JEVTM

# Journal of ENDOVASCULAR RESUSCITATION and Trauma Management

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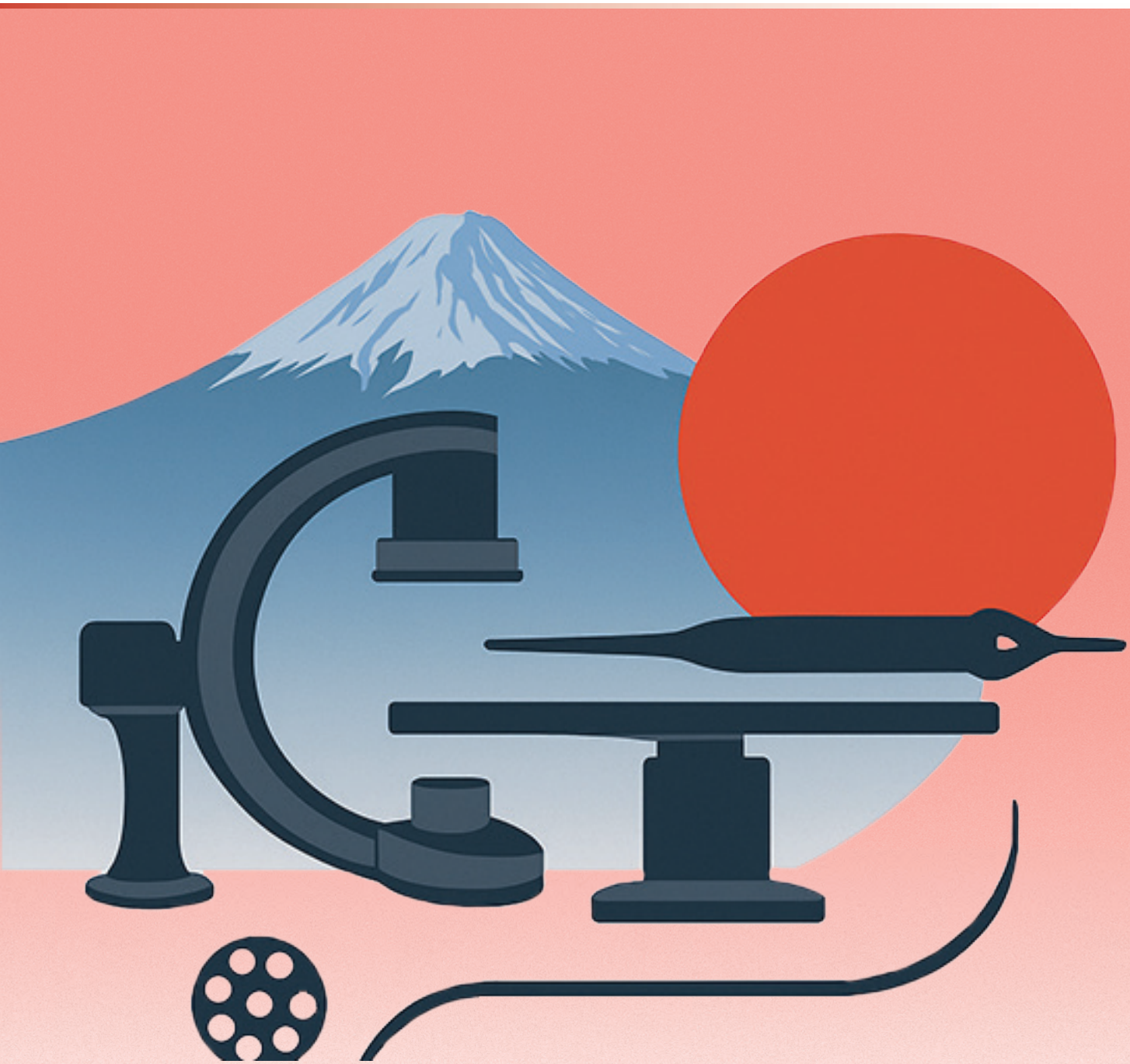

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JEVTM

# Journal of Endovascular Resuscitation and Trauma Management

Volume 9
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**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.

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In cooperation with Örebro University Hospital and Örebro University, Sweden.

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# Author Guidelines

## INSTRUCTIONS FOR AUTHORS

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.

### *Guidelines for Submission*

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/ethics.
6. A clear statement that the authors follow the ethical guidelines as stated on the Journal webpage: https://publicera.kb.se/jevtm/ethics.

### *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.
- Declaration of the Use of Generative AI in the Writing Process (Compulsory): Any use or not use of generative AI or AI-tools during the writing process should be declared here (see Declaration of the Use of Generative AI in the Writing Process below).
- 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):

- Introduction
- 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. Philadelphia: 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*

Images should be provided as TIFF, JPEG or EPS files. Each image must have a minimum resolution of 300 DPI (dots per inch):

- Half page width: 1200 pixels (8 inches / 2 * 300 dpi)
- Full page width: 2400 pixels (8 inches * 300 dpi)

However, the recommended resolution is (600 dpi)

- Half page width: 2400 pixels (8 inches / 2 * 600 dpi)
- Full page width: 4800 pixels (8 inches * 600 dpi)

If an image includes text, it must be a minimum of 10-point font, preferably in Times New Roman. However, the author must make sure that the smallest text size used is perfectly readable on the intended page width.

Please upload the images as separate files in the electronic submission system. This will allow our staff to evaluate the quality of each image separately.

When submitting radiological and other clinical and diagnostic images, as well as pictures of pathology specimens or photomicrographs, before-and-after images should be taken with the same intensity, direction, and color of light.

When submitting photomicrographs, internal scale markers should be included. Remember to explain the internal scale as well as identify the method of staining in in the figure legend.

If symbols such as arrows, asterisks or letters are used in an image, they should contrast with the background. Furthermore, it should be explained in the figure legend what they highlight.

All figures must be cited within the text, presented as Figure 1, Figure 2a,*b*, and Figures 1 and 2. Figure legends should be styled as follows:

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

Figures should be made as self-explanatory as possible, since many will be used directly in slide presentations. Titles and detailed explanations belong in the legends—not on the illustrations themselves. Remember to always include explanations to abbreviations used in the Figure in the Figure legend.

## *Tables*

Tables should be created in Microsoft Word using 12 pt, preferably using Times New Roman font.

All tables must be cited within the text, presented as Table 1, and Table 1 and 2.

Table legends should be styled as follows:

***Title 1*** Title of the table. Explanation of the data presented in the table.

Remember to always include explanations to abbreviations used in the table in the table legend or as a footnote to a table.

## *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. All supplementary digital content should be cited within the text, presented as e.g. Supplementary Table 1, Supplementary Figure 1, Supplementary Video 1 etc. Legends to the supplementary digital content should be styled in the same way as the figures and tables included in the main manuscript.

## *Declaration of the Use of Generative AI in the Writing Process*

The guidance below only refers to the writing process, and not to the use of artificial intelligence (AI) tools to analyze and draw insights from data as part of the research process. We strongly recommend not using AI in any analysis and any such use should be reported. Not reporting use of AI can cause direct rejection of the submission.

Where authors use generative AI and AI-assisted technologies in the writing process, authors should only use these technologies to improve readability and language. Applying the technology should be done with human oversight and control, and authors should carefully review and edit the result. AI and AI-assisted technologies should not be listed as an author or co-author or be cited as an author.

Authors must disclose in their manuscript the use of AI and AI-assisted technologies in the writing process by adding a statement at the end of their manuscript in the core manuscript file, before the References list. The statement should be placed in a new section entitled 'DECLARATION OF THE USE OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS'. This declaration does not apply to the use of basic tools for checking grammar, spelling, references etc. If AI tools were used, please include the following statement:

*STATEMENT: During the preparation of this work the author(s) used [NAME TOOL / SERVICE] in order to [REASON]. After using this tool/ service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication*.

If there is nothing to disclose, please include the following statement:

*STATEMENT: No generative AI or AI-assisted technologies were used during the writing process of this manuscript*.

The statement will appear in the published work. Please note that authors are ultimately responsible and accountable for the contents of the work. The Journal of Endovascular Resuscitation and Trauma Management is using dedicated tools for analysis of use of AI in submitted articles.

## *Proofreading After Acceptance*

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

All proofs should be revised for corrections by both the author and the scientific quality editor of JEVTM within five working days.

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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.

## SUBMISSIONS

### *Types of Articles*

We accept the following types of articles, and all of them 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 for the main body of the text (from introduction to conclusion, and excluding abstract, references, tables and legends). A maximum of 50 references can be included.

Manuscripts should consist of the following sections:

- *Introduction:* This should concisely present the background to the problem that the study hopes to answer. An aim should be clearly stated at the end of the introduction.
- *Methods*: This section should be suitably detailed to permit replication of the study. Subheadings may be useful in this section to help clarify the content in longer papers.
  For established methods, appropriate references and a brief description are sufficient; but for new methods, appropriate details are required.
  For human studies, where relevant, these details are generally important: eligibility (inclusion and exclusion criteria), randomization methods, blinding methods, total consecutive patients enrolled, and number of exclusions or dropouts and reasons. 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.
- *Conclusion*: This section should concisely conclude the findings of your study.

Original articles should contain a structured abstract with a maximum of 250 words.

We recommend that authors use the appropriate Reporting Guideline (https://www.equator-network.org/) for their study. If any checklists are used, they should be included during submission.

*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 a maximum of 1500 words and can include a maximum of ten references. There is no formal structure on this type of manuscript. Abstracts are not included.

*Narrative Review Articles*
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 for the main body of the text (from introduction to conclusion, and excluding abstract, references, tables and legends). A maximum of 125 references can be included. 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 for the main body of the text (from introduction to conclusion, and excluding abstract, references, tables and legends). A maximum of 125 references can be included. Manuscripts should consist of the following sections:

- *Introduction:* This should concisely present the background to the problem that the study hopes to answer. An aim should be clearly stated at the end of the introduction.
- *Methods:* This section should be suitably detailed to permit replication of the study. Subheadings may be useful in this section to help clarify the content in longer papers. For established methods, appropriate references and a brief description are sufficient; but for new methods, appropriate details are required. The complete search strategy, if long, could preferably be included as a supplementary digital table, rather than text directly under the method section.
- *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.
- *Conclusion:* This section should concisely conclude the findings of your study.

Authors should include a PRISMA checklist in their submission. The abstract should be a maximum of 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 for the main body of the text (from introduction to conclusion, and excluding abstract, references, tables and legends). A maximum of 30 references can be included. Manuscripts should consist of the following sections:

- *Introduction:* This should concisely present the background to the problem that the study hopes to answer. An aim should be clearly stated at the end of the introduction.
- *Methods:* This section should be suitably detailed to permit replication of the study. Subheadings may be useful in this section to help clarify the content in longer papers.
- *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.
- *Conclusion:* This section should concisely conclude the findings of your study.

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. Please remember to carefully follow the instructions for figures (https://publicera.kb.se/jevtm/instructions) in this type of publication.

The submitted manuscript should be a maximum of 250 words for the main body of the text, references excluded. A maximum of five references can be included. There is no formal structure on this type of manuscript. Abstracts are not included.

### *Case Reports*

These are short case reports including current literature reviews.

The submitted manuscript should be no longer than 2000 words for the main body of the text (from introduction to conclusion, and excluding abstract, references, tables and legends). A maximum of 30 references can be included. Manuscripts should consist of the following sections:

- *Introduction:* This section should give a brief overview of the problem that the case addresses and include a summary of the relevant literature related to the case. The introduction should end with a single sentence describing the patient and the basic condition that he or she suffers from.
- *Case Presentation:* This section should include relevant demographic details such as background information about the patient, medical history, details of the patient's symptoms, physical examination, and laboratory/imaging results, the confirmed diagnosis and the course of treatment or intervention, management, and clinical outcome.
- *Discussion:* This section should expand on what has been said in the introduction, focusing on why the case is noteworthy and the problem that it addresses.
  This should be followed by a summary of the existing literature on the topic that describes the existing theories and research findings on the key issue in the patient's condition. The review should narrow down to the source of confusion or the main challenge in the case.
  Finally, the case report should connect to the existing literature, mentioning the message that the case conveys. The author should explain whether this corroborates with or detracts from current beliefs about the problem and how this evidence can add value to future clinical practice.
- *Conclusion:* This section should concisely conclude the findings of your study.

An abstract can be included (a maximum of 150 words) but is not compulsory. We recommend that authors use the CARE Reporting Guideline for their study. A completed CARE checklist should be included during submission.

### *Letters to the Editor*

Letters to the Editor that comment on anything within the Journal can be submitted for publication. There is no formal structure on this type of manuscript. The submissions should be a maximum of 1000 words and can include a maximum of ten references. Abstracts are not included.

### *EVTM-ST Section*

Content in this section is published as part of the regular journal issues and is curated by the EVTM-ST Senior Editor.

The EVTM-ST Section is designed to support resident and fellow education. For each issue, the editors will invite one trainee to submit an educational case report. An invited reviewer will then provide a brief accompanying editorial. EVTM-ST editors do not participate as authors or reviewers for this section.

The section includes a standard case report accompanied by relevant figures (e.g. CT scans, angiography, or other pertinent imaging). The discussion should conclude with a concise "What

(*Continued*)

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I learned" summary or bullet points. The invited reviewer's short editorial forms the final paragraph of the section.

Submissions should be no longer than 1500 words for the main body of text (from introduction to conclusion), excluding the abstract, references, tables, and legends). A maximum of 30 references can be included. Manuscripts should consist of the following sections:

- *Introduction:* This section should give a brief overview of the problem that the case addresses and *include* a summary of the relevant literature related to the case. The introduction should end with a single sentence describing the patient and the basic condition that he or she suffers from.
- *Case Presentation:* This section should include relevant demographic details such as background information about the patient, medical history, details of the patient's symptoms, physical examination, and laboratory/imaging results, the confirmed diagnosis and the course of treatment or intervention, management, and clinical outcome.
- *Discussion:* This section should expand on what has been said in the introduction, focusing on why the *case* is noteworthy and the problem that it addresses.
  This should be followed by a summary of the existing literature *on* the topic that describes the existing theories and research findings on the key issue in the patient's condition.
  The review should narrow down to the source of confusion or the main challenge in the case.
  Finally, the case report should connect to the existing literature, *mentioning* the message that the case conveys.
  The author should explain whether this corroborates with or detracts from current beliefs about the problem and how this evidence can add value to future clinical practice.
- *Conclusion/Learning Points:* This section should concisely conclude the findings of your study and what you learned from it.

An abstract can be included (a maximum of 150 words) but is not compulsory. We recommend that authors use the CARE Reporting Guideline for their study. A completed CARE checklist should be included during submission.

*Commentary*
Commentaries that comment on anything within the Journal can be submitted for publication. There is no formal structure on this type of manuscript. The submissions should be a maximum of 1000 words and can include a maximum of ten references. Abstracts are not included.

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There is no formal structure on this type of manuscript. The submissions should be a maximum of 1000 words and can include a maximum of 10 references. Abstracts are not included. This type of work must also follow all Journal ethical and formatting guidelines.

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The JEVTM does not charge any author or publication fees.

Authors are encouraged to deposit the final published version of their article for self-archiving (author's personal website) and/or archiving in an institutional repository immediately upon publication.

## EDITORIAL POLICIES

### *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.

## *Author Self-Archiving*

Article authors have the right to self-archive the submitted ("preprint") version of the manuscript and the postprint 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 (https://orcid.org/).

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.

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## *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 joined Publicera, is made available via Publicera and stored long-term on a secure and central servers at the National Library of Sweden. All old material published before JEVTM joined Publicera is stored at servers at https://jevtm.com, Örebro University Hospital and at Lund University. 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 can therefore not 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 (https://pubpeer.com/).

**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.
- If the article has already been published online, depending on the nature and severity of the infraction, one or more of the following measures may be taken:
    - an erratum/correction may be placed with the article
    - an expression of concern may be placed with the article
    - in severe cases, the article may be retracted

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,

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(*Continued*)
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.

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(*Continued*)

(*Continued*)

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- 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.

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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.

# 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

# Journal News

As the journal approaches its 10th volume of publication, the Editorial Board have been reviewing all journal procedures to ensure they are still fit for purpose.

The Author Guidelines and style documentation have been updated, to ensure they follow best practice, and the journal website is also undergoing similar improvements. All submissions going forward will follow these new guidelines.

In relation to Conflicts of Interest, the Editorial Board have revisited past issues and for full transparency Errata will be published as needed as a Supplement with the next issue.

The aim is to ensure that JEVTM is a professional publication with rigorous procedures and timely publication, providing the dissemination of accurate information and support for professional learning. This is in accordance with general medical publications guidelines. The journal follows the ethical guidelines and best practices set forth by the Committee on Publication Ethics (COPE).

# Contents

Editorial

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# EVTM Today: Building Knowledge, Structure, and Evidence

**Tal M Hörer and David T McGreevy**

*Department of Cardiothoracic and Vascular Surgery, Faculty of Medicine and Health, Örebro University, Örebro University Hospital, Örebro, Sweden*

Endovascular and hybrid resuscitation has, over a relatively short period of time, become an integral component of modern trauma care, vascular emergency management, resuscitation, and acute care surgery. What initially emerged as a collection of technical solutions to specific clinical problems has progressively evolved into a broader, coherent clinical concept, now widely referred to as EndoVascular resuscitation and Trauma Management (EVTM) [1].

Today, EVTM extends well beyond its early applications in traumatic hemorrhage and ruptured aortic aneurysms. It is increasingly applied in the management of aortic dissections, spontaneous and iatrogenic bleeding, complications of complex surgical and endovascular procedures, and selected medical or cardiogenic emergencies [2,3]. In many institutions, EVTM strategies are no longer viewed as experimental or exceptional, but rather as part of routine emergency and resuscitative care pathways.

Parallel to this clinical maturation, EVTM has developed into a truly international and multidisciplinary movement. Dedicated EVTM meetings continue to expand in scope and reach, with the upcoming 10th EVTM Symposium in Japan (EVTM Asia) in 2026 and Pan-American EVTM in Atlanta in 2027 representing important milestones. At the same time, EVTM has gained a stable and growing presence within major international congresses, including those of the European Society for Trauma and Emergency Surgery (ESTES), the European Society for Vascular Surgery (ESVS), the VEITH Symposium, and others. Integrated scientific sessions and invited lectures within these forums reflect a broader recognition that EVTM is no longer a niche interest, but a core component of modern trauma, vascular, resuscitation, and acute care practice.

In parallel, regular EVTM hands-on workshops have become a central element of this development. Conducted both as independent EVTM initiatives and in close collaboration with other scientific societies, such as the upcoming focused EVTM mini-workshop with ESTES in Stockholm, these activities reflect a growing emphasis on practical training, multidisciplinary interaction, and the real-world implementation of EVTM principles.

With this expansion comes a clear responsibility. Clinical experience, scientific data, and conceptual development must not only be shared at meetings but also systematically published, structured, and critically reviewed within a dedicated scientific framework. This is the central mission of the Journal of EndoVascular resuscitation and Trauma Management (JEVTM). The journal is not intended as a platform for individual devices or isolated techniques, but as a forum for EVTM as a comprehensive clinical organizational concept, encompassing strategies, systems of care, physiology-guided resuscitation, endovascular and hybrid bleeding control, as well as educational, organizational, and implementation aspects [4,5].

The current Online First publications illustrate both the breadth and the clinical relevance of this field. Contributions range from reports on spontaneous subdural and spinal epidural hemorrhage, to spontaneous lumbar artery rupture in anticoagulated patients, complex postoperative pseudoaneurysms, and the role of acute embolization within the EVTM concept. Collectively, these studies demonstrate how EVTM thinking can be applied across specialties, anatomical regions, and clinical scenarios, often in situations where rapid, minimally invasive, and physiologically sound decision-making is critical.

Looking forward, EVTM is entering a phase where the integration and structuring of knowledge become increasingly important. This is exemplified by ongoing initiatives such as the Artificial Intelligence Textbook of Vascular Surgery, which aims to provide a continuously updated, structured, and intelligent knowledge platform for vascular and endovascular medicine. This ambition closely aligns with that of JEVTM, namely, to collect,

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organize, and critically evaluate a rapidly expanding and increasingly complex body of knowledge.

For EVTM to continue to develop as a mature, evidence-based discipline, it is essential that clinical series, comparative studies, translational research, and well-documented case material are systematically published and made available to the wider community. We therefore strongly encourage colleagues working in trauma, vascular surgery, acute care surgery, emergency medicine, and intensive care to consider JEVTM as the primary home for their scientific work within this domain.

At the same time, we remain committed to the continuous improvement of the journal itself. This includes rigorous peer review, clearer declarations regarding the use of artificial intelligence in manuscript preparation, and improved transparency concerning conflicts of interest. As part of this quality work, an ERRATA supplement will be published with the next issue, and the Instructions for Authors have been refined and clarified to further strengthen editorial standards.

In this way, EVTM will continue its transition from a collection of innovative solutions to a coherent, structured, and evidence-based clinical framework. JEVTM will remain the forum where this development is documented, critically discussed, and actively shaped.

## 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

TH and DM serve as Editors of the JEVTM. They were not involved in any aspect of the peer review or editorial decision-making process related to this submission.

