JEVTM

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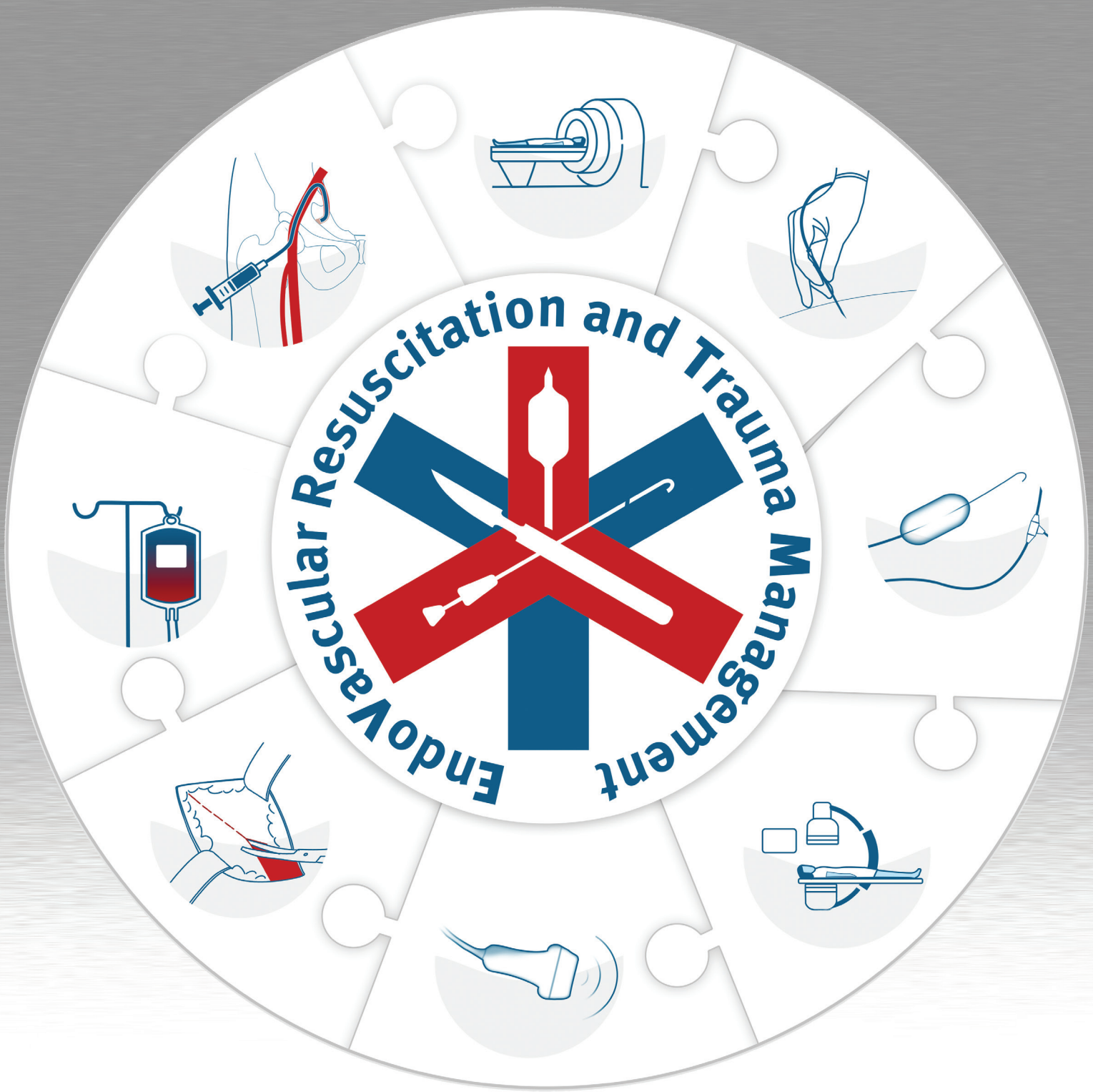

Official publication of the Society of Endovascular Resuscitation and Trauma Management

WWW. JEVTM.COM

Journal of Endovascular Resuscitation and Trauma Management

Volume 7
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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, Orebro 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 *www.jevtm.com*.

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 www.jevtm.com under journals and are there with no time or access limitations.

JEVTM is indexed in Scopus, Web Of Science, EMBASE, Google Scholar and EBSCO.

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

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Örebro University Hospital

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National Library of Sweden

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Author Guidelines

GUIDELINES FOR SUBMISSION

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

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

The submission process requires three discreet documents:

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

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

Cover Letter

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

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

Title Page

This should consist of the following:

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

Main Body

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

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

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

- Background
- Methods
- Results
- Conclusions

Keywords
Three to six appropriate keywords should be included.

References

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

Example references:

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

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

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

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

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

Figures/Tables

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

Figure captions should be styled as follows.

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

Table captions are styled similarly.

Supplementary Digital Content

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

TYPES OF ARTICLES

All of the following article types are peer reviewed.

Original Articles

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

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

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

Editorials

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

Narrative Reviews

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

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

Systemic Reviews and Meta-Analyses

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

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

Tips and Techniques

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

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

Images of Interest

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

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

Case Reports

These are short case reports including current literature reviews.

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

Letters to the Editor

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

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EVTM-ST Section

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

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

Conference Proceedings

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

SUPPORT FOR LANGUAGE AND ARTICLE CONTENT

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

AFTER ACCEPTANCE

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

COPYRIGHT AND LICENSING

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

PROOFREADING

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

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

ONLINE FIRST

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

ACCESS

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

ETHICS AND POLICIES

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

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

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

Authorship Criteria

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

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

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

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

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

Peer Review Policy

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

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

Author Self-Archiving

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

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

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

Preprint Policy

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

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

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

Orcid

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

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

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

Open Data

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

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

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

Archiving Policy

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

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

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

Correction And Retraction Policies

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

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

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

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

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

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

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

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

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(*Continued*)

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

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

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

Complaints and Appeals Policy

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

Policy For Ethical Oversight

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

Authors' Responsibilities

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

All published material will include the following Ethics Statement:

Ethics Statement

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

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

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

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

Editors' Responsibilities

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

Reviewers' Responsibilities

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

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

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

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

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

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

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

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

Patient Anonymity and Informed Consent Policy

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

Protection of Human Subjects and Animals in Research

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

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

Ethical Approval and Informed Consent

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

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

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

General Statement

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

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

EVTM Society

Join the Endovascular Resuscitation Platform

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

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

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

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

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

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

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

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

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

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

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

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

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

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

9th EVTM Symposium

October 17th-19th 2024 in Örebro, Sweden

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Contents

Commentary

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Enhancing Oxygen Uptake in Hypovolemic Shock: Exploring the Role of Oxygen-Increasing Drugs

Kessel–Khan Corner

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INTRODUCTION

Hypovolemic shock is a life-threatening condition characterized by a severe loss of blood volume, resulting in inadequate tissue perfusion and oxygenation. Prompt intervention is crucial to restore perfusion and prevent organ damage. In recent years, researchers have explored the potential of using drugs to increase oxygen uptake in end organs during hypovolemic shock. These medications aim to enhance tissue oxygenation, promote cellular function, and improve overall patient outcomes. In our corner, we will delve into some of the drugs being investigated and their potential impact on hypovolemic shock management.

The Importance of Oxygen Uptake in Hypovolemic Shock

Before we dive into the drugs that can potentially increase oxygen uptake, let us briefly understand why it is essential. In hypovolemic shock, reduced blood volume leads to diminished oxygen delivery to the tissues. Oxygen uptake refers to the process by which tissues extract and utilize oxygen for cellular respiration. Adequate oxygen uptake is vital for maintaining cellular metabolism and preventing cellular injury or death.

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Enhancing Oxygen Uptake: Exploring Drug Options

(1) *Vasopressors and inotropes:* Vasopressors and inotropes are commonly used in the management of hypovolemic shock. These medications work by increasing blood pressure and cardiac output, which in turn enhances tissue perfusion and oxygen delivery. By restoring blood flow to vital organs, these drugs indirectly facilitate oxygen uptake in end organs.

(2) *Oxygen therapies:* Supplemental oxygen is a fundamental intervention in managing hypovolemic shock. It provides a higher concentration of oxygen to the patient, increasing the oxygen-carrying capacity of the blood. Administering oxygen via various methods, such as nasal cannulas or face masks, can effectively improve tissue oxygenation [1].

(3) *Hyperbaric oxygen therapy:* Hyperbaric oxygen therapy involves exposing patients to pure oxygen at higher than atmospheric pressure levels. This therapy can enhance oxygen delivery to tissues, even in conditions where blood flow is compromised. While hyperbaric oxygen therapy may not directly increase blood volume, it promotes the dissolution of oxygen in plasma, facilitating oxygen uptake by end organs.

(4) *Perfluorocarbon emulsions:* Perfluorocarbon emulsions are synthetic compounds that can dissolve large amounts of oxygen and carbon dioxide [2,3]. When administered intravenously, these emulsions can temporarily increase the oxygen-carrying capacity of the blood, providing an alternative means of delivering oxygen to tissues. They have shown promise in experimental studies, but further research is needed to determine their clinical efficacy [4].

DISCUSSION

In the management of hypovolemic shock, the primary goal is to restore blood volume and improve tissue perfusion. While oxygen delivery can be enhanced through various interventions, increasing oxygen uptake in end organs remains a crucial aspect of patient care. Drugs such as vasopressors, inotropes, oxygen therapies, hyperbaric oxygen therapy, and perfluorocarbon emulsions hold the potential for optimizing tissue oxygenation and improving patient outcomes. However, it is important to note that the use of these drugs should be guided by medical professionals and further research is required to establish their efficacy and safety in the specific context of hypovolemic shock.

It is essential to emphasize that the management of hypovolemic shock requires a comprehensive approach, which includes not only the use of oxygen-increasing drugs but also the identification and treatment of the underlying cause of the shock, fluid resuscitation, and other supportive measures. Oxygen-increasing drugs should be utilized as adjunctive therapies in conjunction with these standard interventions.

Moreover, it is crucial to consider the potential side effects and contraindications associated with these medications. Vasopressors and inotropes, for example, can have adverse effects on cardiac function and blood pressure regulation if not appropriately administered. Oxygen therapies, when used at high concentrations for extended periods, may increase the risk of oxygen toxicity. Hyperbaric oxygen therapy requires specialized facilities and careful monitoring due to the risk of barotrauma and other complications. Perfluorocarbon emulsions are still under investigation and their long-term effects and safety profile are not yet fully established.

In conclusion, the utilization of drugs to enhance oxygen uptake in end organs during hypovolemic shock is an area of active research and clinical exploration. While several medications and therapies show promise in optimizing tissue oxygenation, their efficacy and safety must be thoroughly investigated through rigorous studies and trials. It is vital for healthcare professionals to stay up to date with the latest evidence and guidelines to ensure the appropriate and judicious use of these interventions. By combining these oxygen-increasing drugs with established resuscitation strategies, medical professionals can strive to improve outcomes for patients with hypovolemic shock and enhance their chances of a successful recovery.

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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REFERENCES

[1] Li H, Li Y, Fu Y, Zhang X, Zhang D. The intensity of organ support: restrictive or aggressive therapy for critically ill patients. J Intensive Med. 2023;3(4):298–302.
[2] Paxian M, Keller SA, Huynh TT, Clemens MG. Perflubron emulsion improves hepatic microvascular integrity and mitochondrial redox state after hemorrhagic shock. Shock. 2003;20(5):449–57.
[3] Bialas C, Moser C, Sims CA. Artificial oxygen carriers and red blood cell substitutes: a historic overview and recent developments toward military and clinical relevance. J Trauma Acute Care Surg. July 2019;87(1S Suppl 1):S48–S58.
[4] Torres Filho IP. Mini-review: perfluorocarbons, oxygen transport, and microcirculation in low flow states: in vivo and in vitro studies. Shock. October 2019;52(1S Suppl 1):19–27.

Case Report

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Physiologically Guided Thrombolysis in Pulmonary Embolism

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We describe the case of a 69-year-old woman who presented with submassive pulmonary embolism without overt shock, but with significant signs of right ventricular failure and dyspnea on minimal exertion. She was managed using a point-of-care ultrasound and pulmonary artery pressure-guided approach in order to minimize total thrombolytic dose while nonetheless achieving significant physiological improvement.

Keywords: *POCUS; Pulmonary Embolism; Thrombolysis; Pulmonary Artery Catheter*

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INTRODUCTION

While the management of pulmonary embolism (PE) with obstructive shock clearly involves aggressive intervention, that of patients with high symptom burden without overt shock is less clear. A significant proportion of these patients who have large PEs treated conservatively may end up with post-PE syndromes including the most severe form, chronic thromboembolic pulmonary hypertension (CTEPH) [1]. There are a number of existing therapeutic options, from simple anticoagulation therapy and thrombolysis to the more recent mechanical clot aspiration and catheter-directed thrombolysis. In addition, the optimal dose for thrombolytic therapy remains unclear [2]. Here, we describe the case of a woman presenting with bilateral submassive PEs with significant symptoms who was managed with serial assessments of her physiologic parameters to guide thrombolysis and minimize adverse effects.

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CASE REPORT

A 69-year-old woman presented to our community hospital with dyspnea and hypoxia. She was known for type II diabetes mellitus and hypertension, but otherwise quite active in daily life. On examination, she was in no apparent distress, with an oxygen saturation of 97% on 2 L/min nasal prongs. Her blood pressure was 110/82 mmHg, heart rate 94 beats per minute, and respiratory rate 26 breaths per minute. Her extremities were warm and perfused, and capillary refill time was slightly above 3 seconds. She was mentating well and the remainder of the physical examination was unremarkable. A computed tomography (CT) scan at presentation demonstrated bilateral submassive PE (Figure 1). Given these findings, the critical care team was consulted for further management and admission.

Point-of-care ultrasound (POCUS) by the critical care team showed several signs of hemodynamically significant PE, including a plethoric inferior vena cava (IVC) 23 mm in diameter, a right ventricle (RV)-to-left ventricle (LV) ratio greater than 1, the presence of the McConnell sign, as well as septal dyskinesia and a tricuspid annular plane systolic excursion (TAPSE) of 16 mm. The right ventricular outflow tract Doppler pattern was type III with early systolic notching and a "spike and ball" pattern, with an acceleration time of 80 ms. Using tricuspid regurgitant jet Doppler, pulmonary artery pressure (PAP) was estimated to be around 50 mmHg (Figures 2 and 3). An occlusive deep vein thrombosis in the right superficial femoral extending to the common femoral vein was found.

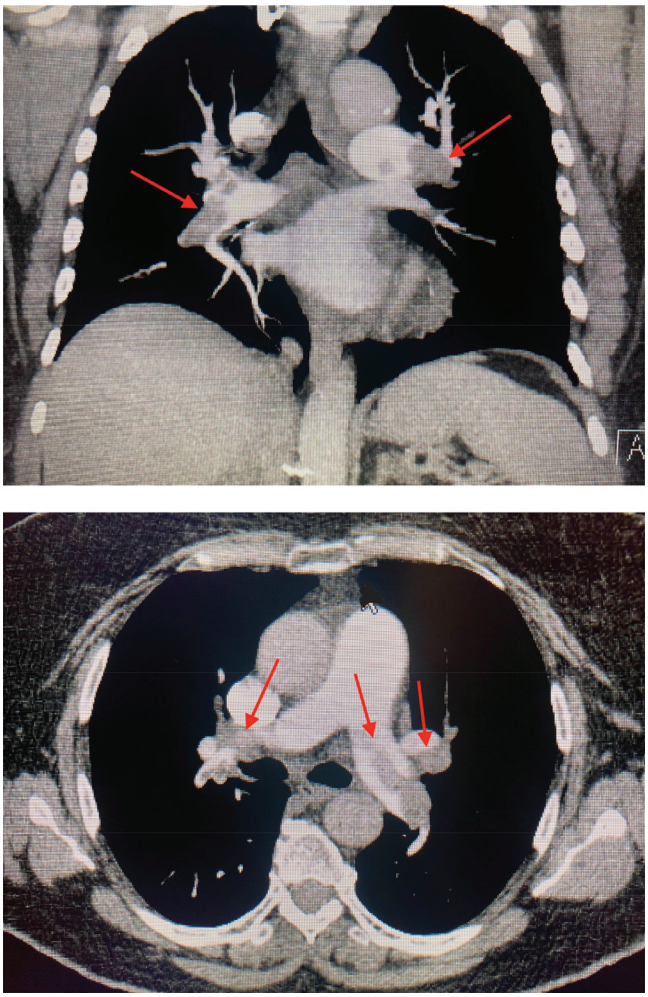

Figure 1 Computerized tomography scan showing occlusive pulmonary emboli (red arrows).

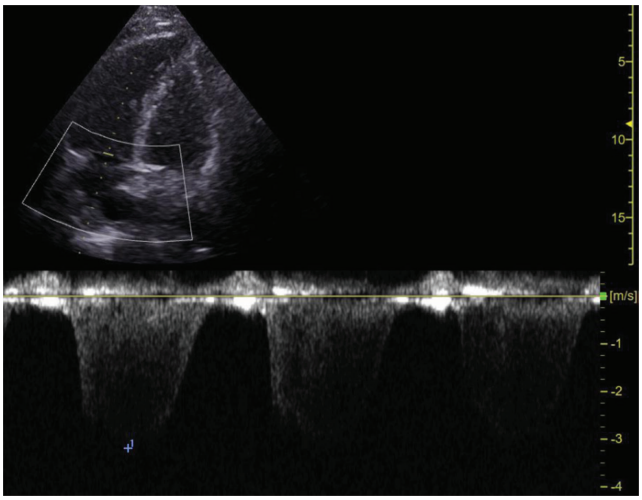

Figure 2 Apical 4 chamber view showing dilated RV and increased RV-to-LV ratio with a peak tricuspid regurgitation envelope maximum velocity (TRVmax) over 3 m/s.

