow allowed is based on pre-clinical research involving the use of partial REBOA [18–21]. While there is no universally fixed definition, this range is a widely accepted

target that balances the need for aortic occlusion while preserving some distal perfusion. In preclinical animal models, direct measurement of downstream flow has been achieved using flow probes that are capable of precise flow measurements. In clinical settings, direct measurement of downstream flow is more difficult but can be estimated by distal pressure targets and Doppler ultrasound. There are several preclinical studies that seek to correlate downstream flow to the distal mean arterial pressure (MAP) below the balloon [18,19,22–24]. These studies demonstrate a fairly linear relationship of distal MAP to flow across various states of hypovolemic shock. Given the lack of granularity in the AORTA registry, and the inability to provide direct flow measurements in a clinical context, this data does not exist.

Without a comprehensive understanding of downstream flow and more precise accounting of relevant variables, the conclusions we can draw are limited. This realization should serve as a caution regarding the limitations inherent in this registry, which is particularly relevant given that many REBOA studies utilize the AORTA registry. While some studies may be designed to address the data shortcomings, others may not, especially when describing outcomes directly related to distal ischemia, as in our present paper. Our data sheds light on the need for improving the granularity of the AAST AORTA registry and reaching a consensus on the definition of partial REBOA, which will allow for better analysis and interpretation of REBOA groups.

Finally, while there were no statistically significant differences for indication between the partial REBOA vs the complete REBOA groups, the indication for use is widely varied. These indications include arrival to the emergency department in arrest, hemodynamic stabilization for additional workup with cross-sectional imaging, transport to the operating room or interventional radiology suite, placement of REBOA intraoperatively for emergency surgery, and placement for planned elective surgery. Increasing the sample size in the registry and completeness of the database will allow us to better analyze these vastly different indications to help determine which patient populations might benefit from the use of endovascular hemorrhage control devices.

CONCLUSION

In conclusion, endovascular technologies such as REBOA have emerged as a valuable tool in the management of NCTH; however, its use remains controversial due to associated morbidity and uncertainty about which patient groups will benefit. While some preclinical studies have demonstrated that partial REBOA can reduce ischemia reperfusion injury, in our registry analysis we found no statistically significant difference in complications between patients who received partial or complete REBOA. These findings may suggest that the observed reduction in ischemic injury in preclinical studies may not necessarily translate to a decrease in patient complications. However, the current body of clinical data falls short in providing the nuanced insights required to address these crucial questions. To understand which patient populations will benefit from these devices and how to best implement them, we need to improve the granularity of the data from which we are studying them. Ultimately, this study is a call for increased enrollment in the database, commitment to data integrity, and attention to detail in recording patient variables.

Ethics Statement

(1) All the authors mentioned in the manuscript have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.
(2) The authors declare that they have read and abided by the JEVTM statement of ethical standards including rules of informed consent and ethical committee approval as stated in the article.

Conflicts of Interest

AJ, LPN, and TKW are co-founders and shareholders of Certus Critical Care, Incorporated. All other authors declare no conflicts of interest.

Funding

No financial support or funding was received for the presented work.

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Case Report

Vol. 8, No. 2; 2024; pp 58–61
DOI: https://doi.org/10.26676/jevtm.24646

Management of Failing Coils During Embolization of Intracranial Aneurysms: A Case Report and a Review of the Literature

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Coils failing through processes such as unraveling, fracturing, and distal migration are rare during embolization of intracranial aneurysm, but these intraoperative complications might lead to serious consequences. Although several rescue techniques have been reported, the standard technique remains unclear. Herein, we report a case pertaining to removing a failing coil by a simple and economical measure. Literature on the concerned topic was also reviewed. Based on the literature, rescue techniques are classified into two types: removing the failing coils; and keeping the failing coils steady in the blood vessel by applying some appropriate measures. The former type consists of twisting, gripping, aspiration, and wedging techniques, whereas the latter includes stent-compressed techniques and end-fixing techniques.

Keywords: *Intracranial Aneurysm; Failing Coils; Rescue Technique*

Received: 26 May 2024; Accepted: 25 June 2024

INTRODUCTION

Endovascular therapy is an increasingly popular and minimally invasive option for patients with intracranial aneurysms. Coils failing through processes such as unraveling, fracturing, and distal migration are rare during embolization of intracranial aneurysm, but these complications might lead to serious consequences. Cerebral infarction is the most obvious complication. Some studies have introduced several remedies to deal with failing coils [1–5], but the optimum method remains unclear.

Recently, we retrieved a failing coil successfully using a simple and economical method which we termed as a "wedging technique." We report the details as follows.

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CASE REPORT

A 75-year-old man with headache was diagnosed with a right intracranial aneurysm (12 mm × 17 mm in size) located in the posterior communicating artery (PcomA) segment of the internal carotid artery (ICA). Coiling for the aneurysm was planned. Under general anesthesia, the patient received systemic heparinization. Afterwards, with the guidance of the guidewire (Terumo Corporation, 0.035 inch), the guiding catheter (6F ENVOY® DA, Cerenovus Corporation, inner diameter 0.071 inch) was navigated into the petrous segment of the right ICA. A stent microcatheter (Cerenovus Corporation, PROWLER Plus, the distal outer diameter 2.3 F/0.030 inch) was placed into the right middle cerebral artery. A coil delivery microcatheter (ev3TM Corporation, Echelon 14) was then navigated into the aneurysm sac. It went well until the tenth coil (Jasper Corporation, 3D 10 mm × 30 cm) was being positioned. The tenth coil was stretched. Retrieving the unraveled coil was attempted but was unsuccessful. The unraveled coil was then fractured, and the coil delivery microcatheter was removed. X-ray fluoroscopy showed that the distal portion of the failing coil was located in the aneurysm sac and a proximally stretched portion was located in the guiding catheter. We planned to wedge the failing coil in the guiding catheter with the stent microcatheter and guidewire (Terumo Corporation, 0.035 inch), subsequently withdrawing them as a

single unit. As expected, the failing coil was wedged firmly in the guiding catheter and retrieved successfully (Figure 1). This simple and economical method was named a "wedging technique." After receiving endovascular treatment, the patient developed no complications.

Ethical Approval and Informed Consent

The study design was approved by Medical Ethics Committee of the Chengdu Second People's Hospital. Informed consent was obtained from the patient for publication of this case report and accompanying images.

LITERATURE REVIEW

Several other rescue techniques have been reported, so literature on the concerned topic was searched on the PubMed database and critically reviewed. Based on the literature [1–12], rescue techniques are classified into two types: removing the failing coils; and keeping the failing coils steady in the blood vessel by applying some appropriate measures. The former type consists of twisting, gripping, aspiration, and wedging techniques, whereas the latter includes stent-compressed techniques and end-fixing techniques. The techniques are described in Table 1. Figure 2 presents a vivid depiction of the techniques of twisting and wedging.