## Funding

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## Author Contributions

Drafting of manuscript: TH and DM.

## Declaration of the Use of Generative AI and AI-assisted technologies in the writing process

No generative AI or AI-assisted technologies were used during the writing process of this manuscript.

## REFERENCES

[1] Hörer TM, Pirouzram A, Khan M, et al. Endovascular Resuscitation and Trauma Management (EVTM) – practical aspects and implementation. Shock. 2021; 56(1S):37–41.
[2] Hörer TM, Ierardi AM, Carriero S, Lanza C, Carrafiello G, McGreevy DT. Emergent vessel embolization for major traumatic and non-traumatic hemorrhage: Indications, tools and outcomes. Semin Vasc Surg. 2023; 36(2):283–99.
[3] Hörer T, DuBose J, Reva V, et al. Top Stent Manual: The Art of EndoVascular Hybrid Trauma and Bleeding Management. 1st ed. Örebro: Örebro University Hospital, c/o KärlThorax kliniken; 2017.
[4] DuBose J. The Journal of Endovascular Resuscitation and Trauma Management: a timely endeavor. J Endovasc Resusc Trauma Manag. 2017;1(1):1–2.
[5] Rasmussen TE. Journal of Endovascular Resuscitation and Trauma Management (JEVTM). J Endovasc Resusc Trauma Manag. 2017;1(1):3.

Case Report

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# Spontaneous Subdural Hemorrhage in a Patient with Marfan Syndrome: Case Report and Literature Review

**Daniel Antonio Encarnación-Santos[1,2], Dmitriy Rubenovich-Chikava[2], Murat Pachev[2], Eugeny Shestov[2], Ismail Bozkurt[3,4], Gennady Chmutin[1], Egor Chmutin[1], Ahmad Kassar[2], Marina Axenova[2], Bipin Chaurasia[5] and Emmanuel Batista-Geraldino[6]**

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**Background:** Marfan syndrome is autosomal dominant with ocular, cardiovascular, and musculoskeletal manifestations. It is caused by mutation that encodes the fibrin gene on chromosome 15.
**Case Presentation:** A 54-year-old man presented to our center with a sudden onset of severe headache followed by a gradual loss of consciousness. His medical history was significant for Marfan syndrome. We found a spontaneous subdural hematoma in the left frontoparietotemporal area. The patient underwent emergency surgical intervention consisting of excision of the acute lesion and decompressive craniectomy in the left frontoparietal-temporal area. A postoperative brain computed tomography scan was conducted, which revealed a reduced midline shift and a subdural hematoma drainage. Laboratory investigations and intensive treatment were continued; however, the patient's clinical condition deteriorated progressively.
**Conclusion:** This case underscores the rare occurrence of spontaneous acute subdural hematoma in the setting of Marfan syndrome, which calls for prompt recognition and surgical intervention.

**Keywords:** *Marfan Syndrome; Acute Subdural Hematoma; Neurological Complications; Surgical Intervention; Multidisciplinary Approach*

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## INTRODUCTION

Marfan syndrome is an autosomal dominant connective tissue disorder caused by mutations in the FBN1 gene located on chromosome 15. These mutations result in abnormalities in fibrillin-1, a crucial component of the elastic fibers that support the structural integrity of connective tissue. The musculoskeletal, cardiovascular, and ocular systems are the primary targets of the disorder, but its cerebrovascular consequences are increasingly recognized. Fibrillin-1 dysfunction leads to aneurysms, arterial dissections, and other vascular abnormalities, which can lead to ischemia or hemorrhage due to its role in preserving vascular elasticity [1].

Subdural hematomas (SDHs) can spontaneously happen on their own. However, it has also been documented in people with vascular anomalies. For instance, one study found 129 cases of Marfan syndrome and 826 patients associated with symptomatic intracranial aneurysms [2]. The first reported case was that of Gabrielle, a 5-year-old girl who displayed the classic symptoms of Marfan syndrome. Antoine Bernard-Jean Marfan (1858–1942) first defined the condition [3]. A study found, in the databases, that the SNP gene (rs112287730), indicated as a genetic variant, has an estimated frequency of 0.1 per 20,000 in Russia [4]. Marfan syndrome was also found to have a prevalence of 6.5 per 100,000 in 2014 and an annual incidence of 0.19 per 100,000. An annual increase of 1.03% (95% CI: 1.02–1.04; $p < 0.001$) was observed

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[5]. In this case study, the aim of this rare manifestation of spontaneous SDH in a patient with Marfan syndrome is examined, along with the diagnostic and therapeutic implications.

## CASE REPORT

A 54-year-old man was brought to the emergency department by his wife after experiencing a sudden, severe headache and gradual loss of consciousness. His medical history included an aortic root aneurysm, aortic regurgitation (grade 2–3), mitral regurgitation (grade 3), a thoracic aortic aneurysm, prosthetic aortic and mitral valves, hypertension (stage 3, controlled), atrial fibrillation, a left renal cyst, and gallbladder polyposis. Urgent imaging was recommended, and owing to his history and Marfanoid features, a cerebral infarction was suspected. He was therefore admitted to our center, Moscow City Clinical Hospital No. 68, Demikhova V.P. The magnetic resonance imaging showed cerebral compression due to a hypertensive subdural hematoma, with no trauma to the left hemisphere. Computed tomography (CT) revealed parenchymal hemorrhage in the dorsal aspect of the left hippocampus, bordering the occipital lobe, with mild perifocal edema. We diagnosed the patient with Marfan syndrome and a spontaneous subdural hematoma and performed a decompressive craniotomy in the left frontoparietotemporal area. After excision of the acute lesions, a 120 cm³ subdural hematoma was recovered in the left hemisphere

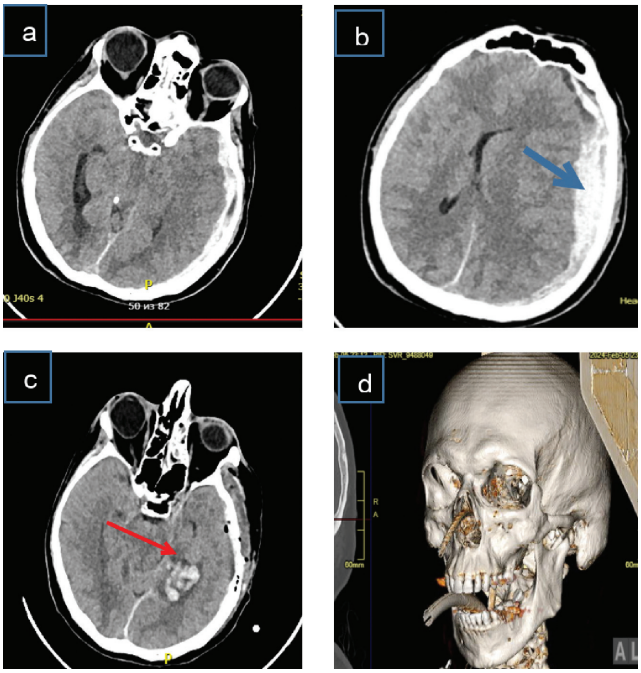


***Figure 1*** Identification of a spontaneous subdural hematoma in the left frontoparietotemporal area. (**a**) Preoperatory image of a cerebral herniation with signs of parenchymal hemorrhage and vascular edema. (**b**) The blue arrow points to a significant acute subdural hematoma. (**c**) The red arrow indicates an area of cerebral ischemia. (**d**) A three-dimensional (3D) reconstruction of the patient's skull.

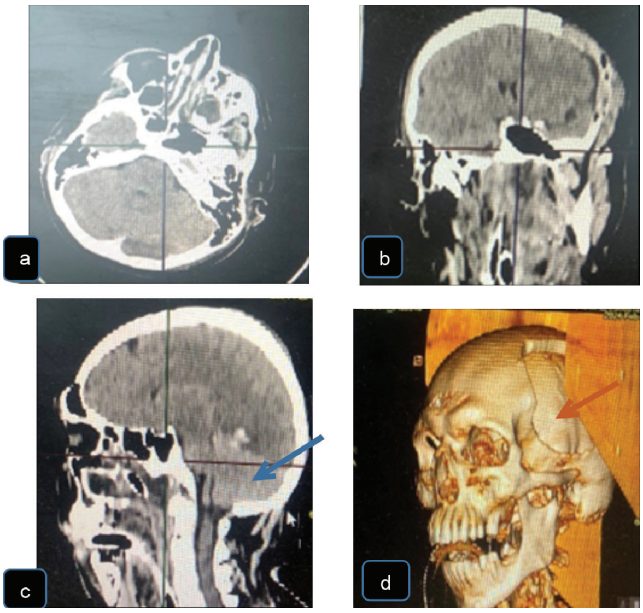


***Figure 2*** Postoperative images of the patients skull. (**a**) Postoperative, axial CT scan showing remnants of acute subdural hematoma and mild narrowing of the left hemisphere. (**b**) Coronal image with decreased transverse cerebral dislocation. (**c**) The blue arrow points towards the formation of a parenchymal hematoma in the left posterior occipital region. (**d**) A 3D reconstructive image with the red arrow pointing towards a postoperative left temporal decompressive craniotomy.

(Figures 1 and 2). Postoperative follow-up in the intensive care unit (ICU), the outcomes, and therapeutic intervention were provided, such as cephalosporin that was changed to vancomycin after sepsis. The patient remained in a critical condition and required continuous respiratory support from the eighth day in the ICU; he presented with moderate edema and coma; therefore intensive treatment was continued. The appointment sheet was modified based on clinical and laboratory findings. A transfusion protocol was initiated, and anemia monitoring was started, with ferric iron exchange and pathogenesis treatment. Because of this patient's prosthetic valve and subarachnoid hemorrhage, the chosen heparin dose was verified by activated partial thromboplastin time every six hours to maintain continuous anticoagulant therapy. However, no improvement was observed. We recommended active antibiotic therapy after the patient presented with fever during follow-up, which confirmed sepsis. No improvement was observed. The patient moved from a moderate to a severe coma with a Glasgow Coma Score of 5 at the time. Despite all concomitant efforts by our team, there was no improvement, and the patient died from respiratory arrest (Figure 3).

### *Ethical Approval and Informed Consent*

An ethical approval was granted at the Moscow City Clinical Hospital No. 68, Demikhova V.P. in Moscow, Russia (Ref. number 1857, dated 02.07.1992, No.

***Figure 3*** Postoperative image of the patient in the ICU where he was under mechanical ventilation and periodic monitoring.

2300-1; amended on 06.11.2021). The ethical guidelines outlined in Good Clinical Practice in the Declaration of Helsinki of the World Medical Association were strictly followed, ensuring that each patient provided informed consent before participating in the research.

## DISCUSSION

Marfan syndrome is an autosomal dominant genetic disorder characterized by systemic manifestations that affect various organ systems, including the ocular, cardiovascular, and musculoskeletal systems. The condition arises from mutations on the FBN1 gene on chromosome 15, which leads to structural abnormalities in connective tissues, especially elastic fibers. Consequently, individuals with Marfan syndrome commonly present with clinical features such as tall stature, arachnodactyly (elongated fingers), chest deformities, joint hypermobility, and ocular abnormalities, including lens subluxation (Figure 4). Acute SDH is a neurosurgical emergency involving the accumulation of blood between the dura mater and the arachnoid matter. Although typically caused by traumatic brain injury, it may also occur spontaneously, particularly in individuals with vascular abnormalities or coagulopathies. Spontaneous SDH is often characterized by severe headache, altered levels of consciousness, focal neurological deficits, or signs of increased intracranial pressure [1,5–7].

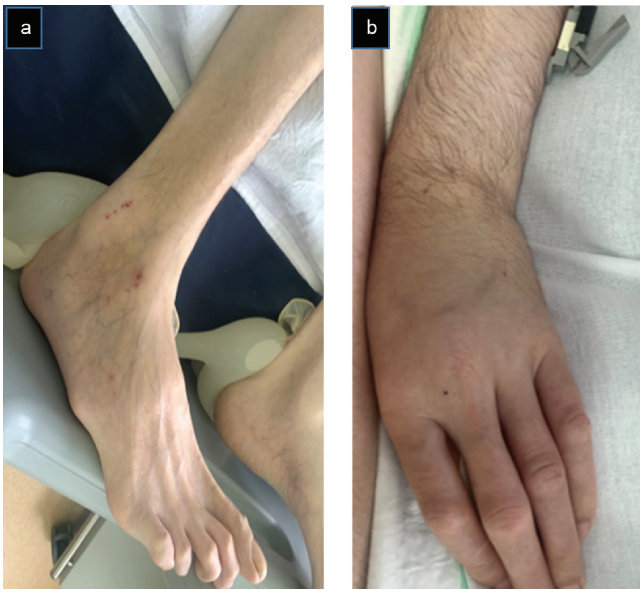


***Figure 4*** Characteristic features of a patient with Marfan Syndrome. Arachnodactyly or (**a**) lengthy toes and (**b**) fingers of the patient.

A retrospective case series study from 1992 in the Dominican Republic examined five patients diagnosed with Marfan syndrome. Only individuals aged 10 to 27 years were officially reported on the island at the Pediatric Medical Genetics Unit of the Robert Reid Hospital in Santo Domingo City. The patients exhibited classic Marfanoid characteristics, such as musculoskeletal abnormalities, lens subluxation, aortic root dilation, and dilatation of vessels for the fibrillin gene, holosystolic mitral valve prolapse, left ventricular hypertrophy in two instances, and systolic clicks in two instances [6].

Hemodynamic factors are critical in the management of aortic disease in Marfan syndrome. Aortic diameters exceeding 5.0 cm are strongly associated with a heightened risk of dissection or rupture. The use of β-adrenergic blockers has been advocated since 1971 to mitigate hemodynamic stress on the aorta, particularly in cases of malignant hypertension [8,9].

Spontaneous SDH associated with severe hypertension is considered an indicator of end-organ damage in hypertensive emergencies. In such cases, treatment protocols include administering up to four doses of 20 mg intravenous labetalol every 10–15 minutes to reduce blood pressure from 255/130 mmHg to 180/113 mmHg while achieving a target heart rate of approximately 61 beats per minute. Additional interventions may include 1 g of levetiracetam for seizure prophylaxis and 40 µg of desmopressin intravenously to reduce the risk of hemorrhage [10–12].

Patients with spontaneous acute SDH, symptoms of intracranial hypertension, and cranial nerve dysfunction, such as abducens nerve palsy, often require emergency hemicraniectomy. Pathological samples may also be analyzed to detect atypical cellular changes, such as

hematopoietic neoplasms, although no such pathological findings are typically observed in Marfan syndrome. The underlying cause in such cases is likely attributable to arterial wall weakness associated with the condition [13–16].

However, in a study of 56 patients with acute subdural hematomas, the incidence of low density in the hematoma according to the initial CT scan and the spontaneous resolution of up to 32% were reported. The majority of the patients did not even undergo surgery because of their poor prognosis, and some studies found significant differences in the use of antiplatelets [7,17].

## CONCLUSION

This case underscores the rare occurrence of spontaneous acute SDH in the setting of Marfan syndrome, emphasizing the need for prompt recognition and surgical intervention. The patient outcome was unfavorable, highlighting the challenges associated with managing neurological complications.

Marfan syndrome is considered a volatile syndrome. The loss of elasticity and other cardiovascular and arterial changes brought on by its fibrillin gene abnormality are so severe that they are linked to the aneurysms that result in these spontaneous SDHs. Therefore, any other type of emergency was expected in the patient's life record, but not this type of SDH. In other words, he was treated as professionally as possible using all available equipment and medical services. From a medical perspective, there are questions, but the management of Marfan syndrome should be done in conjunction with the neurological, emergency, and neurosurgery services without neglecting psychiatric consultation.

### Acknowledgements

We acknowledge the City Clinical Hospital No. 68, Demikhova V.P. in Moscow, Russia, and the People's Friendship University of Russia (RUDN) University.

### 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 they have no conflicts of interest.

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### Author Contributions

Conceptualization, MP, DRC, ES, and DES; methodology, DES and GS; software, DES and GC; validation, IB, GS, and BC; formal analysis, GS and GF; investigation, DES; resources, MB and ES; data curation, GS; writing—original draft preparation, DES; writing—review and editing, GS and DES; visualization, AR and NB; supervision, GC, EC, IB, GS, and BC.

### Availability of Data and Materials

The manuscript has been read and approved by all authors, and availability of data and materials will be facilitated for reasonable requirements.

## REFERENCES

[1] Wityk J, Zanferrari C, Oppenheimer S. Neurovascular complications of marfan syndrome: a retrospective, hospital-based study. Stroke. 2002;33(3):680–4.
[2] Coelho G, Almeida G. Marfan syndrome revisited: from genetics to the clinic. Rev Port Cardiol (Engl Ed). 2020; 39(4):215–26.
[3] von Kodolitsch Y, Demolder A, Girdauskas E, et al. Features of Marfan syndrome not listed in the Ghent nosology - the dark side of the disease. Expert Rev Cardiovasc Ther. 2019;17(12):883–915.
[4] Semyachkina N, Adyan A, Khabadze N, Novikov V, Polyakov V. Clinical and genetic characteristics of Russian Marfan patients. Genetika. 2015;51(7):812–20.
[5] Groth A, Hove H, Kyhl K, et al. Prevalence, incidence, and age at diagnosis in Marfan Syndrome. Orphanet J Rare Dis. 2015;10:153.
[6] Jasquez M, Mendoza J, Suero W. Vascular findings in 5 patients with Marfan syndrome [Spanish]. Act Med Dom. 1992;14(5):173–6.
[7] Yang B. Commentary: how aggressive should we be in a prophylactic surgery for patients with Loeys-Dietz or Marfan syndrome? J Thorac Cardiovasc Surg. 2022;164(1):26–7.
[8] Milewicz M, Braverman C, De Backer J, et al. Marfan syndrome. Nat Rev Dis Primers. 2021 2;7(1):64.
[9] Signorelli F, Ktari O, Agostini L, et al. Spontaneous intracranial hypotension and dural ectasia in Marfan syndrome: an illustrative case successfully treated with steroid therapy and literature review. Brain Sci. 2024 15;14(11):1143.
[10] Haddadin F, Munoz Estrella A, Herzog E. Hypertensive emergency presenting with acute spontaneous subdural hematoma. J Cardiol Cases. 2018;19(1):25–8.
[11] Pollock L, Ridout A, Teh J, et al. The musculoskeletal manifestations of Marfan syndrome: diagnosis, impact, and management. Curr Rheumatol Rep. 2021;23(11):81.
[12] Asano K, Cantalupo A, Sedes L, Ramirez F. Pathophysiology and Therapeutics of thoracic aortic aneurysm in Marfan syndrome. Biomolecules. 2022;12(1):128.

[13] Coombs B, Coombs L, Chin J. Acute spontaneous subdural hematoma in a middle-aged adult: case report and review of the literature. J Emerg Med. 2014;47(3):e63–8.
[14] Laczynski J, Dong S, Kalahasti V, et al. Prevalence of intracranial aneurysms in Marfan syndrome. J Vasc Surg. 2023;78(3):633–7.
[15] Encarnación-Santos D, Pachev M, Bozkurt I, et al. Acute subdural haematoma emergency care regarding glial cystic changes: a case report and literature review. Kerala Surg J. 2025;31(1):26–9.
[16] Encarnación Santos D, Chmutin G, Rami Kassar A, et al. Endovascular treatments, predictors and outcomes of cerebral aneurysm: a systematic review. Rom Neurosurg. 2024;38(4):420–9.
[17] Fujimoto K, Otsuka T, Yoshizato K, Kuratsu J. Predictors of rapid spontaneous resolution of acute subdural hematoma. Clin Neurol Neurosurg. 2014;118:94–7.

Case Reports

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# Spontaneous Lumbar Artery Rupture: Diagnostic and Therapeutic Challenges in Anticoagulated Patients

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Spontaneous rupture of the lumbar artery is a rare and potentially life-threatening complication, particularly in anticoagulated patients. Its diagnosis is challenging due to nonspecific symptoms and rapid progression. We present the case of a 78-year-old woman, without prior arterial disease, who developed atrial fibrillation during hospitalization and was started on enoxaparin (1 mg/kg every 12 hours). She subsequently developed hemodynamic instability, prompting urgent imaging. An initial ultrasound showed a right flank hematoma, and a computed tomography angiogram confirmed a retroperitoneal hematoma due to lumbar artery rupture. The patient received aggressive resuscitation and hemodynamic support, followed by successful catheter embolization, which stabilized her condition. This case highlights the importance of considering spontaneous lumbar artery rupture in anticoagulated patients presenting with unexplained hemodynamic instability. Early diagnosis and timely endovascular intervention can be life-saving and improve outcomes.

**Keywords:** *Spontaneous Rupture; Lumbar Artery; Anticoagulation; Retroperitoneal Hematoma; Catheter Embolization*

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## INTRODUCTION

Spontaneous lumbar artery rupture (LAR) is an extremely rare clinical condition, with limited information about its incidence and underlying mechanisms. While massive retroperitoneal hematomas related to the rupture of this artery are often associated with trauma or retroperitoneal neoplasms, spontaneous rupture poses a clinical challenge due to its high morbidity and mortality and the difficulty of early and accurate diagnosis. Despite technological advances, this condition remains complex to identify [1,2].

