JEVTM
Journal of ENDOVASCULAR RESUSCITATION and Trauma Management
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Issue Highlights

Permissive hypotension or Permissive haemorrhage for trauma?
Damage control strategies for vascular trauma
Endovascular management of aorta-duodenal fistula
REBOA to avoid delays to definitive care
Embolisation of liver bleeders
Validity of Mangled Extremity Severity Score (MESS) system
And more...

Official publication of the Society of Endovascular Resuscitation and Trauma Management

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Journal of Endovascular Resuscitation and Trauma Management

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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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Author Guidelines

GUIDELINES FOR SUBMISSION

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

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

The submission process requires three discreet documents:

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

Please ensure that names and contact details are included for **all** authors of a manuscript 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 can be found below on the publication ethics of the JEVTM.
6. A clear statement that the authors follow the ethical guidelines as stated in the ethical section of the JEVTM.

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. A full address is not required, but enough to ensure identification.
- Corresponding Author: This individual should be clearly identified, along with full institutional address and e-mail 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 a negative statement should be included.
- Author Contributions (Optional): All authors are expected to have substantially contributed to the study and manuscript writing.

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.

Types of Article

Original Articles
Manuscripts reporting unique scientific studies should be no longer than 3000 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.

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. They will not contain an abstract or keywords.

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

Articles should be a maximum of 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.

Systematic 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.

Submission should be a maximum of 5000 words and authors should include a PRISMA checklist in their submission. The overall aim is to provide a pooled analysis that enables firm conclusions to be drawn on a particular subject.

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 or 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.

The submission should be a maximum of 1500 words. The abstract should be unstructured and be a maximum of 150 words.

Images of Interest
The Journal accepts images of interest, which include 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 submission should be a maximum of 250 words. They will not contain an abstract.

Case Reports
These are short case reports including current literature reviews. The submission should be a maximum of 1500 words. An abstract can be included 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.

Letters to the Editor
Letters for publication can be written to the Editor that comment on anything within the Journal.

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 but is not compulsory.

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].

An example article:

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.

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(*Continued*)

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.

Figure/Tables

All figures/tables must be cited within the text, presented as Figure 1, Figure 2*a,b*, Figures 1 and 2, 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), which does not necessarily need inclusion 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.

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.

ETHICAL AND LEGAL CONSIDERATIONS

The Journal is committed to maintaining the highest level of integrity in the content published. This Journal has a Conflict of Interest policy in place and complies with international, national and/or institutional standards on research involving Human Participants and/or Animals 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 may use plagiarism detection software to screen the submissions. If plagiarism is identified, the COPE guidelines on plagiarism will be followed. Content published in this Journal is peer reviewed (double blind review process). Detailed information will follow in the text below.

Authors' Responsiblities

A submitted manuscript must be an original contribution not previously published (except as an abstract and should be indicated); cannot be under consideration for publication in other journals; and, if accepted, must not be published or reproduced elsewhere. 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

(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.

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 original and should not have been published elsewhere in any form or language (partially or in full), unless the new work concerns an expansion of previous 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 are 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) are used for verbatim copying of material, and permissions secured for material that is copyrighted.
- Authors should avoid untrue statements about an entity (who 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.

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 under their given e-mail address and given an opportunity to address the issue. Depending on the situation, this may result in the Journal's and/or Publisher's implementation of the following measures, including, but not limited to:

- If the manuscript is still under consideration, it may be rejected and returned to the author.
- If the article has already been published online, depending on the nature and severity of the infraction:
  - 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.

Editors' Responsibilities

The Editors of 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

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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.

Patient Anonymity and Informed Consent

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/forprofessionals/special-topics/research/index.html). Authors should mask patient's eyes and always remove patient names from figures as well as genital organs as far as possible.

Protection of Human Subjects & 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 animals 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
Ethical approval to report these cases was given by XXXXX. Written informed consent was obtained from xxxx.

Or in the negative

Ethical Approval and Informed Consent
Ethical approval was not required. Informed consent was not possible because XXXX and the information has been anonymised 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. Authors should identify Individuals who provide writing assistance and disclose the funding source for this assistance.

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.

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).

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

8th EVTM Symposium

October 3rd-5th 2024 in Örebro, Sweden

HOT TOPICS in EndoVascular resuscitation and Trauma Management

ENDOVASCULAR RESUSCITATION and TRAUMA MANAGEMENT

Declaration from the JEVTM Editors

A while ago, we published in the JEVTM our support for the people of Ukraine in their suffering due to the war imposed by Russia.

There are no words to describe the horrible atrocities committed against the Israeli people on 7th October 2023. The editors of Journal of EndoVascular resuscitation and Trauma Management strongly condemn this act of terror against Israel. We strongly condemn any antisemitic actions and urge universities and medical institution worldwide to take action against it.

JEVTM will continue to work for collaboration and science, to help, defend and improve rights and health of all human beings. We will continue to help people in need, regardless of religion or any other factors, and continue to do good for our patients worldwide. Our thoughts are with the people suffering from the ongoing conflict. Along with medical professionals from all over the world, we support all acts promoting help to people suffering injuries on all sides following our obligations under our Hippocratic Oath.

Contents

Editorial

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Permissive Hypotension and Permissive Haemorrhage – Are They Necessary Evils of Trauma?

Kessel–Khan Corner

Mansoor Khan[1] and Boris Kessel[2]

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Permissive hypotension is a medical strategy that involves intentionally maintaining lower-than-normal blood pressure in certain situations, typically during the initial resuscitation until achieving definitive haemostasis. This approach aims to prevent further bleeding and tissue damage by reducing blood flow to injured areas. In cases of severe trauma, such as major haemorrhage or penetrating injuries, maintaining normal blood pressure may increase bleeding and worsen the patient's condition. By allowing blood pressure to remain lower than usual (around 80–90 mmHg), permissive hypotension helps limit blood loss and preserve the body's ability to form blood clots, which can aid in controlling bleeding.

The adequate target blood pressure for permissive hypotension can vary depending on the specific situation and the patient's conditions, and especially when severe head injury is suspected/diagnosed. Once the patient is stabilized and definitive treatment options, such as surgery or embolization, are immediately available, blood pressure is often gradually increased to more normo-physiological levels.

One of the most promising advancements in modern trauma resuscitation is resuscitative endovascular balloon occlusion of the aorta (REBOA). This technique is a significantly less traumatic procedure than any open aortic clamping. Moreover, use of intermittent or partial REBOA allows reasonable blood pressure to be maintained for a much longer time than open closure. Nevertheless, the team who decide to perform partial REBOA should realize that this approach may cause arterial rebleeding in some cases. In our Corner, we have decided to define this phenomenon as "permissive haemorrhage" and have opened a discussion on how this terminology may be implemented into our trauma practice.

Permissive hypotension and "permissive haemorrhage" can help to preserve blood. Blood is a precious resource, and it can be difficult to obtain in large quantities, especially in austere or limited resource areas. By allowing patients to bleed for a short period of time, it is possible to save blood for later use. In addition, permissive hypotension and "permissive haemorrhage" can help to reduce the risk of complications. Complications, such as rebleeding due to clot disruption, can occur in patients with major trauma who have a high blood pressure, when haemorrhagic control has not been achieved . The adage of the first clot being your best clot remains. Prompt and effective bleeding control is essential to prevent further injury and promote healing. However, "permissive haemorrhage" allows limited blood flow to occur to end organs to aid perfusion, without which irreversible ischaemia and damage may occur.

Nevertheless, there are also some potential risks associated with permissive hypotension and "permissive haemorrhage". First, it is important to ensure that the patient's blood pressure does not drop too low. Such events may lead to irreversible organ tissue damage and death. Second, permissive hypotension and "permissive haemorrhage" can make it more difficult to control bleeding, which can be fatal.

Overall, the benefits and risks of permissive hypotension and "permissive haemorrhage" need to be carefully considered on a case-by-case basis. In some cases, the benefits may outweigh the risks, while in other

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cases the risks may outweigh the benefits. Therefore, it is crucial to consider the risk/benefit ratio during the decision-making process. We believe future clinical research will better define the types of patient who would benefit from the use of permissive hypotension and/or permissive haemorrhage.

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.

Funding

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Original Article

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Validity of Mangled Extremity Score System to Predict Limb Salvage on Cases of Traumatic Popliteal Artery Injuries: A Case Series and Review of the Literature

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Background: Popliteal artery injuries carry a risk of amputation rate ranging from 9.7% to 28%. The mangled extremity score system (MESS) was originally authenticated in only 26 patients and it was concluded that an MESS ≥ 7 equated to a 100% rate of amputation. In this study we add the effects of combined arterial venous injuries and combined arterial venous and nerve injuries to the risk of amputation and correlate them with the MESS.

Methods: This is a retrospective single arm cohort study conducted using 25 patients included between 1 January 2020 and 1 January 2023 at two hospitals, Ain Shams University Hospital and Shebin Elkoom Teaching Hospital. The study defined two groups: the amputation and non-amputation groups. It assessed the validity of the MESS to predict limb salvage in cases of traumatic popliteal artery injuries.

Results: The overall rate of amputation was 64%. Patients presenting with MESS ≥ 8 had an amputation rate of 25%, while patients with MESS ≥ 9 had an amputation rate of 75%. Patients presenting with combined popliteal artery and vein or combined artery, vein and nerve injury had a 100% rate of amputation (MESS ≥ 8). There was no 30-day mortality.