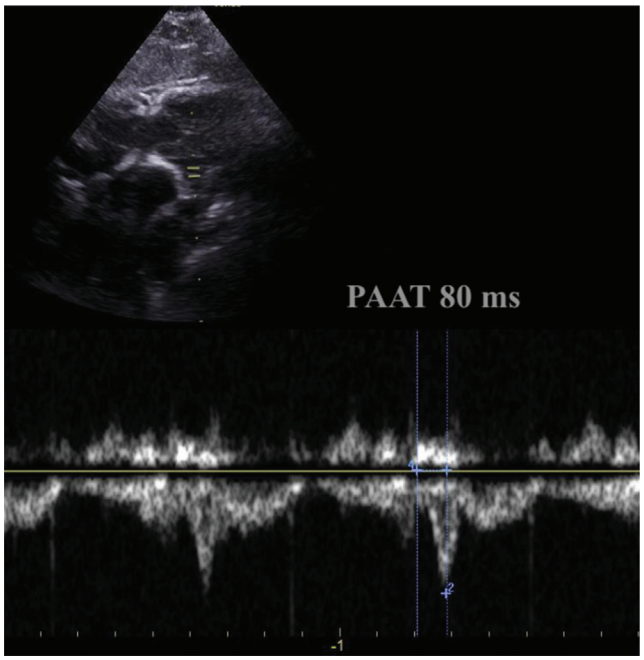

Figure 3 Right ventricular outflow tract Doppler pre-lytic therapy, showing a "spike and ball" pattern with a low pulmonary acceleration time (PAAT) of 80 ms.

Following discussion with the patient and with the cardiology service, it was decided to offer the patient more aggressive therapy with thrombolysis in hopes of reversing right ventricular dysfunction and aiding in the avoidance of potential post-PE syndromes. Informed consent was obtained after explanation of the risks involved.

The patient was admitted to the intensive care unit and a pulmonary artery (PA) catheter was placed with an initial PAP of 51/22 mmHg and central venous pressure (CVP) of 10 mmHg, yielding a PA pulsatility index (PAPi) of 2.9 and a TAPSE/pulmonary artery systolic pressure (PASP) ratio of 0.31. A bolus of 10 mg tissue plasminogen activator (tPA) was given, followed by an infusion of 1 mg/h in the PA catheter. Six hours later, the PAP was 41/16 mmHg and CVP 6 mmHg (PAPi of 4.2). Twenty hours later, there was a significant improvement in PAP at 37/14 mmHg and CVP of 2 mmHg (PAPi > 10). The decision was taken to stop the tPA infusion due to therapeutic success, having given a total of 31 mg. Following this, the patient was weaned off oxygen with complete resolution of her symptoms of dyspnea on exertion. She had a formal echocardiogram on day 3 of admission which showed normal biventricular function and a PAP of approximately 38 mmHg. She was discharged on the fourth day, and followed up 6 weeks later as an outpatient, at which time she was asymptomatic and had resumed her normal activities. Her POCUS examination at that point revealed normal RV dimensions, a TAPSE of 24 mm and a near-normal RV outflow tract Doppler envelope (Figure 4).

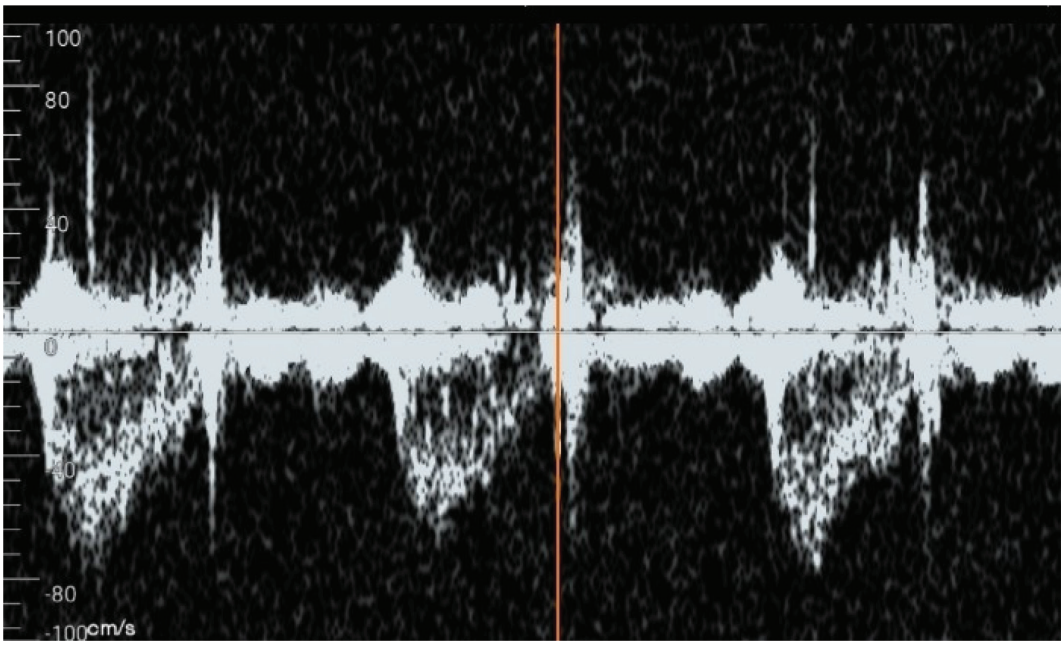

Figure 4 Right ventricular outflow tract Doppler at outpatient follow-up 6 weeks post-discharge showing much improved envelope.

Ethical Approval and Informed Consent

Ethical approval to report these cases was given by the patient herself. Written informed consent was obtained from the patient herself.

DISCUSSION

Current guidelines by the European Society of Cardiology (ESC) recommend risk stratification of acute PE into low, intermediate-low, intermediate-high, and high risk to guide treatment [3]. While the management of low- and high-risk PEs is relatively straightforward, the optimal management of intermediate-risk patients that appear hemodynamically stable with physiologically significant PE is less clear; this category can include patients with essentially normal or near-normal RV function as well as those where it is maximally strained to maintain normal vital signs. Most of the large studies seeking to risk-stratify patients presenting with PE have little or no data assessing dynamic right ventricular function, particularly in terms of ventriculo-arterial (V-A) coupling.

Echocardiographic findings associated with acute PE include RV dilatation, McConnell's sign, and decreased TAPSE [4]. Although studies have shown a negative predictive value of only 40–50% in the workup of acute PE via echocardiography [5], it remains very useful in prognostication. A study by Pruszczyk et al. found an abnormal RV-to-LV ratio yielded a hazard ratio of 7.3 for acute PE-related mortality or thrombolysis; likewise, TAPSE was found to be an independent predictor of 30-day mortality or thrombolysis [6]. RV dysfunction, on the other hand, had a relative risk of 2.4 for predicting mortality in a systematic review of echocardiography in acute PE [7]. Pulmonary arterial pressure during and following acute PE has also demonstrated prognostic utility. Elevated mean PAP at the time of PE diagnosis is independently associated with mortality and a higher prevalence of CTEPH [8, 9]. Indeed, Guerin et al. found dramatic elevations in systolic PAP (75 ± 20 mmHg) at the time of PE diagnosis in patients that would go on to develop CTEPH [10]. Although current ESC guidelines recommend against routine screening for CTEPH post-PE [3], certain populations at elevated risk may benefit from being followed more closely, including those with pulmonary hypertension already present at the time of PE diagnosis [11].

The authors believe that combining the use of functional indices of the RV (acceleration time, RV outflow tract doppler envelope, and the presence of septal dyskinesia, to name a few), with invasive monitoring to detect improvements in PAP, is a potential approach to reaching physiologically meaningful goals while limiting the risks associated with thrombolytics. These risks are well-documented, and can include hemodynamically significant and life-threatening intra- and extracranial bleeding, as documented in the PEITHO trial [12]. The MOPETT trial demonstrated that the optimal lytic dose has not yet been determined, and that a lower dose (half of that typically used) was efficacious with less adverse effects in a group with high-risk PE [2]. Zhang et al.'s

meta-analysis likewise suggests that a lower thrombolytic dose may be associated with less hemorrhagic complications [13]. Several other studies looking at catheter-directed therapy (the ULTIMA, SEATTLE2 and PERFECT trials) showcased how more invasive approaches including thrombolysis can improve mortality in submassive populations [14–16]. In the PERFECT trial, where the average total dose used was 28 mg, there were no significant hemorrhagic complications [16].

Given these data, it would be logical to try to find the lowest effective dose to maximize patient safety. In this case, we feel that significant physiological and clinical improvement was achieved with a significantly lower dose of thrombolysis (about 30% of a typical amount). In our opinion, POCUS likewise plays a central role in screening for and assessing the degree of RV dysfunction and contributes to the decision to potentially escalate therapy. While a PA catheter is not strictly needed, with experienced nursing and adequate resources it provides reliable PA pressure monitoring, which we feel should be the main parameter to follow as it is the root cause of the hemodynamic disturbance. Alternately, frequent POCUS assessments of several parameters could also replace the use of a PA catheter for an entirely non-invasive method. This approach, whether PA catheter-based or not, is fairly simple and can also be done in any intensive care unit; it is not limited to centers with advanced interventional radiology capabilities.

CONCLUSION

The optimal management of patients presenting with intermediate-risk acute PE is an area that has tremendous potential for research and improvement in management, given the broad physiological spectrum of the disease and ongoing significant morbidity and mortality with standard conservative management. Given the ongoing advances in management of PE, we believe that more attention should be focused on risk stratification and therapeutic strategies. Trials that do not assess RV functionality, particularly V-A coupling, while easier to perform on a large scale, will inherently be unable to properly identify the patients who may most benefit from a more aggressive therapy. We truly hope that academic centers with sufficient means can devise a multiarm trial with physiological assessment paired with the different available strategies, invasive and non-invasive, to guide clinicians through the large gray zone that exists within acute PE.

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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REFERENCES

[1] Yuriditsky E, Horowitz JM, Lau JF. Chronic thromboembolic pulmonary hypertension and the post-pulmonary embolism (PE) syndrome. Vasc Med. 2023;28(4):348–60.

[2] Sharifi M, Bay C, Skrocki L, Rahimi F, Mehdipour M. Moderate pulmonary embolism treated with thrombolysis (from the "MOPETT" Trial). Am J Cardiol. 2013;111(2):273–7.

[3] Konstantinides SV, Meyer G, Becattini C, et al. 2019 ESC Guidelines for the diagnosis and management of acute pulmonary embolism developed in collaboration with the European Respiratory Society (ERS). Eur Respir J. 2019;54(3):1901647.

[4] Kurnicka K, Lichodziejewska B, Goliszek S, et al. Echocardiographic pattern of acute pulmonary embolism: analysis of 511 consecutive patients. J Am Soc Echocardiogr. 2016;29(9):907–13.

[5] Roy PM, Colombet I, Durieux P, Chatellier G, Sors H, Meyer G. Systematic review and meta-analysis of strategies for the diagnosis of suspected pulmonary embolism. BMJ. 2005;331(7511):259.

[6] Pruszczyk P, Goliszek S, Lichodziejewska B, et al. Prognostic value of echocardiography in normotensive patients with acute pulmonary embolism. JACC Cardiovasc Imaging. 2014;7(6):553–60.

[7] Sanchez O, Trinquart L, Colombet I, et al. Prognostic value of right ventricular dysfunction in patients with haemodynamically stable pulmonary embolism: a systematic review. Eur Heart J. 2008;29(12):1569–77.

[8] Lewczuk J, Piszko P, Jagas J, et al. Prognostic factors in medically treated patients with chronic pulmonary embolism. Chest. 2001;119(3):818–23.

[9] Ribeiro A, Lindmarker P, Johnsson H, Juhlin-Dannfelt A, Jorfeldt L. Pulmonary embolism: one-year follow-up with echocardiography doppler and five-year survival analysis. Circulation. 1999;99(10):1325–30.

[10] Guérin L, Couturaud F, Parent F, et al. Prevalence of chronic thromboembolic pulmonary hypertension after acute pulmonary embolism. Thromb Haemost. 2014;112(3):598–605.

[11] Delcroix M, Kerr K, Fedullo P. Chronic thromboembolic pulmonary hypertension. Epidemiology and risk factors. Ann Am Thorac Soc. 2016;13 Suppl 3:S201–6.

[12] Meyer G, Vicaut E, Danays T, et al. Fibrinolysis for patients with intermediate-risk pulmonary embolism. N Engl J Med. 2014;370(15):1402–11.
[13] Zhang Z, Zhai ZG, Liang LR, Liu FF, Yang YH, Wang C. Lower dosage of recombinant tissue-type plasminogen activator (rt-PA) in the treatment of acute pulmonary embolism: a systematic review and meta-analysis. Thromb Res. 2014;133(3):357–63.
[14] Kucher N, Boekstegers P, Müller OJ, et al. Randomized, controlled trial of ultrasound-assisted catheter-directed thrombolysis for acute intermediate-risk pulmonary embolism. Circulation. 2014;129(4):479–86.
[15] Piazza G, Hohlfelder B, Jaff MR, et al. A prospective, single-arm, multicenter trial of ultrasound-facilitated, catheter-directed, low-dose fibrinolysis for acute massive and submassive pulmonary embolism: the SEATTLE II study. JACC Cardiovasc Interv. 2015;8(10):1382–92.
[16] Kuo WT, Banerjee A, Kim PS, et al. Pulmonary Embolism Response to Fragmentation, Embolectomy, and Catheter Thrombolysis (PERFECT): initial results from a prospective multicenter registry. Chest. 2015;148(3):667–73.

Case Report

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Urgent Rare Surgical Complication Assessment of Intestinal Gastrointestinal Stromal Tumors

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Gastrointestinal stromal tumors (GISTs) are rare mesenchymal subepithelial tumors originating from abnormal proliferation of interstitial cells of Cajal, with worldwide incidence of about 1–2 per 100,000. Herein, we report an unusual case of a 55-year-old man who presented a severe digestive hemorrhage as a rare post-surgical complication after intestinal GIST surgical removal. The patient was admitted to the Emergency Department of our center affected by abdominal epigastric pain. Different imaging techniques were performed leading to the final diagnosis of a GIST and surgical intervention planning. Immediately after intervention the patient developed a severe intestinal hemorrhage. Multidetector computed tomography (MDCT) confirmed the ongoing bleeding and the patient underwent a new intervention to control the hemorrhage. The aim of the paper is to show the different imaging techniques used to assess GIST. MDCT represents the gold standard for diagnosis and in the emergency setting is used to identify post-surgical complications.

Keywords: *Gastrointestinal Stromal Tumors (GIST); Imaging Techniques; Computed Tomography (CT); Magnetic Resonance Imaging (MRI); Surgical Favorable Outcome*

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INTRODUCTION

Gastrointestinal stromal tumors (GISTs) are rare mesenchymal subepithelial tumors originating from abnormal proliferation of interstitial cells of Cajal [1–3]. GISTs can develop anywhere in the gastrointestinal (GI) tract; the most frequent localizations are within the stomach (40–70%) and small intestine (15–44%) while less frequently they may be located in the rectum (5%) or esophagus (<1%) [4,5]. The symptoms most commonly associated with GISTs are anemia, abdominal pain, dyspepsia, nausea or vomiting, constipation, or diarrhea. Nevertheless, 25% of GISTs are discovered incidentally in asymptomatic patients. In some cases, the symptoms may be more severe, such as digestive bleeding, perforation, or bowel obstruction, requiring emergency surgical treatment [6–10].

Treatment is mainly surgical. Radiology plays a key role not only in diagnosis, but also in monitoring the effects of treatment, in case of complications, and during follow-up [11,12]. Computed tomography (CT) with contrast agent administration is currently the imaging technique of choice, although other methods such as positron emission tomography (PET) with florodeoxyglucose (FDG) and magnetic resonance imaging (MRI) can also be used [13].

Herein, we report an unusual case of a 55-year-old man who presented a severe digestive hemorrhage as a rare post-surgical complication after intestinal GIST surgical removal. The aim of the paper is to show the different imaging techniques used to assess GIST. Multidetector computed tomography (MDCT) represents the gold standard for diagnosis and in the emergency setting is used to identify post-surgical complications.

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CASE REPORT

A 55-year-old man presented to the Emergency Department of our center (Ospedale del Mare, Naples, Italy) with severe abdominal epigastric pain for 24 hours. On physical examination, clinical parameters were stable, and the abdomen was painful in the mesogastric and left hypochondriac regions. Laboratory examinations and complete blood count (CBC) revealed neutrophilia 87.3% (40–75%), lymphopenia 6.7% (19–48%), increased D-dimers 1,001 µg/L (10–500 µg/L), and a mild increase in C-reactive protein (CPR) 0.6 mg/L (0–0.5 mg/L). The values in the brackets represent the reference values of our laboratory.

The patient underwent an abdominal X-ray as a first-level imaging technique, which showed overdistention of the intestinal loops in the umbilical and left lumbar regions with associated pathological hydro-aerial levels (Figure 1). In order to investigate the X-ray findings, a contrast-enhanced abdominal CT scan was performed, which showed distention of the proximal jejunal loops with hydro-aerial levels, a finding indicative of bowel sub-occlusion. MDCT showed a 15 mm solid lesion, located in a jejunal loop downstream of the occlusion, characterized by intense enhancement in the arterial phase and wash-out in the subsequent phases, indicative of a GIST (Figure 2). In addition, two

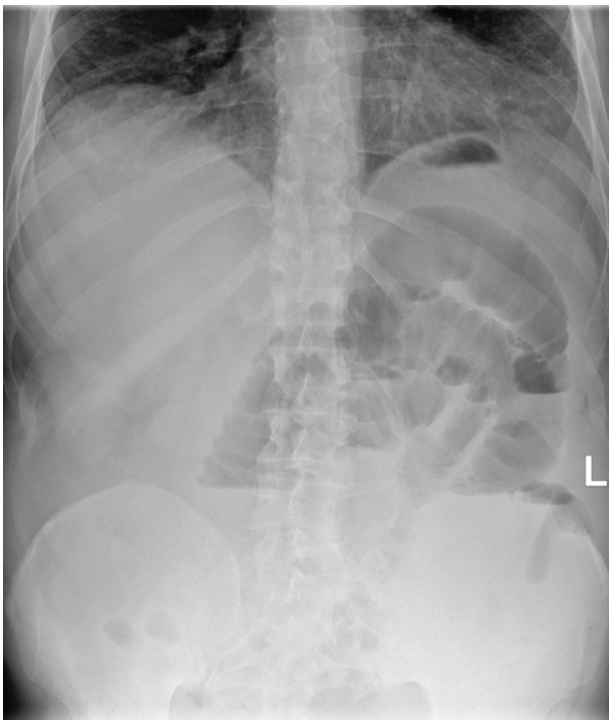

Figure 1 Abdominal X-ray at admission: overdistention of intestinal loops in the umbilical and left lumbar regions with associated pathological hydro-aerial levels.