Over the past decades, an increased incidence of this condition has been observed, likely attributable to the widespread use of anticoagulant and antiplatelet agents. Emerging evidence also suggests associations with unrecognized vascular injuries, underlying coagulopathies, and invasive procedures such as hemodialysis. These factors contribute to vascular fragility and increase the risk of spontaneous bleeding [2,3].

This case report describes a spontaneous rupture of the lumbar artery, analyzing its clinical presentation, diagnostic strategies, and therapeutic management.

Additionally, possible pharmacological interactions that could have influenced the genesis of the event are evaluated. These types of reports are crucial for improving early recognition of the pathology, optimizing interventions, and reducing associated morbidity and mortality. This is the first case reported in Latin America.

## CASE DESCRIPTION

A 78-year-old female patient was admitted to the intensive care unit (ICU) after being referred from another institution due to dyspnea, mixed respiratory symptoms, and respiratory distress. Relevant personal history included chronic obstructive pulmonary disease secondary to heavy smoking (quit 10 years ago), hypertension, and venous insufficiency. The patient was functionally independent and was receiving pharmacological treatment with losartan, acetylsalicylic acid, and rescue inhaled beta-2 agonists. Initial evaluation identified a superinfection of the underlying pulmonary pathology, associated with severe hypercapnia causing

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gasometric and neurological alterations. Management was initiated with non-invasive mechanical ventilation, crisis inhaled therapy, intravenous steroids, and antibiotic therapy.

Seventy-two hours after admission, the patient developed atrial fibrillation with rapid ventricular response, for which antiarrhythmic and anticoagulant therapy was initiated to prevent embolic disease. Subsequently, 48 hours after this event, the patient developed refractory hypotension to fluid resuscitation, tachycardia, and the need for vasopressor support. Over five hours, a rapid increase in vasopressor requirements was observed, associated with an abrupt drop of 2 g/dL in hemoglobin levels. Extended physical examination revealed a non-pulsatile mass in the right abdomen accompanied by a large hematoma (Figure 1a), and the focused ultrasound (FOCUS) revealed an image suggestive of a spontaneous hematoma in the right flank and hypochondrium (Figure 1b).

A hypovolemic hemorrhagic shock protocol was activated, and two emergency red blood cell units were transfused.

Emergency angiographic computed tomography (CT) confirmed the presence of a right abdominal wall hematoma with active bleeding, approximately $20 \times 12 \times 15\,cm^3$, and an estimated volume of 2,000 cc, originating from the lumbar vertebrae (L) L3–L4 lumbar artery (Figure 2). The patient was immediately transferred to the angiography department, where embolization was performed with microparticles (150–250 μm), occluding the distal portion of L4 up to its origin. Additionally, collateral filling of the L5 lumbar artery was identified, which was also embolized using microparticles and 2 × 8 mm coils. More microparticles were applied to ensure hemostasis (Figure 3).

After the procedure, the patient was returned to the ICU with a progressive decrease in vasopressor support requirements. Adequate control of hemoglobin levels was achieved, with an expected increase after the transfusion. During the next 72 hours, strict monitoring of hemoglobin levels and hematoma size was performed, without evidence of rebleeding.

The resolution of the hypovolemic shock was satisfactory, allowing the patient to stabilize. This case highlights the importance of a rapid, multidisciplinary approach in critically ill patients with spontaneous hemorrhagic complications. The use of advanced diagnostic techniques and timely therapeutic intervention resolved the underlying cause of the shock and improved the patient's clinical outcome.

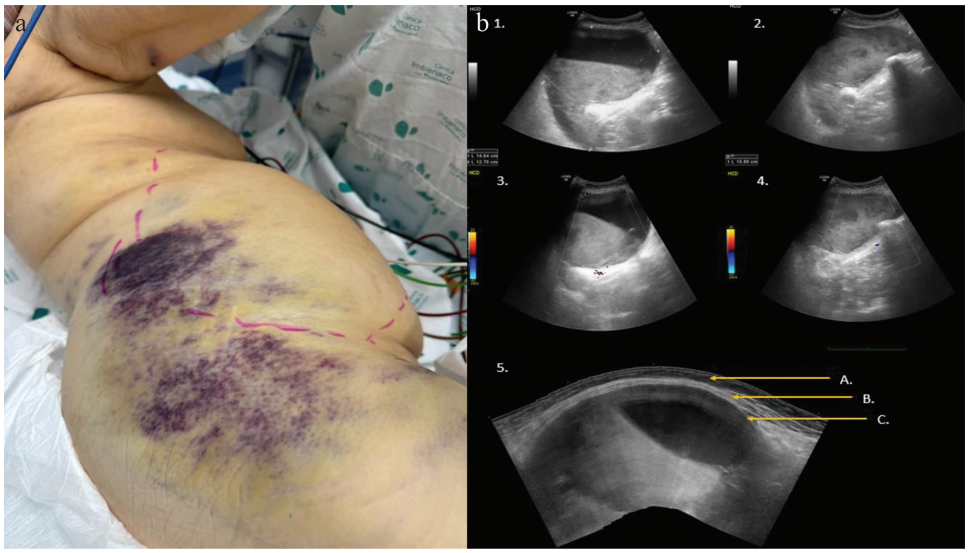


***Figure 1*** **(a)** Photograph of patient in left lateral decubitus position. Ecchymosis is observed from the flank to the iliac crest and the right gluteal ridge. The pink dotted lines correspond to the palpable non-pulsatile mass of the forming hematoma. **(b)** Ultrasound image of the abdominal wall showing different acquisitions (1, axial acquisition of the lesion, 2, longitudinal acquisition, 3 and 4 acquisitions with vascularization using color Doppler technique where absence of vascularization is identified). The image has characteristics of mixed echogenicity, with a fluid-fluid level inside, with an anechoic zone suggesting a component of the collection consistent with a recently formed hematoma, having an approximate volume of 1,464 ml. In image 5, an extended field acquisition is made where the extent of the collection can be distinguished, as well as its relationship with the superficial structures of the abdominal wall, observing that it is immersed in the muscular tissue of the abdominal wall (A, skin and subcutaneous tissue; B, right abdominal oblique muscles; C, abdominal wall collection).

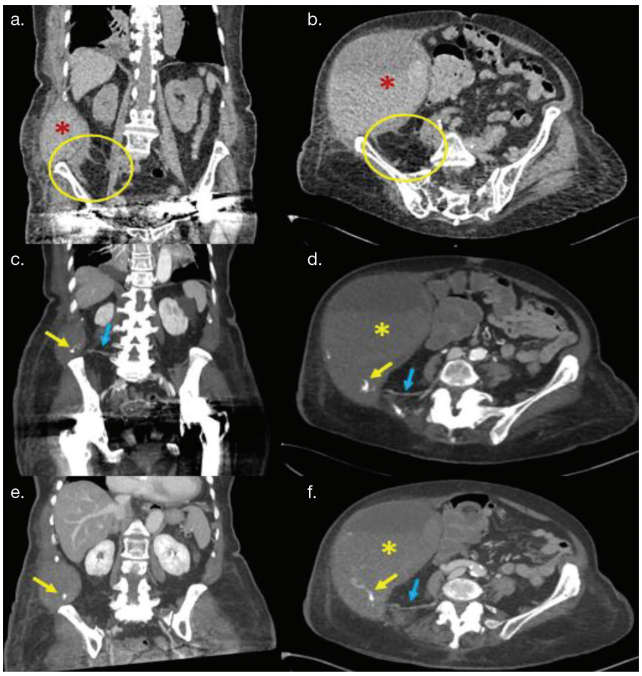


***Figure 2*** Abdominal angiographic-CT scan. Simple phase coronal (**a**) and axial reconstruction (**b**) acquisitions; venous phase coronal (**c**) and axial reconstruction (**d**); late phase coronal (**e**) and axial reconstruction (**f**). The yellow circle circumscribes changes in the fat of the infra-renal region specifically in the inter-fascial space of the right lumbar region. This corresponds to the area marked with blue arrows indicating the ipsilateral lumbar vessel identified in the other acquisitions with findings compatible with fat inflammatory phenomena that correlate with the findings of active bleeding in the abdominal wall collection area. In the anterolateral region of the abdomen, including the oblique muscles of the abdominal wall, a large collection consistent with a hematoma with signs of recent and active bleeding is identified. This is visualized from the simple acquisition (the hematoma is identified in panels **a** and **b** marked with a red asterisk, and in panels **d** and **f** with a yellow asterisk), which become more evident with signs of active bleeding better observed in venous and late acquisitions (panels **c**–**f** marked with a yellow arrow). This bleeding originates from lumbar vessels, specifically the lumbar vessel of the L5 segment on the right side, marked with blue arrows visualized in panels **c**, **d**, and **f**.

### *Ethical Approval and Informed Consent*

Ethical approval to report these cases was given by the ethics committee of the institution. Written informed consent was obtained from the patient.

## DISCUSSION

Retroperitoneal hematomas are frequently associated with conditions such as retroperitoneal neoplasms (in the kidney and adrenal glands), abdominal aortic aneurysms, traumatic vascular injuries, and coagulopathies [1,2]. However, they can also occur in the absence of these underlying factors. Notably, cases have been reported in patients with end-stage renal disease on hemodialysis, often under anticoagulant therapy [3]. The exact mechanism of spontaneous LAR is not fully understood; however, advanced age, renal failure, and anticoagulant therapies are well-documented risk factors [3,4]. Additionally, factors such as prolonged supine position and iliopsoas muscle strain may contribute to the development of this condition [5].

The first documented case of spontaneous LAR was reported by Hodin in 1969, involving a 72-year-old patient with chronic renal failure on hemodialysis, where heparin was identified as a key risk factor [1–6]. Transcatheter arterial embolization was crucial in controlling the bleeding.

Since then, subsequent studies have highlighted the importance of this technique in managing LAR. Yamamura et al. reported on four Japanese patients with spontaneous retroperitoneal bleeding, three of whom were treated with transcatheter embolization and one with surgical hemostasis [7]. Kim et al. conducted a review of 11 cases, observing a median age of 62 years, predominantly men, with renal failure or renal support therapy as common factors [8]. Clinical manifestations of bleeding are diverse and nonspecific, posing a high risk to life. Spontaneous retroperitoneal hemorrhage can present with symptoms such as acute abdominal or lumbar pain, nausea, vomiting, abdominal distension, bowel obstruction, unexplained hypovolemia, anemia, unexplained limb swelling, abnormal sensations (paresthesias), compression of the femoral nerve causing paralysis of a lower limb, muscle weakness, decreased knee or thigh reflexes, and/or increased intra-abdominal pressure associated with abdominal compartment syndrome [8].

Regarding the relationship between the genesis of spontaneous hemorrhage and the use of anticoagulants, spontaneous retroperitoneal hematoma secondary to lumbar artery bleeding in a patient treated with enoxaparin is a severe, rare complication with few scientific reports. However, those reported can be potentially fatal [8,9].

Enoxaparin, a low molecular weight heparin, is widely used for the prophylaxis and treatment of thromboembolic diseases, but its use may be associated with significant bleeding events, especially in patients with risk factors such as renal insufficiency, advanced age, and the concomitant use of other anticoagulants or antiplatelets [7]. Recent scientific studies have evaluated the potential benefit and superiority of clopidogrel use in patients requiring anticoagulant management compared to acetylsalicylic acid, particularly in terms of minimizing bleeding risk. Results suggest that clopidogrel may be a safer option in certain clinical contexts due to its hemorrhagic risk profile [10,11].

Management of retroperitoneal hematoma secondary to enoxaparin includes the immediate suspension

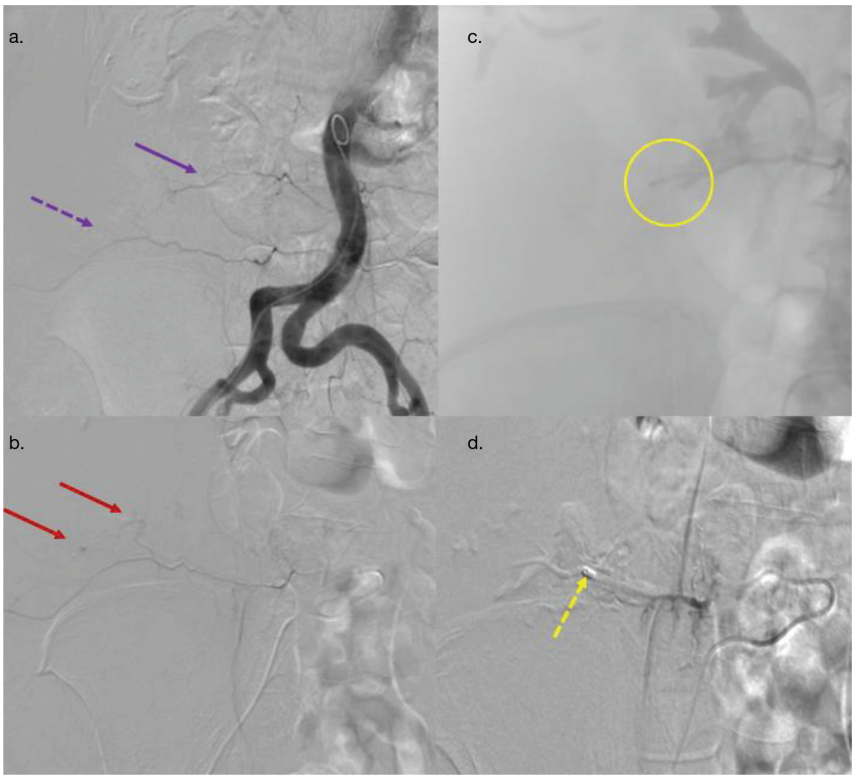


***Figure 3*** Abdominal arteriography showing lumbar branches indicated by purple arrows, the L4 lumbar branch with the continuous purple arrow and the L5 lumbar branch with the dotted purple arrow (**a**). Direct cannulation of the L4 branch revealed an anastomotic arch with L5 and the presence of bleeding from the L5 lumbar branch (red arrows) (**b**), hence embolization was performed with microparticles (150–250 µm) (yellow circle) (**c**). Additionally, embolization was performed with coils and microparticles in the L5 lumbar branch (yellow arrow) (**d**), successfully achieving hemostatic control.

of the anticoagulant and correction of the coagulopathy. In cases of hemodynamic instability, fluid resuscitation and blood transfusions may be required. Arterial embolization via angiography is an effective and less invasive therapeutic option compared to surgery, especially in cases of active bleeding from the lumbar artery, as was the sequence of therapeutic events described in our patient [12]. Surgical intervention may be necessary in cases of persistent clinical deterioration when embolization is not feasible or unsuccessful, and additionally when abdominal compartment syndrome develops [9].

It is crucial to closely monitor patients receiving enoxaparin treatment, especially those with risk factors, to detect early signs of retroperitoneal bleeding, such as abdominal pain, hypotension, and decreased hematocrit levels [3,12]. CT is the imaging modality of choice to confirm the diagnosis and guide therapeutic management [3]. In 2004, Isokangas et al. published the experience of a hospital with endovascular treatment in retroperitoneal hemorrhages secondary to anticoagulation [12]. In 10 consecutive cases, digital subtraction angiography revealed bleeding sites in the lumbar artery (4 cases), branch of the internal iliac artery (3 cases), and multiple sites (3 cases). The diagnostic orientation was premature based on abdominal aortic angiography. Embolization was successful in 89% of cases, while previous surgical interventions failed to control the bleeding.

From a scientific perspective, although information on the incidence, diagnosis, and management of this pathology remains limited, the reported cases and available literature, along with our experience as a level IV care center, underscore the importance of considering spontaneous LAR as a differential diagnosis in anticoagulated patients presenting with progressive anemia and hemodynamic instability without evident sources of macroscopic bleeding [1,5].

This reinforces the need for a multidisciplinary approach and the use of advanced techniques such as transcatheter embolization to improve clinical outcomes [4,7]. Based on our experience, it is suggested that in patients with risk factors for over-anticoagulation and pharmacological interaction, monitoring of anti-Xa levels should be performed. Furthermore, attention should be given to the appearance of new ecchymoses in the absence of trauma, predominantly in the abdominal

wall and lumbar dorsum region, in order to make a rapid and early approach and management.

## CONCLUSION

The spontaneous rupture of the lumbar artery is a rare but potentially fatal complication in anticoagulated patients, requiring early diagnosis and timely management through a multidisciplinary approach. This case highlights the critical role of advanced techniques, such as transcatheter embolization, in controlling bleeding and improving clinical outcomes. Additionally, it emphasizes the importance of carefully evaluating drug interactions, rigorous monitoring in patients at risk of over-anticoagulation, and opting for personalized strategies in the selection of antiplatelet agents to minimize the risk of severe hemorrhagic complications.

### Acknowledgments

We thank Dr. Carlos Gonzales for his advice on the case and for performing the interventional procedure that resolved the cause of the bleeding.

### 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 no conflicts of interest.

### Funding

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### Author Contributions

All authors actively participated in the conception, design, and development of the study. Additionally, they substantially contributed to the drafting, critical review, and final approval of the manuscript, ensuring the integrity and accuracy of the presented content.

### Declaration on the use of Generative AI in the Writing Process

No generative AI or AI-assisted technologies were used during the writing process of this manuscript.

## REFERENCES

[1] Hodin E, Dass T. Spontaneous retroperitoneal hemorrhage complicating anticoagulant therapy. Ann Surg. 1969;170(5):848–51.
[2] Parmer SS, Carpenter JP, Fairman RM, Velazquez OC, Mitchell ME. Femoral neuropathy following retroperitoneal hemorrhage: case series and review of the literature. Ann Vasc Surg. 2006;20(4):536–40.
[3] Topgül K, Uzun O, Anadol AZ, Gök A. Surgical management of enoxaparin- and/or warfarin-induced massive retroperitoneal bleeding: report of a case and review of the literature. South Med J. 2005;98(1):104–6.
[4] Halak M, Kligman M, Loberman Z, Eyal E, Karmeli R. Spontaneous ruptured lumbar artery in a chronic renal failure patient. Eur J Vasc Endovasc Surg. 2001; 21(6):569–71.
[5] Surani S, Estement B, Manchandan S, Sudhakaran S, Varon J. Spontaneous extraperitoneal lumbar artery hemorrhage. J Emerg Med. 2011;40(6):e111–e12.
[6] Hwang NK, Rhee H, Kim IY, et al. Three cases of spontaneous lumbar artery rupture in hemodialysis patients. Hemodial Int. 2017;21(1):E18–E21.
[7] Yamamura H, Morioka T, Yamamoto T, Kaneda K, Mizobata Y. Spontaneous retroperitoneal bleeding: a case series. BMC Res Notes. 2014;7(1):2.
[8] Kim JY, Lee SA, Hwang JJ, et al. Spontaneous lumbar artery rupture and massive retroperitoneal hematoma, successfully treated with arteriographic embolization. Pak J Med Sci. 2019;35(2):569–74.
[9] Quartey B, Nelson J. Massive spontaneous retroperitoneal hemorrhage induced by enoxaparin and subsequent abdominal compartment syndrome requiring surgical decompression: a case report and literature review. Int J Case Rep Imag. 2012;2(10):14.
[10] Bhatt DL, Chew DP, Hirsch AT, Ringleb PA, Hacke W, Topol EJ. Superiority of clopidogrel versus aspirin in patients with prior cardiac surgery. Circ. 2001;103(3):363–8.
[11] Tjerkaski J, Jernberg T, Alfredsson J, et al. Comparison between ticagrelor and clopidogrel in high bleeding risk patients with acute coronary syndrome. Eur Heart J. 2022;43(Supplement_2):ehac544.1390.
[12] Isokangas JM, Perälä JM. Endovascular embolization of spontaneous retroperitoneal hemorrhage secondary to anticoagulant treatment. CardioVasc Interv Radiol. 2004;27(6):607–11.

Case Reports

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# Spontaneous Spinal Epidural Hematoma in Children: Two Case Reports and a Literature Review

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**Background:** Spontaneous Spinal Epidural Hematoma (SSEH) is a rare emergency in the general population. It is an even rarer entity in the pediatric population.
**Case Description:** We report two cases: a 15-month-old boy with SSEH, who was presenting with irritability, acute pain, and a 3-year-old girl who presented with left-sided Horner's syndrome and pain in the left upper extremity. Both patients were misdiagnosed upon admission. At 10 months and 2 months, respectively, after surgery, decompressive surgery was recommended as soon as possible, but this is normally carried out 12 to 24 hours after onset.
**Conclusion:** The clinical presentation of SSEH is atypical and highly difficult to diagnose in children, especially in infants and toddlers. SSEH should always be included in the differential diagnosis when children present with acute back and neck pain, irritability, and uncontrolled crying.

**Keywords:** *Spontaneous Spinal Epidural Hematoma; Pediatric Population; Brain MRI; Case Report*

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## INTRODUCTION

Spontaneous spinal epidural hematoma (SSEH), also known as idiopathic spinal epidural hematoma, refers to a spontaneous or cryptogenic spinal cord compression caused by the collection of blood in the spinal epidural space without obvious predisposing factors.