Conclusions: MESS ≥ 9 carries a high risk of amputation (75%). Combined arterial and venous injuries or arterial, venous and nerve injuries, which already have a high MESS, also carry a high risk of amputation. All of them could be predictors of limb salvage in popliteal artery injury.

Keywords: *Popliteal Artery Injury; MESS; Mangled Score*

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INTRODUCTION

Lower extremity arterial injury may result in limb loss after blunt or penetrating trauma. Popliteal vessel injuries, in particular, remain uncommon accounting for 0.2% of all traumas and lead to amputation rates ranging from 9.7% to 28% [1]. Blunt mechanism and concomitant injuries, such as fractures and knee dislocations, as well as severe soft tissue damage, lead to a significantly higher rate of amputation compared to penetrating trauma [2]. Fractures around the knee result in vascular injuries in about 3% of all cases. However, the incidence of vascular events is about 16% when posterior knee dislocation is present [3]. Traffic accidents (injuries related to motor vehicle and motorcycle accidents) and sports activities (skiing, football) are the

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main reasons for knee injuries associated with posterior knee joint dislocation [4]. Falls from height are the second most common cause of knee dislocations [5]. Up to one-third of patients with popliteal artery trauma undergo amputation, resulting in a negative impact on their quality of life. Phantom limb pain is reported in up to 76% of patients, chronic back pain in 42.1%, residual limb pain in 62.9%, prosthesis-related skin problems in 58% and depression in 24% [6]. Some patients may undergo serial attempts at revascularization after injury but may opt (or be forced) to have an amputation later if appropriate healing does not occur. Therefore, patient selection for revascularization attempts is of paramount importance to ensure the optimum outcome in this patient population. Predictive factors of limb outcome are vital in determining which patients are suitable candidates for revascularization [6]. Predictive scoring systems, primarily created in the 1980s and early 1990s, have proved invalid. The mangled extremity score system (MESS) is calculated by undertaking a subjective review of soft tissue damage, limb ischemia, shock and age revascularization [7]. This system was originally authenticated in a small study with only 26 patients that concluded that an MESS greater than 7 equated to a 100% rate of amputation revascularization [7]. In this study we added the effects of combined arterial venous injuries and combined arterial venous and nerve injuries to the risk of amputation and correlated them with the MESS.

METHODS

Study Population

This is a retrospective single arm cohort study conducted using 25 patients included between 1 January 2020 and 1 January 2023 at two hospitals, Ain Shams University Hospital and Shebin Elkoom Teaching Hospital. Patients had popliteal artery injuries with different modality of trauma. The study defined two groups, the amputation and non-amputation groups, and assessed the validity of the MESS to predict limb salvage in cases of traumatic popliteal artery injuries. We also added the effects of combined arterial venous injuries and combined arterial venous and nerve injuries to the risk of amputation and correlated them with the MESS.

Injury Mechanisms

Injury mechanisms included those that were: low energy (stab, gunshot, simple fracture); medium energy (dislocation, open/multiple fractures); high energy (high speed motor car accident or rifle shot); and very high energy (high speed trauma with gross contamination). All cases were operated on (see technical repair below) by two consultants, the authors. The primary endpoint was limb salvage; the secondary endpoint was 30-day mortality.

Technical Repair

All patients went through preliminary trauma evaluation. There was no decision to undertake primary amputation. Under general anesthesia, the vascular team made a temporary arterial shunt, followed by orthopedic fixation in cases of orthopedic fractures. Vascular exploration of injured vessels took place with repair of the popliteal vessels. Methods of repair included 20 interposition reverse saphenous vein grafts and five femoro-popliteal bypass operations in which two cases were done using vein conduits and three cases were done using polytetrafluoroethylene grafts (Figures 1 and 2).

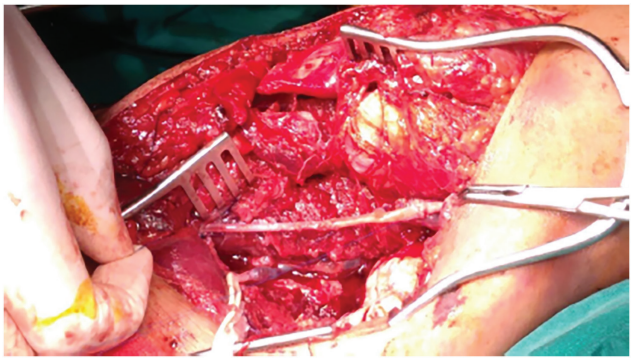

Figure 1 Repair of the popliteal artery using interposition reverse saphenous vein graft.

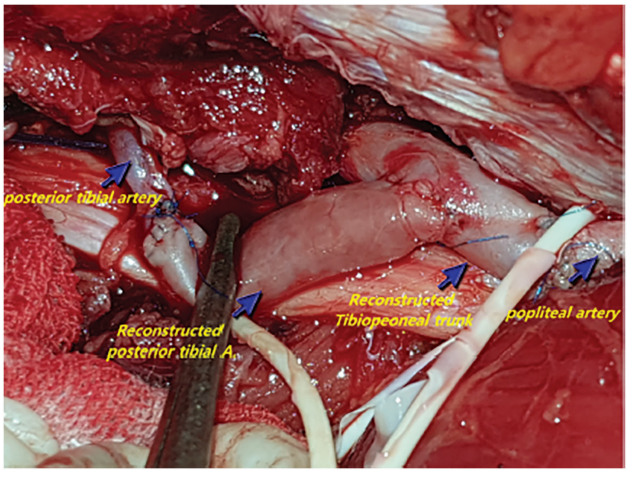

Figure 2 Reconstructed posterior tibial artery and tibioperoneal trunk.

Statistical Analysis

Descriptive data were statistically analyzed using SSPS version 26, IBM. Qualitative data were expressed as number and percentage, while quantitative data were expressed as mean and standard deviation (SD). Student's *t*-test was used for comparison of quantitative variables of normally distributed data. The chi-square test (χ^2) was used to study the association between the descriptive variables of the two groups, amputation and non-amputation. Whenever any of the expected cells were less than five, Fisher's exact test was used. A *P* value of less than 0.05 was considered statistically significant.

Ethical Approval and Informed Consent

Ethical approval to report these cases was given by the Ethical Committee of Ain Shams University Hospitals and Shebin Elkoom Teaching Hospital. Written informed consent was obtained from the patients.

RESULTS

The study included 25 patients presenting with traumatic popliteal artery injury over 3 years between 1 January 2020 and 1 January 2023. There were 17 men (68%) and eight women (32%). The age range of patients was 15–50 years, with a mean age of 35 years. All patients (100%) had no history of comorbidities including diabetes mellitus, hypertension and ischemic heart diseases. Five patients were active smokers (Table 1). There were 23 cases that had blunt trauma (92%), two cases that had penetrating trauma (8%) and one case that was iatrogenic, which therefore was excluded (Figure 3). The mechanisms of injury were low-energy trauma in two patients (8%), medium-energy trauma in five patients (20%), high-energy trauma in 11 patients (44%) and very-high-energy trauma in seven patients (28%). With regard to the shock state at time of admission, there were nine patients (36%) with systolic blood pressure greater than 90 mmHg, 16 patients (64%) with transient hypotension and no case presented with persistent hypotension (Table 1). With regard to the extent of injury, 12 patients (48%) had sustained isolated popliteal artery injury, six patients (24%) had injury of both the popliteal artery and vein (PAV) and seven patients (28%) had combined popliteal artery, vein and nerve (PAVN) injuries.

Patients with sharp popliteal artery injury had a 5% risk of amputation, while those with blunt trauma had a 69.5% risk of amputation. There was a correlation between high-energy injuries and risk of amputation, whereas we observed nine cases of amputation (81.1%) with high-energy injuries and seven cases (100%) with very-high-energy injuries (Table 2).

With regard to associated injuries, 23 cases were associated with orthopedic injuries and fractures (92%) and 16 cases with muscles crush injury (64%). Fasciotomy was carried out for 12 cases (48%), six cases received prophylactic fasciotomy and another six received delayed fasciotomy. There were 15 patients (60%) who presented with delayed ischemia, or had more than 6 hours of ischemia. The amputation rate among them was 66.6% (10 patients). There were 20 patients (80%) who presented with severe ischemia (coldness, paralysis and loss of sensation). The rate of amputation among this group was 80%. There were five cases presenting with mild ischemia (pulseless, paresthesia, slow capillary refill) and there was no rate of amputation among them (Table 3).

The overall amputation rate in this study was 64%. The relative high risk of amputation was mainly

Table 1 Socio-demographic and clinical data of the patients.

	Number	*%*
Age		
<30 years	7	28
30–50 years	18	72
Gender: male	17	68
Comorbidity: No	25	100
Active smoker	5	20
Type of injury		
Sharp	2	8
Blunt	23	92
Injury mechanism		
Low energy	2	8
Medium energy	5	20
High energy	11	44
Very high energy	7	28
Shock		
SBP >90 mmHg	9	36
Transient hypotension	16	64
Persistent hypotension	0	0

SBP: systolic blood pressure.

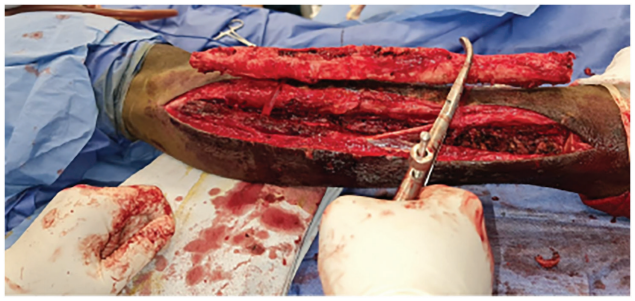

Figure 3 Iatrogenic popliteal artery injury after fibulectomy due to chronic osteomyelitis.