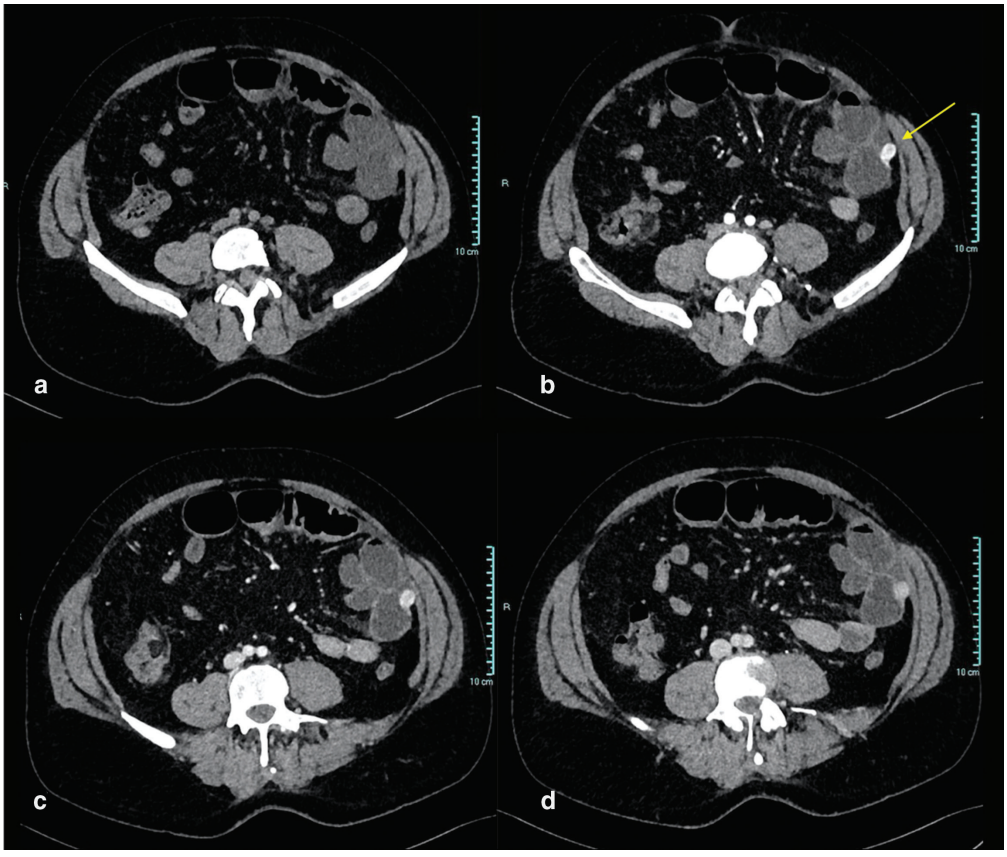

Figure 2 Contrast-enhanced abdominal CT scans, in the axial plane, for non-contrast (**a**), arterial (**b**), venous (**c**), and delayed (**d**) phases. The CT scans showed a 15 mm solid lesion in the wall of a jejunal loop (arrow) with exophytic growth, intense enhancement in the arterial phase (**b**), and wash-out in the subsequent phases (**c**,**d**), indicative of GIST.

analogous smaller solid lesions were evident in other jejunal loops (Figure 3). MRI was then performed confirming a GIST tumor (Figure 4). The MRI was performed with a 1.5 Tesla device, using both an oral biphasic contrast agent, polyethylene glycol (PEG), with a low signal in T1-weighted sequences and a high signal in T2-weighted sequences, and the intravenous contrast agent Gadolinium. Magnetic resonance (MR) enterography confirmed the presence of three jejunal GIST lesions (Figure 5).

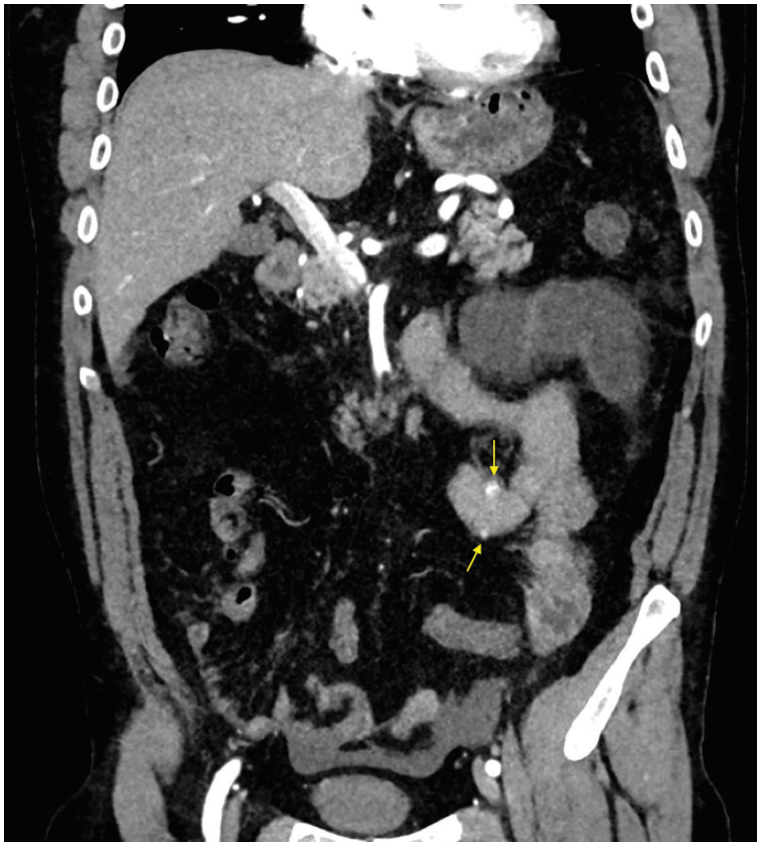

Figure 3 Contrast-enhanced abdominal CT scan, in the coronal plane, with arterial phase. The CT scan showed two lesions in the wall of a jejunal loop (arrows) with exophytic growth and intense enhancement, indicative of GIST.

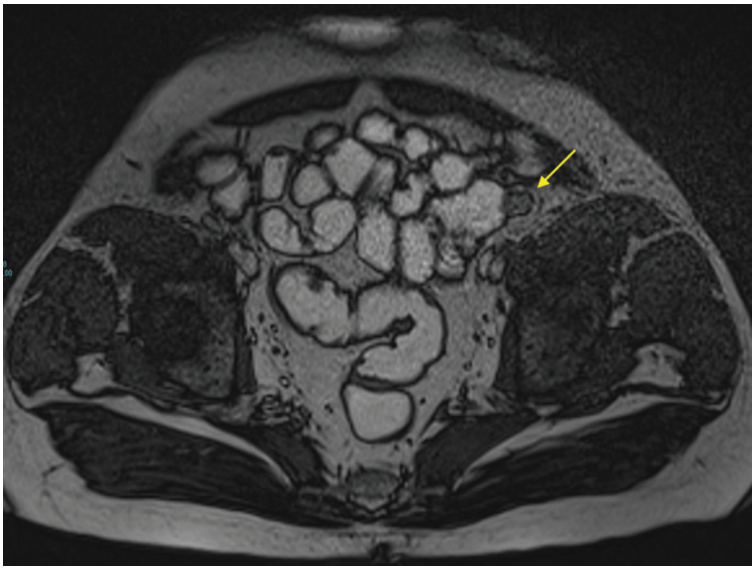

Figure 4 MR enterography, with oral biphasic contrast agent polyethylene glycol (PEG), in the axial plane. MR enterography showed a hypointense lesion in the wall of a jejunal loop (arrow) with exophytic growth, indicative of GIST.

Thus, the patient underwent two surgical interventions with a wedge resection-type excision, the first of the largest parietal exophytic lesion located in the proximal jejunum, and the second of the remaining two smaller parietal nodules also located in the proximal jejunum upstream of the previous one. Finally, segmental resection of the affected loops of the jejunum was performed with subsequent mechanical latero-lateral anastomosis.

Within a few hours of surgery, the patient began to show signs of hypotension, appearing pale and sweaty, and laboratory tests showed a sharp drop in hemoglobin of more than 5 g/dL, from 15.6 g/dL (pre-intervention values) to 10.5 g/dL (post-intervention values), with initial signs of hypovolemic shock. Therefore, the patient underwent a repeated contrast-enhanced abdominal CT scan in the emergency setting. The CT scan showed a large blush of contrast agent in the arterial phase, increasing in the later phases in the lumen of a jejunal loop in the left lumbar region, a finding indicative of severe active bleeding and associated with profuse blood in the lumen

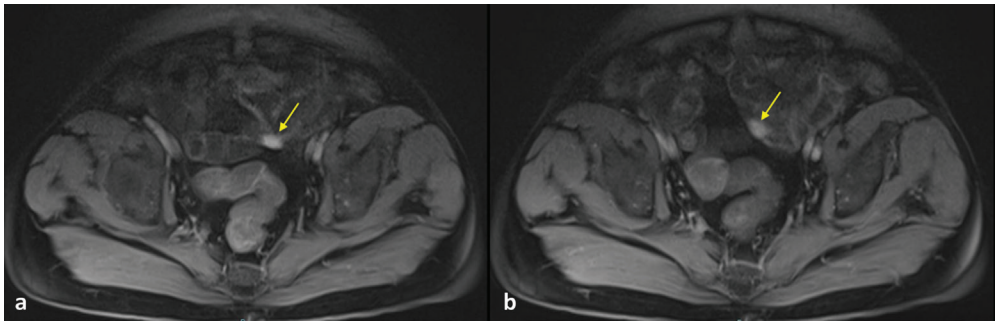

Figure 5 MR enterography, with oral biphasic contrast agent polyethylene glycol (PEG) and Gadolinium by intravenous administration, in the axial plane, with arterial (**a**) and venous (**b**) phases. MRI confirmed the presence of the jejunal GIST lesions with exophytic growth and intense enhancement in the arterial phase (**a**) and wash-out in the venous phase (**b**).

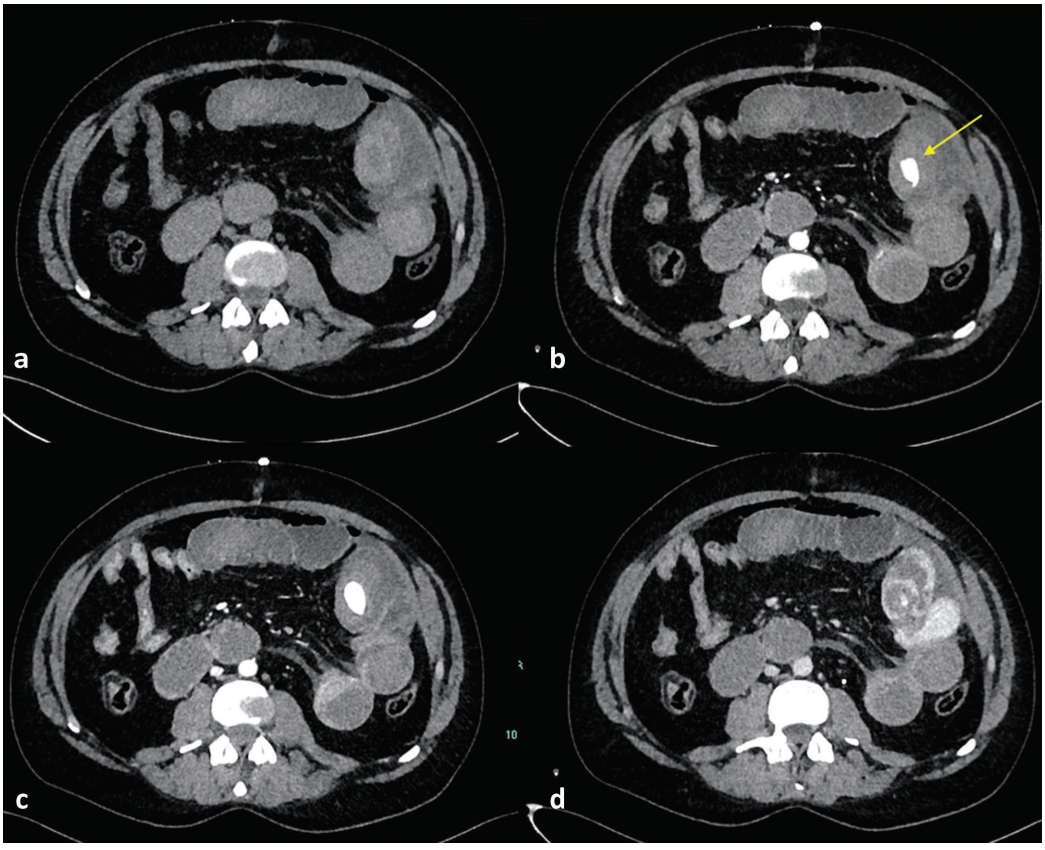

Figure 6 Contrast-enhanced abdominal CT scan, in the axial planes, with non-contrast (**a**), arterial (**b**), venous (**c**), and delayed (**d**) phases. The CT scans showed a large blush of contrast agent in the arterial phase (**b**, arrow) increasing in the later phases (**c**,**d**) in the lumen of a jejunal loop in the left lumbar region, indicative of severe active bleeding and associated with profuse blood in the lumen of multiple jejunal loops downstream (**d**). The CT scan also showed hemoperitoneum adjacent the jejunal loops in the left lumbar region.

of multiple jejunal loops downstream. The CT scan also showed diffuse hemoperitoneum (Figure 6). The patient underwent emergency surgery again with reopening of the recent laparotomy, confirming predominantly localized hemoperitoneum in the resection and perianastomotic sites, and evidence upstream of the jejunal loop of resection/anastomosis of profuse active bleeding. Bleeding control was performed with subsequent resection of approximately 20 cm of the small bowel including the bleeding site and packing of a new downstream latero-lateral anastomosis.

Ethical Approval and Informed Consent

Ethical approval to report these cases was not required. Informed consent was not acquired. All the data referring to the patient were anonymized.

DISCUSSION

GISTs are rare tumors originating from the interstitial cells of Cajal in the muscularis propria, although they are considered the most common mesenchymal tumor of the GI tract (incidence worldwide of 1–2 per 100,000). They arise from abnormal proliferation of interstitial cells of Cajal that are electrical pacemakers and mediators of enteric neurotransmission in the muscularis propria of the GI tract, with 95% of the tumors staining positive for CD117 (c-KIT) and 70% for CD34 [14], in most cases caused by oncogenic activating mutation of the receptor tyrosineproteinkinase [1–3]. Their incidence is very uncommon when compared to GI carcinoma [15] and they usually occur after 40 years of age, most commonly in older patients (median age 60–65 years) with a slight male predilection [9,10]. They can originate throughout the GI tract, most commonly in the stomach (40–70%), followed by the small bowel (15–44%) and rarely the omentum, mesentery, and retroperitoneum [4,5]. Histopathological evaluation is essential for both diagnosis and risk stratification in patients affected by GISTs [13].

The clinical presentations of GISTs vary according to their site, size, and biological behavior: they may present with non-specific GI symptoms (e.g. abdominal pain, nausea, and vomiting) [10], and small tumors are more likely to be asymptomatic, regardless of location, and found incidentally [10]. If they are large tumors they can cause bowel obstruction, intussusception or ulceration, and cause GI hemorrhage [9]: up to 40% of cases manifest with GI bleeding, ranging from chronic anemia to uncommon acute massive GI bleeding [6–8]. Aggressive forms may present with metastases or symptoms relating to local disease [9]. A peculiarity of small intestine GISTs is a higher incidence of bleeding compared with gastric GISTs [16,17]. The tendency of GISTs to bleed is due to the high tumor vascularity, progressive destruction of the mucosa, and tumor invasion of blood vessels, leading to vascular rupture [18].

Multiple imaging modalities can be used to evaluate a tumor's local extent, determine staging, predict risk, conduct surveillance after surgery, and monitor the response to molecularly targeted therapy [13]. Ultrasonography (US) is usually the first-line technique for the investigation of a patient with abdominal pain or palpable abdominal mass. Most commonly, US alone is not diagnostic because GISTs are frequently discovered to be so large that the organ of origin cannot be identified, and they present as heterogeneous masses due to the presence of necrosis, hemorrhage, or cystic changes; liver metastases can also be detected [19,20]. Abdominal X-ray is not diagnostic for the presence of a GIST but may show indirect signs such as overdistention of the loops with hydro-aerial levels as per a sub-occlusive or occlusive state [21]. Contrast-enhanced MDCT is the gold-standard technique for the diagnosis of a GIST, defining its exact location, growth type (exophytic, intraluminal, and mixed/combined/endophytic), size, and features, and whether it has metastasized to other organs [13]. The CT scan is also fundamental to define surgical planning, postsurgical surveillance, and monitoring of therapy response [22]. GISTs are defined as small when the lesion size is <2 cm, and large when the lesion size is >5 cm: small GISTs are usually homogeneous in content, while large GISTs are usually more inhomogeneous due to the presence of hemorrhagic and necrotic areas [13]. In larger lesions, often an afferent arterial vessel is observed due to the phenomena of neoangiogenesis [23,24]. Generally, the growth pattern of GISTs is categorized as exophytic, intraluminal, and mixed/combined/endophytic [13]: exophytic (54%) and mixed growth patterns (39%) are common in the small bowel [25]. On MRI, GISTs typically show low signal intensity on T1-weighted and high signal intensity on T2-weighted sequences, and enhanced signal intensity on post gadolinium images, especially in the arterial phase [26]. MRI provides morphological imaging findings similar to those obtained from a CT scan; additionally, quantitative parameters such as the apparent diffusion coefficient (ADC) and degree of enhancement, and perfusion parameters are helpful in assessing the malignancy and response to treatment [27–31]. FDG PET is more sensitive than morphological imaging in evaluating therapy response [22].

Primary management of small localized primary disease is surgical resection, while large GISTs or locally advanced GISTs may benefit from neoadjuvant Imatinib followed by surgery; for metastatic and recurrent GISTs, Imatinib remains the mainstay of treatment [11,12]. Major postoperative complications include anastomotic leakage, prolonged ileus, infection, delayed perforation, tumor rupture with intraperitoneal seeding, and blood loss [32–35]. Rarely postoperative bleeding can be potentially life-threatening: Ihn et al. report that of 95 patients undergoing surgical resection of a small bowel GIST, 13 patients (13.7%) had postoperative

complications and 1 patient (1.1%) died from postoperative hemorrhage [36]. The incidence of complications has been shown to be lower in laparoscopy than in the open technique [33; 36,37]. Postoperative bleeding is one of the surgical factors associated with a higher risk of recurrence, along with incomplete resection, intraperitoneal rupture, and tumor associated factors such as tumor size, mitotic index, or localization [38–40].