Anticoagulant therapy, therapeutic thrombolysis, hemophilia and factor XI deficiency, long-time aspirin use as a platelet aggregation inhibitor, cocaine abuse, vascular malformations, and Paget disease are all suggested predisposing factors connected with SSEH [1–3].

SSEH is a rare neurosurgical emergency occurring in all age groups, especially among middle-aged and elderly patients [4]. Its age distribution shows bimodal peaks at 15 to 20 and 65 to 70 years [5]. It represents 40% to 50% of all spinal epidural hematomas with a male-to-female ratio of 1.4:1.1 [4]. The annual incidence of SSEH is estimated at an approximate 0.1 per 100,000 patients [6,7].

SSEH is mostly acute but may also be chronic, spanning months or years. According to the literature, chronic forms located in the lumbar spine are rarely described. Chronic lesions in other levels of the spine have shorter progression of neurological deficits [8].

SSEH is an even rarer entity in infants, with mostly case studies published in the literature. Within the pediatric population, especially in infants, presentation is commonly atypical and without remark. This review seeks to help raise a high index of suspicion and alertness on the side of parents, emergency physicians, and neurosurgeons to this treacherous and morbid pathology for effective and timely management.

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### *Ethical Approval and Informed Consent*

Prior to the commencement of the study, ethical approval was obtained from the following ethical review board: The Ethics Committee of the Morozoskaya Children's City Clinical Hospital, Moscow, Russia. No. Reference L035'00115-77/00096790, 103, February 2, 2015. The CARE checklist has been followed. The study was carried out according to the latest revision of the Helsinki Declaration regarding medical research involving human subjects. The written informed consent was obtained from their parents or legal guardian. All procedures were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

## CASE REPORT 1

Here, we report the case of a 15-month-old toddler who presented to our institute with acute pain, weakness, and refusal to stand or walk. His medical history was without remark. A computed tomography (CT) scan of his head revealed no intracranial pathologies. He was examined by a neurologist in the emergency department. It was not possible to examine his gait due to the child's negative response; he could not sit nor stand up on his own. Nuchal rigidity was presumed upon assessment. Muscle tone and reflexes on the right side were increased. The primary diagnosis on transfer to an infectious disease hospital was unspecified meningitis or acute post-infectious cerebellitis.

He was transferred back to our institute after he was evaluated by a magnetic resonance imaging (MRI) scan of the spine that revealed a lesion at C6–Th3. The lesion formation (suggestive of an epidural hemorrhage due to rupture of a vascular malformation) with dimensions up to 10 × 14–19 × 48 mm$^2$ (about 4 ml) was determined dorsally. It spread to the intervertebral foramina on the right at the C7–Th3 level and on the left at the Th2–Th3 level, without reliable signs of any solid composition.

The spinal cord was compressed and displaced anteriorly at the same level (Figure 1*a*). The spinous processes of C6–Th4 were dissected with a Misonix BoneScalpel. An epidural hematoma was observed upon dissection. Retractors were placed in between the spinous processes. The hematoma was entirely removed. The spinous processes were fixed with absorbable sutures.

Histopathological findings revealed clusters of lysed red blood cells, cellular detritus, and adipose tissue with adjacent structures resembling the walls of large-caliber vessels with pronounced deformed and fibrous walls with diffuse polymorphocellular infiltration and foci of hemorrhages. Vessels of a smaller caliber were visualized perifocally, their lumens were dilated, and the endothelium was flattened. Histochemical staining according to the Weigert method did not reveal elastic membranes in the structure of the vessel walls. These findings were consistent with spinal lymphangioma. An MRI the next day revealed complete removal of the lesion and decompression of the spine. A CT scan with contrast following the MRI showed no residual vascular malformations (Figure 1*b*). Neurological examination after surgery revealed mild left-sided hemiparesis. The patient showed a remarkable improvement in muscle strength and tone 3 months after the surgery and rehabilitation. At the 10 month follow-up, the boy could stand and walk independently with no neurological deficits.

## CASE REPORT 2

A 3-year-old girl woke up in the middle of the night complaining of pain in her left hand radiating to the neck, as well as pain in the lumbar region and left half of the sternum. The next day she developed ptosis,

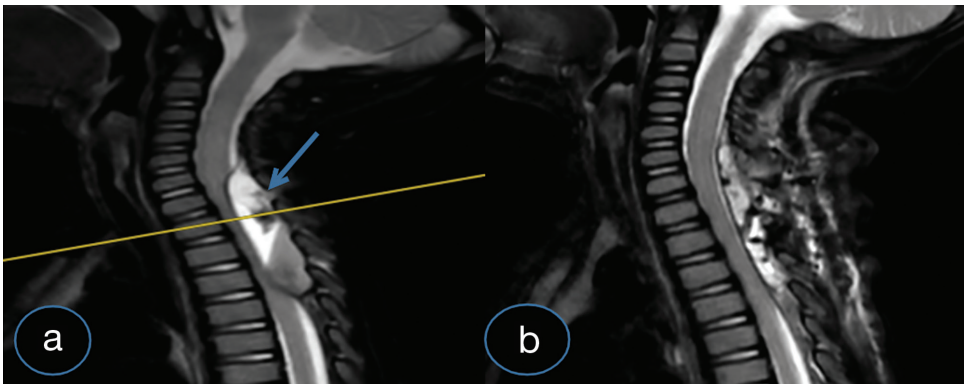


***Figure 1*** (**a**) Sagittal T2 weighted images using magnetic resonance imaging (MRI) revealing a dorsal epidural lesion at C6–Th3 pre-operatively. See blue arrow and yellow line. (**b**) A post-operative MRI scan showing no evidence of residual vascular malformations 10 months post-surgery.

miosis, and enophthalmos. She was examined by a pediatrician in the emergency department and was diagnosed with myalgia. She was given ibuprofen and sent back home after her parents refused admission to the hospital. On the third day, she was admitted to the ophthalmologic department after symptoms persisted and was consequently transferred to the neurological department. Her vital signs were normal and without remark. Her consciousness was clear with no cranial nerve abnormality. No nystagmus was noted. There was no papilledema on eye fundi examination. There was no deficit in motor function, muscle power, and deep tendon reflexes. The sensory examination revealed no disturbance. Laboratory tests, including a full blood cell count and coagulation profile, were without remark. Electroencephalography and electromyography findings were evaluated and found to be normal. An MRI and a contrast CT scan of the cervical spine revealed an extradural intramedullary lesion at the C7–Th4, with compression of the spinal cord (Figure 2*a*). She was urgently transferred to the neurosurgical department. The following day, the child was operated on with the help of intraoperative neurophysiological neuromonitoring. A Th1 to Th2 hemilaminectomy was performed, and 5 ml was evacuated from the epidural hematoma. A malformation of pulsating blood vessels was discovered, coagulated, and a sample was taken for histopathological examination. The pathology report showed evidence of an arteriovenous malformation. Postoperatively, deep tendon reflexes in the right upper extremity were increased. On the 2-month follow-up after surgery, the child had no neurological deficits (Figure 2*b*).

## DISCUSSION

A clear pathogenesis of SSEH still remains unknown, notwithstanding the fact that there are several theories explaining the onset and course of this pathology. It is widely considered that the bleeding springs from the epidural veins. It is asserted that the valveless vertebral venous plexus burst under increased intrathoracic and intra-abdominal pressure resulting from Valsalva maneuvers, coughing, sneezing, etc. A rupture of the vessels at the so-called "locus minoris resistentiae" of the plexus in the dorsal epidural space is caused by the pressure transmitted through the abdominal and retroperitoneal veins [6,9,10]. It is worth noting that the pressure of the epidural venous plexus is lower than the intrathecal pressure. Miyagi and Kamikaseda expressed the same idea of an arterial origin of SSEH leading to the fast accumulation of blood and its accompanying neurological deficits [11,12].

In children, bleeding may be due to rupture of small vascular malformations such as venous angiomas,

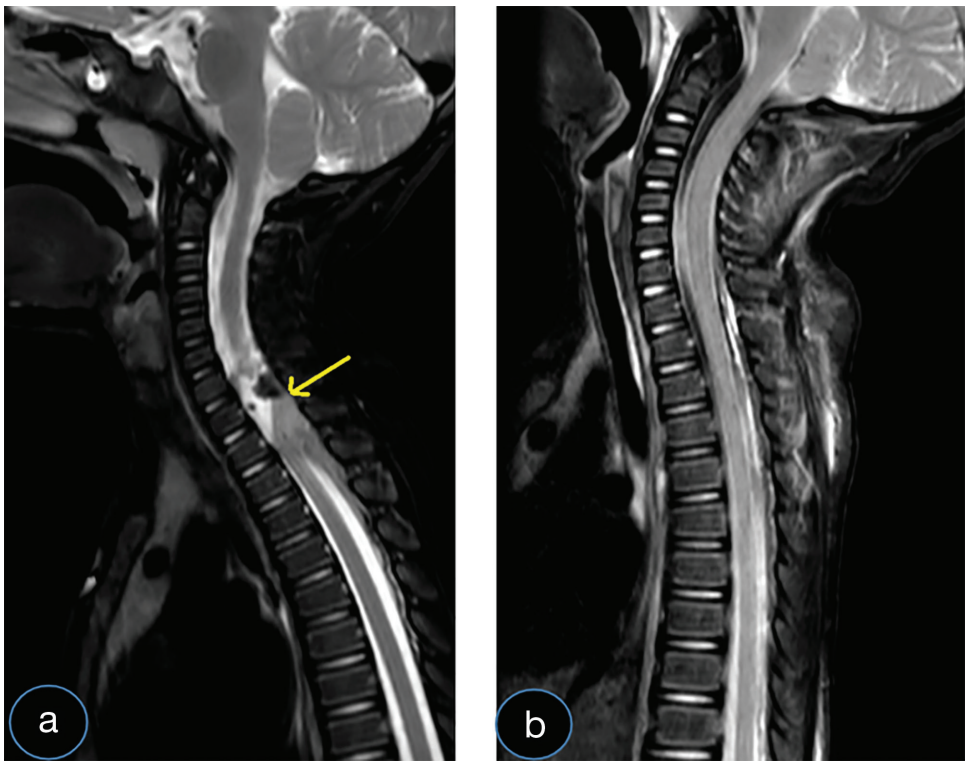


***Figure 2*** (**a**) Sagittal T2 weighted images using magnetic resonance imaging (MRI) showing an elongated lesion (yellow arrow) in the dorsal region of the spinal epidural space from the level of C7 to Th4 with compression of the spinal cord without edema pre-operatively. (**b**) A post-operative MRI scan with contrast showing a complete removal of the lesion 2 months post-surgery.

hemangiomas, or epidural varices. The bleeding sites in adults are C7, the lower thoracic spine, and L1. Conversely, C5 to T1 levels are the major sites of SSEH in children. The hematomas are usually located dorsally, which is anatomically congruent with the location of the venous plexus [13,14].

## CLINICAL PRESENTATION AND DIAGNOSIS

Presentation of SSEH in children highly differs from the somewhat clear presentation in adults. Generally, patients may first present with acute onset of pain localized in a region of the spine and then neurological deficits such as acute or chronic spinal cord or cauda equina compression, motor and/or sensory function loss, radicular paraesthesia, and episodes of transient lower extremity paralysis. In the pediatric population, there are no concrete symptoms that point towards SSEH. Infants mainly present with irritability, restlessness, and uncontrolled crying, while older children may present with acute back pain, weakness, and paresthesia [15]. Torticollis can also be seen in infants [16,17]. The differential diagnosis includes spinal epidural abscess, pathological vertebral fracture, vascular spinal syndromes like a dissecting aortic aneurysm, intrinsic or extrinsic cord tumor, unwitnessed or minor trauma, spinal cord ischemia, disc disease, Guillain–Barré syndrome, transverse myelitis, and congenital abnormality of the spinal cord such as a syrinx [18].

## ETIOLOGY

The etiologies of SSEH include blood-clotting disorders, neoplastic tumors or leukemia, vascular malformation, or spinal procedures such as lumbar puncture. In the study by Lo, it was estimated that only 11% of all intramedullary cavernous malformations discovered were present in the pediatric population. It is also thought that cavernous vascular malformations may appear at several locations in the spine of children. Children are found to present with acute symptoms more often than adults and have more rapid decompensation from their cord injury [15,19].

### *MRI Investigation*

Avrahami et al. in their case report revealed that myelography is unnecessary, invasive, and that a CT scan provides a less suggestive image of epidural hematomas. They concluded that spinal epidural hematoma appears isointense on T1-weighted images and heterogeneous with the spinal cord in T2-weighted images within the first hours after clinical presentation. The hematoma may later become hyperintense and homogeneous in T2-weighted images. MRI of the whole spine is a gold standard for diagnosing SSEH and is taking over the place of CT with contrast. The length and extent of the epidural hematoma can also be assessed on MRI [16,20].

## LABORATORY TESTS

Laboratory tests are done to exclude predisposing pathological factors and coagulation disorders. They include a full blood count, platelet count, and coagulation panel [21].

## MANAGEMENT AND PROGNOSIS

SSEH is mainly managed by timely surgical decompression and evacuation of the epidural lesion followed by rehabilitation. Conservative treatment is employed when there are minimal or no neurological deficits or when evidence of an early resolution is seen. Spontaneous recovery may also occur. There are theories of fatty areolar tissue of the epidural space, which contains a rich vascular network, allowing rapid reabsorption of blood and the draining of the hematoma through the intervertebral foramen [10,22,23].

Decompressive laminectomy, which may damage the spinal ligaments, and laminotomy are employed for surgical management. It is recorded in the literature that laminectomy, especially in the pediatric population, leads to spinal instability and deformity [7,24,25]. Laminectomy with hematoma evacuation is the most effective decompressive approach for epidural hematomas. It can be single level or more depending on the extent of the hematoma [26,27].

A proper prognosis is made by thoroughly analyzing the MRI imaging, evaluating the size and length of the lesion, and the size of the spinal cord edema. Spinal cord edema may be because of the compression of draining local venous paths and circulation and is proportionate to severe neurological deficits preoperatively and unfavorable prognosis postoperatively [28,29,32].

The interval from initial ictus to surgery, the degree of neurological deficits, and the length of the lesion are key to outcome and prognosis. Lawton et al. demonstrated in their study that it was extremely difficult to provide a time range for surgical management after the onset of SSH [28–30]. However, they recommended rapid decompressive surgery for better neurological recovery [31–33].

## CONCLUSION

SSEH affects all age groups, and patients generally present with acute back pain and cord compression symptoms. In the pediatric age group, specifically in infants, presentation is quite atypical and without remark. In up to 28% of all cases, the initial diagnosis is incorrect, such as in our case. MRI is the modality of choice for diagnosis. SSEH is in the cervico-thoracic region in children. Surgery within the first 12 to 24 hours provides a better prognosis, and management in children has better outcomes. Management is mainly surgical decompression followed by complete rehabilitation. A spinal angiography after surgery is highly recommended to exclude any residual lesions.

## 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 they have no conflicts of interest.

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## Authors Contributions

Conceptualization, GGA. Methodology, software, GGA, DAES, BC. Investigation, data, GGA. Curation, surgery, FBB, NSA, DAES. Supervision, PVL, GC, EC. Visualization, validation, GM. Writing – original draft, GGA. Review and editing, formal analysis, DAES, GGA, MM, BC.

## REFERENCES

[1] Sun P. Treatment of spontaneous spinal epidural hematoma in children: analysis of 25 cases. Childs Nerv Syst. 2022;38(8):1557–66.
[2] Domenicucci M. Spinal epidural hematomas: personal experience and literature review of more than 1000 cases. J Neurosurg Spine. 2017;27(2):198–208.
[3] Carlhan-Ledermann A. Spinal epidural hematoma without significant trauma in children: two case reports and review of the literature. BMC Pediatr. 2020;20(1):77.
[4] Chang W, Lin H, Liao T, Hung L, Hwan S. Spontaneous spinal epidural hematoma in a 5-year-old girl: case reports. Acta Paediatr Taiwan. 2002;43(6):345–7.
[5] Kreppel D, Antoniadis G, Seeling W. Spinal hematoma: a literature survey with meta-analysis of 613 patients. Neurosurg Rev. 2003;26(1):1–49.
[6] Patel H, Boaz JC, Phillips JP, Garg BP. Spontaneous spinal epidural hematoma in children. Pediatr Neurol. 1998;19(4):302–7.
[7] Lim JJ, Yoon SH, Cho KH, Kim SH. Spontaneous spinal epidural hematoma in an infant: a case report and review of the literature. J Korean Neurosurg Soc. 2008;44(2):84–7.
[8] Min S, Duan Y, Jin A, Zhang L. Chronic spontaneous cervicothoracic epidural hematoma in an 8-month-old infant. Ann Saudi Med. 2011;31(3):301–4.
[9] Rosenberg O, Itshayek E, Israel Z. Spontaneous spinal epidural hematoma in a 14-year-old girl: case report and review of the literature. Pediatr Neurosurg. 2003;38(4):216–8.
[10] Abram HS, DeLaHunt MJ, Merinbaum DJ, Hammond DN. Recurrent spontaneous spinal epidural hematoma in a child: first case report. Pediatr Neurol. 2007; 36(3):177–80.
[11] Liu Z, Jiao Q, Xu J, et al. Spontaneous spinal epidural hematoma: analysis of 23 cases. Surg Neurol. 2008;69(3):253–60.
[12] Miyagi Y, Kamikaseda K. Spinal epidural vascular malformation presenting in association with a spontaneously resolved acute epidural hematoma: case report. J Neurosurg. 1998;88(5):902–5.
[13] Holtås S, Heiling M, Lönntoft M. Spontaneous spinal epidural hematoma: findings at MR imaging and clinical correlation. Radiology. 1996;199:409–13.
[14] Encarnación Santos D, Scalia G, Bozkurt I, et al. Current insights and surgical interventions in craniovertebral junction instability: a systematic review and meta-analysis. Romanian Neurosurg. 2024;38(2):180–88.
[15] Lo MD. Spinal cord injury from spontaneous epidural hematoma report of 2 cases. Pediatr Emerg Care. 2010;26(6):445–7.
[16] Ramelli GP, Boscherini D, Kehrli P, Rilliet B. Spontaneous spinal epidural hematomas in children: can we prevent a negative prognosis?—reflections on 2 cases. J Child Neurol. 2008;23(5):564–7.
[17] Encarnación Santos D, Chmutin G, Rami Kassar A, et al. Endovascular treatments, predictors and outcomes of cerebral aneurysm: a systematic review. Romanian Neurosurg. 2024;38(4):420–29.
[18] Fok WM, Sun LK, Wong NM, Lau PY, Cheung HM. Spontaneous spinal epidural haematoma in a 15-month-old boy presenting with a wry neck: a case report. J Orthop Surg (Hong Kong). 2007;15(3):373–5.
[19] Paraskevopoulos D, Magras I, Polyzoidis K. Spontaneous spinal epidural hematoma secondary to extradural arteriovenous malformation in a child: a case-based update. Childs Nerv Syst. 2013;29(11):1985–91.
[20] Avrahami E, Tadmor R, Ram Z, Feibel M, Itzhak Y. MR demonstration of spontaneous acute epidural hematoma of the thoracic spine. Neuroradiology. 1989; 31(1):89–92.
[21] Alkhuraiji AS, Alrehaili OA, Al Boukai AA. Spontaneous spinal epidural hematoma in a 12-year-old child. Cureus. 2021;13(7):e16728.
[22] Pecha MD, Able AC, Barber DB, Willingham AC. Outcome after spontaneous spinal epidural hematoma in children: case report and review of the literature. Arch Phys Med Rehabil. 1998;79(4):460–3.
[23] Azumagawa K, Yamamoto S, Tanaka K, et al. Non-operative treated spontaneous spinal epidural hematoma in a 12-year-old boy. Pediatr Emerg Care. 2012;28(2):167–9.
[24] Hosoki K. Infantile spontaneous spinal epidural hematoma. Pediatr Int. 2010;52(3):507–8.
[25] Groen RJM, Ponssen H. The spontaneous spinal epidural hematoma: a study of the etiology. J Neurol Sci. 1990;98(2-3):121–38.
[26] Encarnacion-Santos D, Chmutin G, Abdurakhmonov S, et al. Current concepts, management, and outcomes of traumatic spinal cord injury: a systematic review and meta-analysis. Int J Ortho Surg. 2024;32(2):71–82.

[27] Encarnacion Santos D, Nurmukhametov R, Donasov M, et al. Management of lumbar spondylolisthesis: a retrospective analysis of posterior lumbar interbody fusion versus transforaminal lumbar interbody fusion. J Craniovertebr Junction Spine. 2024;15(1):99–104.
[28] Zhong W, Chen H, You C, et al. Spontaneous spinal epidural hematoma. J Clin Neurosci. 2011;18(11):1490–4.
[29] Arya R, Jain P, Kumar A, Gulati S. Spontaneous spinal epidural hematoma in an infant. J Child Neurol. 2012;27(12):1577–9.
[30] Schoonjans AS. Spontaneous spinal epidural hematoma in infancy: review of the literature and the 'seventh' case report. Eur J Paediatr Neurol. 2013;17(6):537–42.
[31] Ramachandran S, Mishra V, Gera R. Rare presentations of spontaneous spinal epidural hematomas in children. J Pediatr Neurosci. 2020;15(3):171–5.
[32] Lawton MT, Porter RW, Heiserman JE, et al. Surgical management of spinal epidural hematoma: relationship between surgical timing and neurological outcome. J Neurosurg. 1995;83(1):1–7.
[33] Soltani S, Nogaro MC, Rougelot C, et al. Spontaneous spinal epidural haematomas in children. Eur Spine J. 2019;28:2229–36.