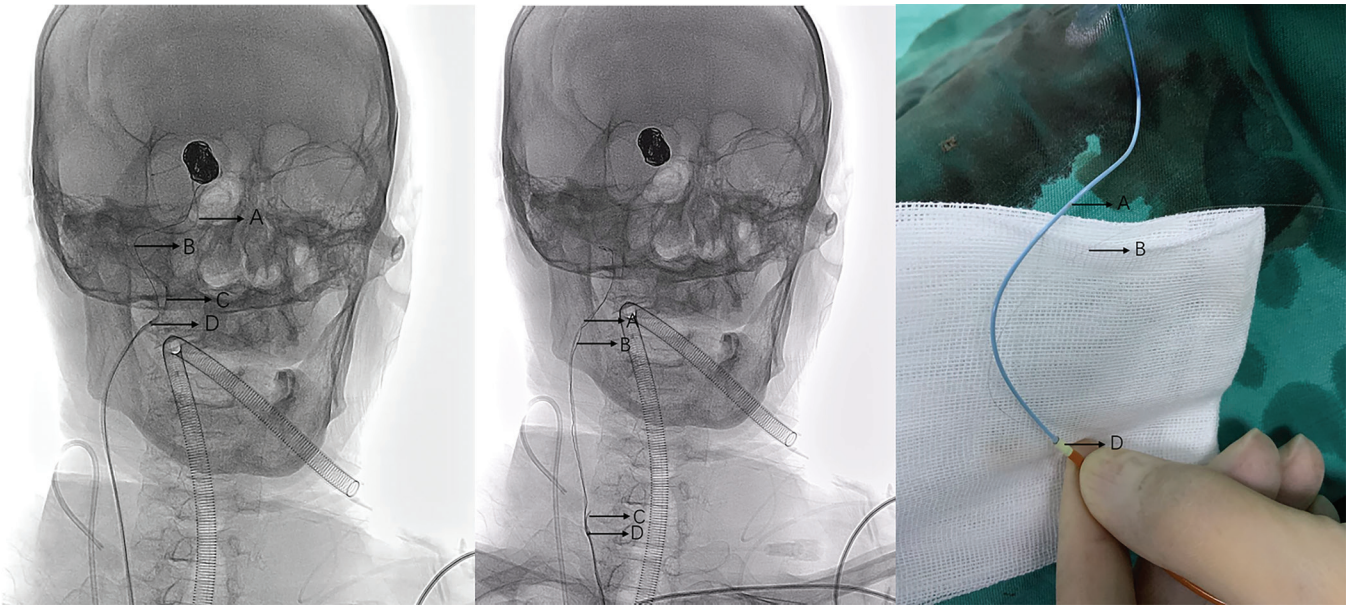

Figure 1 The failing coil was wedged in the guiding catheter (inner diameter 0.071 inch) with the microcatheter (the distal outer diameter 2.3F/0.030 inch) and the terumo guidewire (0.035 inch). Finally, all were withdrawn successfully as a single unit. Labels A, B, C, and D indicate the microcatheter, failing coil, terumo guidewire, and guiding catheter, respectively.

Table 1 Several rescue techniques to deal with failing coils.

Technique	*Description*
Removing the failing coils	
Twisting	Twisting the tip of a microcatheter or microwire to entwine a failing coil and then retrieving them as a single unit (Figure 2)
Gripping	Pulling back a failing coil by the loop of the goose neck snare, a device which was initially designed to retrieve and manipulate foreign objects in the cardiovascular system or hollow viscus
	Gripping a migrated coil using a handmade microwire-snare device, made from a microcatheter, microwire, and silk thread (Figure 3)
	Gripping a failing coil using a stent device, mimicking mechanical thrombectomy in ischemic stroke
	Gripping a failing coil in a chopstick-like manner using a magnetic device, comprising two microwires characteristic of small magnetic rings near to the tips
Aspiration	Aspirating a failing coil, mimicking mechanical thrombectomy in ischemic stroke
Wedging	Wedging a failing coil in a guiding catheter with microcatheters or guidewires, and withdrawing as a single unit
Retaining the failing coils	
Stent-compressed	Compressing the coil between a stent and vascular wall
End-fixing	Fixing the loose end of the coil at the distal end of the external carotid artery
	Fixing the loose end of the coil at the puncture site of the artery

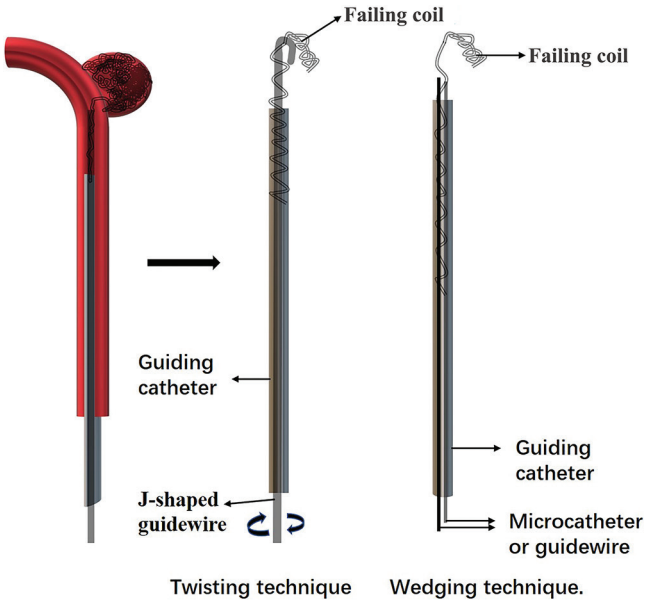

Figure 2 Vivid depiction of the techniques of twisting and wedging.

DISCUSSION

Unraveling, fracturing, or distal migration of coils are rare but challenging complications during intracranial aneurysm embolization. Inappropriate management of these complications likely leads to catastrophic consequences, such as cerebral infarction. However, the optimum method to deal with these complications remains unclear.

In our case, the failing coil was retrieved successfully using a wedging technique. The devices we used to retrieve the failing coil were already being used intraoperatively. As there were no extra devices, this technique is very economical. The process of wedging and retrieving is also simple and feasible.

Several other techniques to remove the failing coils have been reported in the literature. Mimicking mechanical thrombectomy in ischemic stroke, removing the failing coils based on a stent device [2,9] or aspiration device [4,10] is a good modality. However, this technique has a high risk of endothelial injury of cerebral vessels [3,13]. Another disadvantage of this modality is that the stent or aspiration devices are expensive.

The twisting technique is an approach where the tip of a microcatheter or a microwire is twisted to entwine a failing coil firmly and all of the parts are then retrieved as a unit (Figure 2) [6,7]. However, maneuvering in this manner seems to be difficult in clinical practice. He and colleagues [1] reported that a handmade microwire-snare device was used to remove a migrated coil. The handmade device was composed of a microcatheter, microwire, and silk thread (Figure 3). It is true that the handmade snare is economical, but the microwire and microcatheter are so smooth that the snare is likely to be unstable and the thread probably slips easily, which can lead not only to failure of capture, but also have a risk of the thread slipping into cerebral vessels. A magnetic