Table 2 Correlation between type of injury, mechanism of injury and shock state with risk of amputation.

	Amputation		*No Amputation*			
	Number	*%*	*Number*	*%*	*FE*	*P Value*
Type of injury						
Sharp	0	0.0	2	100	3.865	0.120
Blunt	16	69.5	7	30.5		
Injury mechanism						
Low energy	0	0.0	2	100	χ^2	
Medium energy	0	0.0	5	100	17.898	<0.001**
High energy	9	81.1	2	18.1		
Very high energy	7	100	0	0.0		
Shock						
SBP >90 mmHg	4	25.0	5	55.6	2.334	0.200
Transient hypotension	12	75.0	4	44.4		

*FE: Fisher's exact test; χ^2: chi-square test; **P<0.001: highly significant. SBP: systolic blood pressure.*

Table 3 Clinical assessment of the patients (*n* = 25).

			Amputation		*No Amputation*			
	Number	*%*	*Number*	*%*	*Number*	*%*	*FE*	*P Value*
Limb ischemia								
Pulseless, paresthesia, slow capillary refill	5	20	0	0	5	100	11.111	0.002*
Cool, paralysis, numb/insensate	20	80	16	66.6	4	44.4		
Limb ischemia for >6 hours								
Yes	15	66.66	10	62.5	5	55.6	0.116	1.000
No	10	33.33	6	37.5	4	44.4		
Mangled score								
Mean ± SD	8.00 ± 1.89		9.19 ± 0.83		5.89 ± 1.27		7 .861[a]	<0.001**
Range	5.0 – 14.0		8.0 – 10.0		5.0 – 8.0			
Popliteal vein injury								
Yes	6	24	5	83.3	1	16.7	15.234	<0.001**
No	19	76	3	18.7	9	100		
Combined nerve and popliteal vein injury								
Yes	7	28.0	7	100	0	0	5.469	0.027*
No	18	72.0	9	50	9	50		

*FE: Fisher's exact test; a Student's t-test; **P<0.001: highly significant; *P<0.05: significant. SD: standard deviation.*

correlated with a high MESS, where 48% of the patients presented with an MESS of 9 or above. Patients who presented with isolated popliteal artery trauma had an MESS of less than 8 and they did not lose their limbs. Patients presenting with combined PAV or PAVN had an MESS of 8 or more with a 100% rate of amputation. There was a statistically significant correlation between risk of amputation and PAV or PAVN injuries, severity of limb ischemia, as well as the MESS (Table 4). The MESS may be a predictor of limb salvage in the case of traumatic popliteal artery injuries. Patients presenting with an MESS of 8 or lower had a 25% amputation rate, while patients presenting with an MESS of 9 or more had an amputation rate of 75%, $P < 0.001$, sensitivity 75% and specificity 100% (Table 4 and Figure 4).

A limitation of our study is the potentially low number of cases and high rate of amputation, which could be correlated to high MESS, severity of mechanism of injury and severity of limb ischemia presentation.

Table 4 Classification of mangled extremity score system (MESS) according to cut-off point and its relation to amputation.

	Amputation		*No Amputation*		*Total*			
	Number	*%*	*Number*	*%*	*Number*	*%*	*FE*	*P Value*
Mangled score								
<8.5	4	25.0	9	100.0	13	52.0	12.981	<0.001**
≥8.5	12	75.0	0	0.0	12	48.0		

*FE: Fisher's exact test; **P<0.001: highly significant.*

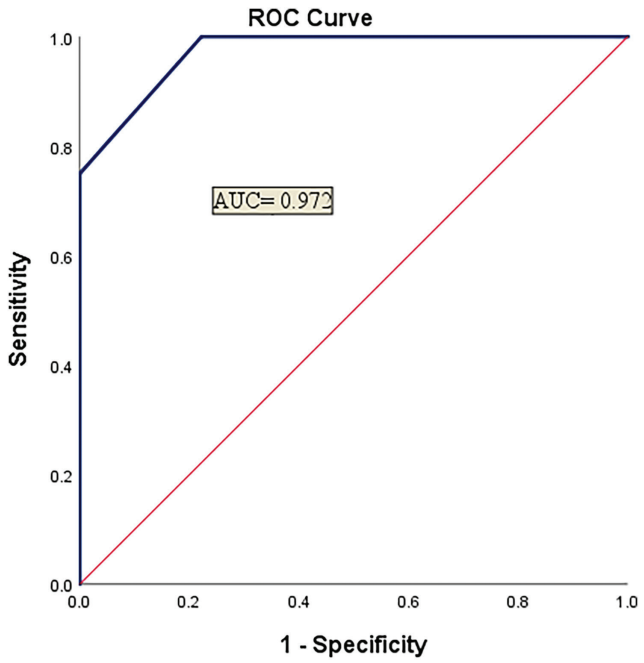

Figure 4 Receiver operating characteristic curve (ROC) for the MESS as a predictor for amputation showed that the minimum cut-off point was 8.5 with an area under the curve (AUC) of 0.972, sensitivity of 75%, specificity of 100% and 95% confidence interval of 0.918–1.000.

DISCUSSION

MESS is calculated by subjective review of soft tissue damage, limb ischemia, shock and age revascularization. This system was originally authenticated in a small study with only 26 patients that concluded that an MESS greater than 7 equated to a 100% rate of amputation revascularization [7]. Multiple studies since the original MESS study have invalidated this scoring system, including a recent large, multicenter prospective study called the Lower Extremity Amputation Project (LEAP) [8]. The LEAP attempted to address concerns surrounding decision-making for limb salvage in the setting of severe lower extremity trauma, but ultimately failed to determine which factors were predictive of long-term outcome [8]. The multi-institutional, randomized LEAP trial was not able to validate predictive models for limb salvage scoring systems [8, 9]. Currently there are no scoring systems that adequately predict functional recovery of patients who present with the potential for limb salvage [9]. Loja et al. reported, between 2013 and 2015, 230 patients with lower extremity arterial injuries who were entered into the PROspective Vascular Injury Treatment registry. Patients being admitted with an MESS of 8 or greater was associated with a longer stay in the hospital and intensive care unit. After controlling for confounding variables including the mechanism of injury, degree of arterial injury, injury severity score, arterial location and concomitant injuries, the MESS between patients with salvaged and amputated limbs was no longer significantly different. Importantly, an MESS of 8 predicted in-hospital amputation in only 43.2% of patients [10]. It is important to have a method of arterial repair to have satisfactory outcomes. Inadequate debridement of contused popliteal artery always results in arterial thrombosis in the early postoperative period [11]. Vascular repair includes primary end-to-end anastomosis, vein graft interposition, or bypass grafting. The majority of popliteal artery injuries (always when the length of the damaged segment is more than 1.5–2 cm) secondary to knee dislocation require an interposition vein graft secondary to the extent of arterial injury. End-to-end repair may require extensive popliteal artery mobilization with sacrifice of collateral vessels to ensure a tension-free repair [12]. Most authors recommend avoiding the use of continuous sutures, because of a possible narrowing along the suture with growth [13, 14]. Ramdass et al. reported 32 cases that presented with popliteal artery injury. There were 20 cases of penetrating trauma (63%) and 12 cases of blunt trauma (37%). The amputation rate associated with popliteal artery injury was 28% with no significant difference in rates between penetrating and blunt trauma (25% vs. 33%). There was no statistical significance in rate of amputation and type of repair (reversed saphenous, synthetic graft or primary repair). Factors associated with poor outcomes include combined artery and vein injury, artery, vein and nerve injury (75% of the patients in each group), concomitant orthopedic injury with fracture in particular and

delayed transfer to vascular surgery [15]. Mullenix et al. reported a retrospective analysis of 1395 popliteal arteries collected from trauma data from the National Trauma Data Bank (NTDB). Amputation rates were 15% with combined artery and vein injuries, 21% for associated nerve injuries and 12% for major soft tissue disruptions. Independent predictors of amputation in logistic regression analysis of the entire cohort included bony fracture, complex soft tissue injury and nerve injury. The amputation rates for these patients stratified by mechanism of blunt versus penetrating trauma were higher for blunt trauma compared to those with penetrating injury (27% vs. 9%) [16]. Factors such as blunt (vs. penetrating) mechanism have been found to be an independent risk factor for amputation, with Grigorian et al. finding a 3.5-fold higher risk for amputation with blunt popliteal artery injury. They theorized that this was due to the higher force required to cause popliteal artery injury in the relatively protected region of the popliteal fossa as well as the increased risk of concomitant injuries such as popliteal vein injury [17]. Hafez et al. have reported the largest number of civilian lower limb arterial injuries and have established a protocol for combined injuries; they routinely repair arterial injuries prior to orthopedic or nerve injuries [18]. In this study we compared those patients who underwent orthopedic repair prior to vascular repair and found that there was no associated increased risk of amputation. In our patient population unstable fractures were felt to increase the risk of early graft failure or graft disruption secondary to manipulation of the lower extremity during orthopedic fixation [18]. We found that those patients requiring amputation had a higher incidence of blunt trauma (80% vs. 35%) and a higher MESS score (7.1 vs. 4.7). There was no difference in the incidence of amputation for those who underwent orthopedic fixation before vascular repair.