Case Report

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# Confronting a Vascular Giant: A Case Report and Review of a Postoperative Brachial Artery Pseudoaneurysm

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**Background:** A pseudoaneurysm (PSA) is a focal arterial dilation caused by blood leakage from a vessel, forming a localized hematoma enclosed by a fibrin wall. Unlike true aneurysms, PSAs lack involvement of all vessel wall layers. Rare in peripheral arteries, they cause life-threatening complications if untreated.
**Case Report:** We report a case of a 42-year-old male who developed a left brachial artery PSA following surgical removal of a titanium elastic nail. The patient presented with a 6-month history of a pulsatile swelling. Imaging revealed a fusiform PSA with partial thrombotic occlusion. Surgical excision was performed, and the brachial artery reconstructed with a great saphenous vein interposition graft.
**Conclusions:** Brachial artery PSAs are uncommon and result from trauma or surgical intervention. Treatment involves open surgical repair with vein grafting. Alternative approaches, including endovascular stent grafting and coil embolization, may be viable. Early diagnosis and tailored management are essential to prevent complications.

**Keywords:** *Pseudoaneurysm; Brachial Artery Pseudoaneurysm; Vascular Surgery; Traumatic Pseudoaneurysm*

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## INTRODUCTION

An aneurysm is an abnormal focal arterial dilation, with an increase in diameter by at least 50% compared with the adjacent non-affected arterial segment. This may result from vessel wall weakness due to proteolytic pathways, inflammation, or loss of the arterial matrix. A pseudoaneurysm (PSA), or a false aneurysm, forms when blood leaks from the vessel and creates a localized hematoma. PSAs usually occur secondary to arterial punctures or trauma, and mimic a true aneurysm in morphological presentation, but they lack involvement of all three vessel layers. Instead, they are enclosed by a clot-derived fibrin wall, which is weaker than the wall formed by a true aneurysm [1,2].

PSAs are a rare entity, and in peripheral locations such as the brachial artery, even more so. They can be limb and life threatening, often leading to thromboembolic complications, hemorrhage, edema, ischemia, and nerve compression, if left untreated, and warrant early diagnosis and management. In the absence of distal neurovascular compression, brachial artery PSAs measuring 2 cm or less may be asymptomatic. When symptomatic, the initial presentation is that of a tender, pulsating mass with possible nerve injury or compression, requiring emergency investigation and appropriate treatment to prevent complications [3].

We present here a case of a 42-year-old male patient who presented with a massive left brachial artery PSA that developed following left upper limb surgery. We managed it by successful surgical excision of the PSA.

### *Ethical Approval and Informed Consent*

Ethical approval for the retrospective case report was given by the Institutional Ethics Committee of Bhaikaka University. Written informed consent was obtained from the patient for the use of clinical images and publication

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of the case report without revealing any personal information or identification.

## CASE REPORT

A 42-year-old male, with no known comorbidities or addictions, presented with complaint of a painless, slow-growing swelling over the lower end of the left arm for 6 months. The patient had a history of surgery of the left arm for a fracture of the left humerus for which the patient underwent humeral titanium elastic nailing (TENS). The TENS was removed surgically 1 year ago, following which the patient developed his complaints. Initially, the patient complained of a small nodular swelling, which had started to significantly grow in size over the past 6 months. Upon examination, there was a solitary, irregularly shaped, non-tender, pulsatile swelling over the anteromedial aspect of the left arm, measuring 15 cm x 10 cm in size, with a palpable thrill, with no distal neurovascular deficit or restriction of mobility in the left upper limb (Figure 1).

Radiograph of the left upper limb depicted an old-healed fracture of the left humerus with a soft tissue mass arising in close relation to the humerus. The patient underwent a computed tomography angiography (CTA) of the left upper limb. The results were suggestive of a contrast-enhanced fusiform outpouching arising from the brachial artery, with a surrounding mixed density non-enhancing area, suggestive of a brachial artery PSA with surrounding hematoma formation (Figure 2), along with partial thrombotic occlusion of the brachial artery distal to the PSA and proximal part of the ulnar artery.

Based on the clinical findings and the CTA report, the patient was taken up for surgical excision of the PSA. The left brachial artery was exposed superior and inferior to the swelling, and proximal and distal controls of the brachial artery were taken. The incision was extended along the anterior margin of the swelling; the PSA was exposed completely and thereafter excised. A long segment of calcified thrombus was evacuated from the distal segment of the brachial artery and proximal ulnar artery. Brachial artery repair was done with a great saphenous vein interposition graft, with an end-to-end anastomosis using a 6-0 polypropylene suture. Normal distal circulation was ensured (Figure 3).

***Figure 1*** Clinical image showing a massive swelling over the left arm. (**a**) Medial aspect. (**b**) Anterior aspect.

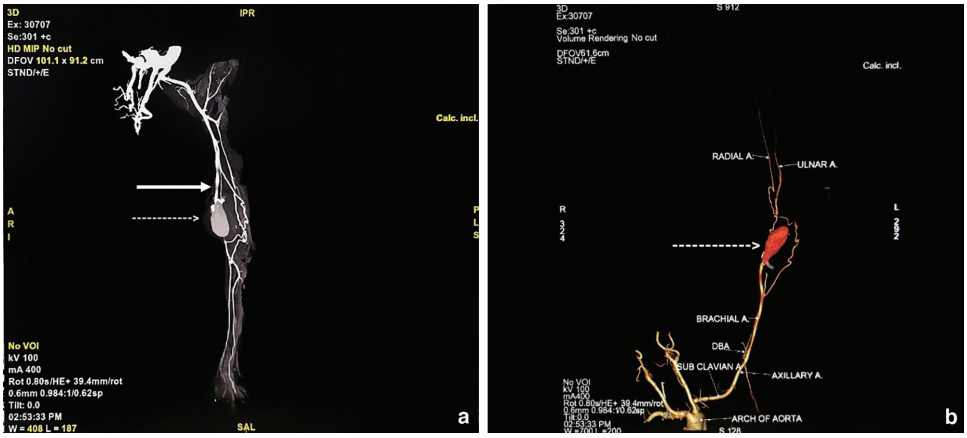


***Figure 2*** Computed tomography angiography (CTA) of the left upper limb. (**a**) CTA of the left upper limb showing enhancing aneurysmal dilatation (dashed white arrow) arising from the left brachial artery (solid white arrow). (**b**) CTA of the left upper limb – Virtual Reality image showing fusiform aneurysmal dilation (dashed white arrow) arising from the left brachial artery.

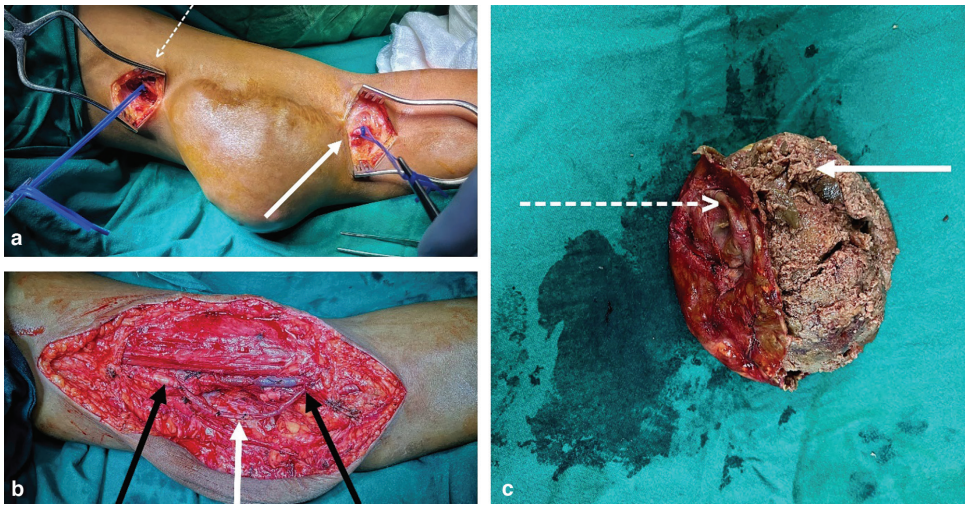


***Figure 3*** Intraoperative images. **(a)** Intraoperative image showing proximal control of the brachial artery at the superior edge of the pseudoaneurysm (dashed arrow) and distal control of the brachial artery at the inferior edge of pseudoaneurysm (solid arrow). **(b)** The left great saphenous vein placed as interposition graft (solid white arrow) with end-to-end anastomosis proximally and distally (solid black arrows) to the left brachial artery. **(c)** Excised specimen showing a chronic organized hematoma (solid white arrow) with a thick pseudoaneurysm wall (dashed white arrow).

Following the procedure, the patient made an uneventful recovery and was discharged two days later. Subsequent Doppler scanning upon follow-up revealed no residual abnormalities and good flow in the left upper limb, and no evidence of leakage or vascular insufficiency, as well as no neurovascular deficits.

## DISCUSSION

A PSA is defined as a collection of blood secondary to leakage of blood from an artery into the surrounding tissue, resulting in a pulsatile hematoma encapsulated by fibrous tissue. It commonly results from arterial puncture, trauma, or infection. Unlike true aneurysms, which involve all layers of the vessel wall, PSAs involve only two of the three. PSAs can be iatrogenic or non-iatrogenic, caused by arterial access during endovascular procedures, open surgery, blunt or penetrating trauma, infection, degenerative lesions, or catheter-based interventions [4].

Brachial artery PSAs, like the other peripheral PSAs, can be caused by blunt or penetrating trauma, or can be iatrogenic, occurring owing to surgical trauma. Imaging plays a crucial role in evaluating PSAs, and several modalities including Doppler ultrasonography, magnetic resonance angiography, and CTA are routinely used. The choice of imaging technique depends on the location of the PSA. For cases of a suspected brachial artery PSA, Doppler ultrasound is preferred. While Duplex ultrasound confirms the diagnosis and provides details on the size, anatomy, and origin of the PSA, arteriography helps assess the aneurysm's extent, the location of extravasation with respect to the relation with surrounding tissue, and the evaluation of landing zones if an endovascular intervention is considered [5].

The treatment approach for PSAs is guided by their size, location, and ensuing complications. The most employed technique is open surgical repair, which yields the best long-term results. Kemp et al. conducted an open repair in a case of brachial artery PSA secondary to a mid-humeral fracture and had an uneventful recovery post op [6]. Yetkin and Gurbuz reported a series of nine cases of post-traumatic brachial artery PSAs wherein they performed successful aneurysmal resection followed by saphenous vein interposition graft in all [3]. Similarly, Shi et al. described a case of brachial artery PSA formation after vaccination in an infant, in whom resection of the PSA with vein interposition grafting was successful with return of peak systolic velocity to normal at 5 months post op [7]. In our case as well, the PSA was excised via open surgery and reconstruction was done using a great saphenous vein interposition graft.

Alternatives to open surgery have also been reported in the literature for high-risk cases and minimally invasive management. Klonaris et al. described a series of five cases, adopting a novel hybrid repair consisting of primary endovascular stent grafting and subsequent surgical opening and evacuation of the PSA for decompression of adjacent structures [8]. Centola et al. described a successful endovascular treatment using a percutaneous implantation of a polytetrafluoroethylene-covered stent in a patient on hemodialysis presenting with a large iatrogenic brachial artery PSA [9]. Yuksel et al. performed a percutaneous coil embolization, as an alternative to

open surgical repair, in a 2-year-old patient presenting with a giant brachial artery PSA [10].

Owing to the limited number of cases, there is little evidence to suggest the best management strategy for a PSA. The onus must be on rapid diagnosis of the condition and defining a plan of management dictated by clinical and radiological findings, with an intent to cure and prevent complications.

## 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 they have no conflicts of interest.

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## Declaration of the Use of Generative AI and AI-assisted technologies in the writing process

No generative AI or AI-assisted technologies were used during the writing process of this manuscript.

## REFERENCES

[1] Johnston KW, Rutherford RB, Tilson MD, Shah DM, Hollier L, Stanley JC. Suggested standards for reporting on arterial aneurysms. J Vasc Surg. 1991;13(3):452–8.
[2] Costa D, Andreucci M, Ielapi N, et al. Vascular biology of arterial aneurysms. Ann Vasc Surg. 2023;94:378–89.
[3] Yetkin U, Gurbuz A. Post-traumatic pseudoaneurysm of the brachial artery and its surgical treatment. Tex Heart Inst J. 2003;30(4):293–7.
[4] Rivera PA, Dattilo JB. Pseudoaneurysm. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024. Accessed 3 January 2025. http://www.ncbi.nlm.nih.gov/books/NBK542244/
[5] Sueyoshi E, Sakamoto I, Nakashima K, Minami K, Hayashi K. Visceral and peripheral arterial pseudoaneurysms. Am J Roentgenol. 2005;185(3):741–9.
[6] Kemp K, Radwan R, Shingler G, Davies C. Brachial artery pseudoaneurysm. BMJ Case Rep. 2014;2014:bcr2014203924.
[7] Shi H-F, Yuan S, Liang K-J, Ye P, Yang H. Pseudoaneurysm of the brachial artery in an infant due to vaccination: a case report. BMC Pediatr. 2023;23(1):9.
[8] Klonaris C, Patelis N, Doulaptsis M, Katsargyris A. Hybrid treatment of large brachial artery pseudoaneurysms. Ann Vasc Surg. 2016;32:20–4.
[9] Centola M, Ferraresi R, Danzi GB. Dialysis access pseudoaneurysm: endovascular treatment with a covered stent. Case Rep. 2010;2010:bcr0720080477.
[10] Yuksel A, Nas OF, Kan II, Tok M, Erdogan C. Percutaneous coil embolization for the treatment of a giant brachial artery pseudoaneurym in a child. Ann Vasc Surg. 2017;45:266.e5–266.e8.

Case Reports

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# The Modern Vascular Surgeon: Acute Embolization within the EVTM Concept

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**Keywords:** *Endovascular; Embolization; Embolic Agents; Embolic Materials; Vascular Surgery*

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## INTRODUCTION

Uncontrolled hemorrhage remains a leading cause of preventable death in trauma patients [1,2]. Historically, definitive control of bleeding relied on surgical laparotomy, a strategy associated with substantial morbidity and mortality [3,4]. Despite advances in trauma systems, mortality after emergent laparotomy remains high, highlighting the need for less invasive approaches [5].

Over the past two decades, vascular surgery has transitioned from a predominantly open specialty into one that routinely employes advanced endovascular techniques [6,7]. The EVTM (EndoVascular resuscitation and Trauma Management) concept provides a framework for rapid and definitive hemorrhage control in unstable patients by integrating open surgery, endovascular interventions, and resuscitation strategies within hybrid settings [8–10].

In most centers, acute embolization is performed by interventional radiologists. Current guidelines strongly recommend transarterial embolization as first-line therapy for parenchymal organ hemorrhage [11–15]. Given their expertise in both open and endovascular surgery, vascular surgeons are uniquely positioned to incorporate embolization into emergency care.

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## CASE PRESENTATION

To illustrate the practical application of vascular surgeon-led embolization within the EVTM framework, we present four cases of artery embolization performed at Örebro University Hospital (Table 1). All procedures were performed by vascular surgeons trained in endovascular techniques within the Swedish national vascular surgery curriculum, without additional interventional radiology fellowship training. Their endovascular competence is maintained through elective practice, EVTM workshops, and simulation-based training. Trauma cases are initially managed in a hybrid emergency room (ER) with computed tomography (CT) capability, where vascular surgeons function as integrated members of the trauma team.

### *Case 1: Endovascular Control of Penetrating Splenic Injury via Aberrant Superior Mesenteric Artery (SMA) Origin*

A 16-year-old male presented to the emergency department (ED) after stab wounds to the back, left flank and thigh. Upon arrival in the hybrid ER, he was hemodynamically unstable but responded to transfusion with two units of whole blood. Given the multiple injury sites and his transient stabilization, CT angiography (CTA) was performed. The CTA revealed a left sided hemothorax and a grade IV splenic injury.

Because the hybrid suite was initially unavailable, the patient was transferred to the operating room, intubated, and a thoracic drain was inserted. Resuscitation continued with a total of six units of packed red blood cells, five units of plasma, and two units of platelets before the patient was moved to the hybrid suite for further management.

#### *Technical approach*

The CTA demonstrated an aberrant splenic artery originating from the SMA at the level of the L2 vertebra

***Table 1*** Summary of four cases of vascular surgeon-led embolization for traumatic and non-traumatic hemorrhage. Each case highlights the indication, anatomical or technical challenges, embolic agents used, techniques applied, and the clinical rationale or benefits of the chosen strategy.

| *Case* | *Indication* | *Anatomy/challenge* | *Embolic(s)* | *Technique* | *Rationale/Benefits* |
|---|---|---|---|---|---|
| 1 | Penetrating splenic injury (aberrant SMA origin) | Variant anatomy, unstable trauma | Penumbra coils | Progreat microcatheter selective coiling (aberrant SMA origin) | Avoided SMA dissection; targeted perfusion reduction preserved splenic viability |
| 2 | Pelvic fracture with arterial bleeding | Multiple possible bleeding sites; delayed instability; fragile iliac anatomy | Covera stent graft | Stent graft from external iliac to common femoral artery | Provided rapid, definitive hemostasis while preserving limb perfusion; minimized risk of further hemorrhage in frail vessel walls |
| 3 | Bleeding splenic artery aneurysm post-bypass | Unstable access, dual wire technique | Coils + Squid 34LD | Dual 0.018″ wire stability technique; coils + Squid 34LD packing | Dual-wire technique achieved stability in tortuous anatomy; coil + liquid combination ensured complete aneurysm exclusion |
| 4 | Massive GI bleed + REBOA | Shock, multivessel bleed | Squid 34LD + coils | Zone I–II REBOA + sequential vessel embolization with Squid 34LD and coils | REBOA enabled temporary proximal control; sequential embolization addressed multiple bleeding sources without losing hemodynamic stability |

*GI, gastrointestinal; LD, low density; REBOA, Resuscitative Endovascular Balloon Occlusion of the Aorta; SMA, Superior Mesenteric Artery.*

***Figure 1*** Computed tomography angiography (CTA) in Case 1 demonstrating an aberrant splenic artery (arrow) arising from the proximal superior mesenteric artery (SMA) at the level of the L2 vertebra.

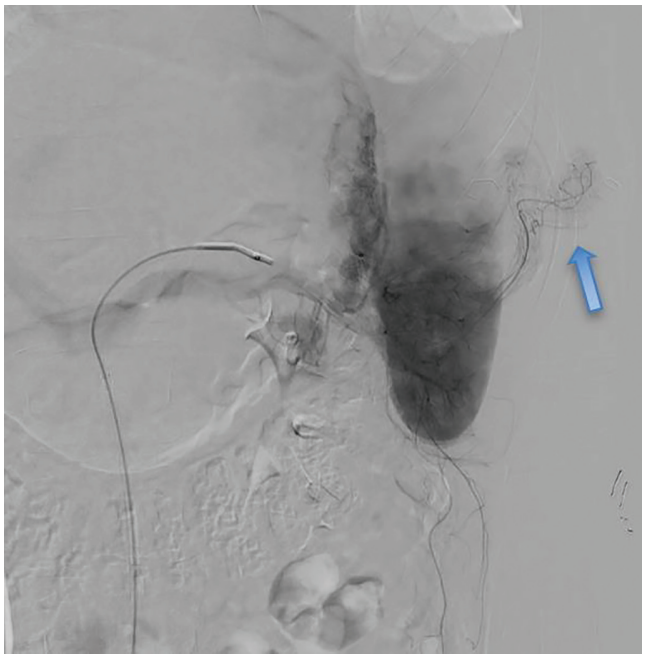

***Figure 2*** Angiography in Case 1 confirming selective catheterization of the aberrant splenic artery with active extravasation (arrow) before coil embolization.

(Figure 1). Ultrasound guided retrograde puncture of the right common femoral artery was performed. A 0.035″ Terumo Advantage guidewire was advanced, over which a 6 Fr Destination (45 cm) introducer and a mini SOS-Omni 4 Fr catheter were placed. By carefully reversing the SOS-Omni catheter at the level of L2, the SMA was directly catheterized without angiography and the guidewire was advanced into the splenic artery. Owing to the aberrant origin and potential risk of SMA dissection, the introducer was not advanced into the SMA and splenic artery to place a proximal plug, the otherwise standard procedure in these cases at our center. Instead, a Prograte microcatheter was used for selective access. Angiography confirmed splenic artery catheterization and active splenic hemorrhage (Figure 2). Four standard Penumbra coils were deployed proximally to reduce splenic perfusion

and control bleeding while preserving partial parenchymal viability. Completion angiography demonstrated decreased perfusion with no ongoing extravasation.

No closure device was used owing to the patient's young age and vessel size. Instead, hemostasis was achieved with manual compression (15 minutes) and FemoStop (2 hours). A follow-up CTA at day seven showed a partial splenic infarct with an estimated 50% viable tissue.