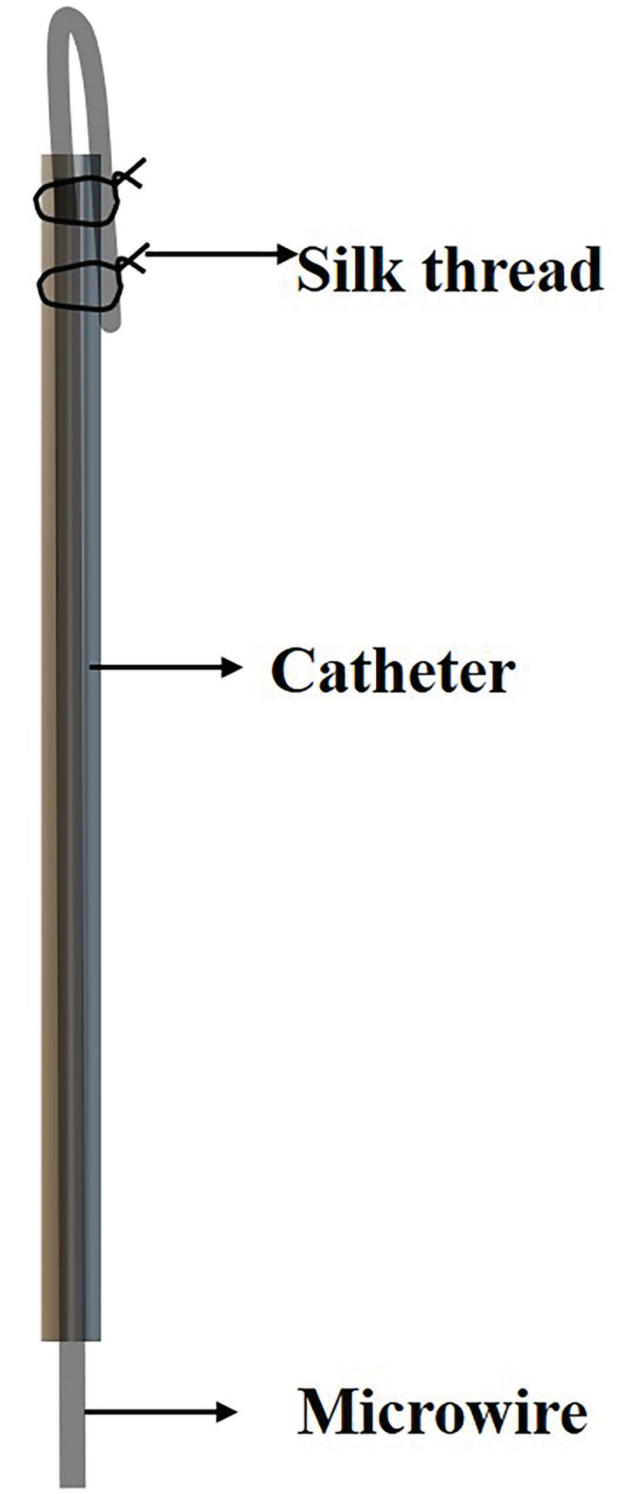

Figure 3 Handmade microwire-snare device, made from a microcatheter, microwire, and silk thread.

device which consists of two microwires with small magnetic rings near to the tips was developed to catch a target coil in a chopstick-like manner in an animal test [3]. However, the "chopsticks" are long and soft, so that we do not think it is easy to control the "chopsticks."

Although retrieving failing coils is the best strategy, retrieval is not always possible. If coil retrieval cannot

be achieved, some measures should be taken to keep the failing coils steady. Compressing the coil between a stent and vascular wall is likely to be a good option [11]. If the loose end of a failing coil is long and a stent-compressed technique is not applicable, fixing the end at the distal part of the external carotid artery [5] or at the puncture site of the artery [12] is an alternative method. Patients with failing coils retained in the cerebral vessel tend to receive antiplatelet therapy to prevent thromboembolic complications.

CONCLUSION

This study suggests that a wedging technique is the simplest and most economical procedure and should be considered as the primary technique. Other rescue techniques might be alternative options when the wedging technique is not applicable.

Ethics Statement

(1) All the authors mentioned in the manuscript have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.
(2) The authors declare that they have read and abided by the JEVTM statement of ethical standards including rules of informed consent and ethical committee approval as stated in the article.

Conflicts of Interest

The authors declare that there is no conflict of interest.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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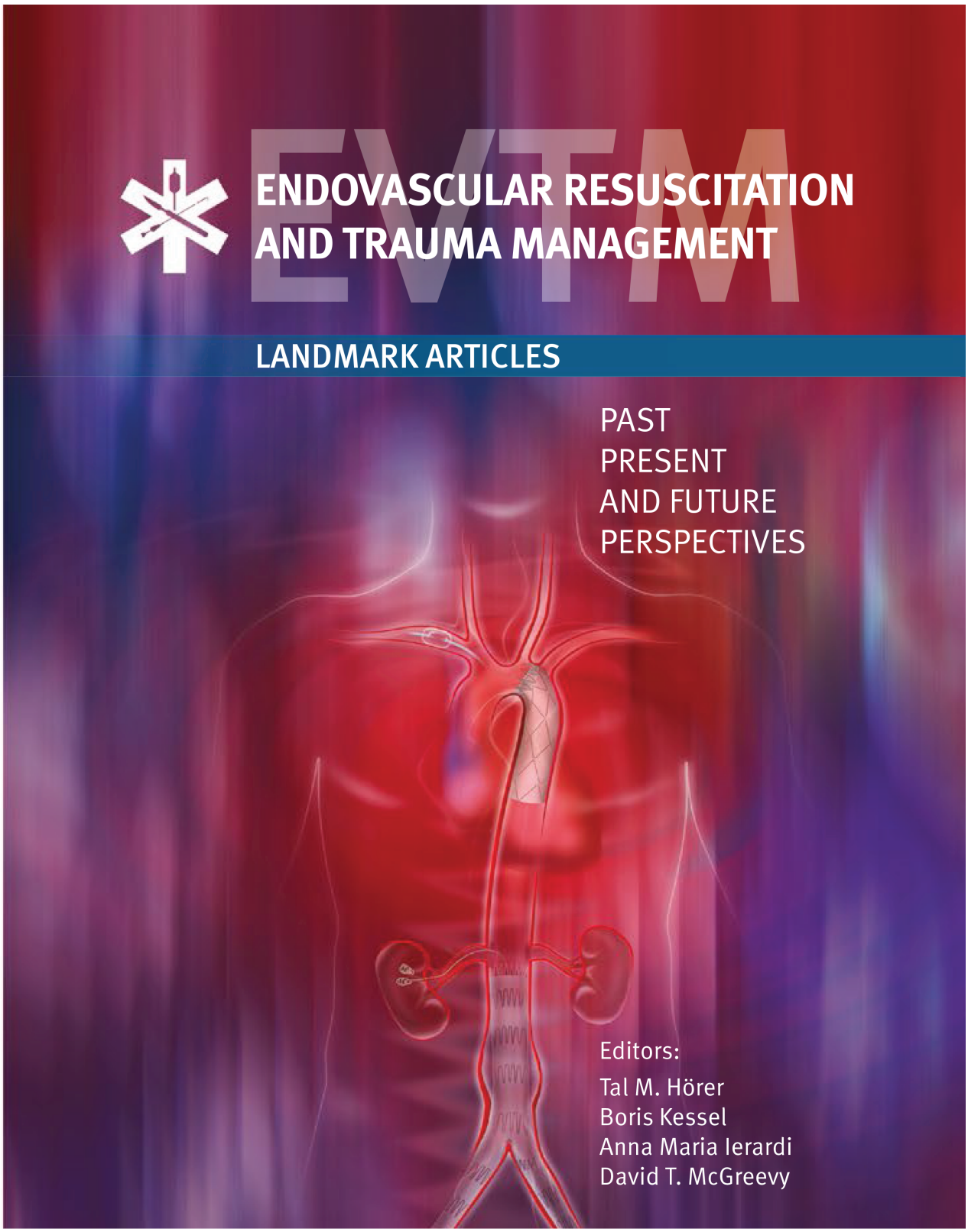

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EndoVascular resuscitation and Trauma Management – Specialists in Training (EVTM-ST) is a newly formed group within the EVTM Society and EVTM Council who represent the interests of trainees, especially with regards to training, education, research and exchange programmes.