In our case, the diagnosis was made on hospital admission by contrast-enhanced CT, which showed three jejunal lesions indicative of a GIST that was further confirmed by MRI. Our patient subsequently underwent surgery but there was an early complication of bleeding, which was quickly recognized by further abdominal contrast-enhanced CT examination. Thus, the patient underwent a life-saving reoperation.

CONCLUSIONS

To conclude, in this report we have presented an unusual case of a patient affected by jejunal GIST that presented a rare postoperative complication, a potentially life-threatening event that quickly needed prompt CT diagnosis and further surgery.

The aim of this study is to show the use of the different imaging techniques to assess the diagnosis of a GIST and to highlight the role of contrast-enhanced CT, which represents the gold-standard imaging method not only in the diagnosis of a GIST but also in detecting immediate operative complications such as hemorrhage that, although statistically rare, can be life-threatening for patients. In order to promote the increasing use of contrast-enhanced CT in the emergency setting, this case is reported both for the excellent iconography and the favorable outcome of the patient.

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

All the authors made a substantial contribution to the manuscript and participated sufficiently in submission to take public responsibility for its content. Publication was seen and approved by all authors and by the responsible authorities where the work was carried out.

REFERENCES

[1] Mantese G. Gastrointestinal stromal tumor: epidemiology, diagnosis, and treatment. Curr Opin Gastroenterol. 2019;35(6):555–9.
[2] El-Menyar A, Mekkodathil A, Al-Thani H. Diagnosis and management of gastrointestinal stromal tumors: an up-to-date literature review. J Cancer Res Ther. 2017;13(6):889.
[3] Yue L, Sun Y, Wang X, Hu W. Advances of endoscopic and surgical management in gastrointestinal stromal tumors. Front Surg. 2023;10:1092997.
[4] Wang ZH, Liang XB, Wang Y, Ma GL, Qu YQ, Tian XW. [Epidemiology survey of gastrointestinal stromal tumor in Shanxi Province in 2011]. Zhonghua Yi Xue Za Zhi. 27, August 2013;93(32):2541–4. In Chinese.
[5] Rubió J, Marcos-Gragera R, Ortiz MR, et al. Population-based incidence and survival of Gastrointestinal Stromal Tumours (GIST) in Girona, Spain. Eur J Cancer. 2007;43(1):144–8.
[6] Liu Q, Kong F, Zhou J, Dong M, Dong Q. Management of hemorrhage in gastrointestinal stromal tumors: a review. Cancer Manag Res. 2018;10:735–43.
[7] Sorour MA, Kassem MI, Ghazal AE-HA, El-Riwini MT, Abu Nasr A. Gastrointestinal Stromal Tumors (GIST) related emergencies. Int J Surg. 2014;12(4):269–80.
[8] Shimazaki J, Tabuchi T, Nishida K, et al. Emergency surgery for hemorrhagic shock caused by a gastrointestinal stromal tumor of the ileum: a case report. Mol Clin Oncol. 2016;5(1):103–6.
[9] Levy A, Remotti H, Thompson W, Sobin L, Miettinen M. Gastrointestinal stromal tumors: radiologic features with pathologic correlation. Radiographics. 2003;23(2):283–304, 456.
[10] Goldblum J, Tos A, Hornick J, et al. In: WHO Classification of Tumours Editorial Board, editors. Soft Tissue and Bone Tumours. 5th ed. (WHO classification of tumours series; vol. 3). Lyon (France): International Agency for Research on Cancer; 2020.
[11] Poveda A, García Del Muro X, Antonio López-Guerrero J, et al. Tumour review GEIS guidelines for gastrointestinal sarcomas (GIST). Cancer Treat Rev. 2017;55:107–19.
[12] Sandrasegaran K, Rajesh A, Rushing DA, Rydberg J, Akisik FM, Henley JD. Gastrointestinal stromal tumors: CT and MRI findings. Eur Radiol. 2005;15(7):1407–14.
[13] Inoue A, Ota S, Yamasaki M, Batsaikhan B, Furukawa A, Watanabe Y. Gastrointestinal stromal tumors: a comprehensive radiological review. Jpn J Radiol. 2022;40:1105–20.
[14] Corvino A, Granata V, Tafuri D, et al. Incidental focal spleen lesions: integrated imaging and pattern recognition approach to the differential diagnosis. Diagnostics (Basel). 2023;13(15):2536.

[15] Ma G, Murphy J, Martinez M, Sicklick J. Epidemiology of gastrointestinal stromal tumors in the era of histology codes: results of a population-based study. Cancer Epidemiol Biomarkers Prev. 2015;24(1):298–302.
[16] Fan X, Han H, Sun Z, et al. Prognostic value of bleeding in gastrointestinal stromal tumors: a meta-analysis. Technol Cancer Res Treat. 2021;20:15330338211034260.
[17] Liu Q, Li Y, Dong M, Kong F, Dong Q. Gastrointestinal bleeding is an independent risk factor for poor prognosis in GIST patients. Biomed Res Int. 2017;2017:7152406.
[18] Saleem A, Husain F, Boushehry R, Alshamali M, Fahim E, Mohammad K. An unexpected GIST causing life-threatening bleeding after an elective hernia repair. Surg J (NY). 2023;9(1):e18–22.
[19] Vernuccio F, Taibbi A, Picone D, et al. Imaging of gastrointestinal stromal tumors: from diagnosis to evaluation of therapeutic response. Anticancer Res. 2016;36:2639–48.
[20] Chan KP. What's the Mass? The gist of point-of-care ultrasound in gastrointestinal stromal tumors. Clin Pract Cases Emerg Med. 2018;2:82–5.
[21] King DM. The radiology of gastrointestinal stromal tumours (GIST). Cancer Imaging. 2005;5(1):150–6.
[22] Dimitrakopoulou-Strauss A, Ronellenfitsch U, Cheng C, et al. Imaging therapy response of gastrointestinal stromal tumors (GIST) with FDG PET, CT and MRI: a systematic review. Clin Transl Imaging. 2017;5(3):183–97.
[23] Lau S, Tam KF, Kam CK, et al. Imaging of gastrointestinal stromal tumour (GIST). Clin Radiol. 2004;59(6):487–98.
[24] Darnell A, Dalmau E, Pericay C, et al. Gastrointestinal stromal tumors. Abdom Imaging. 2006;31(4):387–99.
[25] Baheti AD, Shinagare AB, O'Neill AC, et al. MDCT and clinicopathological features of small bowel gastrointestinal stromal tumours in 102 patients: a single institute experience. Br J Radiol. 2015;88(1053):20150085.
[26] Caramella T, Schmidt S, Chevallier P, et al. MR features of gastrointestinal stromal tumors. Clin Imaging. 2005;29(4):251–4.
[27] Yu MH, Lee JM, Baek JH, Han JK, Choi BI. MRI features of gastrointestinal stromal tumors. Am J Roentgenol. 2014;203(5):980–91.
[28] Kim H, Keene KS, Sarver DB, et al. Quantitative perfusion- and diffusion-weighted magnetic resonance imaging of gastrointestinal cancers treated with multikinase inhibitors: a pilot study. Gastrointest Cancer Res. 2014;7(3–4):75–81.
[29] Tang LZX, Sun YS, Shen L, et al. Gastrointestinal stromal tumors treated with imatinib mesylate: apparent diffusion coefficient in the evaluation of therapy response in patients. Radiology. 2011;258(3):729–38.
[30] Zheng T, Du J, Yang L, et al. Evaluation of risk classifications for gastrointestinal stromal tumor using multi-parameter magnetic resonance analysis. Abdom Radiol. 2021;46(4):1506–18.
[31] Masselli G, Casciani E, Polettini E, Laghi F, Gualdi G. Magnetic resonance imaging of small bowel neoplasms. Cancer Imaging. 2013;13(1):92–9.
[32] Lai I-R, Chen C-N, Lin M-T, Lee P-H. Surgical Treatment of gastric gastrointestinal stromal tumors: analysis of 92 operated patients. Dig Surg. 2008;25(3):208–12.
[33] Gluzman MI, Kashchenko VA, Karachun AM, et al. Technical success and short-term results of surgical treatment of gastrointestinal stromal tumors: an experience of three centers. Transl Gastroenterol Hepatol. 2017;2:56.
[34] Zhang X, Song W, Han F, et al. [Efficacy analysis of laparoscopic surgery for primary local gastric and intestinal gastrointestinal stromal tumors]. Zhonghua Wei Chang Wai Ke Za Zhi. 2014;17(4):340–3 (in Chinese).
[35] Abbas M, Farouk Y, Nasr MM, et al. Gastrointestinal Stromal Tumors (GISTs): clinical presentation, diagnosis, surgical treatment and its outcome. J Egypt Soc Parasitol. 2008;38(3):883–94.
[36] Ihn K, Hyung WJ, Kim H-I, et al. Treatment results of small intestinal gastrointestinal stromal tumors less than 10 Cm in diameter: a comparison between laparoscopy and open surgery. J Gastric Cancer. 2012;12(4):243–8.
[37] Park S-H, Lee H-J, Kim M-C, et al. Early experience of laparoscopic resection and comparison with open surgery for gastric gastrointestinal stromal tumor: a multicenter retrospective study. Sci Rep. 2022;12(1):2290.
[38] Beham AW, Schaefer I-M, Schüler P, Cameron S, Michael Ghadimi B. Gastrointestinal stromal tumors. Int J Colorectal Dis. 2012;27(6):689–700.
[39] Corvino A, Catalano F, Cipolletta Campanile A, et al. Interventional ultrasound in dermatology: a pictorial overview focusing on cutaneous melanoma patients. J Ultrasound Med. 2022;41(12):3137–44.
[40] Corvino A, Catalano O, de Magistris G, et al. Usefulness of doppler techniques in the diagnosis of peripheral iatrogenic pseudoaneurysms secondary to minimally invasive interventional and surgical procedures: imaging findings and diagnostic performance study. J Ultrasound. 2020; 23(4):563–73.

Case Report

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REBOA: A Device to Gain Time

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The management of trauma and emergency procedures (i.e., aneurysm repair, visceral and pelvic bleeding, and others) has undergone considerable changes due to the presence of new endovascular and mini-invasive approaches, which have supplanted the surgical approach in some cases. The use of Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) has been largely used to manage trauma patients, but it is, nowadays, increasingly also being used for other types of bleeding, such as vascular emergencies, post-partum hemorrhages, and gastrointestinal and iatrogenic or spontaneous bleeding. We present a case of an unexpected hemorrhagic shock in a patient with a locally advanced cervix neoplasm involving sacrum and pelvic vessels, where we used a REBOA to manage an intraprocedural massive bleed due to the rupture of the descending branch of the right hypogastric artery.

Keywords: *Resuscitative Endovascular Balloon Occlusion of the Aorta; REBOA; Aortic Occlusion; Endovascular Procedures; Emergency; Bleeding*

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INTRODUCTION

Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) is a minimally invasive endovascular intervention capable of stopping bleeding and preserving cerebral and cardiac perfusion in the case of hemorrhage from the thorax, abdomen or pelvis [1].

REBOA can be inflated in three aortic zones, based on the site of bleeding: Zone 1, extends from the origin of the left subclavian artery to the celiac artery; Zone 2 extends from the celiac artery to the lowest renal artery; Zone 3 extends from the lowest renal artery to the aortic bifurcation [1].

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The use of REBOA has been largely used to manage trauma patients, but it is, nowadays, increasingly being used also for other types of bleeding, such as vascular emergencies, post-partum hemorrhages (PPH), and gastrointestinal and iatrogenic or spontaneous bleeding [2]. The role of REBOA in these settings is predominantly as a bridge to definitive surgical or endovascular treatment [2].

Five sequential steps have to be considered for the use of REBOA: (1) arterial access and positioning of sheath; (2) selection and positioning of the balloon; (3) inflation of the balloon; (4) deflation of the balloon; and (5) sheath removal [3].

The aortic balloon must present the following features: a large diameter to perform the occlusion and high compliance in order to reduce the risks of dissection or rupture of the aorta [4].

Complications of REBOA can be related to arterial access and balloon positioning, balloon inflation and deflation, and to sheath removal [5]. The most serious complication that can happen when REBOA has been used for a prolonged period of time is ischemia caused by total aortic occlusion. A prolonged ischemia followed by reperfusion can result in multiple organ failure including acute kidney injury, liver failure, spinal cord infarction, intestinal ischemia, myonecrosis, limb loss, and death [5].

We present a case of an intraprocedural unexpected hemorrhagic shock in a patient with a locally

advanced cervix neoplasm referred to the Interventional Radiology (IR) service for chronic metrorrhagia and otherwise unmanageable anemia.

CASE REPORT

We present a case of a 54-year-old female affected by locally advanced cervix neoplasm despite multiple lines of chemotherapy and radiotherapy treatment. The patient was admitted to the emergency department of our Institution (Fondazione IRCCS Cà Granda Ospedale Maggiore Policlinico, Milan, Italy) due to the occurrence of severe rectorrhagia and metrorrhagia at home.

At arrival, the patient was in hemorragic shock, confused, hypotensive, tachycardic, with lactacidemia up to 10 mmol/L: resuscitation required crystalloid infusion 2,000 mL, Norepineprine (maximum dose 0.1 mcg/kg/min) and blood volume replacement (4 packed red blood cells (PRBC), 4 fresh frozen plasma (FFP), 2 g Fibrinogen). Tranexamic acid bolus and continuous infusion were started. Once hemodynamic stability was obtained, contrast-enhanced computed tomography (CECT) of the abdomen and pelvis was performed as first imaging modality, which showed a locally advanced cervix tumor involving almost all of the pelvic structures. No active bleeding but an infiltration of major vessels, such as the hypogastric right artery, was observed (Figure 1). The patient was subsequently transferred to the sub-intensive care unit to continue the hemodynamic monitoring while awaiting an oncological consult. A few hours later, a new episode of severe bleeding occurred requiring the intervention of the medical emergency team: a further 2 PRBC, 2FFP, and 1 Platelet pool were transfused. Due to the persistence of metrorrhagia and rectorrhagia, despite the radiological evidence of active bleeding on the CT scan, an endovascular treatment was also considered.

A 5-Fr right arterial femoral access was obtained, and the diagnostic angiogram of the left hypogastric artery showed an anomalous tumor vascularization which was treated with spongeal foam embolization (Figure 2).

A diagnostic angiogram of the right hypogastric artery was then performed which showed neither the source of bleeding nor anomalous tumor vascularization (Figure 3).

However, a bland embolization with spongeal foam was carried out. The procedure was intended to be the final intervention but a sudden new episode of metrorrhagia was observed, with a loss of approximately 2 to 2.5 L of blood in about 10 minutes. The patient's parameters became unstable, with systolic arterial

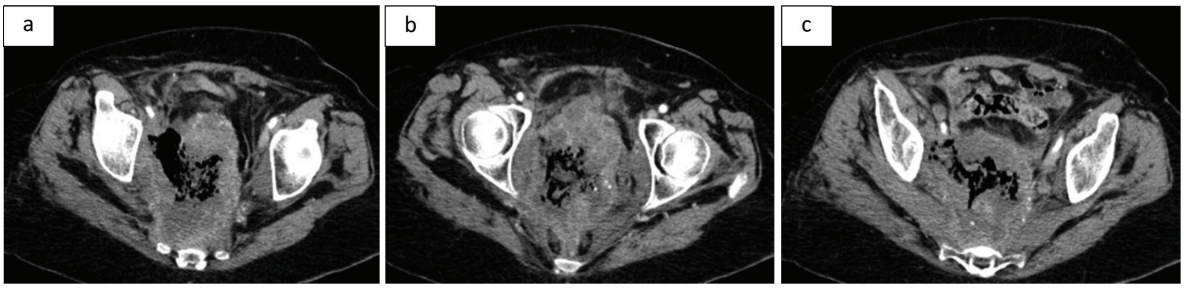

Figure 1 Contrast-enhanced computed tomography (CECT) showing a cervix tumor with the infiltration of the body of the uterus, vagina, rectum, bladder, ureters, pelvic floor muscles and sacrum. No active bleeding was observed but an infiltration of the major vessels, such as the hypogastric right artery, was observed.

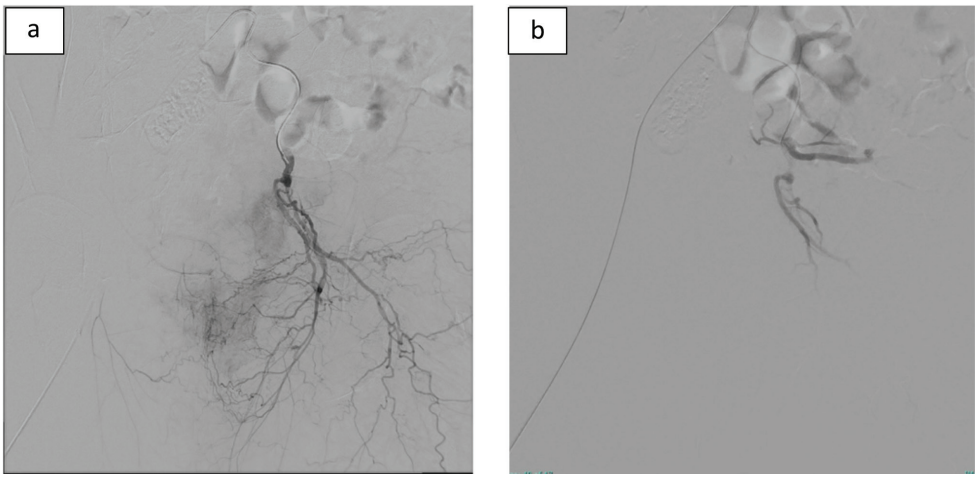

Figure 2 Diagnostic angiography of the left hypogastric artery showed an anomalous tumor vascularization (**a**). Embolization with spongeal foam on this left side was made, providing satisfactory final angiographic control (**b**).