### *Case 2: Endovascular Management of Pelvic Hemorrhage from a Pelvic Fracture*

An 80-year-old woman was admitted to the ED following a ground-level fall. She had experienced dizziness while standing and fell backward, striking her right hip and head. On examination, she was alert, oriented, and hemodynamically stable. CTA demonstrated a minimally displaced fracture of the right superior pubic ramus accompanied by a surrounding hematoma and focal contrast extravasation. Her hemoglobin level decreased from 109 g/L to 91 g/L within four hours of admission.

The trauma and orthopedic teams jointly assessed the patient and, in consultation with the on-call vascular surgeon, initially chose conservative management. Overnight, however, she developed progressive hemodynamic instability, and repeat CTA demonstrated hematoma expansion. The vascular surgeon was re-consulted, and a decision was made to proceed with embolization.

#### *Technical approach*

Ultrasound-guided puncture of the left common femoral artery was performed. A Universal Flush catheter was advanced over a guidewire into the contralateral iliac system. Angiography demonstrated active extravasation at the level of the femoral head. Selective angiography of several internal iliac artery branches was performed using a Glide and Progreat microcatheter, with no active bleeding identified. The catheter was withdrawn to the common iliac artery for repeat angiography, which suggested possible extravasation from the external iliac system.

Selective angiography of the external iliac artery revealed a very thin, thread-like vessel near the origin of the inferior epigastric artery with medial contrast leakage (Figure 3*a*). Given the frailty of the arterial wall, a covered stent graft was used to exclude the bleeding. The sheath was upsized to 8 Fr, and a Rosen guidewire was advanced to provide stable support. A Covera stent graft (7 × 46 mm, Bard) was deployed and completion angiography confirmed exclusion of the bleeding site (Figure 3*b*). Hemostasis at the puncture site was achieved with a ProGlide closure device.

### *Case 3: Dual-wire Technique for Splenic Artery Aneurysm Embolization*

A 64-year-old woman with a history of gastric bypass surgery presented with hematemesis. CTA demonstrated varicose vessels surrounding the gastric pouch

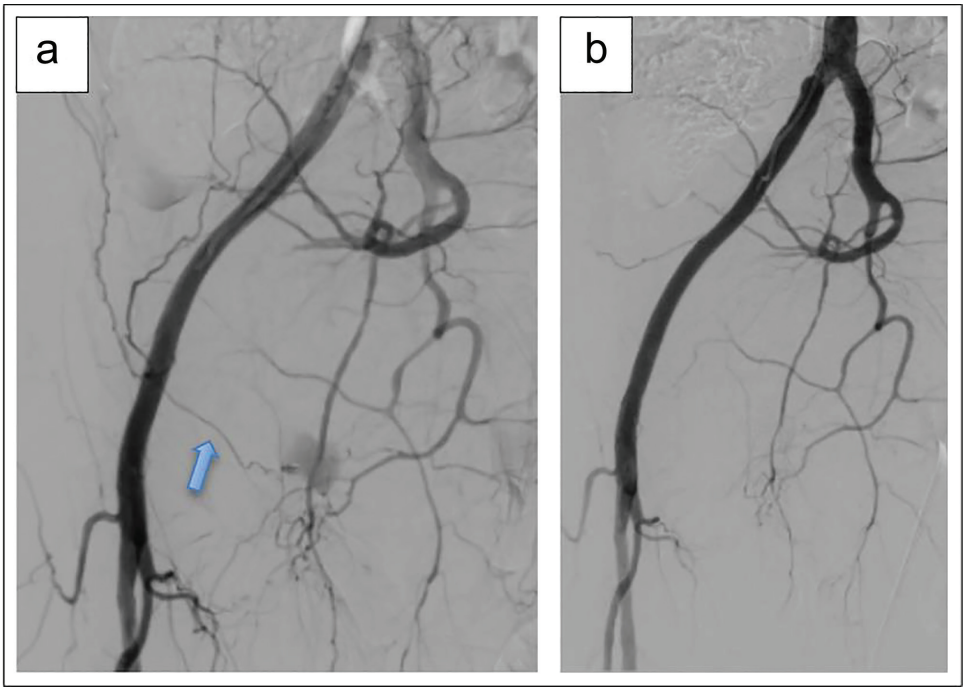


***Figure 3*** Angiography in Case 2 demonstrating a thin, thread-like branch (arrow) arising from the external iliac artery with active extravasation near the level of the inferior epigastric artery. **(a)** Angiography prior to stent graft placement. **(b)** Completion angiography after deployment of a Covera stent graft, showing successful exclusion of the bleeding vessel.

as well as a splenic artery aneurysm with an associated pseudoaneurysm. Emergency gastroscopy identified a pulsatile gastric ulcer bleed, but endoscopic hemostasis was unsuccessful, and the procedure was further complicated by cardiac arrest. Following cardiopulmonary resuscitation and return of spontaneous circulation, the senior general surgeon consulted the on-call vascular surgeon, and the patient was transferred to the hybrid suite for embolization.

### *Technical approach*

Ultrasound-guided retrograde puncture of the right common femoral artery was performed, and a 5F introducer was inserted. A 0.035″ Advantage guidewire was advanced, over which a 6F Ansel (45 cm) introducer and Mini SOS-Omni catheter were positioned. Selective catheterization of the splenic artery proved challenging, as the wire repeatedly prolapsed into the hepatic artery. To overcome this, a double 0.018″ wire technique was employed. Two 0.018″ Advantage guidewires were advanced: one positioned in the hepatic artery to provide counter-support, while the second was manipulated into the splenic artery (Figure 4). A Glide catheter was advanced over both 0.018″ wires to the celiac trifurcation, after which the hepatic wire was withdrawn and redirected into the splenic artery alongside the first wire. This maneuver allowed the Glide catheter to track securely over both wires. Despite this, the 6F Ansel could not be advanced into the celiac trunk. The sheath was therefore exchanged for a short 8F Cordis introducer, through which a 5F Ansel catheter was introduced and advanced into the celiac trunk and further into the splenic artery.

The 0.018″ wires were exchanged for a Progreat microcatheter, which was navigated distally beyond the two splenic artery aneurysms. Angiography revealed active extravasation from the distal aneurysm (Figure 5*a*). Embolization was performed using a combination of Penumbra standard coils (5 × 30 mm), POD coils (14 mm and 12 mm), additional packing coils, and Squid 34 low density (LD) liquid embolic.

Completion angiography demonstrated exclusion of the aneurysms with no bleeding (Figure 5*b*).

## *Case 4: Endovascular Balloon Occlusion of the Aorta (REBOA) as a Bridge to Definitive Multivessel Embolization in Severe Gastric Hemorrhage*

A 49-year-old man with a complex surgical history, including gastric bypass, duodenal ulcer perforation, and percutaneous endoscopic gastrostomy (PEG) dependence, was admitted with gastrointestinal bleeding. He became progressively hypotensive. CTA demonstrated active extravasation near the gastric remnant.

The patient was taken emergently to the operating theatre for gastroscopy, but endoscopic hemostasis was unsuccessful. At this point, he was in hemorrhagic shock.

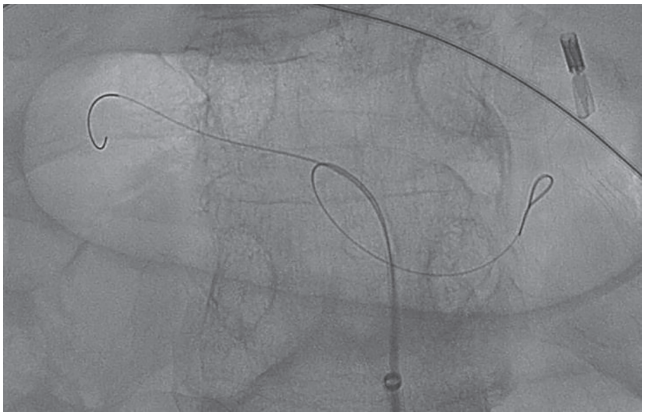

***Figure 4*** Illustration of the dual 0.018″ wire technique in Case 3. One wire was positioned in the hepatic artery to provide counter-support while the second wire was advanced into the splenic artery, enabling stable access for embolization.

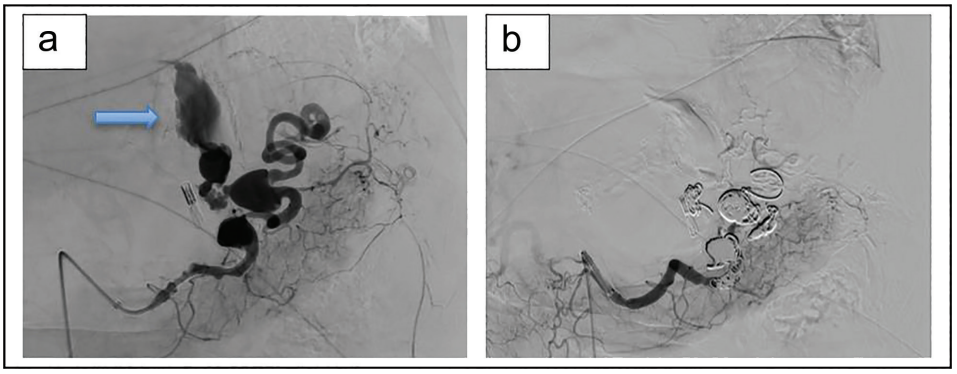


***Figure 5*** Angiography in Case 3. **(a)** Angiography before embolization demonstrating an ongoing hemorrhage (arrow) from the distal splenic artery aneurysms. **(b)** Completion angiography after coil and Squid 34LD embolization shows complete exclusion of the aneurysms with no residual bleeding.

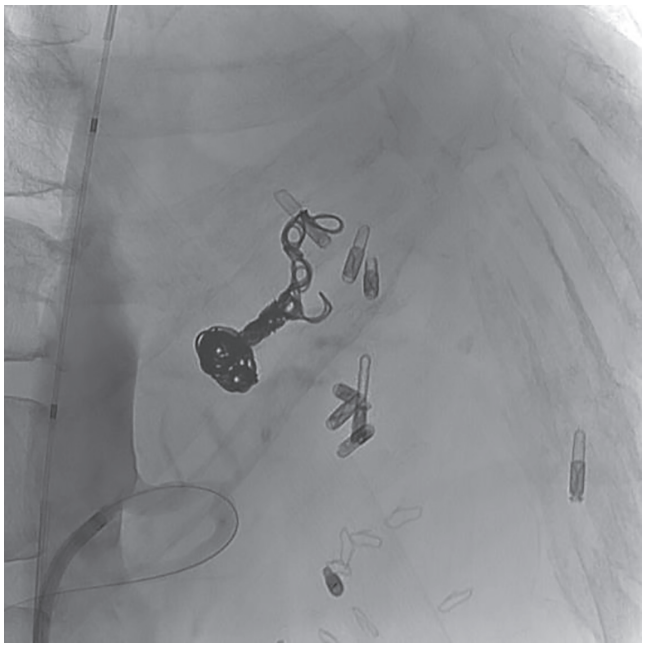

***Figure 6*** Angiography in Case 4 performed with concurrent Zone I–II Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA), before sequential embolization of gastric, hepatic, and splenic branches.

The on-call vascular surgeon was consulted and performed an ultrasound-guided retrograde puncture of the left common femoral artery, placed an 8F introducer, and deployed REBOA at the junction of Zones I and II. After 7–8 minutes of full occlusion, the balloon was titrated to partial occlusion, maintaining systolic pressures of 90–100 mmHg and the patient was transferred to the hybrid suite.

### *Technical approach*

Contralateral femoral access was established with a 6.5F Aptus introducer. The inflated REBOA balloon not only provided hemodynamic stabilization but also aided catheterization of the celiac trunk by stabilizing the Aptus introducer (Figure 6). Angiography demonstrated bleeding from the proximal stomach. A small branch arising near the celiac origin, likely the left gastric artery, was selectively catheterized using a Vanshi 3 catheter and a 0.018″ Advantage guidewire, and embolization was performed with Squid Peri 34LD via a Progreat microcatheter. Persistent supply to the bleeding territory was noted from both hepatic and splenic branches. These were selectively catheterized and embolized sequentially with Squid 34LD, with Penumbra coils deployed proximally to prevent reflux into the celiac trunk. Final angiography confirmed complete exclusion of the bleeding vessels.

### *Ethical Approval and Informed Consent*

Ethical approval and informed consent was not required for this case report in accordance with local institutional policy.

## DISCUSSION

In most institutions, acute embolization is performed by interventional radiologists. In contrast, our center has adopted a model in which vascular surgeons are responsible for all emergency embolizations. Embedded within the EVTM framework, this approach streamlines workflows, minimizes inter-specialty hand-offs, and ensures immediate readiness for hybrid conversion [8,10].

The evolution of vascular surgery into an endovascular specialty, parallels international recommendations. In a European guideline on endovascular hemorrhage management, transarterial embolization is strongly endorsed as the first-line therapy for parenchymal organ bleeding [15]. This is consistent with World Society of Emergency Surgery (WSES) guidelines for splenic, hepatic, renal, and pelvic trauma, all of which support embolization as an essential treatment strategy [11–14]. Similarly, Hörer et al. emphasized embolization as a cornerstone of the EVTM concept, increasingly applied even in hemodynamically unstable patients when combined with adjuncts such as REBOA and performed in hybrid settings [8]. For patients with life-threatening hemorrhage, having a single team responsible for resuscitation, definitive endovascular control, and immediate readiness for open surgery ensures a seamless continuum of care. In Case 4, for example, a massive gastrointestinal bleed was managed entirely by the vascular team, transitioning directly from REBOA placement to multivessel embolization without delay. Such continuity of care minimized critical time to hemostasis in a situation where minutes determined survival.

From a hospital perspective, consolidating responsibility for diagnosis, embolization, and surgical intervention within one specialty enhances efficiency and resource use. It reduces dependence on multiple on-call specialists, simplifies logistics, and guarantees hybrid readiness. Unlike interventional radiology, which is often available only during working hours, the vascular surgery service provides continuous 24/7 coverage. In addition, the vascular team's ability to perform both endovascular and open procedures within the same setting ensures hybrid readiness and minimizes the risk of fragmentation of care.

The feasibility of such models has been validated elsewhere. Kwon et al. demonstrated that trauma surgeons with vascular training performed emergency embolization with outcomes equivalent to those of interventional radiologists, with no differences in rebleeding, reintervention, or mortality [16]. Other studies confirm that trained acute care or trauma surgeons can perform catheter-based hemostatic procedures safely and effectively, expanding access to embolization in time-critical scenarios [6,17–19].

Finally, repeated exposure to acute embolization reinforces technical proficiency across vascular surgery. Skills developed in emergency settings, wire manipulation, catheter navigation, and decisive hemostatic strategies, translate directly into elective procedures with high hemorrhagic risk, such as aortic repairs [20–22].

## CONCLUSION

Our experience demonstrates that vascular surgeon-led acute embolization within the EVTM framework is a safe and effective approach for managing both traumatic and non-traumatic hemorrhage. Vascular surgeons can perform endovascular procedures with outcomes comparable to interventional radiologists, while offering additional advantages such as faster decision-making, hybrid readiness, immediate conversion capability and continuity of care. This model has proven effective in our institution and may serve as a framework for other centers, complementing interventional radiology and strengthening multidisciplinary emergency care.

### 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

Rami Hammadi declares that he has no conflicts of interest. David McGreevy is a member of the editorial board of the JEVTM. He had no involvement in the peer review, editorial decision-making, or handling of this manuscript.

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### Author Contributions

David McGreevy and Rami Hammadi drafted the manuscript.

## REFERENCES

[1] Park Y, Lee GJ, Lee MA, et al. Major causes of preventable death in trauma patients. J Trauma Inj. 2021;34:225–32.
[2] Rhee P, Joseph B, Pandit V, et al. Increasing trauma deaths in the United States. Ann Surg. 2014;260:13–21.
[3] Mattox KL, Allen MK, Feliciano DV. Laparotomy in the emergency department. JACEP. 1979;8:180–3.
[4] Lammers DT, Holcomb JB. Damage control resuscitation in adult trauma patients: what you need to know. J Trauma Acute Care Surg. 2023;95:464–71.
[5] Harvin JA, Maxim T, Inaba K, et al. Mortality after emergent trauma laparotomy: a multicenter, retrospective study. J Trauma Acute Care Surg. 2017;83:464–8.
[6] Brenner M, Hoehn M, Teeter W, Stein D, Scalea T. Trading scalpels for sheaths: catheter-based treatment of vascular injury can be effectively performed by acute care surgeons trained in endovascular techniques. J Trauma Acute Care Surg. 2016;80:783–6.
[7] Avery LE, Stahlfeld KR, Corcos AC, et al. Evolving role of endovascular techniques for traumatic vascular injury: a changing landscape? J Trauma Acute Care Surg. 2012;72:41–7.
[8] Hörer TM, Lamhaut L, Dogan EM, et al. Endovascular resuscitation and trauma management: a review of applications, opportunities, and challenges. J Trauma Acute Care Surg. 2023;94:621–30.
[9] Matsumoto J, Lohman BD, Morimoto K, Ichinose Y, Hattori T, Taira Y. Damage control interventional radiology (DCIR) in prompt and rapid endovascular strategies in trauma occasions (PRESTO): a new paradigm. Diagn Interv Imaging. 2015;96:687–91.
[10] Coccolini F, Stahel PF, Montori G, et al. Pelvic trauma: WSES classification and guidelines. World J Emerg Surg. 2017;12:5.
[11] Coccolini F, Montori G, Catena F, et al. Splenic trauma: WSES classification and guidelines for adult and pediatric patients. World J Emerg Surg. 2017;12:40.
[12] Coccolini F, Coimbra R, Ordonez C, et al. Liver trauma: WSES 2020 guidelines. World J Emerg Surg. 2020;15:24.
[13] Coccolini F, Moore EE, Kluger Y, et al. Kidney and urotrauma: WSES-AAST guidelines. World J Emerg Surg. 2019;14:54.
[14] Chehab M, Afaneh A, Bible L, et al. Angioembolization in intra-abdominal solid organ injury: does delay in angioembolization affect outcomes? J Trauma Acute Care Surg. 2020;89:723–9.
[15] Wagner HJ, Albrecht R, Biberthaler P, et al. Endovascular management of hemorrhage in trauma: an updated guideline. Eur J Trauma Emerg Surg. 2025;51:1–21.
[16] Kwon S, Kim K, Jeong S, et al. Angioembolization performed by trauma surgeons for trauma patients: is it feasible in Korea? J Trauma Inj. 2024;37:28–36.
[17] Brenner M, Hoehn M, Pasley J, Dubose J, Stein D, Scalea T. Basic endovascular skills for trauma course: bridging the gap between endovascular techniques and the acute care surgeon. J Trauma Acute Care Surg. 2014;77:286–91.
[18] Herrold JA, Adnan S, Romagnoli A, et al. Certification in endovascular hemostasis for trauma surgeons: possible and practical. J Trauma Acute Care Surg. 2021;91:775–80.
[19] Tsurukiri J, Ohta S, Mishima S, et al. Availability of on-site acute vascular interventional radiology techniques performed by trained acute care specialists: a single-emergency center experience. J Trauma Acute Care Surg. 2017;82:126–32.
[20] Assi R, Dardik A. Endovascular training of vascular surgeons in the USA. Ann Vasc Dis. 2012;5:423–7.
[21] White RA, Hodgson KJ, Ahn SS, Hobson RW 2nd, Veith FJ. Endovascular interventions training and credentialing for vascular surgeons. J Vasc Surg. 1999;29:177–86.
[22] Messina LM, Schneider DB, Chuter TA, et al. Integrated fellowship in vascular surgery and interventional radiology: a new paradigm in vascular training. Ann Surg. 2002;236:408–15.

Case Reports

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# Selective Vesical Artery Embolization for Controlling Hematuria due to Actinic Cystitis

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This article describes the case of a 45-year-old female patient who had been treated with radiotherapy for vaginal cancer and who developed actinic cystitis with frequent episodes of severe hematuria, requiring repeated blood transfusions. The patient was treated with selective embolization of the vesical arteries. The procedure was successful, and the patient has been in follow-up for six months without other hematuria episodes, nor needing further blood transfusions or hospital admissions. A review of technical aspects regarding bladder embolization and possible complications related to this procedure is also provided.

**Keywords:** *Therapeutic Embolization; Cystitis; Hematuria; Endovascular Procedures; Urinary Bladder*

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## INTRODUCTION

Untreatable hematuria secondary to actinic cystitis constitutes a therapeutic challenge since, in many patients, severe hematuria cannot be controlled by conservative measures such as bladder irrigation or endoscopic procedures with electrocoagulation, laser or argon hemostasis [1,2].

When hemostasis is not achieved, cystectomy may be performed, but besides being a high complexity procedure, individual features such as age and comorbidities may increase surgical risk [1–3].

Although not frequently performed and accounting for few case descriptions in the literature, selective arterial embolization may be considered as a minimally invasive option for stopping hemorrhage secondary to actinic cystitis, avoiding cystectomy [3–6].