CONCLUSIONS

Mangled extremity severity scores equal or over 9 carry a high risk of amputation of 75%. Combined arterial and venous injuries or arterial, venous and nerve injuries, which already have a high MESS, also carry a high risk of amputation. All of them could be used as predictors of limb salvage in popliteal artery injury.

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 were responsible for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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Original Article

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Assessing the Awareness of EVTM Practices Among Emergency Medicine Physicians in Turkey

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Background: Trauma is the leading cause of death in those aged 1–44 years; nearly half of these fatalities are due to bleeding. As resuscitative endovascular balloon occlusion of the aorta (REBOA) and other endovascular resuscitation and trauma management (EVTM) methods became known in Turkey, they started to arouse interest. The main objective of this study is to reveal the impressions of emergency medicine (EM) doctors about EVTM and REBOA application possibilities, and the secondary objective is to determine the issues that are limiting their spread.
Methods: We conducted a 22-question cross-sectional survey via e-mail between 1 January and 1 April 2020. The questions were formulated to be closed-ended, semi-closed-ended, and open-ended. The evaluation questions utilized 3- and 5-point Likert scales and Yes/No questions. EM specialists, residents, consultants, and physicians working as emergency department (ED) directors in Turkey were included. EM specialists working in units other than EDs and specialists from other branches were excluded.
Results: Among the 512 people contacted for this study, 132 agreed to participate. The numbers of participants that were aware of REBOA and EVTM were 114 and 99, respectively. Participants thought that femoral vascular access, extracorporeal membrane oxygenation (ECMO), and REBOA were more applicable in EDs (median 4, 4, and 4.5, respectively; interquartile range 1–5). Participants considered lack of knowledge and skills and lack of equipment as barriers to REBOA (median 5 and 5, respectively).
Conclusions: To disseminate EVTM practices in Turkey, projects should be conducted primarily to address lack of knowledge, skills, and equipment.

Keywords: *REBOA; EVTM; Emergency Department; Survey Study*

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INTRODUCTION

Trauma ranks first among the causes of death for individuals aged 1–44 years [1], with nearly half of these fatalities resulting from bleeding within the golden hours. The death of a disease-free person, who is not expected to pass away due to health reasons, while living their daily life is a social and public concern. Although local administrations and occupational health teams take indispensable precautions, it is imperative to ensure that trauma patients receive optimal care.

Endovascular resuscitation and trauma management (EVTM) is a ground-breaking concept based on the permanent repair of the cause of bleeding through methods such as endovascular stent and graft procedures or embolization, following fast-acting but temporary bleeding control with resuscitative endovascular balloon occlusion of the aorta (REBOA). The methods for achieving rapid and high-quality intervention to stop bleeding are still discussed in many trauma study groups [2,3]. This highlights the applications of EVTM [4].

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EVTM, a concept recently recognized in Turkey, has been an undeniable help in providing the comfort needed for golden hour interventions for trauma patients [4,5]. However, given the limited use of EVTM in Turkey, it is crucial to identify and discuss the factors hindering its widespread implementation. For this reason, this survey study aims to investigate the awareness and applicability of EVTM, with two objectives. The main objective is to explore the awareness of EVTM and REBOA procedures among emergency medicine (EM) physicians in Turkey, and the secondary objective is to identify strategies for addressing issues that are limiting the spread of knowledge and use.

METHODS

This cross-sectional survey consists of 22 questions. The Cronbach's Alpha value of the scale utilized in this study was measured to be 0.78.

The study participants consisted of EM physicians, residents, and consultants working in second- and third-level emergency departments (EDs) in Turkey. Moreover, physicians working as ED directors were included. EM physicians not currently working in the ED and specialists from other branches were excluded. Third-level health service providers are high-level health institutions that provide training and research services for diseases that require advanced examination and special treatment defined in the relevant legislation. Second-level health service providers are health institutions that provide outpatient or inpatient diagnosis, treatment, and rehabilitation services.

After asking certain demographic data questions, the participants were queried about their knowledge, experience, and ideas about REBOA and other EVTM procedures. In the next section, they were asked questions about obstacles to REBOA implementation, applicability of EVTM procedures in EDs, and management of EVTM complications. The questions were formulated to be closed-ended, semi-closed-ended, and open-ended. The evaluation questions utilized 3- and 5-point Likert scales and Yes/No (Y/N) questions. The options for closed-ended questions were determined using an open-ended pre-study. At the end of this preliminary question and options determination process, all the authors gave their consent for the questions determined. The questionnaire was modified to ensure that all questions could be completed and to prevent any missing data. To further minimize the risk of incomplete or inaccurate answers, the contact information of the team was provided so that the participants could reach them for any clarifications.

The questionnaire was sent to the participants via e-mail, using a web-based link shared on common platforms of professional groups. Between 1 January and 1 April 2020, 132 out of the 512 people contacted agreed to participate in the study.

Data Analysis

The data collected during this study was analyzed using the SPSS 21 software program. The denominator in each proportion presented represents the number of participants who answered the question. As some participants skipped certain questions based on the subject matter, the denominator varied for each individual question. Descriptive statistics, including median (range) values, were used to analyze the responses. The responses were compared using the Fisher's exact test, Chi-square test, and Kruskal–Wallis test when appropriate. An alpha of 0.05 was used for significance.

Ethical Approval and Informed Consent

This study was conducted with the approval of the Aydin Adnan Menderes University Clinical Research Ethics Committee, with the reference number 2019/192, and informed consent was not required.

RESULTS

Among the 512 people contacted for this study, 132 agreed to participate. These 132 people consisted of 58 (43.9%) EM residents, 46 (34.9%) EM specialists, 25 (18.9%) EM consultants, and 3 (2.3%) ED directors. As to work experience in the ED, 23 (17.4%) had worked for less than two years, 41 (31.1%) had worked for two to five years, and 68 (51.5%) had worked for more than five years. Three (2.3%) participants worked in a private hospital (secondary care), 23 (17.4%) in a public hospital (secondary care), 51 (38.6%) in a training and research hospital (tertiary care), and 55 (41.7%) in a university hospital (tertiary care). The median age of the participants was 32 (25–50) years.

REBOA and EVTM Knowledge, Experience, and Opinions

The knowledge, experience, and opinions of the participants about REBOA and EVTM are presented in Table 1. A total of 114 (86.4%) of the participants were aware of REBOA. Among these 114, 15 (13.2%) had previously performed REBOA, while the rest obtained their awareness through various means, such as attending congresses, seminars, and courses, or reading articles and books. Participants who had experience with REBOA performed the procedure for indications such as pelvic fractures, massive vaginal bleeding, cardiogenic shock, and on patients with multiple traumas. Out of the 114 participants with REBOA awareness, 42 (36.8%) declared it feasible, 39 (34.2%) declared it not applicable, and 33 (29%) were undecided on this issue. When they were compared according to their institutions, participants working in secondary care thought that REBOA was not applicable more, and the results

Table 1 Familiarity of the participants with REBOA and EVTM.

	Answer	*No.*	*%*
Have you heard of the name REBOA? *n* = 132	Yes	114	86.4
	No	18	13.6
Is REBOA application performed in your clinic? *n* = 114	Yes	15	13.2
	No	99	86.8
Do you think the REBOA procedure is applicable in your clinic? *n* = 114	Yes	42	36.8
	No	39	34.2
	Partially	33	29
Have you heard of the complications of REBOA application? *n* = 114	Yes	77	67.5
	No	37	32.5
If complications develop while administering REBOA in the emergency clinic, can you manage? *n* = 77	Yes	39	50.6
	No	38	49.4
Do you think other clinics in the hospital will support you if complications develop during the REBOA procedure? *n* = 77	Yes	7	9.1
	No	26	33.8
	Partially support	29	37.6
	They must support	15	19.5
Have you heard of the name EVTM? *n* = 132	Yes	99	75
	No	33	25
Do you have EVTM experience? *n* = 99	Yes	17	17.2
	No	82	82.8
Do you think other clinics in the hospital will support you if complications develop during the EVTM procedure? *n* = 132	Yes	17	12.9
	No	41	31.1
	Partially support	46	34.8
	They must support	28	21.2

EVTM: endovascular resuscitation and trauma management; REBOA: resuscitative endovascular balloon occlusion of the aorta.

were statistically significantly different from those working in tertiary care ($p < 0.05$). Out of the 77 participants who declared that they were aware of the complications related to REBOA, 39 (50.6%) stated that they were able to manage these complications in the ED. However, only seven participants (9.1%) thought that the relevant departments would provide support without any difficulty if complications were to occur.

Obstacles to REBOA Implementation

The responses to the closed-ended question about the obstacles to REBOA implementation are summarized in Table 2 (Q.12). The participants identified lack of knowledge or skills, lack of equipment, and other clinics' inhibitions as barriers to the implementation of REBOA, with median scores of 5, 5, and 4, respectively (interquartile range (IQR) = 1–5). When these obstacles were compared according to the institutions, the lack of knowledge or skills for those working in secondary care hospitals was found to be statistically significant ($p < 0.05$).

The responses of the participants to the open-ended questions about the barriers to REBOA application can be summarized in their own words as follows: lack of awareness about REBOA; limited studies on its reliability; inadequate knowledge and experience of relevant departments to help in case of any complications; reluctance of clinic chiefs to include REBOA application in their curriculum; high cost; lack of support of the hospital management; and need for additional training of other health professionals on REBOA.