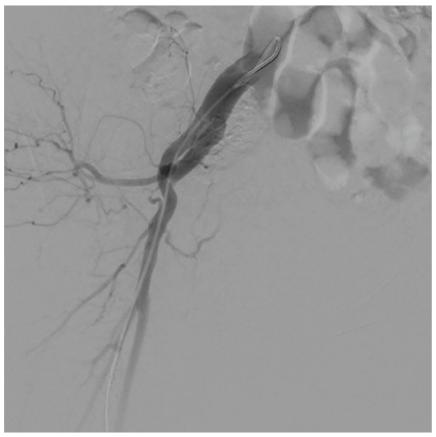

Figure 3 Diagnostic angiography of the right hypogastric artery with no evidence of source of active bleeding.

pressure 50/30 mmHg, heart rate 120 bpm accompanied by loss of consciousness. As an immediate measure, a rapid infusion of crystalloid and noradrenaline was started followed by 4 FFP and 4 PRBC. Therefore, in consideration of the uncontrollable bleeding, the decision was made to inflate the REBOA (Rescue Balloon Occlusion Catheter, Tokai Medical Products, Japan) in Zone 3.

Therefore, the 5-Fr sheath was changed to a 7-Fr sheath over the wire (180 cm long, 0.018 inch hydrophilic guidewire (Radiofocus, Terumo, Leuven, Belgium)) and the balloon was inserted under fluoroscopic guidance.

Balloon inflation required administration of analgesia due to the sudden occurrence of acute pain in the lower limbs. The inflation with approximately 10 mL of a mixture of sterile saline and iodinated contrast (Visipaque 370) was maintained until the blood pressure increased and the contralateral femoral pulse was stopped. An intermittent REBOA (iREBOA) inflation and deflation of the balloon was made twice, with a total of 12 minutes of inflation (5 minutes for each session and 2 minutes of deflation). A progressive final slow deflation was made, guided by the new hemodynamic stability obtained (Figure 4). Finally, a diagnostic aortography showed the presence of bleeding with active contrast media extravasation from the right hypogastric artery. An embolization using glue (1:1 of Glubran 2 :Lipiodol) followed by a distal embolization with coils (Azur TM CX Peripheral Coil system, Terumo Europe) to avoid contralateral collateralization was made and the final angiogram showed no further active bleeding (Figure 5*a*,*b*). However, an angiogram of the inferior mesenteric artery showed an anomalous vascularization of the pelvic mass, and therefore it was embolized using a microcoil (Azur TM CX Peripheral Coil system, Terumo Europe) (Figure 5*c*,*d*).

The final angiogram demonstrated no active bleeding, and the vital parameters were stable with blood pressure 90/50 mmHg and heart rate 110 bpm; the patient was conscious and not suffering. The patient was still lactacidemic (lactate 11mmol/L and standard base excess –11), anemic (hemoglobin 6.2 g/dL) and requiring moderate vasopressor dose (norepinephrine 0.07 mcg/kg/min). Volume resuscitation required further infusion of PRBC, FFP and platelets in a 1:1:1 ratio. The patient was discharged from the angiography suite to the sub-intensive care unit with a trend toward vital parameter improvement and lactate decrease, with anemia already resolved.

Ethical Approval and Informed Consent

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from the patient included in the study.

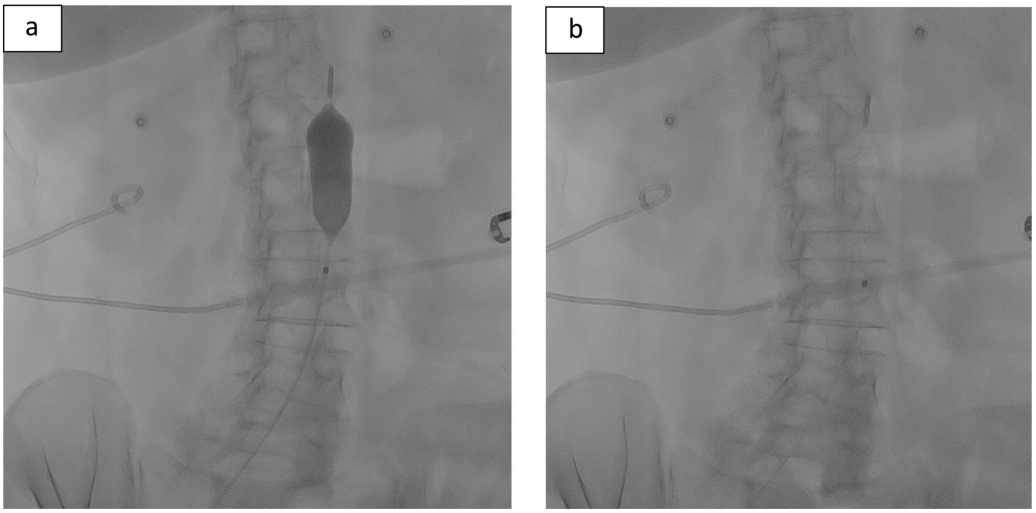

Figure 4 Fluroscopic images during the inflation of the REBOA (**a**) with a deployment in Zone 3 of the aorta and after deflation of the REBOA (**b**).

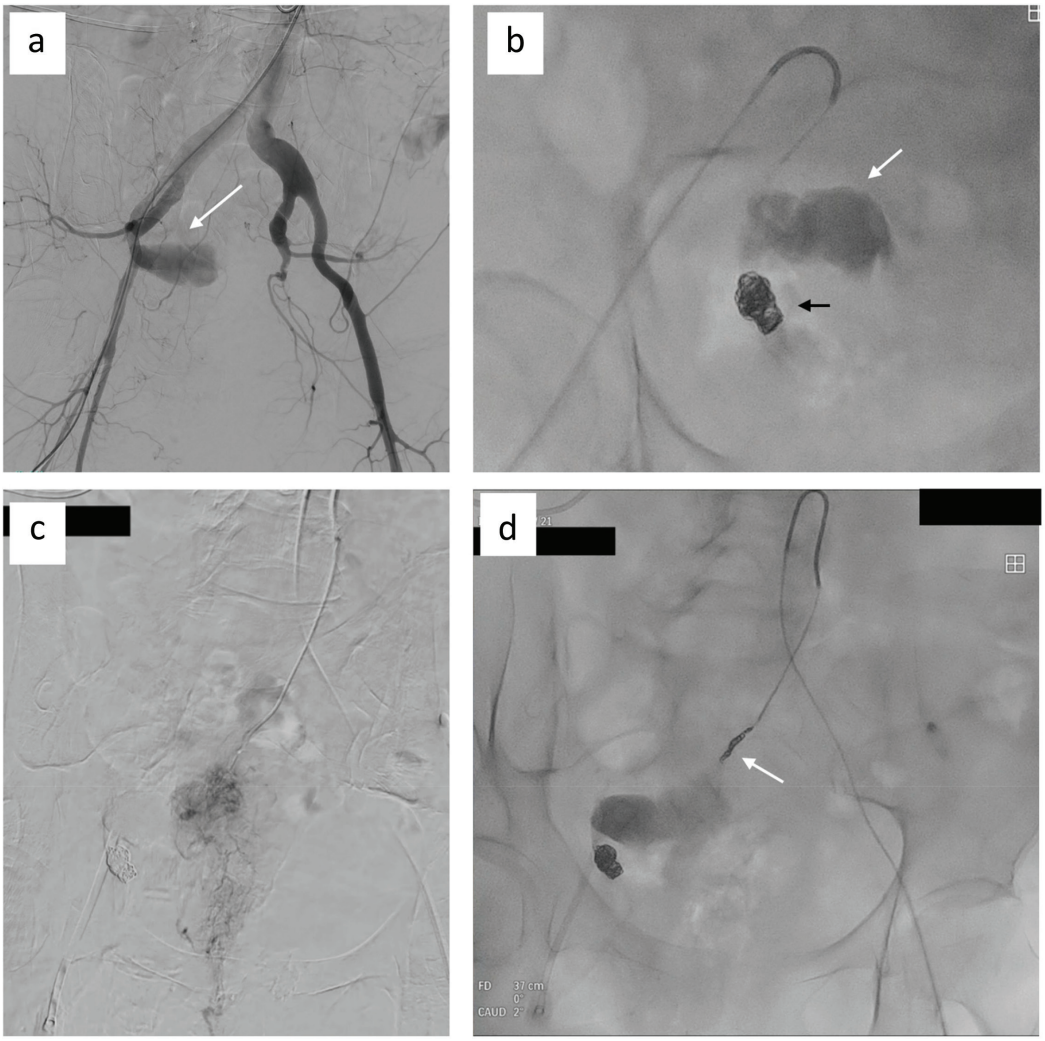

Figure 5 A diagnostic aortogram performed with a pig-tail catheter shows the presence of bleeding with active contrast media extravasation from the right hypogastric artery (white arrow (**a**)). Embolization using glue (1:1 of Glubran 2: Lipiodol) (white arrow) and coils (Azur TM CX Peripheral Coil system, Terumo, Leuven, Belgium) (black arrow) was performed (**b**). The angiography of a branch of the inferior mesenteric artery (IMA) rising an anomalous vascularization of the pelvic mass (**c**) and embolization with a microcoil (Azur TM CX Peripheral Coil system, Terumo, Leuven, Belgium) (white arrow (**d**)).

DISCUSSION

In the case presented, the inflation of REBOA permitted the re-establishment of vital parameters and allowed time to be gained to plan for the correct strategy to arrest hemorrhage and enable resuscitation supplies so as to recover blood loss. The intra-procedural new episode of metrorrhagia was so copious as to simulate the sound of an "open tap".

The most important steps during the use of REBOA are the correct and rapid placement of the device, and the management of the inflation and deflation of the balloon.

The technique can provide total occlusion of the aorta either just above the diaphragm (Zone 1), to control intra-abdominal bleeding, or above the aorto-iliac bifurcation (Zone 3), to control bleeding in the pelvis or proximal extremities. The inflation of the balloon in Zone 2 is usually not recommended due to the potential severe complications [5].

The balloon inflation represents a "key step" in the procedure and must be performed carefully.

In order to avoid over-inflation and consequent rupture of the balloon and/or of the aorta, continual monitoring of systolic blood pressure (SBP) and contralateral femoral pulse is recommended.

REBOA is associated with ischemia–perfusion injuries and multiple organ failure when used for a long time. Aorta occlusion exceeding 40 minutes can result in irreversible organ injury and death [5].

Furthermore, supraphysiological rises in blood pressure proximal to the occlusion balloon may contribute to heart failure and traumatic brain injury [5].

Reva et al. evaluated organ damage following 30 and 60 minutes of aortic balloon inflation in an ovine model with severe hemorrhagic shock and showed that 60 minutes of occlusion results in significant metabolic derangement and organ damage [6].

Morrison et al. conducted a systematic review of 83 studies reporting a total of 11 arterial injuries that required surgical interventions to restore lower extremity perfusion, and in three cases lower extremity amputation was also required [7].

In order to minimize the risk of ischemia, new methods, such as partial REBOA (pREBOA) and iREBOA have been introduced [2].

In our case, we decided to use an iREBOA inflation, with the cooperation of the anesthetist. Communication with the resuscitation team is also fundamental during the deflation of the balloon. In the literature, cases of refractory hypotension, which ultimately lead to hemodynamic collapse after balloon deflation, are described [8]. In these cases, an immediate re-inflation of the balloon is needed.

In our case, we carried out an iREBOA inflation and a final slow deflation with a total restoration of vital parameters [9].

One of the real advantages of using REBOA is the possibility of using a small caliber sheath (7-Fr). As blood flow is inversely proportional to the vessel cross-sectional area, it is acceptable that large-sized sheaths may decrease blood flow to the extremities.[5] For this reason, the use of a balloon catheter via a 7-Fr sheath appears to have fewer complications despite relatively prolonged placement.[5] In our experience, it is advisable to use a slightly larger introducer to facilitate the removal of the device at the end of the procedure, such as an 8-Fr sheath.

Teeter et al. evaluated the safety of 7-Fr REBOA catheters and demonstrated that their use can significantly elevate systolic blood pressure with no access-related complications [10].

In fact, there is a low level of evidence of REBOA's use for other types of hemodynamic instabilities outside of the trauma setting. The case presented in this report highlights the advantage of having all kinds of device available, including REBOA. Situations like ours are unpredictable, and a simple maneuver with experienced hands and multi-specialty cooperation may be life-saving.

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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REFERENCES

[1] Qazi AS, Phillips JL, Kabutey N-K, et al. REBOA in hemorrhagic shock: a unique nonresponder? Trauma Surg Acute Care Open. 2017;2:1–2.
[2] Hörer T. Resuscitative endovascular balloon occlusion of the aorta (REBOA) and endovascular resuscitation and trauma management (EVTM): a paradigm shift regarding hemodynamic instability. Eur J Trauma Emerg Surg. 2018;44:487–9. doi: 10.1007/s00068-018-0983-y.
[3] Cannon J, Morrison J, Lauer C, et al. Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) for hemorrhagic shock. Mil Med. 2018;183(suppl_2):55–9. doi: 10.1093/milmed/usy143.
[4] Stannard A, Eliason JL, Rasmussen TE. Resuscitative endovascular balloon occlusion of the aorta (REBOA) as an adjunct for hemorrhagic shock. J Trauma. 2011;71(6):1869–72. doi: 10.1097/TA.0b013e31823fe90c.
[5] Ribeiro Junior MAF, Feng CYD, Nguyen ATM, et al. The complications associated with Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA). World J Emerg Surg. 2018;13:20. doi: 10.1186/s13017-018-0181-6.
[6] Reva VA, Matsumura Y, Hörer T, et al. Resuscitative endovascular balloon occlusion of the aorta: what is the optimum occlusion time in an ovine model of hemorrhagic shock? Eur J Trauma Emerg Surg. 2018;44:511–8. doi: 10.1007/s00068-016-0732-z.
[7] Morrison JJ, Galgon RE, Jansen JO, et al. A systematic review of the use of resuscitative endovascular balloon occlusion of the aorta in the management of hemorrhagic shock. J Trauma Acute Care Surg. 2016;80(2):324–34. doi: 10.1097/TA.0000000000000913.
[8] Martinelli T, Thony F, Decléty P, et al. Intra-aortic balloon occlusion to salvage patients with life-threatening hemorrhagic shocks from pelvic fractures. J Trauma. 2010;68:942–8. doi: 10.1097/ta.0b013e3181c40579.
[9] Davidson AJ, Russo RM, Reva VA, et al. The pitfalls of resuscitative endovascular balloon occlusion of the aorta. J Trauma Acute Care Surg. 2018;84(1):192–202. doi: 10.1097/ta.0000000000001711.
[10] Teeter WA, Matsumoto J, Idoguchi K, et al. Smaller introducer sheaths for REBOA may be associated with fewer complications. J Trauma Acute Care Surg. 2016;81(6):1039–45. doi: 10.1097/TA.0000000000001143.

Case Report

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Endovascular Treatment in a Polytraumatized Patient with Rupture of the Infrarenal Aorta and Thrombosis of the Superior Mesenteric Artery

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Keywords: *Aerial Trauma; Endovascular; Aorta*

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INTRODUCTION

Abdominal aortic injury is diagnosed in 0.04% of all blunt trauma admissions and is frequently associated with the presence of fractures of the thoracolumbar spine [1-3]. The superior mesenteric artery (SMA) ranks second, followed by the renal arteries, as the most commonly injured abdominal vessel after blunt trauma [4].

Vascular injuries after blunt trauma can be caused by three mechanisms [4]: rapid deceleration (as in high-speed traffic accidents, which is the most common cause in our environment [1], or falls from height), by direct anteroposterior crushing (as caused to car occupants by seatbelts) or by direct rupture of a major vessel by a bone fragment.

The clinical presentation depends on the injured vessel, the size and type of injury, the presence of concomitant injuries and the time elapsed since the injury [3]. Many patients may be normotensive on admission due to vascular thrombosis or a contained tear, and become unstable minutes later [3,4]. Protocolized management of these patients is critical. According to the Advanced Trauma Life Support (ATLS) diagnostic algorithm [5], a stable patient with blunt abdominal trauma requires axial computed tomography angiography with contrast to assess for possible injury. Endovascular techniques have revolutionized the treatment of traumatic thoracic aortic injuries [2,6-8], although their role in the abdominal aorta is generally limited. They are gradually being used successfully in selected cases with infrarenal aortic lesions, such as dissections, pseudoaneurysms, ruptures or aortocaval fistulas [6,9].

Ethical Approval and Informed Consent

Ethical approval was not required as all data was anonymized. Informed consent was obtained from the patient. The patient consented to the description of his clinical course for educational purposes.

CASE REPORT

We present the case of a 24-year-old man with multiple traumas after a traffic accident involving a road exit and a fall from a height of about 5 meters, who was wearing a seat belt. On arrival at the hospital, he was conscious, oriented and cooperative with a Glasgow score of 15/15, hemodynamically stable with a blood pressure of 110/60 mmHg and a heart rate of 70 bpm, had 98% saturation without work of breathing and had no external bleeding. CT angiography showed rupture of the infrarenal abdominal aortic artery and thrombosis of the SMA (Figures 1 and 2) approximately 4 cm from its origin, distal to the middle colic artery with hemoperitoneum and infarction in the lower left renal pole. In addition to the bone injuries in the left upper extremity, there were rib fractures of

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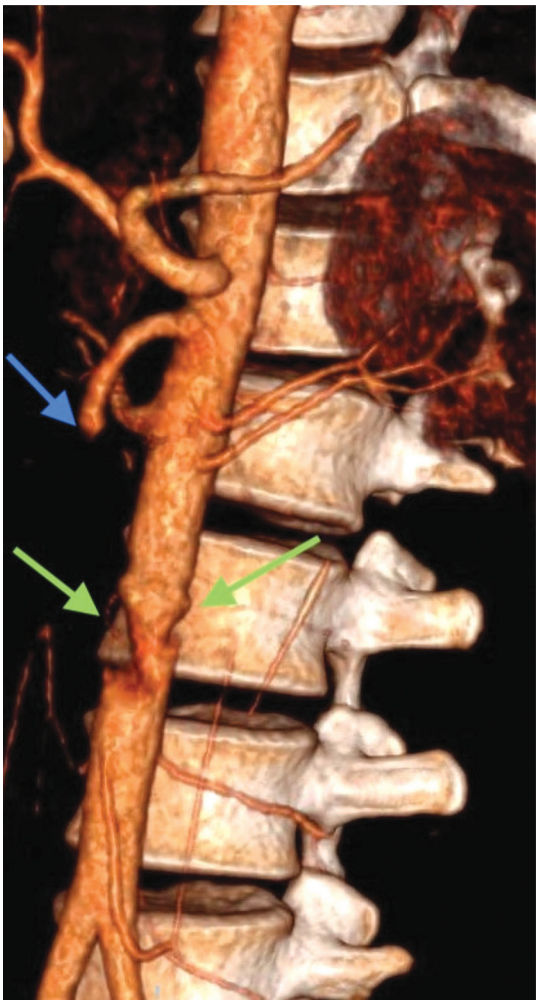

Figure 1 CT angiography reconstruction of the lesion in the infrarenal aorta (green arrows) and thrombosis of the superior mesenteric artery (blue arrow).