One of the main EVTM-ST events is the monthly multidisciplinary international case discussions on Zoom. An appreciated concept with focus on allowing the participating trainees to discuss a presented EVTM case, with only one consultant present for guidance. Participants are from all around the world, from various disciplines and with different levels of experience. We have great discussions, exchange of knowledge and hear about different local experiences that everyone can learn from.

If you are interested in joining the EVTM-ST case discussions,

please email: david.mcgreevy@regionorebrolan.se

Coming Meetings

ESVS 38th Annual Meeting 2024, 24–27th September 2024, Kraków, Poland
https://esvs.org/events/annual-meeting/annual-meeting-2024/

EVTM Workshop 16th October 2024, Örebro, Sweden
https://jevtm.com/workshop/

9th EVTM Symposium 17–19th October 2024, Örebro University Hospital, Sweden
https://jevtm.com/evtm-symposium/

VEITH Symposium, 19–23rd November 2024, New York
https://www.veithsymposium.org/index.php

25th Congress of the Asian Society for Vascular Surgery (ASVS 2024), 3–6th December 2024, Bangkok, Thailand
https://asvs2024.com/

Paris Vascular Insights Course, 12–14th December 2024, Paris, France
https://www.paris-vascular-insights.com/

Leipzig Interventional Course (LINC) 20th Anniversary Congress, 28–30th January 2025, Leipzig, Germany
https://www.leipzig-interventional-course.com/

24th European Congress of Trauma and Emergency Surgery, 13–15th April 2025, Aachen, Germany

47th Annual CX Symposium, 23–25th April, 2025, London, UK
https://www.cxsymposium.com/

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https://ssvs.nu/event/ssvs-nationella-mote-2025-goteborg/

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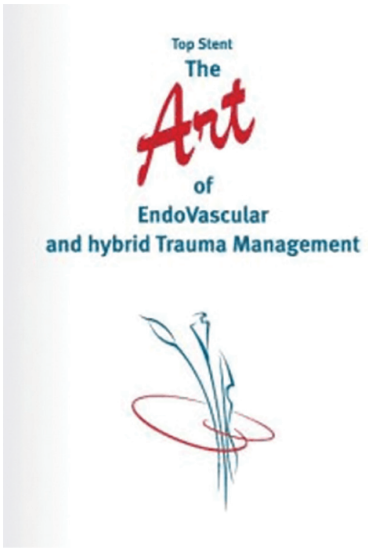

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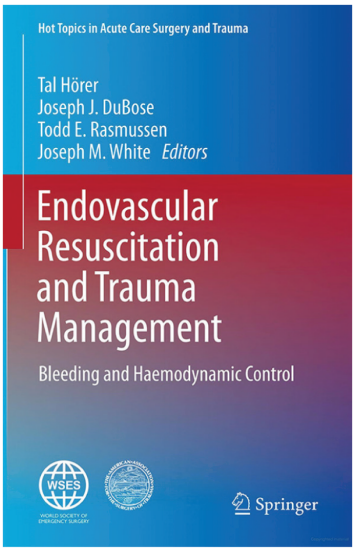

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EndoVascular resuscitation *and* Trauma Management (EVTM)

Hands-on Workshop

Örebro University Hospital, Sweden 16th October 2024

EndoVascular Resuscitation and Trauma Management

EVTM instructors

Chance Spalding (Trauma, US), Frank Plani (Trauma, ZA), Boris Kessel (Trauma, IL), Joakim Jörgensen (Vasc, NR), Andreu Martinez H (Prehosp, Sp), Josep Chorro (Prehosp, Sp), Artai Pirouzram (Vasc, SE) Adenauer Góes Jr (Vasc, BR), Federico Cocolini (Trauma, IT).

Local team: Tal Hörer, David McGreevy, Kristofer Nilsson, Nina Adolfsson, Rami Hammadi, Johan Josefsson, Jonas Berlin, Ida Liljeholm

Target: Surgeons, Vascular, IR, ED, Intensivists, Trauma, Civilians and Military with interest in trauma/bleeding/resuscitation, emergency & pre-hospital teams

Date: 16/10 2024

Workshop Directors: Tal Hörer and David McGreevy

Workshop Registration: lotta@mkon.se or hilda@mkon.se

Cost (cover expenses only): 500Eu. 400Eu for EVTM Society members

Place: Facility for experimental studies and surgical training, Örebro University Hospital.

Partners: See partner list on EVTM symposium site via www.jevtm.com

The aim of this one-day workshop is to train, stimulate discussion, **mutual learning and sharing** of experiences while practicing EndoVascular resuscitation *and* Trauma Management (EVTM) using a multidisciplinary team approach with emphasis on local resources. “No ego, just good science, care and collaboration” is the main motion of the event. We are all here to share, learn and develop, for our patients.

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The workshop is built on an individual, professional level and we will together explore different methods for resuscitation, bleeding control, hemostasis, trauma management and bail-outs. Some methods are used clinically world-wide, while some are under development and have been used on selected patients. This workshop concentrates on basic and advanced aspects of *open and endovascular* bleeding control techniques. We will combine open hemostasis and endo aspects with vascular access, angiography, embolization, endografts, shunts and other endo/hybrid solutions for the unstable patient. Hemodynamic instability with a focus on trauma, non-trauma, bleeders and non-bleeders. From ruptures to gastrointestinal and gynecological bleeders with a wide range of hemodynamic instabilities in focus. We will explore how methods used by some disciplines can be used by others.

We will focus on clinical data and lessons learned from more than 20 years use of these methods in clinical practice.

- Vascular access:
  - Different methods (blind, doppler, ultrasound, fluoroscopy and cut down)
  - Its use in hemodynamic unstable patients
- Aortic Balloon Occlusion (REBOA) basic and advanced methods and SAAP
- Basic/advanced angiography principles and practical tips
- Damage control EVTM and bailout methods – open, endo and hybrid
- Maintaining and closing a vascular access
- Basic and advanced postoperative considerations
- Up-to-date research and clinical experience
- Cases/discussions
- Knowledge of basic/advanced material and new technologies on the market
- Endografts, embolization material on the market, and what to use and when
- Open and endo/hybrid hemostasis. From junctional bleeding to rAAA
- Intensive training on live tissue
- ICU and post-operative aspects (such as IAH and ACS and its treatment)
- Basics for building an “EVTM service”; tools needed
- Advanced experimental methods in resuscitation using REBOA and ECMO with CPR on live tissue models.
- When should we choose open surgery and stop playing with endo?