Opinions of the Applicability for Each EVTM Procedure in EDs

The opinions among the participants about the applicability for each EVTM procedure in EDs are summarized in Table 2 (Q.19). Among the EVTM methods, participants think that femoral vascular access and extracorporeal membrane oxygenation (ECMO) are more applicable in the ED, with both methods having a median score of 4 (IQR = 1–5). When the applicability of these methods was compared according to the institutions, no statistically significant difference was found ($p = 0.433$ and $p = 0.470$ respectively). The awareness of the use of the endovascular stent graft, endovascular plug, endovascular selective balloon occlusion, and hybrid

Table 2 Distribution of participants' opinions about REBOA and other EVTM procedures.

Q.12 What do you think about the reasons that prevent REBOA from being performed in the ED? n = 114 (%)						
	Disagree completely	*Strongly disagree*	*Undecided*	*Strongly agree*	*Agree completely*	*Median (Min.–Max.)*
Lack of knowledge and skills	5 (4.4)	5 (4.4)	3 (2.6)	36 (31.6)	65 (57)	5 (1–5)
Lack of materials and equipment	3 (2.6)	2 (1.7)	5 (4.4)	27 (23.7)	77 (67.5)	5 (1–5)
Inhibition/reaction of my colleagues in my branch	15 (13.2)	29 (25.4)	27 (23.7)	24 (21)	19 (16.7)	3 (1–5)
Not enough time for the procedure	13 (11.5)	25 (21.9)	17 (14.9)	34 (29.8)	25 (21.9)	4 (1–5)
Not in the scope of the emergency	41 (35.9)	32 (28.2)	20 (17.5)	7 (6.1)	14 (12.3)	2 (1–5)
Inhibition/reaction of other branches	9 (7.9)	22 (19.3)	22 (19.3)	28 (24.6)	33 (28.9)	4 (1–5)
It doesn't interest me	56 (49.1)	26 (22.8)	12 (10.6)	11 (9.6)	9 (7.9)	2 (1–5)
Q.19 What do you think about the applicability of the each EVTM procedure by EM specialists? n = 132 (%)						
	No idea	*Disagree completely*	*Strongly disagree*	*Undecided*	*Strongly agree*	*Agree completely*	*Median (Min.–Max.)*
Femoral vascular access	37 (28)	1 (0.8)	2 (1.5)	15 (11.4)	23 (17.4)	54 (40.9)	4 (0–5)
ECMO	30 (22.7)	3 (2.3)	5 (3.8)	11 (8.3)	40 (30.3)	43 (32.6)	4 (0–5)
Endovascular stent graft	48 (36.4)	3 (2.3)	12 (9.1)	22 (16.7)	25 (18.9)	22 (16.7)	3 (0–5)
Endovascular embolization	40 (30.3)	5 (3.8)	13 (9.8)	15 (11.4)	25 (18.9)	34 (25.8)	3 (0–5)
Endovascular plug	68 (52.5)	2 (1.5)	10 (7.6)	21 (15.9)	16 (12.1)	15 (11.4)	2 (0–5)
Endovascular selective balloon occlusion	44 (33.3)	3 (2.3)	6 (4.5)	19 (14.4)	28 (21.2)	32 (24.2)	3 (0–5)
Hybrid resuscitation	58 (43.9)	2 (1.5)	6 (4.5)	20 (15.2)	20 (15.2)	26 (19.7)	3 (0–5)
Q.20 What do you think about the manageability of the each EVTM complication in your clinic? n = 132 (%)						
	No idea	*Disagree completely*	*Strongly disagree*	*Undecided*	*Strongly agree*	*Agree completely*	*Median (Min.–Max.)*
Bleeding at the intervention site	11 (8.3)	1 (0.8)	3 (2.3)	5 (3.8)	30 (22.7)	82 (62.1)	5 (0–5)
Aortic-artery dissection rupture	18 (13.6)	22 (16.7)	29 (22)	19 (14.4)	32 (24.2)	12 (9.1)	2 (0–5)
Embolic events	15 (11.7)	5 (3.8)	20 (15.2)	25 (18.9)	45 (34.1)	22 (16.7)	4 (0–5)
Balloon-related mechanical complications	19 (14.4)	11 (8.3)	24 (18.2)	29 (22)	37 (28)	12 (9.1)	3 (0–5)
Reperfusion injury	17 (12.9)	9 (6.8)	18 (13.6)	30 (22.7)	40 (30.3)	18 (13.6)	3 (0–5)
Circulatory disorder	14 (10.6)	7 (5.3)	15 (11.4)	22 (16.7)	54 (40.9)	20 (15.2)	4 (0–5)

ECMO: extracorporeal membrane oxygenation; ED: emergency department, EM: emergency medicine; EVTM: endovascular resuscitation and trauma management; Q: Question; REBOA: resuscitative endovascular balloon occlusion of the aorta

resuscitation is not sufficient. Out of 132 participants, rates of awareness were 63.6%, 47.5%, 66.7%, and 56.1%, respectively.

Reflections on the Management of EVTM Complications

Reflections on the management of EVTM complications are summarized in Table 2 (Q.20). Opinions regarding the most and the least manageable complications were bleeding at the access area and aortic rupture (median 5 and 2, respectively) (IQR = 1–5). There was no significant difference in the answers given by the participants according to their title and institution (p = 0.195 and p = 0.438, respectively).

DISCUSSION

Since EVTM has led to satisfactory results in increasing the rate of patients managed non-operatively [6], the care given to trauma patients is being continuously improved. Therefore, it is important to contribute to the spread of this development in Turkey, by revealing the points of view of the doctors working in the EDs in Turkey on EVTM methods.

In a study conducted by Sutherland et al. in the United States, the usage rate of REBOA of the participants was given as 49.3% [7]. In this study that we conducted in Turkey, the REBOA awareness rate was 86.4%, while the application rate was 13.2%; the EVTM awareness rate was 75% and the implementation rate was 17.2% among emergency physicians (Table 1).

Despite this Level of Awareness, Why are the Implementation Rates in Turkey Low?

In our study, when we asked if REBOA could be applied in EDs, we found that the answers Yes/No/Partially were 36.8%, 34.2%, and 29%, respectively (Table 1). In the study conducted by Sutherland et al they asked about the applicability of REBOA. The answers Yes/No/Undecided were found to be 37.7%, 12.2%, and 50.1%, respectively. Of those, the most cited reason was lack of clear patient selection and indication criteria [7]. Samuels et al. listed the reservations about using REBOA in their study as follows: (1) a lack of practice guidelines for REBOA implementation based on high-quality evidence; and (2) the inability to acquire and maintain the knowledge and skills [8]. In our study, the obstacles in its implementation were: (1) lack of knowledge and experience; (2) lack of materials and equipment; and (3) other clinics' inhibitions/negative reactions to the case (Table 2). In contrast, in a Canadian study, it was stated that most of the REBOA applications were performed by trauma surgeons, and they were used less by emergency specialists, cardiovascular surgeons, and intensive care specialists [9].

How Can We Overcome the Obstacles in REBOA Application?

This situation can be overcome by: (1) course training; (2) involving hospital administrators so that they are able to support innovative approaches; and (3) re-setting a multidisciplinary approach to trauma patients with hospital sources. REBOA training was implemented in September 2017 in Örebro, Sweden. According to the results of this training workshop, it has been revealed that with a limited-hour training curriculum, successful REBOA practice by clinicians without REBOA training or previous experience is possible [10]. From our study, it is indicated that planning training courses would be the best way to spread the knowledge of REBOA. Persuading the hospital administrators of the benefits of using REBOA catheters would be another part of the solution. In addition, perioperative management of REBOA and REBOA administration procedures should be studied with anesthesiologists and surgeons in an interdisciplinary way.

Hybrid Resuscitation Models in EDs

According to Coccolini et al., with the modern conception of hybrid and EVTM procedures, satisfactory results have been increasing for patients managed non-operatively, opening up new options in trauma patient management [6]. In our study, the awareness rate of hybrid Resuscitation was determined to be 56.1%. For us to participate in this evolution, hybrid resuscitation rooms should be introduced, designed, and implemented in our emergency services. In this context, the hybrid emergency service model was introduced to Turkey in a special issue series recently published, and all the details, from its architecture to the healthcare opportunities it is expected to offer, were mentioned [11].

Reflections on the Management of EVTM Complications

In a study by McGreevy et al., balloon rupture occurred in one patient, there was one occurrence of distal embolism, and acute kidney failure developed in two out of 15 patients who survived 22 interventions with the ER-REBOA catheter. A surgical embolectomy was performed for distal embolism. Bleeding at the intervention site, balloon migration, or multiorgan failure were not reported [12]. In our study, 50.6% of the participants thought that they could manage the complications of REBOA themselves. Despite this, only 9.1% for REBOA and 12.9% for other EVTM procedures answered "Yes" to the question of having peace of mind regarding support for the management of complications by other branches (Table 1). REBOA complications can be minimized with practical exercises and mental preparations. Since the EVTM concept is a practice that other clinics

do not know well in Turkey, the proportion who answer "Yes" is low. Therefore, after an EVTM procedure, how the anesthetist should manage the patient in the operation room, how to make decisions in a situation that the surgeon is not used to, and how to intervene in complications should be studied more widely in our clinics.