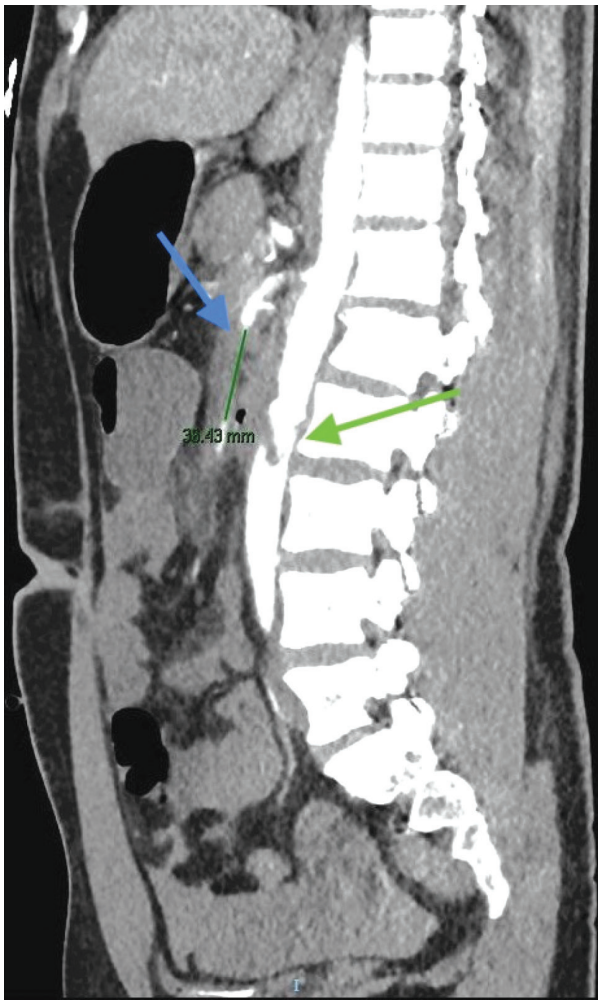

Figure 2 Sagittal CT angiography section of the lesion in the infrarenal aorta (green arrow) and 36.43 mm thrombosis of the superior mesenteric artery (blue arrow).

the 9th and 10th on the left and the 10th and 11th on the right, and vertebral fractures at the level of D12 and L1.

In view of these findings, an urgent intervention was decided jointly by the Departments of Angiology and Vascular Surgery and General Surgery. Through a bilateral open transfemoral approach, a 16 × 48 mm balloon-expandable covered BeGraft Bentley® endoprosthesis was implanted in the infrarenal aorta under fluoroscopic view and with the assistance of intravascular ultrasound, with an oversizing of 10% and proximal to the inferior mesenteric artery (IMA), which measured approximately 14 mm at this level of the aorta, with the rupture area sealed (Figure 3). The SMA was then canalized and thromboaspiration performed using an AngioJetTM ZelanteDVTTM catheter. After a control arteriography, the dissection could be seen at the origin of the thrombosed segment, so it was decided to implant a self-expanding, covered 6 × 50 mm GORE® VIABAHN endoprosthesis. We prefer this stent to a balloon-expandable stent because of the lower stiffness of self-expanding stents. The control angiography showed the closure of the aortic rupture area, the patency of the renal arteries, the SMA and the IMA.

The total time for the endovascular procedure was 70 minutes with a fluoroscopy time of approximately 12 minutes for which 50 ml of iodinated contrast medium was used.

A midline laparotomy was then performed by general surgery, which revealed an injury to the abdominal wall below the belt mark with diffuse hemoperitoneum. The entire abdominal cavity was explored and a mesenteric lesion of the small bowel was found 60 cm distal to the Treitz angle with a traumatic segment of the omentum that was dislocated (Figure 4). This required resection of 5 cm of the jejunum. Necrotic plaques were found in the cecum and transverse colon (Figure 5).

The abdomen was left open with the ABTHERA system for review in 24 hours, where, due to the progression of the lesions, a re-resection of 10 cm of jejunum distal to the previous resection was performed and a mechanical isoperistaltic ileo-ileal anastomosis carried

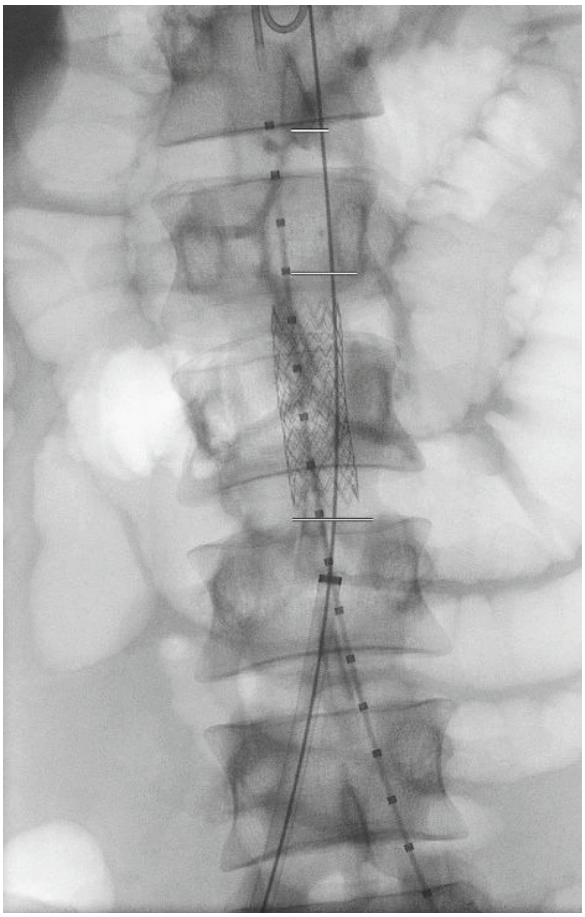

Figure 3 Implantation of the aortic graft, with markings from top to bottom indicating emergence from the celiac trunk, the kidneys and the inferior mesentery.

out from side to side with a 55-mm linear stapler. In addition to the removal of the necrotic plaque in the transverse colon and a simple suture with 3/0 Monocril, the abdominal wall was finally closed.

The patient, after making good progress and with CT angiography showing patency of the stent in the SMA and the aortic graft 72 hours after the procedure (Figure 6), was discharged from trauma 30 days after closure of the

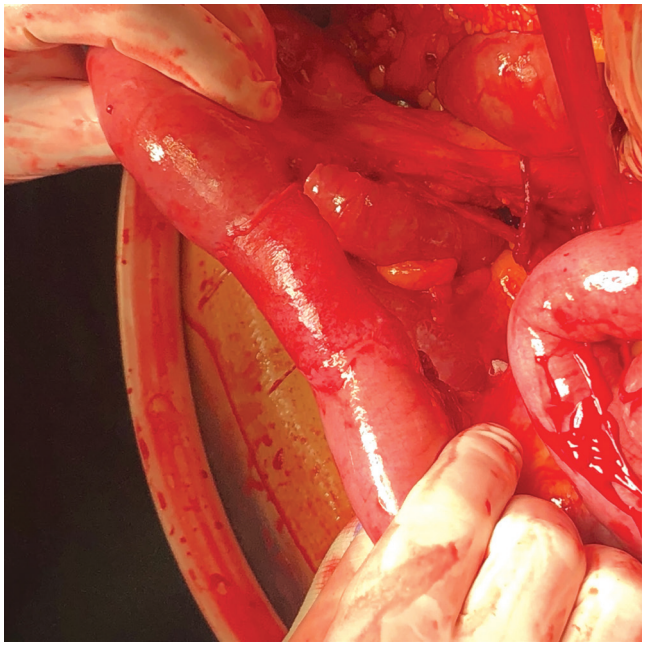

Figure 4 Abdominal laparotomy. Loop of small bowel 60 cm from the Treitz angle, separated from its meso.

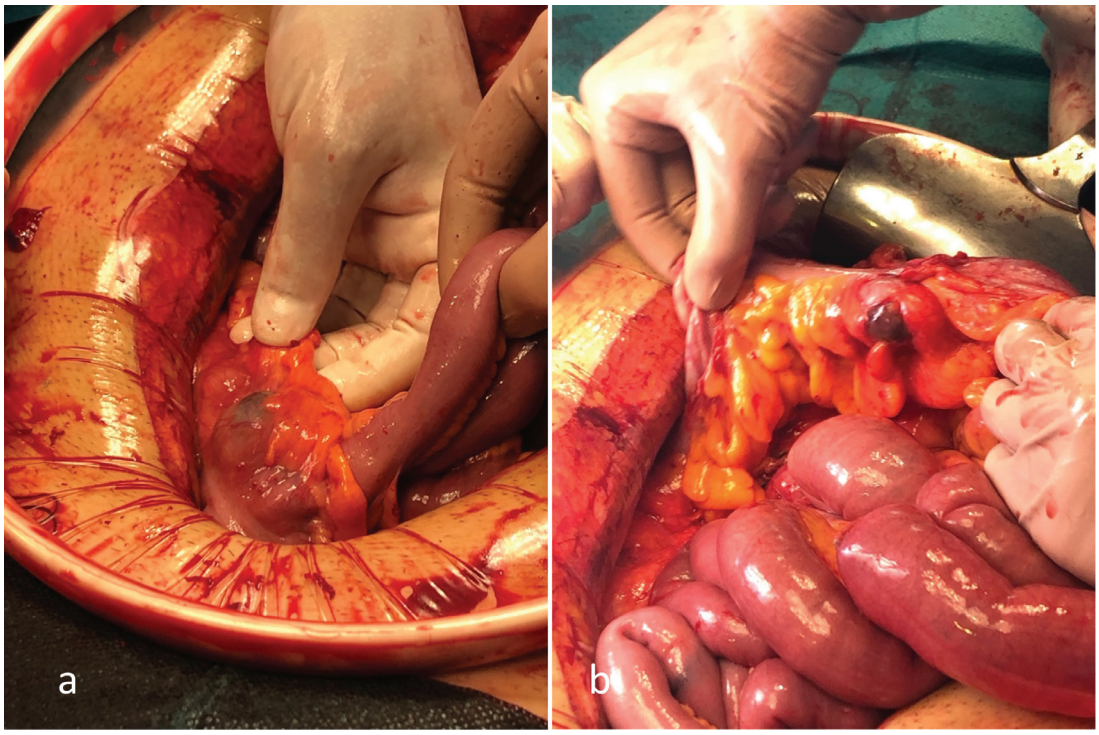

Figure 5 Abdominal laparotomy. Examination of the remaining intestinal loops reveals the following: (**a**) necrotic plaque in the cecum; (**b**) necrotic plaque in the transverse colon.

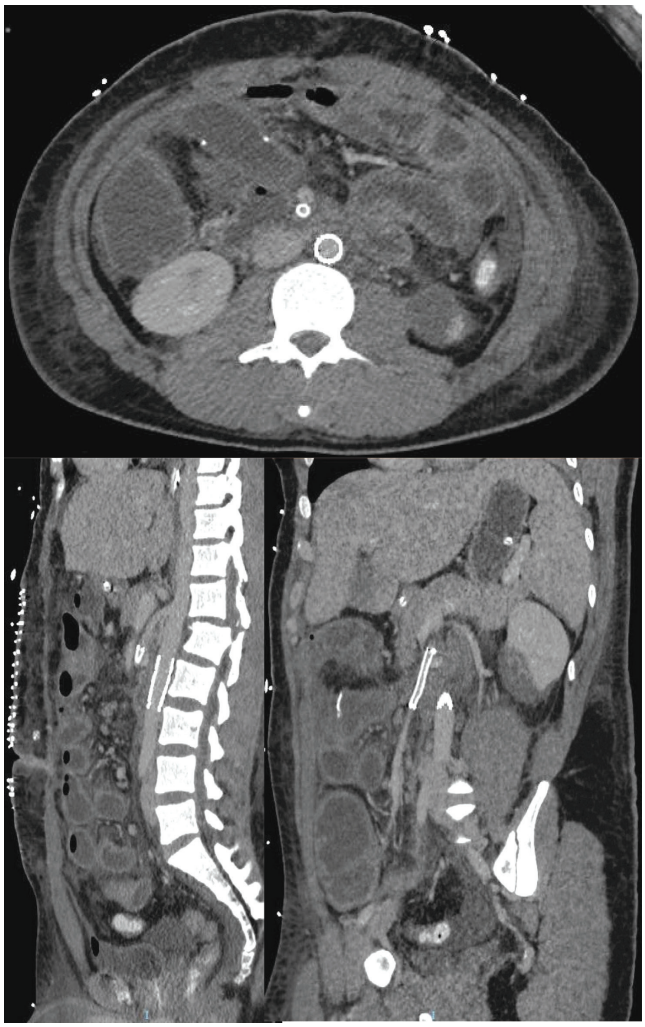

Figure 6 Control CT angiography with aortic Begraft and Viabahn patency in SMA.

abdominal wall and surgical repair of fractures of the lumbar spine, ribs and left upper extremity. The patient received treatment with acetylsalicylic acid 100 mg and clopidogrel 75 mg, which he maintained for 6 months, followed by simple antiplatelet therapy indefinitely.

We will follow up with the patient in consultations with a follow-up CT angiography at 3 months, 6 months, 1 year and 2 years. Thereafter, we will continue to monitor the patient annually and only request a follow-up CT angiography in case of clinical changes.

DISCUSSION

The treatment of patients with traumatic injuries to the abdominal aorta and its vessels is very complex and requires a multidisciplinary team. A correct diagnosis of all lesions is crucial for the success of the treatment and the survival of the patient, which is why, as already mentioned, CT angiography must be performed when the patient arrives at the hospital. Currently, the choice of aortic repair strategy is challenging as there are no clear guidelines [10].

Conservative treatment may be considered for small dissections [10,11] as described by Shalhub et al. [12] in which 89.5% of patients with small dissections were successfully treated conservatively.

At surgery, in addition to the surgeon's preference, some aspects must be considered to decide between open or endovascular repair. Injuries to the bowel are common and in these cases the possibility of graft infection is greater when an in-situ repair with prosthetic material is performed [13]. Therefore, an endovascular approach would be the optimal option in these patients as the risk of infection is lower. However, it must be kept in mind that aortic or iliac thrombosis carries a risk of distal thrombosis and a greater risk of stent complications [10].

In such cases, the use of rifampin-soaked Dacron grafts and covering of the omentum flap help to protect these grafts from infection [10].

When considering endovascular repair, there are a few factors that should be considered. Age is important, as patients may be young with a life expectancy that requires a long durability of the procedure and a high fatigue resistance of the endovascular material. In young patients, growth can lead to an anatomical mismatch between the adjacent native aorta and the aortic segment treated with endovascular technology, resulting in hemodynamically significant stenosis with flow restriction, especially during exercise and possible endograft migration. An additional difficulty arises from the underestimation of the true aortic diameter in patients in shock. We normally oversize by 10%. This helps to compensate for the measurement error in a hemodynamically unstable patient and to avoid excessive oversizing, which can lead to kinking and thrombosis in young patients with a small aortic diameter [10].

CONCLUSION

Endovascular treatment for closed abdominal traumatic injuries with vascular involvement of the visceral arteries and/or abdominal aorta shows good results in polytraumatized patients with hemodynamic stability, when working with the collaboration of a multidisciplinary team.

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

All authors made a substantial contribution to the manuscript and were sufficiently involved in the submission to take public responsibility for the content. The publication has been seen and approved by all authors and by the competent authorities where the work was performed.

REFERENCES

[1] Domenicucci M, Ramieri A, Landi A, et al. Blunt abdominal aortic disruption (BAAD) in shear fracture of the adult thoraco-lumbar spine: case report and literature review. Eur Spine J. 2011; 20(Suppl 2):S314–19. DOI: 10.1007/s00586-011-1732-7

[2] Xenos ES, Abedi NN, Davenport DL, et al. Meta-analysis of endovascular vs open repair for traumatic descending thoracic aortic rupture. J Vasc Surg. 2008;48(5):1343–51. DOI: 10.1016/j.jvs.2008.04.060

[3] Jammeh ML, Ohman JW, Reed NR, English SJ, Jim J, Geraghty PJ. Management of seat belt-type blunt abdominal aortic trauma and associated injuries in pediatric patients. Ann Vasc Surg. 2020;69:447.e9–447.e16. DOI: 10.1016/j.avsg.2020.07.024

[4] Norgren L, Hiatt WR, Dormandy JA, et al. TASC II Working Group. Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II). J Vasc Surg. 2007;45 Suppl S:S5–67. DOI: 10.1016/j.jvs.2006.12.037.

[5] Durán Muñoz-Cruzado VM, Pareja Ciuró F, Navarro Morales L. Trauma abdominal cerrad. In: Duran Muñóz-Cruzado VM, Pareja Ciuró F, Peñuela Arredondo, JD, editors. Manual de A lgoritmos para el M anejo del P aciente P olitraumatizado. Sevilla: QU24 Publicitat Estratègica; 2018. 46–55.

[6] Cline M, Cooper KJ, Khaja MS, Gandhi R, Bryce YC, Williams DM. Endovascular management of acute traumatic aortic injury. Tech Vasc Interv Radiol. 2018;21(3):131–6. DOI: 10.1053/j.tvir.2018.06.002

[7] Hosn MA, Nicholson R, Turek J, Sharp WJ, Pascarella L. Endovascular treatment of a traumatic thoracic aortic injury in an eight-year old patient: case report and review of literature. Ann Vasc Surg. 2017;39:292.e1–292.e4. DOI: 10.1016/j.avsg.2016.11.001

[8] Benz RM, Makaloski V, Brönnimann M, Mertineit N, von Tengg-Kobligk H. Diagnostik und therapie traumatischer aortenverletzungen [Diagnostics and treatment of traumatic aortic injuries]. Unfallchirurg. 2021;124(8):601–9. In German. DOI: 10.1007/s00113-021-01044-0

[9] Azizzadeh A, Keyhani K, Miller CC, et al. Blunt traumatic aortic injury: initial experience with endovascular repair. J Vasc Surg. 2009;49(6):1403–8. DOI: 10.1016/j.jvs.2009.02.234

[10] Freni L, Barbetta I, Mazzaccaro D, et al. Seat belt injuries of the abdominal aorta in adults—case report and literature review. Vasc Endovascular Surg. 2013;47(2):138–47. DOI: 10.1177/1538574412469446.