This article reports the case of a 45-year-old female patient who has developed episodes of severe hematuria secondary to actinic cystitis and was treated with selective embolization of the vesical arteries.

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## CASE PRESENTATION

A 45-year-old woman presented with recurrent hematuria episodes that became progressively more frequent and intense, being triggered even by daily basic physical activities and requiring repeated blood transfusions.

The patient reported having received 27 radiotherapy sessions and chemotherapy for treating a vaginal cancer (squamous cell carcinoma) three years previously.

After approximately 12 months presenting with hematuria at minimal physical efforts, the urologist referred the patient to a vascular surgeon to be assessed for embolization of vesical arteries, which was performed electively and under epidural anesthesia.

Vascular access was obtained under ultrasound guidance, by a retrograde puncture of the right common femoral artery, and a 5F angiographic introducer was inserted. A pigtail and a cobra 2 5F catheter were used to obtain angiographies from the abdominal aorta and internal iliac arteries.

Hypervascularization was identified in the pelvic area and early contrast drainage was observed when selective angiographies of the vesical arteries were performed using a 2.7 F microcatheter (Progreat-TERUMO TM) (Figure 1).

Vesical arteries embolization was performed with 600 µm embosphere-type microparticles. Although using delicate manual pressure when injecting the embolizing agent, signs of arterial rupture with free contrast extravasation were detected on the left inferior vesical artery. This was managed with microcatheter traction and more proximal embolization with the same particles. Control angiography demonstrated

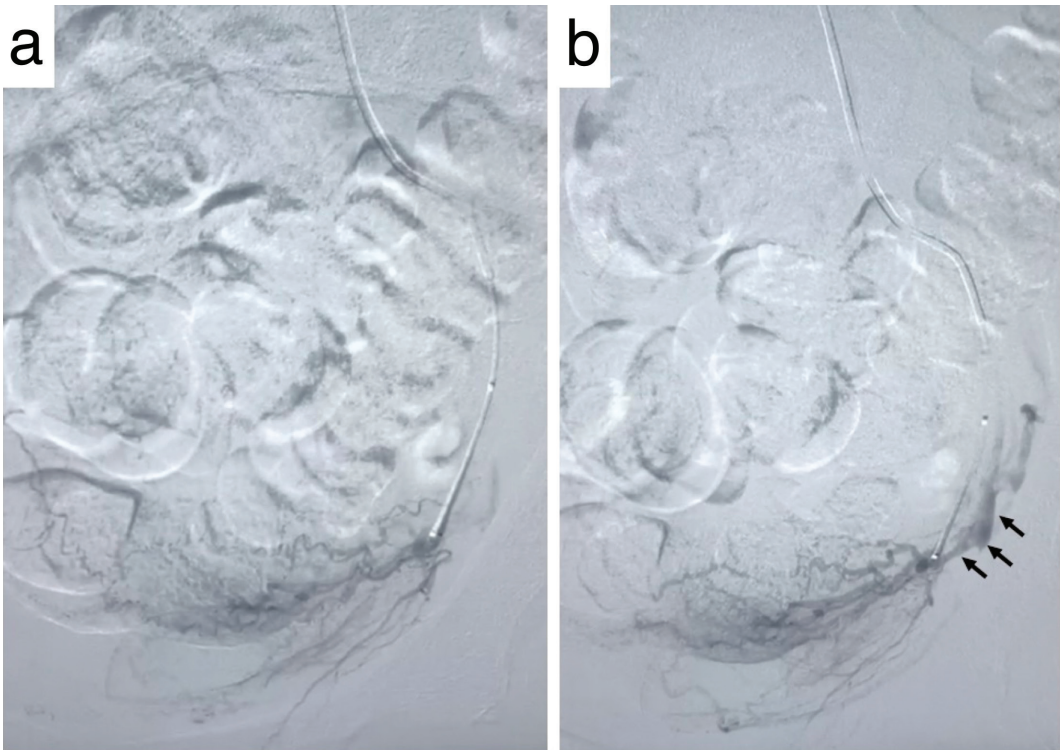



***Figure 1*** Selective angiography. **(a)** Selective angiography of the left inferior vesical artery. **(b)** Early venous drainage (arrows).

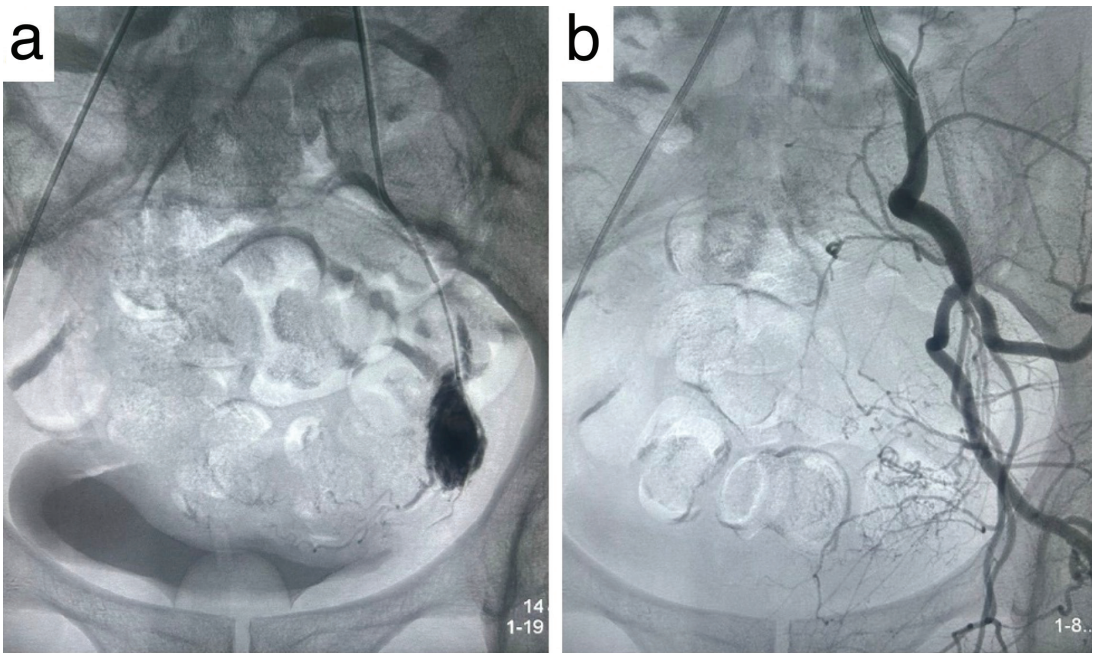



***Figure 2*** Angiographies. **(a)** Selective angiography of the left inferior vesical artery showing contrast extravasation. **(b)** Angiography of the left internal iliac artery without signs of bleeding after proximal embolization of the inferior vesical artery.

vesical arteries occlusion and no sign of bleeding from the arterial rupture (Figure 2).

The patient was taken to the intensive care unit for postoperative recovery; no prophylactic anticoagulation was administered, but mechanical measures were used for thromboembolic prevention. The patient was discharged from the hospital 24 hours later, with an uneventful postoperative course.

On the first two postoperative days, the patient complained of mild to moderate pain in the lower abdomen,

which improved after symptomatic treatment and was interpreted as post-embolization syndrome.

The patient has been in follow-up for six months and has not required further hospital admissions or blood transfusions; she also reports no new hematuria episodes and a marked improvement in quality of life.

### *Ethical Approval and Informed Consent*

Ethical approval was not required as all data were anonymized. The patient signed an informed consent and endorsed the description of her clinical course for educational purposes.

## DISCUSSION

Patients requiring vesical embolization owing to actinic cystitis frequently might already be weakened by anemia or presenting with a compromised clinical status secondary to advanced cancer.

Specially in such scenarios, complex surgical procedures such as radical cystectomy with or without a neobladder creation are associated with high morbidity and mortality rates [3,7,8].

Certain angiographic and technical aspects must be considered when vesical embolization is to be performed.

On each side, the bladder is usually vascularized by a pair of arteries: the superior and the inferior vesical arteries. The inferior vesical artery is a branch of the anterior division of the hypogastric artery. This vessel supplies the fundus of the bladder and, in male patients, also the seminal vesicles, the deferent duct and the prostate are analogous to the vaginal artery in females. Alternative origins of the inferior vesical artery include a common trunk with the superior gluteal and the pudendal arteries or emerge directly from the pudendal artery [9]. In turn, the superior vesical artery gives rise to branches that supply higher areas of the bladder and distal segments of the ureter [1,9,10].

It is of paramount importance to be aware that, in cases of actinic cystitis, the bleeding might be related not only to the vesical arteries, as in the present case, but by anomalous arteries that developed after radiotherapy [2,4,11].

The large number of anatomic variants means that vascular intervention is dependent on identification of signs that indicate which vessels should be occluded. It is more common to identify areas of hypervascularization than clear leakage of contrast; spiral or ecstasia arteries and retention of contrast in terminal branches or precocious venous drainage also suggest a connection with the bleeding [1,9].

Every effort should be made to ensure that bilateral embolization is as selective as possible. Hematuria secondary to actinic cystitis is often associated with bleeding fed by several different vessels, as in the case described here. However, if it appears that only one of the vesical arteries is involved, contralateral embolization can be conducted later, to reduce the risk of necrosis of the bladder [10,12].

Before embolization, the patient should undergo rigorous intravenous hydration; if active intense bleeding is ongoing at the time of embolization, the bladder should be irrigated, and any clots should be removed [8,11,13].

A Foley catheter should be placed and kept "clamped" during the procedure. This will lead to bladder repletion, facilitating the recognition of the target vessels by showing the bladder "silhouette" after super selective angiography, therefore reducing the risk of non-target vessel embolization by mis-identification [4,10] (Figure 3).

While this procedure can be conducted under local anesthesia, the anesthetic technique should be chosen based on the general condition of the patient and the need for their collaboration in terms of remaining still during a procedure with unpredictable duration, since selective vessel catheterization may be challenging [12,13].

A range of different catheters and microcatheters can be used at different stages of the procedure and the choice is influenced by the anatomy of the arteries, by availability and by the endovascular surgeon's preference [5,9].

A great variety of agents have been used for embolizing the vesical arteries. Besides non-absorbable microparticles with diameters calibrated to 300–500 μm and 500–700 μm, as in this case, n-butyl cyanoacrylate surgical glue mixed with lipiodol and coils may be used [1,5,6].

Even though there is no consensus regarding the type of embolization agent, most authors advocate for permanent particulate agents, such as the calibrated microspheres used in the case described here [3,4].

As previously stated, particle sizes ranging from 300 μm to 700 μm are described in the literature for bladder embolization. Because of the authors' personal experience with microspheres for different cases of visceral bleeding, including a previous case of bladder embolization, the option of using microspheres was chosen. The precise size was chosen considering availability and visual evaluation of the diameter of the identified arteries. Based on previous cases using particles of the same size in a wide range of scenarios, the authors strongly believe that the arterial ruptures that happened in this case were much more related to the fragility of the arterial wall, secondary to radiation effects, than to the size of the embolic agents.

When vesical arteries are identified, treatment success can reach up to 90% [9]. Early clinical success is defined as absence of macroscopic hematuria, no formation of intravesical clots, no fall in hemoglobin by more than 2.0 mg/dl and/or failure of more conservative measures for management of hematuria during the first month after embolization. In the case described here, the patient has been in follow-up for three months, without signs of recurrence [6].

Complications related to this procedure include post-embolization syndrome (characterized by self-limiting manifestations of pain, nausea, vomiting and fever)

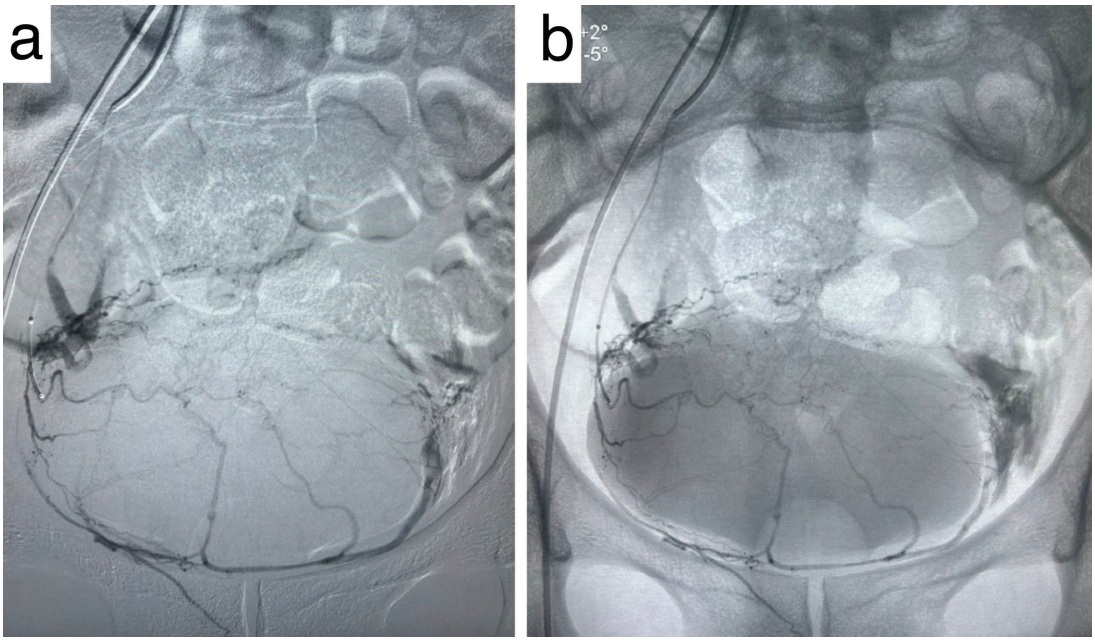



***Figure 3*** Selective angiography of the right superior vesical artery showing the bladder "silhouette." **(a)** With digital subtraction. **(b)** Without digital subtraction.

urinary incontinence, gluteal and perineal pain, Brown-Séquard syndrome caused by anastomoses between vesical arteries and sacral arteries (which should be screened for during arteriography), gluteal paresis and cutaneous necrosis; bladder necrosis is a possibility, but rarely happens, because of the rich vascularization [9,10] related to arterial anastomosis (Figure 4). More modern studies using selective embolization techniques report complication rates of less than 10% [4,9].

However, studies on vesical artery embolization for bladder hemorrhage using only super selective technique are scarce and patients included in these studies are relatively heterogeneous in the cause of hematuria, including tumors, hemorrhagic cystitis and radiation cystitis. Literature presents technical success rates ranging from 88% to 100%, clinical success from 80% to 100%, and complication rates from 9.1% to 27%; all complications comprising the ones presented above [1,3,8]. An specific search on PubMed using the "(vesical artery [Title/Abstract]) AND (rupture[Title/Abstract])" strategy revealed no case of a vesical artery burst secondary to the embolization procedure, and, to the best of our knowledge, this case report is the first to describe such a complication for this specific procedure.

Our personal experience with vesical artery embolization regards a single case, performed about a decade ago [2], that evolved with urinary incontinence due to detrusor muscle dysfunction.

On the other hand, intra operative arterial rupture might occur, as in the present case. This complication is probably prompted by the combination of chronic inflammation in the arterial wall leading to vascular wall frailty and because an increased flow resistance after distal vascular occlusion occurs secondary to embolization.

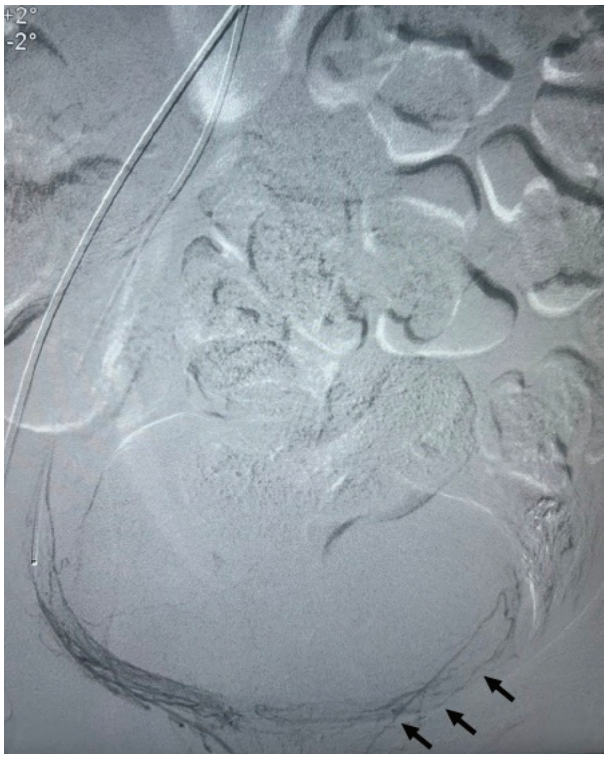



***Figure 4*** Selective angiography of the right inferior vesical artery showing connections with the left inferior vesical artery (arrows).

To prevent that complication, it is important that the manual injection of the embolizing agent is performed with minimal pressure, but, as in this case, arterial rupture might still occur despite that precaution.

If an arterial burst happens, the first measure should be to access the bleeding pattern and decide how to

manage it. A proximal embolization with micro coils would certainly be an option. However, it was not performed in this case because of lack of availability [1,13].

After a proximal embolization with particles was performed and angiography from the hypogastric artery showed no signs of persistent bleeding, no other procedure was undertaken. Because of the risk of earlier recanalization and secondary bleeding from the ruptured embolized arteries, no prophylactic anticoagulation was prescribed postoperatively [4,6].

## CONCLUSION

Embolization of vesical arteries is not frequently performed and literature describing the procedure's technique and its complications is scarce. The procedure can be useful for controlling hematuria due to bladder conditions, such as actinic cystitis, in both elective and urgent settings, and so doctors who treat hematuria cases and those who perform endovascular procedures should be familiarized with this potentially useful procedure.

### 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

At the time this manuscript was accepted, Adenauer Marinho de Oliveira Góes Junior served as Associate Senior Scientific Editor of the journal. They were not involved in any aspect of the peer review or editorial decision-making process related to this submission.

### Funding

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

### Author Contributions

All the authors substantially contributed to the study and manuscript writing.

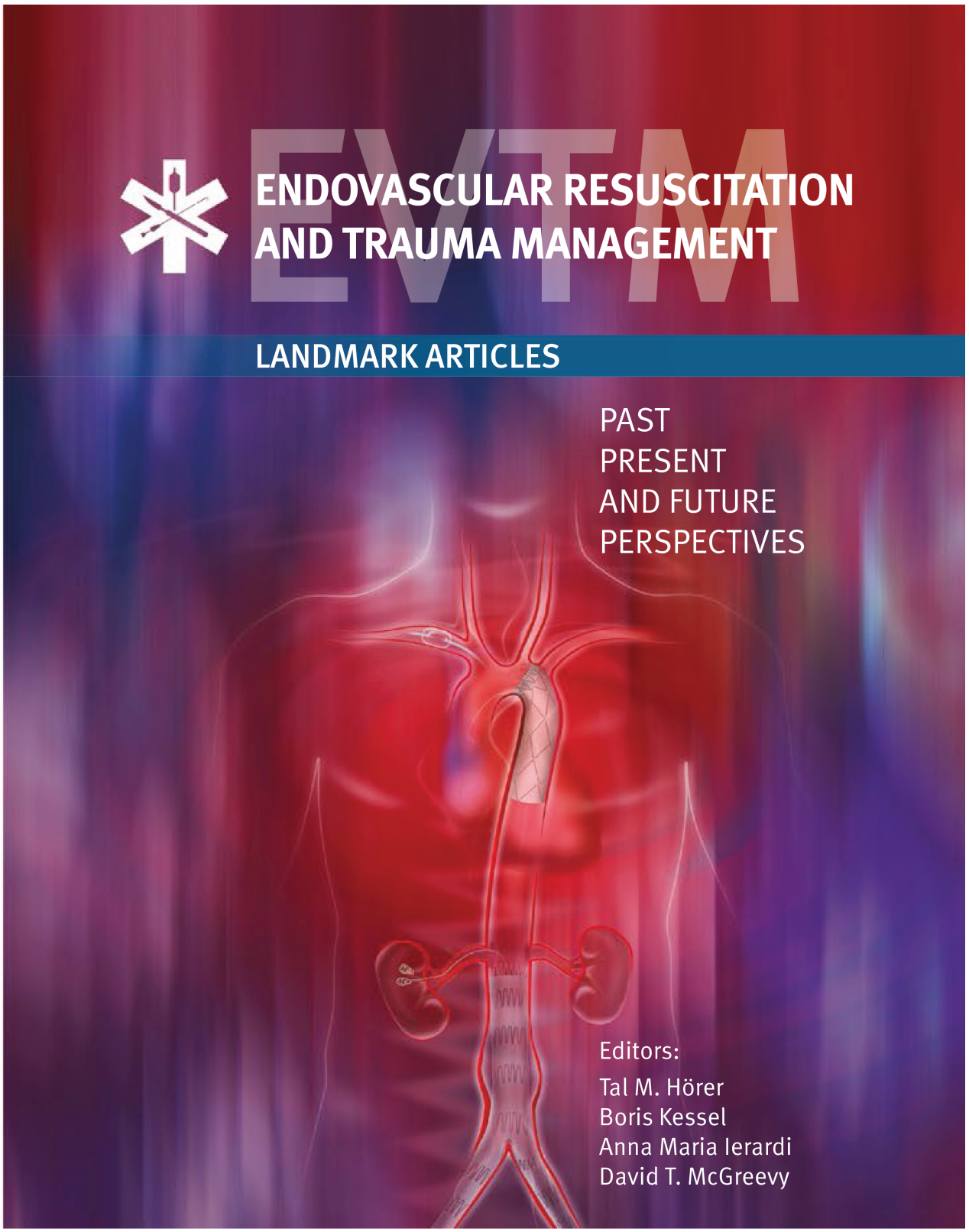
### Declaration of the use of generative AI and AI-assisted technologies in the writing process

No generative AI and AI-assisted technologies were used for writing this manuscript.