CONCLUSION

Improving the quality of care of trauma patients shortens the recovery time of patients and increases the likelihood of them returning to their original lives. As the Tr-EVTM team (Turkish Endovascular Hybrid Trauma and Bleeding Management Team), our task in Turkey is to improve the knowledge of and skills in EVTM among ED doctors, to develop improvement projects that will provide the appropriate environment and time such as structural rearrangement of ED plans, and to increase interdisciplinary cooperation between emergency medicine, trauma surgery, intensive care, interventional radiology, and anesthesiology departments.

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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Case Report

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Emergency CTA Diagnosis and Successful Endovascular Management of Aorto-duodenal Fistula

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Aorto-enteric fistula is defined as a communication between the aorta and the gastrointestinal tract. It is a rare but life-threatening condition associated with almost 100% mortality without prompt surgical intervention. The most common type of aorto-enteric fistula is the aorto-duodenal fistula. Upper gastrointestinal bleeding is the most common presentation, ranging from a minor haemorrhage to massive life-threatening bleeding.

Computed tomography angiography is the first-line modality for imaging evaluation of suspected aorto-enteric fistula. Surgical treatment of this condition may be open aortic repair, in situ graft replacement if present, or placement of an extra-anatomical bypass.

We present our case of a 71-year-old woman with infected aorto-aortic graft complicated by aorto-duodenal fistula. The patient was successfully treated by aortic Zenith Cook cuff endovascular placement in the emergency setting as a life-saving treatment and a bridge solution to elective surgery.

Keywords: *Aorto-Enteric Fistula; Computed Tomography Angiography (CTA); Endovascular Approach; Life-Saving Treatment; Emergency Setting*

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INTRODUCTION

Aorto-enteric fistula (AEF) is defined as a communication between the aorta and the gastrointestinal (GI) tract. It is a rare but life-threatening condition associated with very high mortality rates without prompt surgical intervention [1].

The aetiology is divided into primary and secondary (more common) causes. Primary AEFs occur in the absence of previous aortic surgery and are uncommon events, with an incidence of 0.04% to 0.07% [2]. Typically, a large untreated aneurysm erodes into the adjacent bowel; pulsatile pressure is transmitted through a weakened aortic wall, causing pressure necrosis and adhesive granulation tissue between the aorta and adjacent bowel wall, leading to a fistula. Rarer causes of primary AEF are infectious aortitis, penetrating peptic ulcer, tumour invasion, vasculitis, collagen-vascular disorders, and radiation-induced changes [3].

Secondary AEFs have a reported prevalence of 0.5–2.3% and generally occur in patients with previous aortic endovascular prosthesis or reconstruction, typically between the suture line of a vascular graft and the bowel. Fistula may develop due to the combination of pulsatile pressure of the aortic graft on the bowel wall and chronic low-grade infection of the graft, with or without pseudoaneurysm formation [1]. The interval between surgery and the development of fistula can range from months to years [4].

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The most common AEF is the aorto-duodenal fistula. The third part of the duodenum is most commonly involved because of its close proximity to the abdominal aorta, followed by the fourth duodenal part, jejunum, ileum and large intestine [5,6].

Upper GI bleeding is the most common presentation, ranging from a minor haemorrhage to massive life-threatening bleeding. Major haemorrhage may be preceded by transient self-limited haemorrhage ('herald bleed'), which results from mucosal ulceration followed by temporary tamponade by coagulation and bowel loops [2,7]. The classic triad of primary AEFs (upper GI bleeding, abdominal pain, and pulsatile abdominal mass) occurs in only 10–25% of patients [7,8]. In patients with previous aortic reconstruction, sepsis and lower extremity ischaemia may indicate secondary AEF even in the absence of GI bleeding, as infectious graft thrombosis may prevent communication between blood flow and the duodenum, and septic emboli may cause leg symptoms [9,10].

Computed tomography angiography (CTA) is the first-line modality for imaging evaluation of suspected AEF, despite its variable sensitivity (40–90%) and specificity (33–100%). Conventional angiography may be helpful for surgical planning in certain cases [1]. The esophagogastroduodenoscopy (EGD) is useful in diagnosis and in management, but it is reported to have a sensitivity of 24% for secondary AEFs [11].

Treatment of AEF may be open aortic repair or endovascular treatments, such as a cuff, prosthesis and device placement. In the case of secondary AEF, it requires excision of the graft, debridement of infected tissue, bowel repair or resection and revascularisation with in situ graft replacement or placement of an extra-anatomic bypass [3].

Here, we present our case of a 71-year-old woman with infected aortic vascular prosthesis complicated by aorto-enteric fistula. The patient was successfully treated by aortic Zenith Cook cuff endovascular placement in the emergency setting as a life-saving treatment.

Ethical Approval and Informed Consent

The Institutional Review Board for this Case Report was waived. Informed consent was not acquired. All the data referring to the patient were anonymized.

CASE REPORT

We report the case of a 71-year-old woman who presented at the emergency department (ED) of our centre (Ospedale del Mare, ASL Napoli 1 centro, Naples, Italy) in severe haemorrhagic and septic shock, with profuse melena. The patient had undergone aorto-aortic graft placement in a different centre 17 months earlier and had missed the postoperative follow-up.

Laboratory examinations and complete blood count (CBC) revealed:

- Haemoglobin: 9 g/dl,
- Red blood cells: 3.30 × 10^6/mm^3,
- Haematocrit: 29.4%,
- White blood cells: 20.33 × 10^3/mm^3,
- Platelets: 82 × 10^3/mm^3,
- Activated partial thromboplastin time ratio: 0.72,
- C-reactive protein: 5.3 mg/dl.

The patient immediately (<30 minutes) underwent CTA for suspected infection of the aortic prosthesis and active bleeding due to the state of severe haemorrhagic and septic shock. CTA showed a direct connection between the abdominal aorta and the III duodenal portion in the context of severe periaortic adipose tissue thickening due to infection of the previous aorto-aortic graft (Figure 1*a*). CTA also showed profuse bleeding in the duodenal and jejunal loops lumen (Figure 2), causing profuse melena on admission to the ED, and aerial nuclei in the aortic lumen and periaortic adipose tissue adjacent to the fistula (Figure 1*b*).

After the CTA diagnosis, the patient urgently (1 hour) underwent life-saving surgical and interventional

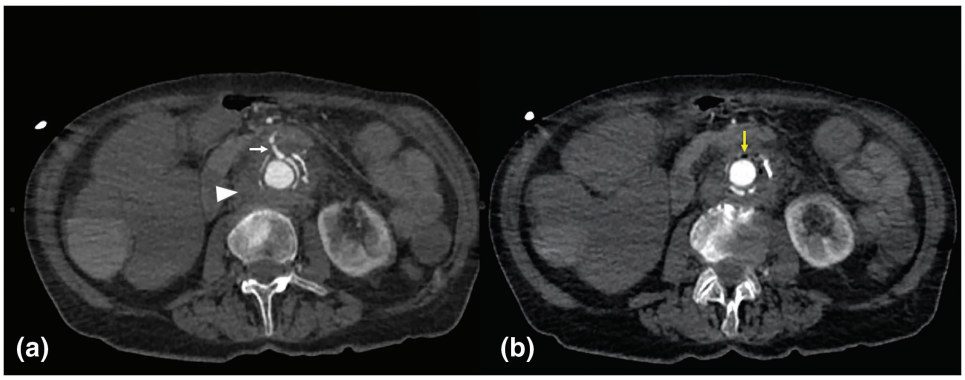

Figure 1 Computed tomography angiography (CTA), axial planes, arterial phase: in (**a**) a direct connection between the abdominal aorta and the III duodenal portion can be noted (white arrow) in the context of severe periaortic adipose tissue thickening (arrowhead) due to infection of the previous aorto-aortic graft. (**b**) Aerial nuclei in the aortic lumen can be seen (yellow arrow).

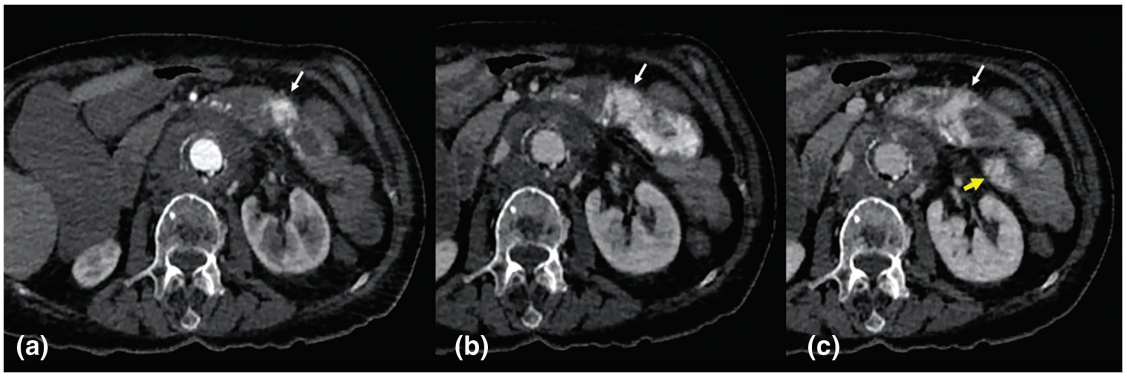

Figure 2 Computed tomography angiography (CTA), axial planes, arterial (**a**), portal (**b**) and venous (**c**) phase: profuse bleeding in the duodenal loops lumen can be seen in (**a**), (**b**) and (**c**) (white arrow). In the venous late phase, the bleeding can be noted also in the jejunal loops lumen (yellow arrow).