[11] Gouveia E, Melo R, Amorim P, et al. Clinical aspects and present challenges of the seat belt aorta. J Vasc Surg. 2020;72(3):995–1004. DOI: 10.1016/j.jvs.2019.11.038.

[12] Shalhub S, Starnes BW, Brenner ML, et al. Blunt abdominal aortic injury: a Western Trauma Association multicenter study. J Trauma Acute Care Surg 2014;77:879–85.

[13] Harris DG, Drucker CB, Brenner ML, Sarkar R, Narayan M, Crawford RS. Patterns and management of blunt abdominal aortic injury. Ann Vasc Surg. 2013;27:1074–80.

Images of Interest

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DOI: https://doi.org/10.26676/jevtm.20311

Endovascular Snaring of a Foreign Body

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Department of Cardiothoracic and Vascular Surgery, Örebro University Hospital, Sweden

Keyword: *Endovascular Techniques*

Received: 24 January 2024; Accepted: 31 January 2024

We present the case of a 79-year-old patient with critical ischemia who underwent percutaneous transluminal angioplasty (PTA) in his left external iliac artery with stent placement, as well as PTA in the superficial femoral artery (SFA) using crossover access through a retrograde puncture in his right femoral artery. At postoperative follow-up the patient complained of extertion-induced pain in his right lower leg and was referred for a computer tomography angiography (CTA). CTA revealed a foreign body resembling the remnant of a guide wire in the midsection of the SFA (Figure 1). To retrieve the foreign body we used an endovascular approach with a snare (AndraTec Exeter Snare ES-25) to catch the foreign body, which was then easily extracted through the 6 French introducer used for access via an antegrade puncture in the patient's right femoral artery (Figures 2–6).

Figure 1 CTA showing the foreign body in the midsection of the SFA.

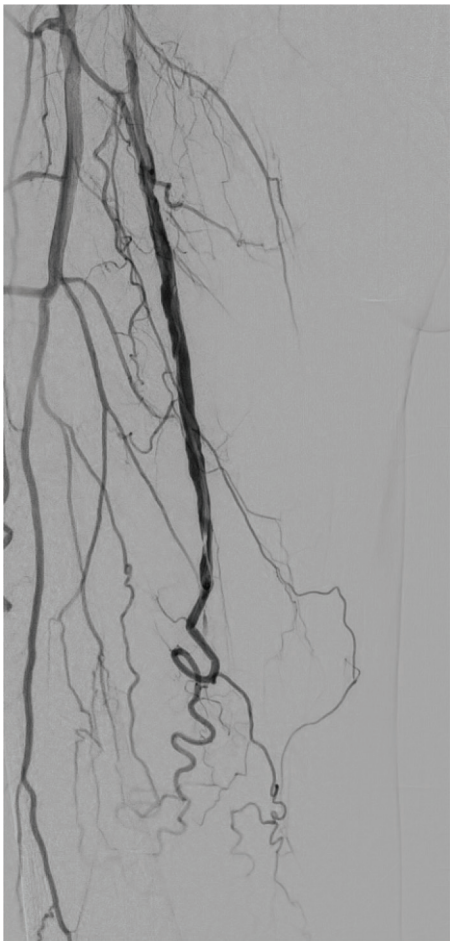

Figure 2 Angiography of the SFA with the foreign body.

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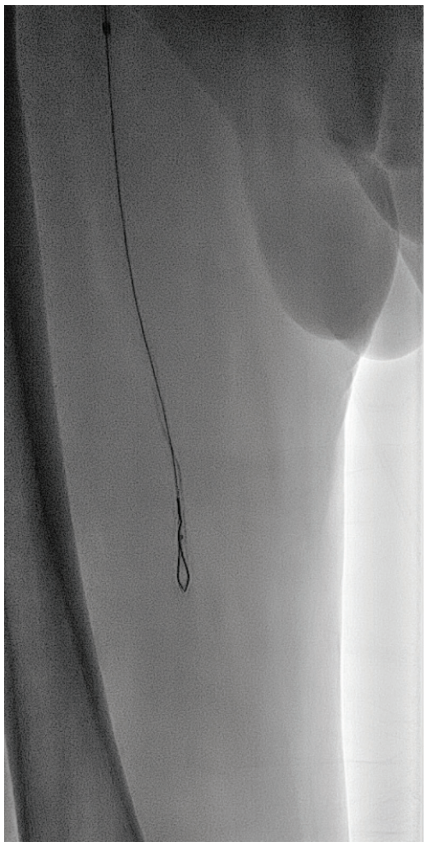

Figure 3 The snare advanced distal of the foreign body.

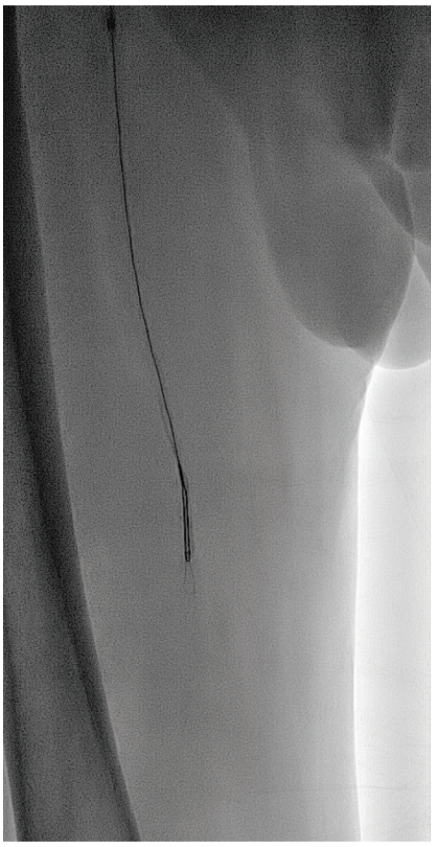

Figure 4 Snaring of the foreign body.

Figure 5 Final angiography after extraction of the foreign body.

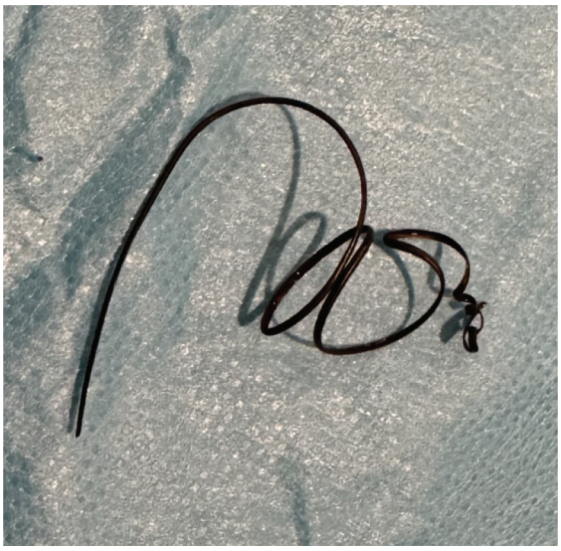

Figure 6 The extracted foreign body.

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 author declares that they have no conflicts of interest.

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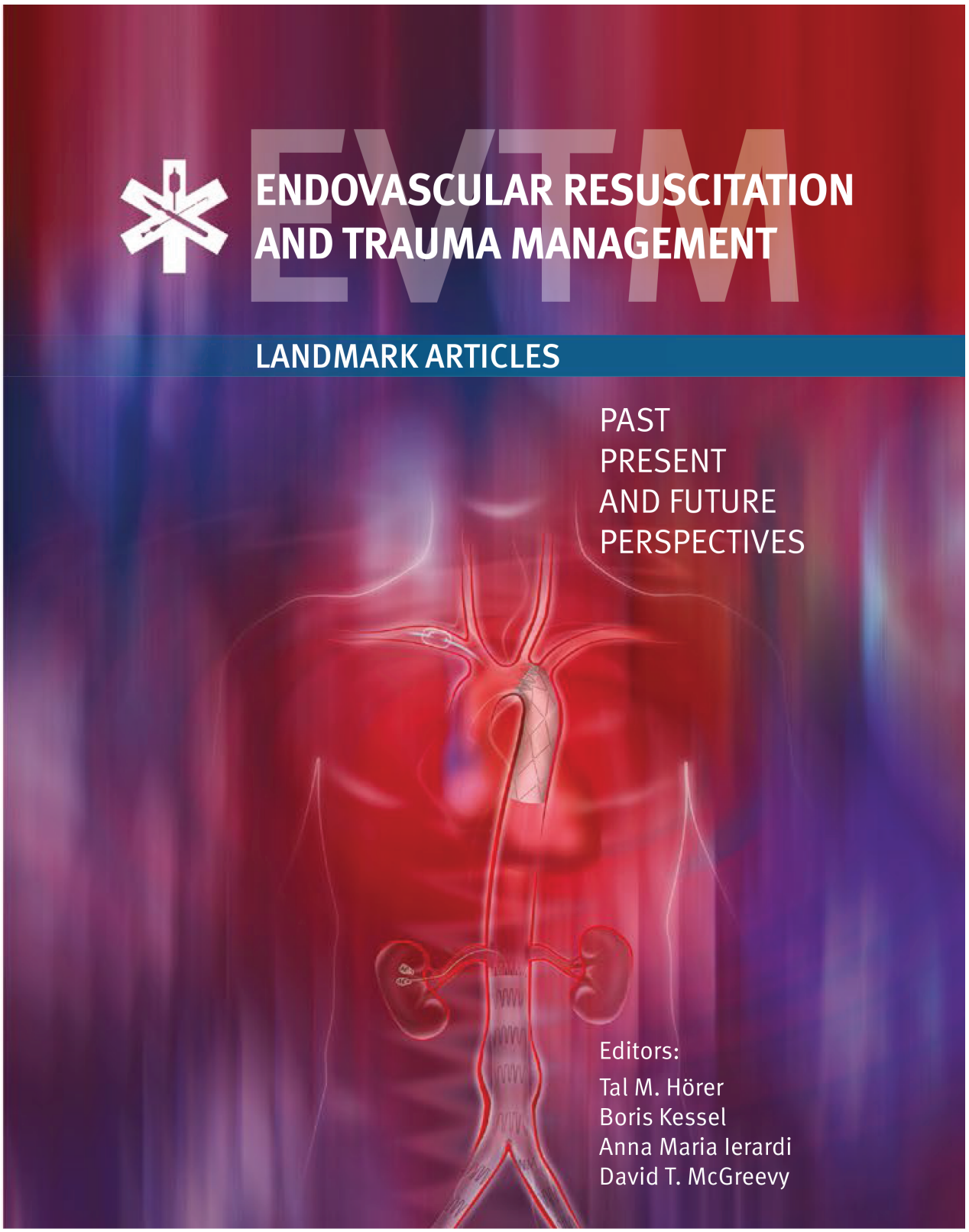
EVTM Landmark Articles



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

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

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

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Coming Meetings

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https://estes-congress.org/

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

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

EVTM Workshop 16th October 2024, Örebro, Sweden
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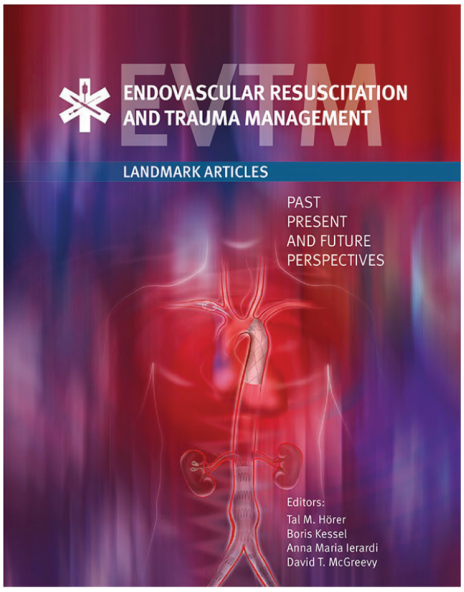

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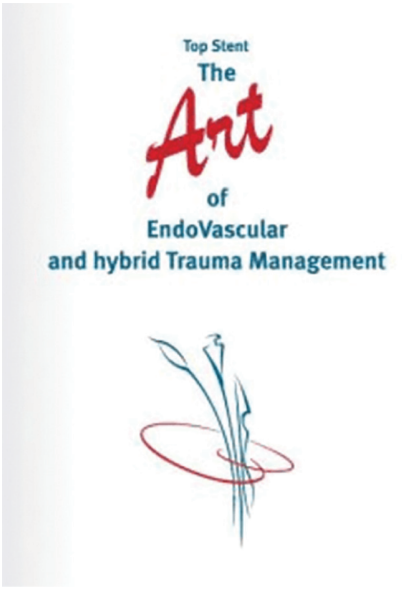

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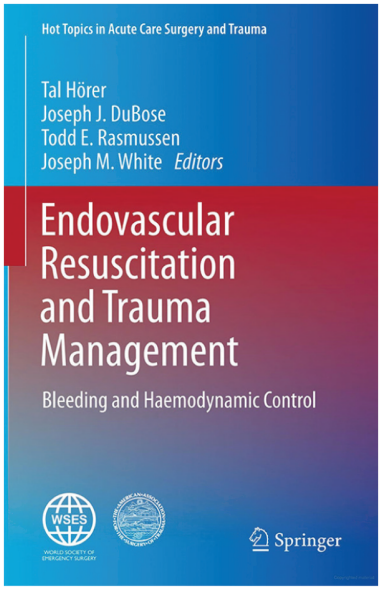

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EndoVascular resuscitation *and* Trauma Management (EVTM)

Hands-on Workshop

Örebro University Hospital, Sweden

EndoVascular Resuscitation and Trauma Management

EVTM instructors TBA

Local team: Tal Hörer, David McGreevy, Kristofer Nilsson, Artai Pirouzram

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

Date: TBA

Workshop Directors: Tal Hörer and David McGreevy

Workshop Registration: Lotta Ahlbertz lotta@mkon.se

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

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

Partners: TBA

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

The workshop is built on an individual, professional level and we will together explore different methods for resuscitation, bleeding control, hemostasis, trauma management and bail-outs. Some methods are used clinically world-wide, while some are under development and have been used on selected patients. This workshop concentrates on basic and advanced aspects

of *open and endovascular* bleeding control techniques. We will combine open hemostasis and endo aspects with vascular access, angiography, embolization, endografts, shunts and other endo/hybrid solutions for the unstable patient. Hemodynamic instability with a focus on trauma, non-trauma, bleeders and non-bleeders. From ruptures to gastrointestinal and gynecological bleeders with a wide range of hemodynamic instabilities in focus. We will explore how methods used by some disciplines can be used by others.

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

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

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

Region Örebro County
Örebro University Hospital

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

DATE
2024-01-30 **www.jevtm.com**

Program at the live tissue lab training and dry lab/cadaver lab.

Day 1:

The day starts at 12:00 with <u>Lunch at the training facilities</u> at Örebro University Hospital, Sweden.

Bleeding control issues; hemostasis; the hemodynamic unstable patients. Short presentations on vascular access, how to, complications, indications for REBOA (pREBOA, iREBOA), Abdominal compartment and complications. Endografts, embolization, choosing correct products etc. Data regarding EVTM will be presented. Different hemodynamic instabilities will be discussed as GI bleeding, trauma, Gyn, rAAA and others. Basic and advanced techniques for diagnostic and treatment of hemodynamic instability. Methods to use endografts, embolization agents, balloons and other tools will be presented and discussed. When open surgery is the best option and when not to play endo. Tips and tricks, bailouts.

Day 2:

07:00 Gathering/changing at the Training Center

07:15–08:40 "EVTM hands-on review – what can we do?" (Cadaver)
(Preliminary – if available, to be announced the day before)

08:40–09:30 Breakfast with the industry.