## REFERENCES

[1] Tsitskari M, Spiliopoulos S, Konstantos C, Palialexis K, Reppas L, Brountzos E. Long-term results of superselective trans-catheter embolization of the vesical arteries for the treatment of intractable bladder haematuria. CVIR Endovasc. 2020;3:97.
[2] Góes Junior AMO, Jeha SAH, Queiroz MVB, et al. Embolização arterial seletiva no tratamento de hematúria vesical intratável: relato de caso e revisão da literatura. J Vasc Bras. 2015;14(4):341–5.
[3] Kim MS, Hong HP, Kang KA, et al. Superselective vesical artery embolization for intractable bladder hemorrhage related to pelvic malignancy. Acta Radiol. 2020; 62(9):1229–37.
[4] Zhou C, Zhou CG, Wang B, Liu XL, Shi HB, Liu S. Superselective vesical artery embolization for intractable hemorrhagic cystitis following hematopoietic stem cell transplantation: a single-center retrospective study in 26 patients. Cardiovasc Intervent Radiol. 2021; 44(6):943–51.
[5] Sonmez G, Tombul ST, Herdem N, Demirtas T, Tatlısen A, Demirtas A. Superselective vesical artery embolization versus intravesical formalin for intractable hematuria in patients with bladder cancer. Actas Urol Esp (Engl Ed). 2022;46(1):35–40.
[6] Peng J, Weng Z, Zhang C, et al. Analysis of prognostic factors in patients diagnosed with bladder cancer complicated by hemorrhage treated by drug-eluting bead embolization. Transl Androl Urol. 2023;12(11):1697–707.
[7] Oh CH, Lee HJ, Choi SL. Clinical outcomes of transcatheter arterial embolization in patients with high-grade gross hematuria. Curr Med Imaging. 2024; 20(11):e15734056359111.
[8] Chen C, Kim PH, Shin JH, et al. Transcatheter arterial embolization for intractable, nontraumatic bladder hemorrhage in cancer patients: a single-center experience and systematic review. Jpn J Radiol. 2021;39(3):272–81.
[9] Loffroy R, Pottecher P, Cherblanc V, et al. Current role of transcatheter arterial embolization for bladder and prostate hemorrhage. Diagn Interv Imaging. 2014; 95(11):1027–34.
[10] Cho CL, Lai MHY, So HS, Kwok KKM, Chan JCS, Velayudhan V. Superselective embolisation of bilateral superior vesical arteries for management of haemorrhagic cystitis. Hong Kong Med J. 2008;14(6):485–8.
[11] Zhou Y, Chen J, Chen P, et al. Super-selective transcatheter vesical arterial chemoembolization with drug-loaded beads for muscle-invasive bladder cancer with hematuria. Abdom Radiol (NY). 2023;48(6):1818–27.
[12] Palandri F, Bonifazi F, Rossi C, et al. Successful treatment of severe hemorrhagic cystitis with selective vesical artery embolization. Bone Marrow Transplant. 2005; 35(5):529–30.
[13] Bahadir A, Oguz Ş, Erduran E, et al. Bladder artery embolization for massive hematuria treatment in a patient with ataxia-telangiectasia acute lymphoblastic leukemia. J Pediatr Hematol Oncol. 2020;42(4):316–8.

# EVTM Landmark Articles

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# Education


EndoVascular resuscitation and Trauma Management – Specialists in Training (EVTM-ST) is a 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

*MiniEVTM Workshop*

# Hybrid Bleeding Control Course

*Pre-Congress Course – ECTES 2026 & 8th World Trauma Congress*
Stockholm, Sweden | 24th April 2026
Karolinska Experimental Research and Imaging Centre (KERIC)
**By EVTM (EndoVascular resuscitation and Trauma Management) Society**

---

## DIRECTORS

- **Andreu Martínez Hernández.** (General & Emergency Surgeon, Spain - PHCC)
- **David McGreevy** (Vascular Surgeon, Sweden - EVTM)
- **Tal Hörer** (General & Vascular Surgeon, Sweden - EVTM)
- **Carl-Magnus Wahlgren** (General & Vascular Surgeon, Sweden - EVTM)
- **Shahin Mohseni** (Trauma & Acute Care Surgeon, Sweden - ESTES)

## TEAMs

- EVTM/ESVS: EndoVascular resuscitation and Trauma Management society
- ESTES: European Society for Trauma and Emergency Surgery.
- Örebro University Hospital
- Karolinska University Hospital
- Swedish Society for Trauma and Emergency Surgery
- Prehospital Critical Care Team (PHCC)

## Instructors (TBA, not final)

Frank Plani (Trauma, South Africa), Hany Bahouth (Trauma, Israel), Federico Coccolini (Trauma, Italy), Pirkka Vikatmaa (Vascular, Finland), Artai Pirouzram (Vascular, Sweden), Itzik Arda (Surgery, Turkey), Dominika Högberg (Trauma, Sweden), Carlos Yanez (Surgery, Spain), Tongporn Wannatoop (Trauma, Thailand), Anna Maria Ilardi (Interventional Radiology, Italy), Yosuke Matsumura (ICU, ED, JP).

## TARGET AUDIENCE

Physicians: Surgeons (Trauma, Vascular, General), Interventional Radiologists, Emergency Physicians, Intensivists, Military Doctors,

Teams: Shock Teams, Paramedics, Military.

Nurses and Trainees: Critical Care Nurses, Advanced Nurse Practitioners, Residents.

## REGISTRATION & COST (TBA)

- **Regular fee**: 500€
- **Residents / ESTES / AAST / EVTM members** : 400€
- **Registration**: Through the official ECTES 2026 website https://mkon.nu/estesevtm_workshop/registration_form
- **Further details available at** https://www.estesonline.org/event/mini-evtm-workshop-pre-estes/
- **Administration**- MKON Sweden and Örebro University Hospital. lotta@mkon.se and David.McGreevy@regionorebrolan.se, tal.horer@regionorebrolan.se

## WORKSHOP OBJECTIVES

This immersive one-day workshop is designed to make cutting-edge knowledge and practical training in *hybrid and endovascular trauma management* accessible to all. The goal is to train, inspire, and empower healthcare professionals through multidisciplinary collaboration, dynamic learning, and hands-on simulation.

Participants will develop both basic and advanced skills in vascular access, bleeding control, aortic occlusion (REBOA), and endovascular decision-making in trauma care by combining theory with high-fidelity simulation, and real clinical case discussions.

Both open and endovascular (hybrid) techniques will be used for different bleeding challenges, including junctional, hepatic and other injuries. The workshop is tailored to individual needs, covering the full spectrum, from basic bleeding control methods to very advanced state-of-the-art hybrid interventions.

"No ego, just good science, care, and collaboration."

## Workshop Format – 1 Full Day (08:00–17:00)

**Morning**: Theoretical Foundations + Case Discussions + Simulation models
**Afternoon**: Hands-On Training (**Live tissue session**)

## Program

**08:00–08:15 Registration & Welcome. Opening Remarks**

---

## Morning Block – Lectures/discussion & Case-Based Sessions

**08:15–08:30** – The **EVTM Philosophy**: Teamwork, Training & Translational Thinking
(T Hörer)
**08:30–08:45** – ***Vascular Access*** *Under Pressure:Ultrasound, Cut-down, Fluoro & Pitfalls*
(A Pirouzram)
**08:45–09:00** – ***REBOA*** *Essentials: From Basic Applications to Advanced Strategies*
(D McGreevy)
**09:00–09:15** – *Case 1*: Pelvic Bleeding with Unstable Hemodynamics
(C Yanez)
**09:15–09:30** – **Hybrid Bleeding Control** *in the Unstable Patient –Open vs Endo*
(C Wahlgren)
**09:30–09:45** – *Case 2: Junctional Penetrating Trauma. A Hybrid approach*
TBA
**09:45–10:00** – ***Coffee Break***
**10:00–10:15** – ***Endovascular Hemorrhage Control****: Embolization & Endografts*
(P Vikatmaa or A M Ierardi)
**10:15–10:30** – ***Prehospital Resuscitation****: ECPR and REBOA in Cardiac Arrest*
TBA
**10:30–10:45** – *Case 3:* **Aortic Injury** in Blunt Trauma – Timing of TEVAR?
(D Högberg)
**10:45–11:00** – *Case 4: Prehospital* ***Traumatic Cardiac Arrest***
TBA
**11:00-11:15** - ***Shunts*** *indications and use*
(S Mohseni)
**11:15–12:30** – ***Dry lab skill rotation (20 min each)***

- Station 1: REBOA Models
- Station 2: Ultrasound Vascular Access and tools
- Station 3: REBOA Placement
- Station 4: Dry Shunts placement
- Station 5: Endovascular tools and closure devices

**12:30–13:20** – Lunch Break

## Afternoon Block – Hands-On Training (lab area)

**13:30–17:00** – Rotating Skill Stations (30 minutes on each):

- **Station 1** – Arterial Access: Ultrasound-Guided, Cut-down, Bailout Techniques
- **Station 2** – REBOA: Placement, Inflation, Zone Strategies
- **Station 3** – Hybrid Bleeding Control/junctional bleeds/shunts/endografts/more
- **Station 4** – Embolization Techniques: Materials & Endografts, Closure devices

**17:00–17:20 – Debrief & Certification**

- Key Take-Home Messages
- Participant Feedback
- Certificate Delivery

Region Örebro County
Örebro University Hospital

HANDLED BY
Dept. of Cardiothoracic and Vascular Surgery, Prof. Tal Hörer

DATE
20251210

# EndoVascular resuscitation bleeding and Trauma Management (EVTM)

## Multidisciplinary Workshop

## Örebro, Sweden 10–11th September 2026

*Endovascular and hybrid solutions* for the bleeding and resuscitation patient; Aortic balloon occlusion (*REBOA*) usage, Vascular Access, Embolization, Imaging, Endografts, Endo-embolectomy, ECMO, SAAP and modern techniques in Resuscitation

**EVTM instructors (preliminary)**
TBA

Dept. of Cardiothoracic and Vascular Surgery, Dept. of General Surgery,
Dept. of Anesthesia and Intensive Care, Örebro University Hospital, Sweden

**Local team:** David McGreevy, Tal Hörer, TBA

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

**Date:** TBA  Place:  Örebro University Hospital experimental Lab

**Workshop Directors:** Dr. Tal Hörer MD, PhD, Dr. David McGreevy, MD, PhD

**Workshop Secretary / Registration:** Åsa Strandberg (asa.strandberg@regionorebrolan.se)

Tal Hörer, Örebro University Hospital, tal.horer@regionorebrolan.se
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More info at www.jevtm.com/workshop and social media #EVTM

**Cost** (cover expenses only): 500€, 400€ for EVTM Society members, ESVS/SSVS members

**Partners:** Örebro University Hospital; TBA

The aim of this two days' workshop is to stimulate discussion, mutual learning and sharing of experiences while practicing EndoVascular resuscitation and Trauma Management (EVTM) using a multidisciplinary team approach. "No ego, just good science and cooperation" is the main motion of the event. It is built on an individual, professional level and we will together explore different methods for resuscitation, bleeding control and trauma management. Some methods are used clinically world-wide while some are under development and have been used in selected patients.

- 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
- ECMO access
- Basic and advanced endograft and embolization methods
- Bleeding control methods
- Damage Control EVTM and Bailout methods
- Basic and advanced postoperative considerations
- Up-to-date research and clinical experience
- Knowledge of basic material and new technologies on the market
- Intensive training on live tissue
- ICU and ECMO aspects
- Basics for building an "EVTM service"
- Advanced experimental methods in resuscitation

The workshop is designed for experienced physicians but is individually tailored during the practical parts. Participants will get basic training and knowledge of REBOA placement as part of the EVTM concept. The workshop has been certificated by the EACCME and acknowledged by collaboration with societies like the European Society for Trauma and Acute Care Surgery, the European vascular society and others.

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Region Örebro County
Örebro University Hospital

HANDLED BY
Dept. of Cardiothoracic and Vascular Surgery, Prof. Tal Hörer

DATE
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# Program at the animal lab training & research center, Örebro University Hospital.

**Detailed schedule and program:** TBA

Day 1 (Start lunch): Clinical and research data, guidelines and case presentations with discussions. Models.

**Start 12:00 with Lunch at the lab.**

**17:00–18:00** Clinical Scenarios & Group Model Discussion

**Day 2 (whole day): Workshop on live tissue**

**Practical training points in the animal lab:**

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. The team is a multidisciplinary one with vascular, IR, Trauma, Thorax, ICU and ED experts.

1. Material usage in bleeding patients, general considerations and management scenarios
2. Vascular Access
   - Basic principles/advanced methods
   - Cut down techniques
   - Endoshunts (and shunts)
   - Hybrid procedures stentgrafts and more
   - Puncture methods
   - Seldinger technique
   - The failing access - alternatives
   - Venous access and Ultrasound
3. Upgrading/introducers/guide wires
4. 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
5. ECMO practical use with tips and tricks (own station)
6. Endo-embolectomy
7. Embolization – from coils to fluid embolization, with hands on practice
8. Endografts for bleeders with practical use
9. Balloon in alternate locations (Iliac, Subclavian, Brachiocephalic trunk/Zone 1 neck)
10. Aortography and Angiography considerations (type, volume etc.)
11. Bailouts in endovascular and hybrid surgery
12. Open thorax and abdominal methods and hybrid solutions

"No ego, just good science and cooperation"

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# Coming Meetings

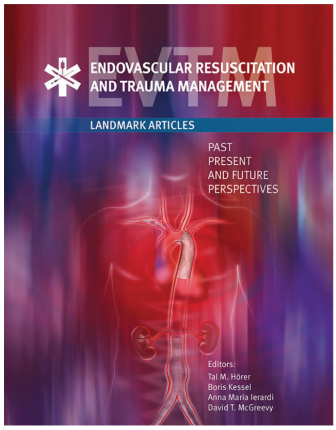
Pre-Congress Course – ECTES 2026 & 8th World Trauma Congress, 24th April 2026, Stockholm, Sweden
https://mkon.nu/estesevtm_workshop

EVTM Multidisciplinary Workshop, September 2026, Örebro, Sweden
https://jevtm.com/workshop/

EVTM Asia 2026, 8–10 October 2026, Tokyo Bay Makuhari Hall, Chiba, Japan
https://supportoffice.jp/evtm/

11th EVTM Pan American Symposium, November 2027, Atlanta, GA, USA

# Books

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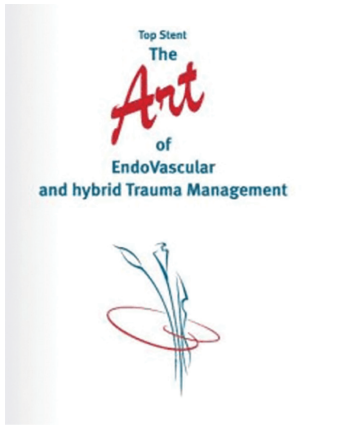


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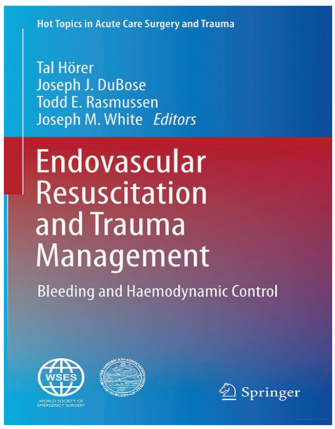


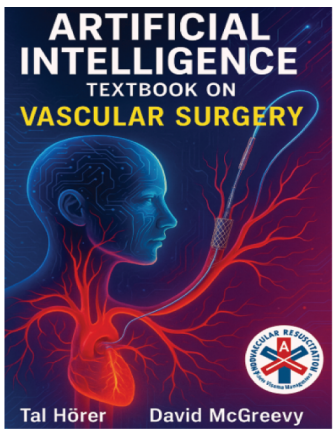


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# EVTM Asia 2026

## 8-10 October, 2026

## TKP Tokyo Bay Makuhari Hall, Chiba, Japan

Dr. Thomas M. Scalea,
The Legend of Trauma,
will join !

the 10th

## EVTMSymposium
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St Marianna University School of Medicine, Japan

**Sungwook Chang, MD,PhD**
Congress Vice Chair

Professor of Trauma center,
Department of Thoracic and Cardiovascular surgery,
Dankook University


EndoVascular resuscitation and Trauma Management

# Dear EVTM colleagues around the world,

Trauma, Vascular Surgery, ICU, IR, ED, Military Medicine, and related specialties)

The Endovascular Resuscitation and Trauma Management Society (EVTM) invites you to contribute to a Special Issue of the Journal of Endovascular Resuscitation and Trauma Management (JEVTM)

Planned for 2026:

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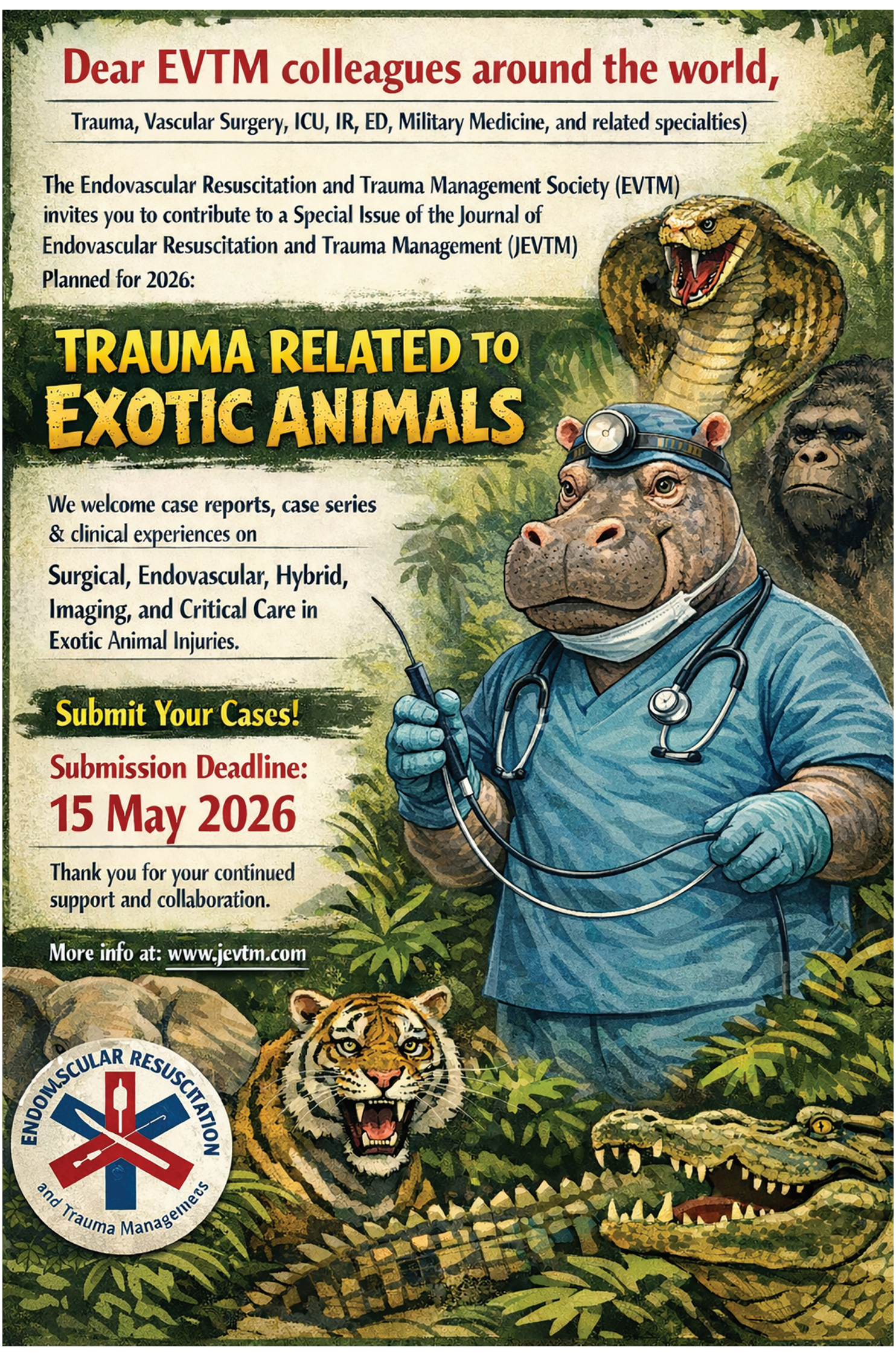

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