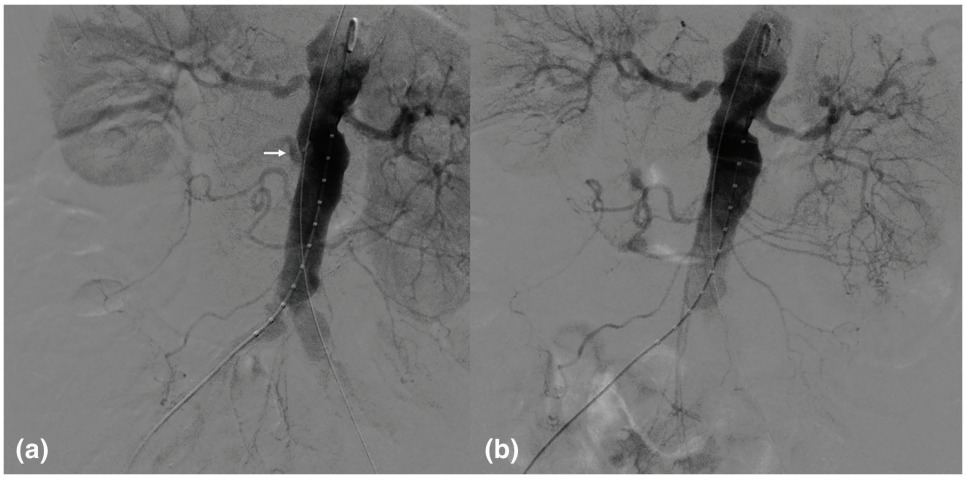

Figure 3 Angiography performed for the endovascular procedure by a vascular surgeon and an interventional radiologist. (**a**) Extra-aortic bleeding can be seen (white arrow), not visible after Zenith Cook cuff positioning (**b**).

radiologist treatment by Zenith Cook (ZLBE 28-45) cuff endovascular placement (Figures 3 and 4) as a bridge solution to elective surgery. The treatment was successful.

We chose to use a shorter aortic cuff to simplify the elective surgical approach. In cases such as the one presented, it is critical to resolve the sepsis state and lead the patient in the best possible condition to elective surgery.

The patient's laboratory examinations and CBC gradually improved the day after, with initial restoration to normal values. The same day the patient underwent a follow-up CTA that showed no active bleeding, endoleaks, or blood in the lumen of the bowel loops (Figure 5).

At the physical examination on the second postoperative day, blood pressure values were 140/60 mmHg, heart rate 120 bpm and saturation (SpO_2) 99%.

The patient also underwent blood culture and targeted antibiotic therapy for resolution of the aorto-aortic graft infection.

DISCUSSION

The AEF is a life-threatening condition, with the mortality rate reaching almost 100% in the case of no prompt surgical or endovascular treatment.

Secondary forms of AEF are more frequent than primary forms and may occur in patients with previous aortic interventions, and more frequently in the case of open aortic reconstruction. In the case we presented, the AEF was determined by the complication of the infection of an aorto-aortic graft placed 17 months earlier. Notably, the interval between surgery and the development of fistula can range from months to years [4].

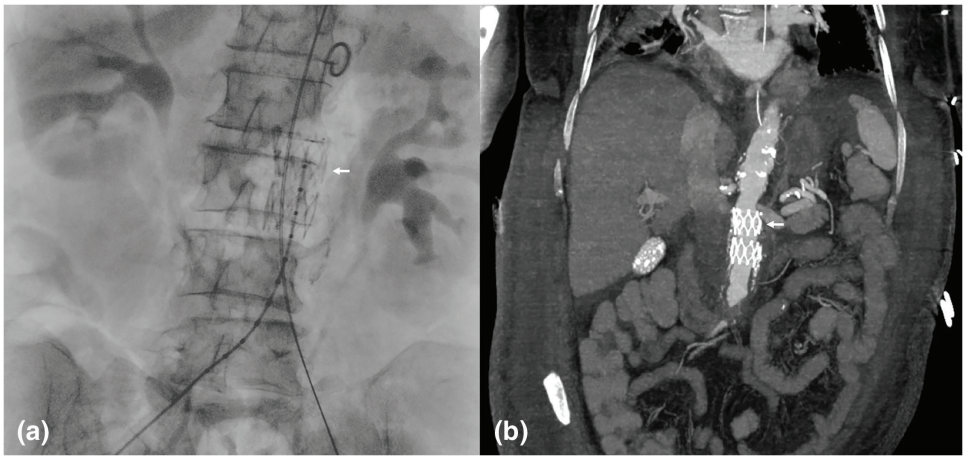

Figure 4 Angiography (**a**) and computed tomography angiography (CTA) with maximum intensity projection (MIP) reconstructions in the coronal plane (**b**) in the immediate postoperative follow-up after Zenith Cook cuff placement (white arrows).

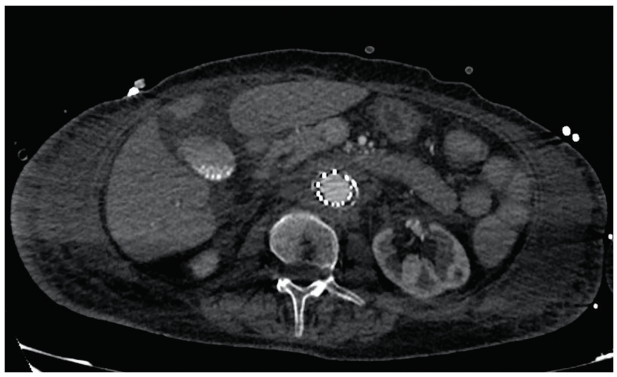

Figure 5 Postoperative follow-up computed tomography angiography (CTA), axial plane: correct cuff position, no active bleeding, endoleaks, or blood in the bowel loops lumen.

Our patient developed aortitis resulting in infection and inflammation of the periaortic adipose tissue up to the walls of the III duodenal portion, leading to the formation of an aorto-duodenal fistula and massive upper GI bleeding. The most common AEF is the aorto-duodenal fistula, especially involving the third part of the duodenum due to its close proximity to the abdominal aorta [5], as in our case.

The clinical presentation of our patient was already advanced, with massive upper GI bleeding at the time of presentation in the ED, probably due to the severe pre-existing infection. Moreover, in our case, the patient was already in septic shock, another common symptom in advanced stage AEF cases [9].

In our case, the diagnosis was made exclusively by CTA, which promptly – less than 30 minutes after the ED admission – showed the direct connection between the abdominal aorta and the III duodenal portion, the presence of aerial nuclei in the aortic lumen and in the periaortic adipose tissue adjacent to the fistula, and the massive active bleeding in the duodenal and jejunal loops lumen (Figures 1 and 2).

CTA also allowed prompt and correct operative planning, and conventional angiography during the endovascular treatment was helpful to confirm the diagnosis.

In our case, due to the patient's very serious clinical presentation, surgery was performed in an emergency setting by Zenith Cook cuff endovascular placement by the vascular surgeon and the interventional radiologist as a life-saving treatment and a bridge solution to elective surgery. We decided to use this cuff specifically for the patient's surgical needs, but there are a variety of additional devices suitable for temporarily endovascular treatments, such as stent grafts usable without suprarenal fixation.

CONCLUSIONS

AEF is a rare pathological entity that most commonly involves the duodenum.

Upper GI bleeding is the most common presentation, ranging from a minor haemorrhage to massive life-threatening bleeding, followed by sepsis and lower extremity ischaemia in the case of secondary AEF. CTA is considered the first-line imaging modality in the diagnosis of AEF. Conventional angiography and EGD may be useful in the diagnosis and management. Treatment of AEF is generally an open aortic repair.

Here we presented our case of a 71-year-old woman with infected aorto-aortic graft complicated by aorto-duodenal fistula, successfully treated by aortic Zenith Cook cuff placement as a bridge solution to elective surgery.

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.

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Case Report

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Damage Control Strategies For Vascular Injuries – A Report From The Amazon

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Patients may sustain vascular injuries in rural areas or isolated locations, which are very common in the vast area of the Amazon rainforest. In situations like this, patients may take many hours, or even days, to get access to hospitals capable of dealing with these potentially lethal injuries, arriving in severe conditions that may require damage control strategies. Among the currently available techniques for damage control resuscitation and damage control surgery, the endovascular balloon occlusion of the aorta (REBOA) and temporary vascular shunts play an important role, but appropriate devices are often unavailable; in such scenarios, surgeons' expertise on how to improvise devices, using more accessible materials, can be lifesaving. This paper presents a case of femoral vessel injury in a patient who required REBOA and vascular shunt improvisation; discussions regarding possible improvisation strategies are provided and technical steps on how to implement them are described.

Keywords: *REBOA; Vascular Shunts; Damage Control; Vascular Injuries.*

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INTRODUCTION

Although expeditious rescue and early treatment are paramount for the management of vascular injuries, in many vast areas and isolated locations around the world this cannot always be accomplished. The Amazon rain forest is distributed between eight countries, with 60% of its area located in Brazilian territory [1]; because of the great distances to be covered and frequent unavailability of air rescue, access to hospitals capable of managing vascular injuries may take hours and even days.

Previous studies have shown that the victims of vascular injuries that require terrestrial transportation for more than 200 km tend to arrive in severe shock with critical limb ischemia, frequently requiring damage control strategies, and have a higher probability of limb loss and death [2].