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The workshop is individually tailored during the practical parts (advanced and basic as needed). Participants will get basic training and knowledge of vascular access, angiography, endografts, embolization and REBOA placement and other basic catheters and hybrid tools as part of the EVTM concept. This will be combined with open techniques and bleeding control maneuvers. The workshop has been certificated by the EACCME and acknowledged by collaboration with societies such as the European Society for Trauma and Acute Care Surgery, the European Vascular Society and others.

08:00 meeting in the training center ("Technical house" near the CAMPUS USÖ)- instructions will be sent by mail to the participants.

Introduction on EVTM and agenda of the day- Tal Hörer and David McGreevy

08:30–09:00 Breakfast with the industry.

Hands-on animal lab including:

Every station is led by a highly experienced instructor with one-to-one training on live tissue as well as group scenario discussions (lunch and coffee will be served in the lab). Changing stations according to interest is encouraged. Dedicated stations per discipline/area according to the groups.

Practical training points in the animal lab:

1. Material usage in bleeding patients, general considerations and management scenarios
2. Open techniques for bleeding control/hemostasis and combinations with endo/hybrid.
3. Vascular access
    - Basic principles/advanced methods
    - Cut-down techniques
    - Endoshunts and shunts
    - Hybrid procedures
    - Puncture methods
    - Seldinger technique
    - The failing access – alternatives
    - Venous access and ultrasound
    - Basic and advanced methods
4. Upgrading/introducers/guide wires
5. REBOA
    - Material and REBOA kit
    - Deflation and re-positioning
    - Intermittent/partial inflation (MAP as target – iREBOA/pREBOA)
    - Ongoing bleeding practice
    - CPR procedures and pending arrest
6. Balloon in alternate locations (Iliac, Subclavian, Brachiocephalic trunk/Zone 1 neck)

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7. Hybrid procedures for hemostasis – junctional bleedings, balloons/exchange
8. Aortography and angiography considerations (type, volume, etc.)
9. Endografts/embolization advanced as needed – what, when, how
10. Junctional bleedings- solutions
11. Bailouts in endovascular and hybrid surgery

All training aspects will be modified to the participants' level and interest.

15:00 End of workshop and evaluation/feedback; Diploma

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9th EVTM Symposium

HOT TOPICS in EndoVascular resuscitation and Trauma Management

Symposium chairs:

Charles Fox (Vasc, US), Boris Kessel (Surgery, IL), Anna Maria Ierardi (IR, IT)

Scientific committee:

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David McGreevy (Vasc, SE), Kristofer Nilsson (ICU, SE), Chuck Fox (Vasc, US), Anna Maria Ierardi (IR, IT),
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Stacy Plotkin (Vasc, US)

Local organizing committee:

Tal Hörer, David McGreevy

(IR- Interventional Radiology, Surg- Surgery/trauma, Vasc- Vascular Surgeon, ICU- Intensive care, intensivist, Anesthesia and pre-hospital, Ort- Orthopedics, Emerg- Emergency medicine/pre-hospital)

Thursday October 17th	
07.00	**Registration opens / Coffee and industry exhibition**
Opening session: EVTM in modern bleeding care current international trends and developments 6 min talk + 4 min discussions **Chairs**: Anna Maria Ierardi (IR, IT), Laura Moore (Surg, US) and Chuck Fox (Vasc, US) **Panelists:** Mansoor Khan (Surg, UK), Elina Quiroga (Vasc, US), Erica Mitchell (Vasc, US), Anahita Dua (Vasc, US), Lionel Lamhaut (ICU, FR), Zoran Rancic (Vasc, CH)	
07.45	Opening remarks – Boris Kessel (Surg, IL) and Chuck Fox (Vasc, US) Greetings from the local committee – David McGreevy (Vasc, SE)
08.00	**Keynote lecture (**20 minutes)**:** Decreasing Time to Hemostasis in a Trauma Hybrid OR – Laura Moore (Surg, US)
08.20	EVTM Worldwide practice updates in trauma and non-trauma – Where are we now and future aspects – Tal Hörer (Vasc, SE)
08.30	Non-Operative Management in bleeders (Trauma) – should we be more conservative? And when endo? – Joakim Jorgensen (Vasc, NR)
08.40	Endovascular resuscitation in Japan. Experience and Current trends – Yosuke Matsumura (ICU, JP)
08.50	South African experience and trends in bleeding care. Where do we stand? Can endo help us? – Frank Plani (Surg, ZA)
09.00	Current trends in interventional radiology for bleeding control, what's new and what's coming? – Anna Maria Ierardi (IR, IT)
09.10	Current developments in emergent (bleeders) vascular surgery in the US. Where do we stand? – Greg Magee (Vasc, US)
Session 2: Endo and hybrid tools and techniques for bleeding trauma patients what to use, when and how 6 min talk + 4 min discussion **Chairs**: Greg Magee (Vasc, US), Erica Mitchell (Vasc, US) **Panelists:** Pirkka Vikatmaa (Vasc, FI), Mansoor Khan (Surg, UK/UEA), Elina Quiroga (Vasc, US), Artai Pirouzram (Vasc, SE)	
09.20	**Keynote lecture (**20 minutes)**:** Past, present, and future techniques for open, endo and hybrid hemorrhage control. How, when and what to use? – Ernest Moore (Surg, US)
09.40	Extremity trauma: Is it still only open surgery? When endo? Examples – Chuck Fox (Vasc, US)
09.50	Visceral bleeding: When to choose endo or hybrid surgery? Endografts/Colis and more – Erica Mitchell (Vasc, US)
10.00	Embolization in trauma – When and how to do it? How to choose and use? – Maria Antonella Ruffino (IR, IT)
10.10	Endovascular thrombectomy – Is it taking over? When and when not? When open thrombectomy? – Anahita Dua (Vasc, US)
10.20	Endografts for visceral and peripheral bleeders – How to choose, how to use and what to know? – Greg Magee (Vasc, US)
10.30	Best Current Management of Pediatric Vascular Injuries: When Conservative; When Open; Endo? – Elina Quiroga (Vasc, US)
10.40	**Coffee mingle and industry exhibition**
Session 3: Advancements for bleeding patients (trauma and non-trauma) and technological developments 6 min talk + 4 min discussion **Chairs**: Ernest Moore (Surg, US), Erica Mitchell (Vasc, US) **Panelists:** Mario D'oria (Vasc, IT), Joakim Jorgensen (Vasc, NR), Maria Antonella Ruffino (IR, IT), Peter Hilbert-Carius (ICU, DE), Mansoor Khan (Surg, UK)	
11.10	What is new/different in endovascular resuscitation 2024? From pre-hospital to the ICU – Jonny Morrison (Vasc, US)
11.20	What is new in imaging for bleeding patients? CT, Hybrid suites and upcoming products – Anna Maria Ierardi (IR, IT)
11.30	Hybrid / Semi-hybrid rooms: Where and who should have them, what to invest in and how to use them? – Greg Magee (Vasc, US)
11.40	REBOVC (Vena Cava Balloon) in Juxtahepatic Venous bleeding. Experimental data and can it be used? – Maria Wikström (Surg, SE)
11.50	Non-traumatic visceral bleeding and endo management (coils? Endografts?); When and how? – Anahita Dua (Vasc, US)
12.00	OB-GYN bleeding and endo tools – what, when and how? What to use? – Maria Antonella Ruffino (IR, IT)
12.10	When to take a bleeding patient to CT (yes you can!) and when not? Semi and unstable patients? – Erica Mitchell (Vasc, US)
12.20	CT-first resuscitation protocol for severe trauma in hybrid ER; Japanese experience – Satomi Seno (IR, JP)