Hands-on animal lab including:

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

Practical training points in the animal lab:

1. Material usage in bleeding patients, general considerations and management scenarios
2. Open techniques for bleeding control/hemostasis and combinations with endo/hybrid.
3. Vascular access
    - Basic principles/advanced methods
    - Cut-down techniques
    - Endoshunts and shunts
    - Hybrid procedures
    - Puncture methods
    - Seldinger technique
    - The failing access – alternatives
    - Venous access and ultrasound
    - Basic and advanced methods
4. Upgrading/introducers/guide wires
5. REBOA

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- Material and REBOA kit
- Deflation and re-positioning
- Intermittent/partial inflation (MAP as target – iREBOA/pREBOA)
- Ongoing bleeding practice
- CPR procedures and pending arrest

6. Balloon in alternate locations (Iliac, Subclavian, Brachiocephalic trunk/Zone 1 neck)
7. Hybrid procedures for hemostasis – junctional bleedings, balloons/xchange
8. Aortography and angiography considerations (type, volume, etc.)
9. Endografts/embolization advanced as needed – what, when, how
10. Junctional bleedings- solutions
11. Bailouts in endovascular and hybrid surgery

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

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

Email us for interest and follow www.jevtm.com and social media for details

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More info at www.jevtm.com/workshop and social media #EVTM

9th EVTM Symposium

HOT TOPICS in EndoVascular resuscitation and Trauma Management

Symposium chairs:
Charles Fox (US), Boris Kessel (IL), Anna Maria Ierardi (IT)

Scientific committee:
Boris Kessel (IL), Frank Plani (ZA), Eugene Moore (US), Artai Pirouzram (SE), David McGreevy (SE), Kristofer Nilsson (SE), Chuck Fox (US), Anna Maria Ierardi (IT), Federico Coccolini (IT), Maria Antonella Ruffino (CH), Pirkka Vikatmaa (FI), Stacy Plotkin (US), Alon Schwartz (IL), Tal Hörer (SE)

Preliminary program – not confirmed yet/TBA

Local organizing committee:
Tal Hörer, David McGreevy

Thursday October 17th	
07.00	**Registration opens / Coffee and industry exhibition**
	Opening session: EVTM in modern bleeding care **Current international trends and developments** 6 min talk + 4 min discussions **Chairs**: Anna Maria Ierardi (IT) and Chuck Fox (US) **Panelists:** Frank Plani (ZA), Hayato Kurihara (IT), Eugene Moore (US), Anahita Dua (US) TBA, Rebecka Hultgren (SE)
07.45	Opening remarks – Boris Kessel (IL) and Chuck Fox (US)
08.00	**Keynote lecture** – Decreasing Time to Hemostasis in a Trauma Hybrid OR – Laura Moore (US)
08.20	EVTM – Worldwide practice updates in trauma and non-trauma – Tal Hörer (SE)
08.30	EVTM – Endovascular and hybrid management in trauma USA today – Pedro Teixera (US)
08.40	Endovascular resuscitation in Japan. Experience and Current trends – Yousuke Matsumura (JP)
08.50	Can we do better with bleeding care in Europe? – Hayato Kurihara (IT)
09.00	South African experience and trends in bleeding care. Where do we stand? Can endo help us? – Frank Plani (ZA)
09.10	Current trends in interventional radiology for bleeding control, what's new and what's coming? – Anna Maria Ierardi (IT)
09.20	Current developments in emergent vascular surgery. Where do we stand? – Greg Magee (US)
	Session 2: Endo and hybrid tools and techniques for bleeding trauma patients **What to use, when and how** 6 min talk + 4 min discussion **Chairs**: Greg Magee (US), George Oosthuizen (ZA), Erica Mitchell (US) **Panelists:** Pedro Teixeira (US), Artai Pirouzram (SE), Junichi Mastumoto (JP), Sheldon Teperman (US), KJ Nagarsheth (US)
09.40	Past, present and future techniques for open, endo and hybrid hemorrhage control. How, when and what to use? – Eugene Moore (US)
09.50	Extremity trauma: Is it still only open surgery? – Chuck Fox (US)
10.00	Visceral bleeding: When to choose endo or hybrid surgery? Endografts/Colis and more – Pedro Teixeira (US)
10.10	Embolization in trauma – When and how to do it? How to choose and use? – Maria Antonella Ruffino (IT)
10.20	Hybrid techniques in trauma, the Baltimore Shock Trauma experience of EVTM – KJ Nagarsheth (US)
10.30	Endografts for visceral and peripheral bleeders – How to choose, how to use and what to know? – Greg Magee (US)
10.40	Best Current Management Of Pediatric Vascular Injuries: When Conservative; When Open; When Endo? – Elina Quiroga (US)
10.50	**Coffee and industry exhibition**
	Session 3: Advancements for bleeding patients (trauma and non-trauma) and technological developments 6 min talk + 4 min discussion **Chairs**: E Moore (US), Rishi Kundi (US), Anna Romagnoli (US) **Panelists:** George Oosthuizen (ZA), Mario D'oria (IT), Alon Shwartz (IL), Rishi Kundi (US), Elina Quiroga (US)
11.10	What is new and different in bleeding care 2024? From pre-hospital to the ICU in Shock & Trauma Baltimore – Jonny Morrison (US)
11.20	What is new in imaging for bleeding patients? CT, Hybrid suites and more – Anna Maria Ierardi (IT)
11.30	Hybrid / Semi-hybrid rooms: Where and who should have them, what to invest in and how to use them? – Rishi Kundi (US)
11.40	REBOVC (Vena Cava Balloon) in Juxtahepatic Venous bleeding. Experimental data and can it be used? Maria Wikström (SE)
11.50	Non-traumatic visceral bleeding and endo management (coils? Endografts?) – When and how? – Anahita Dua (US)
12.00	OB-GYN bleeding and endo tools – what, when and how? What to use? – Maria Antonella Ruffino (IT)
12.10	When to take the patient to CT (or CT to the patient) and when not? Semi and unstable patients? – Erica Mitchell (US)
12.20	CT-first resuscitation protocol for severe trauma in hybrid ER – Satomi Seno (JP)
	Session 4: Education of the future trauma and vascular surgeon **Joint session with the European Society for Trauma & Emergency Surgery (ESTES)** 6 min talk + 4 min discussion **Chairs**: Hayato Kurihara (IT), Joakim Jorgensen (NR), Carl Montan (SE) **Panelists:** Anna Romagnoli (US), Paul Puchwein (AT), Anahita Dua (US), Joao Sahagoff (BR)
12.30	What have we learnt in trauma and education? Team up with the vascular people? My view – Joakim Jorgensen (NO)
12.40	Do we need vascular surgeons for traumatic bleeders? How to team up and educate? – Carl Montán (SE)
12.50	Vascular surgeons should be educated in trauma and vice versa? How to build good collaboration? – TBA

13.00	Abdominal compartment syndrome? How not to miss it? How to follow, treat and educate? – Boris Kessel (IL)
13.10	Local Anesthesia in bleeders? Educational/team issues – TBA
13.20	Vascular trauma open and endo aspects in modern times – how do we educate future surgeons? – Juan Duchesne (US)
13.30	Beyond blood – Mansoor Khan (UK)
13.40	Specialists in Training corner – Intersociety collaboration to promote education? Y-ESTES and EVTM-ST – Gabriele Bellio (IT)
13.50	**Lunch**
Session 5: Debate session: Endo vs. Open 6 min talk + 4 min discussion **Chairs**: David McGreevy (SE) and Stacy Plotkin (US) **Panelists:** TBA	
14.30	Debate: The bleeding femoral access – You should always OPEN IT! (Call Anesthesia!) – Stacy Plotkin (US)
14.40	Debate: The bleeding femoral access – We'll fix it with ENDO (Local Anesthesia!) – Artai Pirouzram (SE)
14.50	Debate: Revascularization Should PRECEDE External Bone Fixation – Erica Mitchell (US)
15.00	Debate: Revascularization Should FOLLOW External Bone Fixation – Paul Puchwein (AT)
15.10	Debate: REBOA is an IMPORTANT tool for unstable bleeding patients – David McGreevy (SE)
15.20	Debate: No REBOA, OPEN SURGERY is the way to go! – Daniel Shefer (IL)
Session 6: Hot topics in thoracic endovascular resuscitation: The trauma patient from imaging to treatment 6 min talk + 4 min discussion **Chairs**: Pedro Teixeira (US), Manuel Garcia-Toca (US) and Zoran Rancic (AT) **Panelists:** Ozcan Gur (TR), Erica Mitchell (US), TBA	
15.30	SVS Blunt Thoracic Aortic Injury Guidelines – how should we treat these patients? – Pedro Teixera (US)
15.40	Endografts for thoracic aortic bleeders (dissection, rupture, trauma) – What to use and when? – Zoran Rancic (CH)
15.50	Blunt thoracic aortic injury trends, how to treat and data from the Aorta Trauma Foundation – David McGreevy (SE)
16.00	Axillo-subclavian trauma and iatrogenic injuries – is endo the solution? World collected data – Mario D'oria (IT)
16.10	BTAI In Pediatric Patients: When Should They Undergo Invasive Treatment: When Endo, When Open? – Elina Quiroga (US)
16.20	Prediction of mortality in Blunt Thoracic Aortic Injury – Mario D'oria (IT)
16.30	Acute Thoracic Aortic Pseudocoarctation after Blunt Thoracic Aortic Injury – Erica Mitchell (US)
16.40	**Coffee and industry exhibition**
Session 7: The non-trauma patient; Tools, techniques, and results From pre-hospital to ICU 6 min talk + 4 min discussion **Chairs**: Lionel Laumhaut (FR), Paul Puchwein (AT) and Marius Rehn (NR) **Panelists:** Jonny Morrison (US), TBA	
17.00	eCPR – current status and future aspects – Marius Rehn (NO)
17.10	VA ECMO in the management of trauma associated cardiogenic shock– Chris Bishop (UK)
17.20	Pre-hospital ECMO cannulation – practical aspects and limitations – Lionel Laumhaut (FR)
17.30	REBOA/balloons in OncoVascular Surgery? – Joao Sahagoff (BR)
17.40	Pre-hospital REBOA in cardiac arrest/eCPR? Value, limitations and future aspects – Lionel Laumhaut (FR)
17.50	Intestinal ischemia after endovascular resuscitation – Bjørn Farbu (NO)
18.00	Cardiac arrest and REBOA? Experimental data and future aspects – Emanuel Dogan (SE)
18.10	TBA
18.20	**Get Together Party – With light meal and more**

Friday October 18th	
07.15	**Coffee / Industry Exhibitors**
Session 8: Hot topics in acute vascular surgery –Endografts and more Joint session with the European Society for Vascular Surgery (ESVS) 6 min talk + 4 min discussion **Chairs**: Pirkka Vikatmaa (FI), Rebecka Hultgren (SE) **Panelists:** Zoran Rancic (CH) & TBA	
08.00	Is EVAR/TEVAR taking over ruptures? – Rebecka Hultgren (SE)
08.10	100% EVAR in all infrarenal rAAA – a single center 15 year experience – David McGreevy (SE)
08.20	Thoracoabdominal ruptures, what can be done and when? – Artai Pirouzram (SE)
08.30	Acute vascular access: How to do it and how to avoid complications? – Zoran Rancic (CH)
08.40	Technical and post-op aspects in ruptures, what can we learn for other bleeding patients? – Pirkka Vikatmaa (FI)
08.50	Endografts for iatrogenic access bleeding – how to deal with access complications? – Shahram Aarabi (US)
09.00	Endovascular treatment or open surgery in thoracic aortic trauma. Overview, what to do and when? – Ozcan Gur (TR)
09.10	EVTM-Specialists in Training corner: Late rupture after EVAR, single center data – Rami Hammadi (SE)

Session 9: The great debate on REBOA/Endo in trauma and non-trauma **Joint session with the World Society of Emergency Surgery (WSES)** 6 min talk + 4 min discussion **Chair**: Ernest Moore (US) and Boris Kessel (IL) **Panelists:** Federico Coccolini (IT), Fausto Catena (IT) & TBA	
09.20	Liver trauma – Endo/open/hybrid aspects – Ernest Moore (US)
09.30	Splenic trauma – Endo/open/hybrid aspects – Fausto Catena (IT)
09.40	Pelvic trauma – Endo/open/hybrid aspects – Federico Coccolini (IT)
09.50	Pancreatic trauma – Endo/open/hybrid aspects – Enrico Cicuttin (IT)
10.00	Kidney and ureter trauma – Frank Plani (ZA)
10.10	Liver and pelvic trauma – Damage control surgery? – Kristina Doklestić Vasiljev (SR)
10.20	Specialists in Training corner – TBA
10.30	**Coffee and industry exhibition**
Session 10: Modern trauma care including EVTM methods and mass casualty issues **Joint session with the Israeli Trauma Society** 6 min talk + 4 min discussion **Chairs**: Allon Scwartz (IL) and Gad Shaked (IL) **Panelists:** Joakim Jorgensen (NO), Juan Duchesne (US), Chuck Fox (US), George Oosthuizen (ZA), Joao Sahagoff (BR), Sheldon Teperman (US) TBA	
10.40	Hybrid approach for ileac artery stab wound – Ori Yaslowitz (IL)
10.50	Surgical Department experience on October 7th attack in Israel – Morris Batumsky (IL)
11.00	Balloon occlusion of inferior vena cava – Where we are? – Nimrod Aviran (IL)
11.10	We sure could use REBOA – Itay Zoarets (IL)
11.20	A single trauma center experience with Mega Multiple Casualties Incident – Yulia Elobra (IL)
11.30	Vascular injuries in Mega Multiple Casualties Incident – Dimitry Shapovalov (IL)
11.40	REBOA in severe brain injury: fatal combination or treatment alternative? – Ron Daskal (IL)
11.50	Rare complications in abdominal trauma – case and discussion – Guy Golani (IL)
12.00	Surgical education during armed conflict – educational aspects and more – Daniel Shefer (IL)
Session 11: Registry data, experimental studies and developments within EVTM 6 min talk + 4 min discussion **Charis**: Kristofer Nilsson (SE), Carl M Wahlgren (SE) **Panelists:** Sam Sadek (UK), Maria Wikström (SE), Jostein Brede (NO), Marius Rehn, TBA	
12.10	ESVS new Vascular Trauma Guidelines – Carl M Wahlgren (SE)
12.20	Details from the UK-REBOA Trial – what does it actually show? What can we learn? – Sam Sadek (UK)
12.30	PROOVIT trauma vascular registry – what does the data from USA say? More endo? – Rishi Kundi (US)
12.40	Time to (endo) bleeding control is important. Data – Anna Romagnoli (US)
12.50	ERICA ARREST study – Hutchinson Halden (UK)
13.00	Specialists in Training corner – Nitric Oxide (NO)-donator in ischemia – Anna Stene Hurtsén (SE)
13.10	**Lunch**
Session 12: Hot topics in anesthesia and critical care with EVTM aspects **New developments** 6 min talk + 4 min discussion **Chairs**: Peter Hilbert-Carius (DE), Marius Rehn (NR), Juan Duchesne (US) **Panelists:** Lars Helsten, TBA	
14.00	A trauma surgeons view of an unstable patient, decision making and the anesthetic team collaboration – George Oosthuizen (ZA)
14.10	An anesthesiologist's view of an unstable patient – Physiology aspects and strategies – Kristofer Nilsson (SE)
14.20	RIBCAP-HEMS project – Axel Großstück (DE)
14.30	TBA
14.40	REBOA ARREST trial – Jostein Brede (NO)
14.50	Pre-clinical hypovolemia research – Lars Øyvind Høiseth (NO)
Session 13: EVTM rising technologies: Imaging, devices, endografts and more 6 min talk + 4 min discussion **Chairs**: Yousuke Matsumura (JP), Junichi Matsumoto (JP) and Rebecka Hultgren (SE) **Panelists:** Shahram Aarabi (US), Anna Romagnoli (US), Anahita Dua (US)	
15.10	CTA – what is out there and what is new? Hybrid suite, ER and more – Junichi Matsumoto (JP)
15.20	Ultrasound – Can we see better, when to use it and for what? – Maria Antonella Ruffino (IT)
15.30	New endografts on the market and coming soon (US and EU) – Greg McGee (US)
15.40	New Embolization agents – what is on the market and what is coming? – Anna Maria Ileradi (IT)
15.50	REBOA – what is on the market? Future? – Rishi Kundi (US)
16.00	Hybrid ER, RAPTOR and implementing these technologies – experience, what about the limitations? – Pirkka Vikatmaa (FI)
16.10	**Coffee and industry exhibition**

Session 14: EVTM and interventional radiology – Bleeding control, embolization agents, new technologies. What to use and when for bleeding control? **Chairs:** Anna Maria Ierardi (IT) and Maria Antonella Ruffino (IT) **Panelists**: Mario D'Oria, TBA	
16.30	Surgeon, anesthesiologist, radiologist, emergency doctor: who does what – Hayato Kurihara (IT)
16.40	IR team: The prompt activation in the management of emergency bleeding – Jan Raupach or Hradec Kralove (CZ)
16.50	Hybrid room: what has changed in the endovascular approach for bleeding control? – Tal Hörer (SE) / TBA
17.00	EVTM: What can IR do? Procedures and techniques – Nikolaos Galanakis (GR)
17.10	Post Partum Hemorrhage – how to save the uterus – Francesco Giurazza (IT)
17.20	Pediatric hemorrhagic patients: logistics, approaches, precautions – Franchi Abella (FR) or Alex Bernacle (UK) TBA
17.30 – 18.45	**Session 15: EVTM Society meeting (open to all)** Hosted by Boris Kessel (IL), Chuck Fox (US)
19.30	**Symposium Dinner – Place TBA**

Saturday October 19th	
08.00	**Coffee and Industry Exhibition**
	Session 16: Ruptures: endo, open and hybrid aspects 6 min talk + 4 min discussion **Chairs:** **Panelists:**
08.30	What graft to use in ruptures AAA? Options? Technical aspects TBA
08.40	What graft to use in ruptured Thoracic AA? Options? Technical aspects TBA
08.50	Adjunct techniques in ruptures: Viceral endografts and Technical aspects TBA
09.00	Adjunct techniques in ruptures: Coils and embolisation agents, what can be used to prevent endoleaks? TBA
09.10	Post-operative aspects of the ruptured patient and ICU care TBA
09.20	Local anesthesia in rAAA? Hemodynamic unstable? When? How? Results TBA
09.30	Abdominal compartment in the ICU – what, when and how to decompress? Khatereh Djavani Gidlund (SE)
	Session 17: Trauma and vascular controversies. New civilian and military developments in bleeding control 6 min talk + 4 min discussion **Chairs**: Kristina Doklestić Vasiljev (SR), Mansoor Khan (UK) **Panelists:** George Oosthuizen (ZA), Laura Moore (UK), Sheldon Teperman (US), Shahram Aarabi (US)
09.40	New developments in bleeding care in the pre-hospital and emergency room settings ED viewpoint – TBA
09.50	EVTM integrated in trauma service reduces time to hemostasis? – Jonny Morrison (US)
10.00	Integrating Endo and hybrid for trauma patients in Shock and Trauma Baltimore – Anna Romagnoli (US)
10.10	Vascular injuries – any place for endo in modern trauma/war injuries? – Sami Nitezki (IL)
10.20	Vascular trauma and use of shunts – data and cases from Ukraine – Yulia Nahaliuk (UA)
10.30	Vascular injuries in the current conflict Israel – Viktor Bilman (IL)
10.40	Open and endo in war injuries, changes over time and modern decision making – George Greenberg (IL)
10.50	**Coffee and Industry Exhibition**
	Session 18: From pre-hospital and austere environment to the ICU 6 min talk + 4 min discussion **Chairs:** Frank Plani (ZA), Chuck Fox (US), Chance Spalding (US) **Panelists:** Adenauer Goes (BR), Sami Nitezki (IL), George Greenberg (IL) TBA
11.10	Developing a Helipad to THOR Process – Laura Moore (US)
11.20	How to do vascular access in pre-hospital settings? – Hutch/ Chris Bishop (UK)
11.30	Current use of REBOA in pre-hospital and military settings – Chance Spalding (US)
11.40	Vascular damage control in limited resources environment: reports from Amazon – Adenauer Goes (BR)
11.50	Tips and tricks , shunts and more in vascular trauma – Shahram A (US)
12.00	Tips and tricks in bleeding patients and what to think of in the ICU – Sheldon Teperman (US)
12.10	Endovascular management of high grade TBAI and Axilosubclavian injuries – practical tips and tricks – Manuel Garcia-Toca (US)
12.20	EVTM-Specialists in Training corner/abstract TBA
12.30	Closing remarks, JEVTM and more – Tal Hörer (SE)
12.40 Grab and go lunch	

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28-30 April 2024

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