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Session 4: Education of the future trauma and vascular surgeon Joint EVTM session with the European Society for Trauma & Emergency Surgery (ESTES) 6 min talk + 4 min discussion **Chairs**: Joakim Jorgensen (Vasc, NR), Carl Montan (Vasc, SE) **Panelists:** Paul Puchwein (Ort, AT), Juan Duchesne (Surg, US), Jonny Morrison (Vasc, US), Khatereh Djavani Gidlund (Vasc, SE)	
12.30	What have we learnt in trauma and education? Team up with the vascular people? My view – Joakim Jorgensen (Vasc, NR)
12.40	Do we need vascular surgeons for traumatic/non-trauma bleeders/ECMO? How to team up and educate? – Carl Montán (Vasc, SE)
12.50	Vascular surgeons should be educated in trauma and vice versa? How to build good collaboration? – Carl Wahlgren (Vasc, SE)
13.00	Abdominal compartment syndrome? How not to miss it? How to follow, treat and educate residents? – Boris Kessel (Surg, IL)
13.10	Vascular trauma open and endo aspects in modern times – how do we educate future surgeons? – Juan Duchesne (Surg, US)
13.20	Beyond blood in bleeders and educational issues in trauma – Mansoor Khan (Surg, UK)
13.30	Specialists in Training corner – Intersociety collaboration to promote education Y-ESTES and EVTM-ST – Gabriele Bellio (Surg, IT)
13.40	**Lunch**
Session 5: EVTM "survival games" Endo vs. Open or maybe hybrid? 6 min talk + 4 min discussion **Chairs**: Stacy Plotkin (Vasc, US) and David McGreevy (Vasc, SE) **Panelists:** Joakim Jorgensen (Vasc, NR), Zoran Rancic (Vasc, CH), Per Skoog (Vasc, SE), Khatereh Djavani Gidlund (Vasc, SE)	
14.30	Debate: The bleeding femoral access – You should always OPEN IT! (Call Anesthesia!) – Stacy Plotkin (Vasc, US)
14.40	Debate: The bleeding femoral access – We'll fix it with ENDO (Local Anesthesia!) – Artai Pirouzram (Vasc, SE)
14.50	Debate: Revascularization Should PRECEDE External Bone Fixation – Erica Mitchell (Vasc, US)
15.00	Debate: Revascularization Should FOLLOW External Bone Fixation – Paul Puchwein (Ort, AT)
15.10	Debate: REBOA is an IMPORTANT tool for unstable bleeding patients – David McGreevy (Vasc, SE)
15.20	Debate: No REBOA, OPEN SURGERY is the way to go! – Daniel Shefer (Surg, IL)
Session 6: Hot topics in Thoracic Endovascular resuscitation: From imaging to treatment 6 min talk + 4 min discussion **Chairs**: Manuel Garcia-Toca (Vasc, US) and Zoran Rancic (Vasc, AT) **Panelists:** Erica Mitchell (Vasc, US), Juan Duchesne (Surg, US), Giuseppe Asciutto (Vasc, SE)	
15.30	SVS Blunt Thoracic Aortic Injury Guidelines – how should we treat these patients? – Juan Duchesne (Surg, US)
15.40	Endografts for thoracic aortic bleeders (dissection, rupture, trauma) – What to use and when? – Zoran Rancic (Vasc, CH)
15.50	Blunt thoracic aortic injury trends, how to treat and data from the Aorta Trauma Foundation – David McGreevy (Vasc, SE)
16.00	Axillo-subclavian trauma and iatrogenic injuries – is endo the solution? World collected data – Mario D'oria (Vasc, IT)
16.10	BTAI In Pediatric Patients: When Should They Undergo Invasive Treatment: When Endo, When Open? – Elina Quiroga (Vasc, US)
16.20	Prediction of mortality in Blunt Thoracic Aortic Injury – Mario D'oria (Vasc, IT)
16.30	Acute Thoracic Aortic Pseudocoarctation after Blunt Thoracic Aortic Injury – Erica Mitchell (Vasc, US)
16.40	**Coffee and industry exhibition**
Session 7: The non-trauma patient; Tools, techniques, and results From Pre-hospital to ICU 6 min talk + 4 min discussion **Chairs**: Paul Puchwein (Ort, AT) Lional Lamhaut and Marius Rehn (ICU, NR) **Panelists:** Elina Quiroga (Vasc, US), Emre Özluer (Emerg TR), Amit Frenkel (ICU, IL), Peter Hilbert-Carius (ICU, DE), Laura Moore (Vasc, US)	
17:00	**Keynote lecture** (20 minutes)**:** Intensive care from the street – our experience, results and future – Lionel Lamhaut (ICU, FR)
17.20	eCPR – Current status and future aspects – Marius Rehn (ICU, NO)
17.30	Endovascular optimized resuscitation for out of hospital cardiac arrest' – Halden Hutchinson-Bazely (ICM/PHEM, UK)
17.40	Emergency room ECMO Indications, practical aspects and limitations – Emre Özluer (Emerg, TR)
17.50	Adjunct techniques in ruptures: Visceral endografts and Technical aspects – Greg Magee (Vasc, US)
18.00	Hybrid room: what has changed in endovascular approach for bleeding control? What can be done – Giuseppe Asciutto (Vasc, SE)
18.10	Intestinal ischemia after endovascular resuscitation – Bjørn Farbu (ICU, NO)
18.20	Cardiac arrest and REBOA? Experimental data and future aspects – Emanuel Dogan (ICU, SE)
18.45	**Get Together Party – With light meal (in the symposium reception area)**

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Friday October 18th

07.15	**Coffee / Industry Exhibitors**
	Session 8: Hot topics in acute vascular surgery – Endografts and more **Joint session with the European Society for Vascular Surgery (ESVS)** 6 min talk + 4 min discussion **Chairs**: Pirkka Vikatmaa (Vasc, FI), Rebecka Hultgren (Vasc, SE) **Panelists:** Zoran Rancic (Vasc, CH), Magnus Jonsson (Vasc, SE), Giuseppe Asciutto (Vasc, SE), Jonny Morrison (Vasc, US)
08.00	Is EVAR/TEVAR taking over ruptures in Sweden? Should it? And why female gender matters? – Rebecka Hultgren (Vasc, SE)
08.10	100% EVAR in all infrarenal rAAA – a single center 15-year experience update – David McGreevy (Vasc, SE)
08.20	Do we need to open all Femoral arteries access complications? No, Many by endo (Örebro data) – Artai Pirouzram (Vasc, SE)
08.30	Acute vascular access: How to do it and how to avoid complications? Examples – Magnus Jonsson (Vasc, SE)
08.40	Technical and post-op aspects in ruptures, what can we learn for other bleeding patients? – Pirkka Vikatmaa (Vasc, FI)
08.50	Endografts for iatrogenic access bleeding – how to deal with access complications? – Shahram Aarabi (Vasc, US)
09.00	Endovascular or open surgery in thoracic aortic trauma. Overview, what to do and when? – Zoran Rancic (Vasc, CH)
09.10	EVTM-Specialists in Training corner: Late rupture after EVAR, single center data – Rami Hammadi (Vasc, SE)
	Session 9: The great debate on REBOA/Endo in trauma and non-trauma **Joint session with the World Society of Emergency Surgery (WSES)** 6 min talk + 4 min discussion **Chairs**: Ernest Moore (Surg, US) and Boris Kessel (Surg, IL) **Panelists:** Federico Coccolini (Surg, IT), Fausto Catena (Surg, IT), Kristina Doklestić Vasiljev (Surg, SR), Anahita Dua (Vasc, US)
09.20	Liver trauma – Endo/open/hybrid aspects – Ernest Moore (Surg, US)
09.30	Splenic trauma - Endo/open/hybrid aspects – Fausto Catena (Surg, IT)
09.40	Pelvic trauma - Endo/open/hybrid aspects – Federico Coccolini (Surg, IT)
09.50	Pancreatic trauma – Endo/open/hybrid aspects – Enrico Cicuttin (Surg, IT)
10.00	Kidney and ureter trauma – Frank Plani (Surg, ZA)
10.10	Liver and pelvic trauma – Damage control surgery? – Kristina Doklestić Vasiljev (Surg, SR)
10.20	Critical analysis of the UK REBOA Trial – What can we conclude about REBOA in trauma? – Martinez-Hernandez (ICU, SP)
10.30	**Coffee and industry exhibition**
	Session 10: Modern trauma care including EVTM methods and mass casualties' issues **Joint session with the Israeli Trauma Society** 6 min talk + 4 min discussion **Chairs**: Boris Kessel (Surg, IL) and Asaf Kedar (Surg, IL) **Panelists:** Juan Duchesne (Vasc, US), Chuck Fox (Vasc, US), Frank Plani (Surg, ZA), Ernest Moore (Surg, US), Laura Moore (Surg, US)
10.40	Israeli medical system response on 7th October mass casualties' event. Numbers and preliminary lessons. – Asaf Kedar (Surg, IL)
10.50	Surgical Department experience on October 7th attack in Israel – Morris Batumsky (Surg, IL)
11.00	TBA – Maya Pran (Surg, IL)
11.10	We sure could use REBOA. Lessons and examples – Itay Zoarets (Surg, IL)
11.20	A single trauma center experience with Mega Multiple Casualties Incident – Yulia Elobra (Surg, IL)
11.30	Vascular injuries in Mega Multiple Casualties Incident Oct 7th – Dimitry Shapovalov (Vasc, IL)
11.40	REBOA in severe brain injury: fatal combination or treatment alternative? – Hagar Halevy Shahar (Surg, IL)
11.50	Rare complications in abdominal trauma – cases with short discussion – Guy Golani (Surg, IL)
12.00	Surgical education during armed conflict – Is it possible? How? Lessons – Daniel Shefer (Surg, IL)
	Session 11: Registry data, experimental studies and developments within EVTM 6 min talk + 4 min discussion **Chairs**: Kristofer Nilsson (ICU, SE), Carl Wahlgren (Vasc, SE), Federico Coccolini (Surg, IT) **Panelists:** Maria Wikström (Surg, SE), Jostein Brede (ICU, NO), Marius Rehn (ICU, NO), Peter Hilbert-Carius (ICU, DE)
12.10	ESVS new Vascular Trauma Guidelines: Main points to know – Carl M Wahlgren (Vasc, SE)
12.20	Personalizing antithrombotic medications post revascularizations – what's the data? How to think after endo? – Anahita Dua (Vasc, US)
12.30	PROOVIT trauma vascular registry – what does the data from USA say? More endo? – Jonny Morrison (Vasc, US)
12.40	Endovascular Management of Traumatic Inferior Vena Cava Injuries: A Five-Year Experience and Literature Analysis – Marco Franchin (IT)
12.50	ERICA ARREST study – Halden Hutchinson-Bazely (ICM/PHEM, UK)
13:00	Endovascular shunt-what is it, experimental data and WHEN to use? – Johan Millinger (Vasc, SE)
13.10	**Lunch**

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Session 12: Hot topics in anesthesia and critical care with EVTM aspects New developments 6 min talk + 4 min discussion **Chairs**: Peter Hilbert-Carius (ICU, DE), Marius Rehn (ICU, NR), Juan Duchesne (Surg, US) **Panelists:** Kristofer Nilsson (ICU, SE) TBA	
14.00	A trauma surgeons view of an unstable patient, decision making and the anesthetic team collaboration – Juan Duchesne (Surg, US)
14.10	Mass casualties – Anesthesia and intensive care aspects and lessons from the recent conflict in Israel – Amit Frenkel (ICU, IL)
14.20	RIBCAP-HEMS project – Axel Großstück (ICU, DE)
14.30	ECMO in selected trauma patients – latest experience from the conflict in Israel – Guy Golani (Surg, IL)
14.40	REBOA ARREST trial – Where are we and where are we heading? – Jostein Brede (ICU, NO)
14.50	Pre-clinical hypovolemia research – Lars Øyvind Høiseth (ICU, NO)
Session 13: EVTM rising technologies: Imaging, devices, endografts and more 6 min talk + 4 min discussion **Chairs**: Yosuke Matsumura (ICU, JP) and Anahita Dua (Vasc, US) **Panelists:** Shahram Aarabi (Vasc, US), Pierpaolo Biondetti (IR, IT), Viktor Bilman (Vasc, IL), Zoran Rancic (Vasc, CH)	
15.00	CTA – what is out there and what is new? Hybrid suite, ER and more – Junichi Matsumoto (IR, JP) (recorded)
15.10	Ultrasound – Can we see better, when to use it and for what? – Maria Antonella Ruffino (IR, IT)
15.20	New endografts on the market and coming soon (US and EU) – Greg Magee (Vasc, US)
15.30	New Embolization agents – what is on the market and what is coming? – Anna Maria Ierardi (IR, IT)
15.40	pREBOA in focus – data! – Chance Spalding (Surg, US)
15:50	Hybrid ER, RAPTOR and implementing these technologies – experience, what about the limitations? – Pirkka Vikatmaa (Vasc, FI)
16:00	Specialists in Training corner – Nitric Oxide (NO) donator in ischemia – can it help? – Anna Stene Hurtsén (Vasc, SE)
16.10	**Coffee and industry exhibition**
Session 14: EVTM and interventional radiology – Bleeding control, embolization agents, new technologies What to use and when for bleeding control? **Chairs:** Anna Maria Ierardi (IR, IT) and Maria Antonella Ruffino (IR, IT) **Panelists**: Mario D'Oria (Vasc, IT), Adenauer Goes Jr (Vasc, BR), Pirkka Vikatmaa (Vasc, FI), Manuel Garcia-Toca (Vasc, US), Yulia Nahaliuk (Vasc, UA),	
16.30	Embolization in bleeders – What to use and how? – Pierpaolo Biondetti (IR, IT) and Anna Maria Ierardi (IR, IT)
16.40	IR team: The prompt activation in the management of emergency bleeding – Jan Raupach (IR, CZ)
16.50	Percutaneous mechanical thrombectomy: an effective treatment option for acute limb ischemia – Anahita Dua (Vasc, US)
17.00	Post Partum Hemorrhage – how to save the uterus – Pierpaolo Biondetti (IR, IT)
17.10	Evidence –Where do we stand with guidelines? When to embolize and when other methods in trauma? – Federico Coccolini (Surg, IT)
17:20	TBA
17.30 – 18.45	**Session 15: EVTM Society meeting (open to all)** Hosted by Boris Kessel (IL), Chuck Fox (US) Agenda: latest activities, Economic summary, elections results, Committees, Future planes
19.15	**Symposium Dinner – Makeriet Örebro (City centrum)**

Saturday October 19th	
08.00	**Coffee and Industry Exhibition**
Session 16: Aneurysm ruptures: Endo, open and hybrid aspects 6 min talk + 4 min discussion **Chairs:** Magnus Jonsson (Vasc, SE), Per Skoog (Vasc, SE) and Jonny Morrison (Vasc, US) **Panelists:** Shahram Arabi (vasc, US), Johan Millinger (SE), Adenauer Goes Jr (Vasc, BR)	
08.10	**Keynote lecture** (20 minutes): Development of Endo in acute vascular surgery – Where are we heading? Zoran Rancic (Vasc, AT)
08.30	What graft to use in ruptured Thoracic AA? Options? Technical aspects – Magnus Jonsson (Surg, Vasc, SE)
08.40	How to choose open or endo in rAAA? How do we do? Gothenburg experience and tips – Per Skoog (Vasc, SE)
08.50	Adjunct techniques in ruptures: Coils and embolization agents, what can be used to prevent endoleaks? – Artai Pirouzram (Vasc, SE)
09.00	Post-operative aspects of the ruptured patient and ICU care (both for Open and endo) – Erika Mitchell (Vasc, US)
09.10	Local anesthesia in rAAA? Hemodynamic unstable? When? How? – Carl Wahlgren (Vasc, SE)
09.20	Abdominal compartment in the ICU – what, when and how to decompress? – Khatereh Djavani Gidlund (Vasc, SE)
	Coffee and Industry Exhibition

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Session 17: Trauma and vascular controversies. New civilian and military developments in bleeding control 6 min talk + 4 min discussion **Chairs**: Kristina Doklestić Vasiljev (Surg, SR), Chuk Fox (Vasc) and Mansoor Khan (Surg, UK) **Panelists:** Shahram Aarabi (US), Carl Wahlgren (SE), Johan Millinger (SE), Laura Moore (Surg, US)	
09:40	**Keynote Lecture** (20 minutes)**:** Vascular trauma in South Africa – my experience, developments and future – Frank Plani (ZA)
10:00	New developments in bleeding care in the pre-hospital, military and emergency room settings; What's new? – Mansoor Khan (Surg, UK)
10:10	EVTM integrated in trauma service reduces time to hemostasis? – Jonny Morrison (Vasc, US)
10:20	Integrating Endo and hybrid for trauma patients – Chuk Fox (Vasc, US)
10:30	Endovascular management of non-traumatic bleeding: how to do it/think in place with low resources? – Adenauer Goes Jr (Vasc, BR)
10.40	Vascular trauma and use of shunts – data and cases from Ukraine – Yulia Nahaliuk (Vasc, UA)
10.50	Vascular injuries in the current conflict Israel; data; what do we know? – Viktor Bilman (Vasc, IL)
11:00	Open and endo in recent war injuries in Israel; cases, lessons and how would we do in the future? – Dimitry Shapovalov (Vasc, IL)
Session 18: From prehospital and austere environment to the ICU 6 min talk + 4 min discussion **Chairs:** Frank Plani (Surg, ZA), Chuck Fox (Vasc, US), Chance Spalding (Vasc, US) **Panelists:** Adenauer Goes Jr (Vasc, BR), Manuel Garcia-Toca (Vasc, US), Yulia Nahaliuk (Vasc, UA), Viktor Bilman (Vasc, IL)	
11.10	Developing a Helipad to THOR Process – Laura Moore (Vasc, US)
11.20	VA ECMO in the management of trauma associated cardiogenic shock – Chris Bishop (ICU, UK)
11.30	Current use of REBOA in Pre-hospital and military settings – Chance Spalding (Surg, US)
11.40	Vascular damage control in limited resources environment: reports from Amazon – Adenauer Goes Jr (BR)
11.50	Tips and tricks, shunts and more in vascular trauma and post op how to – Shahram Aarabi (Vasc, US)
12.00	Endovascular management of high grade TBAI and Axilosubclavian injuries – practical tips and tricks – Manuel Garcia-Toca (Vasc, US)
12.10	Low-cost FAA/REBOA simulators for training and training experience in Spain – Josep Chorro (ICU, SP)
12:20	Building functional ED ECMO program; How does it work in Turkey? – Emre Özluer (ED, TR)
12:30	ICU modern care of battle injuries – more practical lessons from the recent conflict – Amit Frenkel (ICU, IL)
12.40	Closing remarks, from EVTM to JEVTM and more – Tal Hörer (Vasc, SE), David McGreevy (Vasc, SE)
13:00 Grab and go lunch	

Round table discussion forum (by pre-registration only to hilda@mkon.se or lotta@mkon.se)

1. **Mass casualties' lessons** recent events: **17th October 2024 14:30–16:00** room X1403
2. **Intensive care** and anesthesia lessons in recent ongoing conflicts: **18th October 2024 08:00–09:30** room X1403
3. **Battlefield bleeders** up-to-date experience and data: **18th October 2024 14:00–15:30** room X1403

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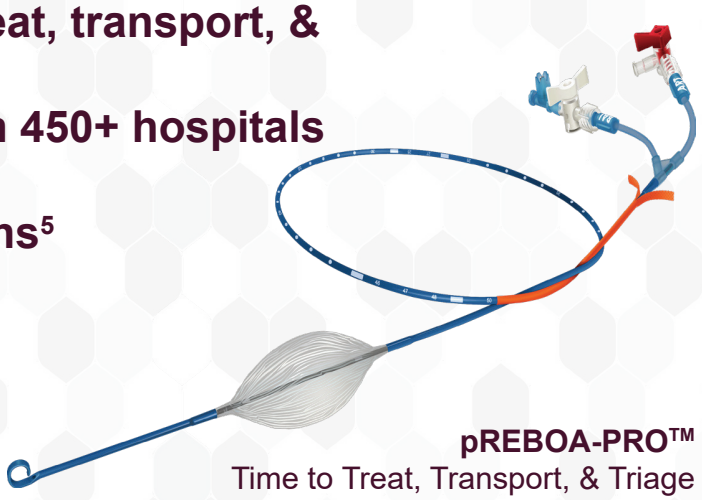

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1. Centers of Excellence data. Internal data on file. Available upon request. 2. Ho et al., (2023) J Trauma Acute Care Surg. 3. Individual patient tolerance to occlusion may vary based on a variety of factors including age, health, status, injury pattern and severity, previous ischemic insult, etc. Surgical judgment is necessary when determining duration of occlusion for each patient. 4. Applies to all complete and partial REBOA uses. 5. Applies to all publications about complete and partial REBOA.

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