The cornerstones of vascular damage control are resuscitation, hemorrhage control and blood flow re-establishment. In recent decades, resuscitative endovascular balloon of the aorta (REBOA) has been used as a temporary adjunct, redistributing the circulating blood volume, raising arterial pressure and increasing heart and brain perfusion. Many models are currently available around the world but, unfortunately, in many regions, none is commercialized [3,4].

Regarding limb reperfusion, unstable patients are unsuitable for complex techniques, such as autologous venous grafts. If the injury cannot be treated by simple ligature or lateral suture, the implantation of a temporary vascular shunt (TVS) is usually advised [5], but industrial models are frequently unavailable in less-provided regions.

This article reports a case in which materials often available in general hospitals were improvised for REBOA and TVS.

Ethical Approval and Informed Consent

Informed consent from the patient was obtained; ethical approval was not required as all data were anonymized.

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The patient endorsed the description of her clinical course for educational purposes.

CASE REPORT

A 27-year-old female patient sustained a penetrating injury from an agricultural lawn mower blade to her left thigh at an isolated area in the Amazon region. She was rescued by boat and ambulance in an approximately 400 km journey to the hospital, which took about 8 hours. Unfortunately, no additional pre-hospital data was able to be retrieved.

On admission, airways were clear, the patient had no palpable peripheral pulses and blood pressure was 80 × 50 mmHg. The blade was still in place at the femoral vessel topography and no active hemorrhage was noticed (Figure 1).

The patient was immediately taken to the operating room (OR), received general anesthesia and had her clothes removed; during this process the blade was unintentionally dislodged, but no bleeding was triggered. The anesthesiologist gave the alert that the carotid pulse was no longer palpable, but pulsatility was still detected on ultrasound and arterial blood pressure was 76 × 40 mmHg. The traumatic wound was tamponed with a surgical sponge and a cut down to the left common femoral artery was made, aiming for both proximal control and aortic occlusion.

Common, profunda and femoral (superficial) arteries were dissected. A small transverse arteriotomy was performed at the common femoral artery and a 6 Fr Fogarty thrombectomy catheter was inserted, advanced until the xiphoid topography and inflated for an aortic Zone 1 occlusion; arterial pressure rose to 101 × 47 mmHg and a carotid pulse was reassumed (Figure 2).

The balloon was kept insufflated while surgical exploration confirmed a complete transection of the femoral artery and vein (both thrombosed at that time) and a femur fracture. Thrombectomy and local anticoagulation were performed, and pieces of an 18 Fr nasogastric tube were inserted as TVSs for both the artery and vein; fasciotomies of four compartments were performed on the leg and orthopedic surgeons installed an external fixator for the fracture (Figure 3).

After 30 minutes the aortic balloon was deflated, the catheter was removed and the arteriotomy was closed. The patient was sent to the intensive care unit (ICU) for continued resuscitation.

At postoperative day 2 the patient was stable, distal pulses were palpable on the right lower limb, no distal pulses were palpable on the left side, but the left foot presented satisfactory perfusion. The patient was moved back to the OR; the arterial shunt was still patent and the venous one was occluded.

TVSs were explanted; the femoral vein was ligated, and a segment was harvested and used as an interposition graft, restoring femoral artery flow. After 2 more days the patient was discharged from the ICU and remained waiting for fasciotomy closure by the plastic surgery team.

Figure 1 The blade: in place and after unintentional removal. (**a**) Blade still in place at femoral vessel topography in the emergency room. (**b**) Blade after being removed in the operating room (a 20 cc syringe was used for scale).

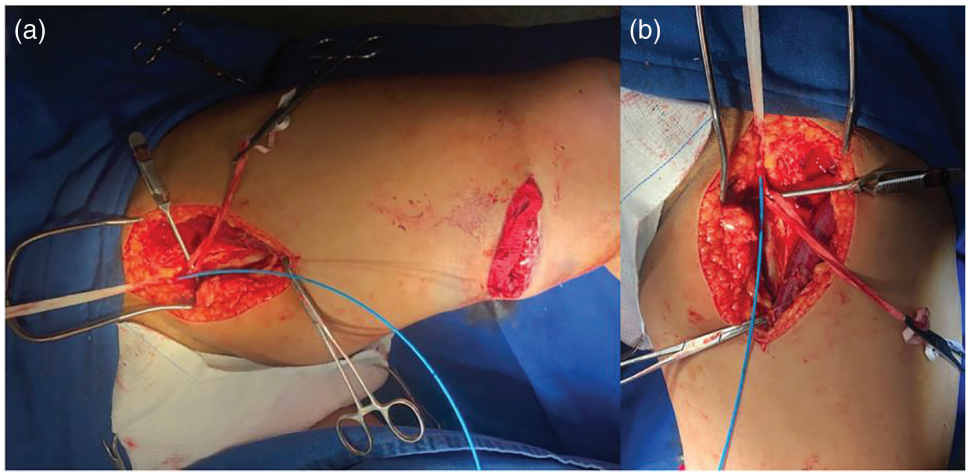

Figure 2 Intraoperative: access for REBOA insertion. (**a**) Proximal incision for common femoral artery access; notice the traumatic wound tamponed by a surgical sponge. (**b**) 6 Fr Fogarty catheter introduced at the common femoral artery.

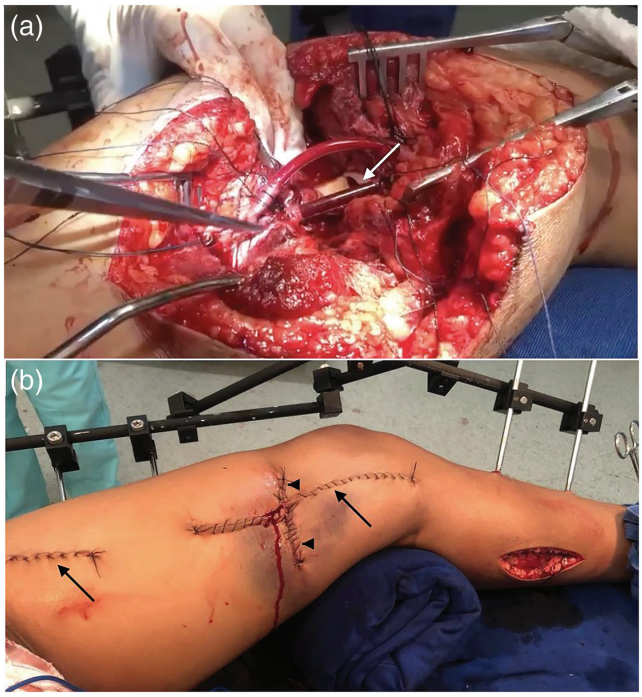

Figure 3 Intraoperative: shunts in place and surgical incisions. (**a**) Arterial and venous shunts (nasogastric tube pieces) in place, the arrow points to the femur fracture. (**b**) Arrows point to the surgical incisions (the proximal one for REBOA insertion and arterial control, and the distal one for the vascular exploration). The arrow heads point to the traumatic wound. Notice one of the leg incisions for fasciotomy.

DISCUSSION

REBOA was first described in 1954, during the Korean War [6,7]. As the years passed by, specific devices were developed and currently at least 22 commercial devices, with diameters ranging from 5 Fr to 14 Fr, are available [8].

Three aortic zones have been stablished for REBOA insufflation; insufflation in Zone 2 should be avoided, to prevent visceral ischemia; the most common trauma-related indication for aortic Zone 3 occlusion is hypovolemic shock secondary to pelvic fractures and aortic Zone 1 occlusion can be performed in a variety of scenarios related to hypovolemic shock [9].

Access site complications are related to the device diameter and the operator's proficiency in gaining vascular access. Earlier REBOA models were 14 Fr, usually placed after cutdown to the common femoral artery, and access site complications were about 21%. Most modern devices are <7 Fr and they are frequently inserted under ultrasound guidance, with an approximately 7% complication rate [10].

Evidence suggests partial and intermittent REBOA lead to fewer ischemic complications and some of the new catheters are made specifically to achieve partial occlusion (pruned REBOA) [11].

In this case, since no industrial device was available, a REBOA device was improvised with a 6 Fr Fogarty catheter. The catheter could be inserted through a 6 Fr introducer sheath, but neither sheaths nor any other endovascular resources were available. Previous studies have shown that the descending aorta diameter in young patients ranges from 17 to 20 mm. Because a 6 Fr Fogarty catheter can achieve a 12 mm diameter when inflated at its maximum volume (4.5 cc), partial aortic occlusion can be achieved in young patients [12].

If the catheter had been inserted through a cutdown made for the contralateral common femoral artery, with TVSs in place, the balloon could have been deflated, restoring vascular flow through the shunts, allowing the arteriotomy to be sutured with limb circulation already reassumed. On the other hand, a surgical cutdown on the ipsilateral side of the injured vessels, as performed in this case, provides proximal arterial

control and REBOA access simultaneously. The arteriotomy can be narrow, so that it can be quickly closed by a few stiches or by a purse string suture around the catheter [5,13].

In an even more austere scenario, if a Fogarty catheter is not available and aortic occlusion is required, the surgeon may consider inflating a Foley catheter inserted though the axillary artery, or cross clamping the descending aorta through thoracotomy.

After stopping the bleeding, flow restoration is the next priority. Vessel reconstruction may require complex procedures, such as bypasses with an autologous vein graft, but time-consuming techniques are unsuitable for unstable patients. TVSs have long been proved to be effective for vascular damage control [14].

All lower extremity veins are amenable to ligation if the situation requires it, but experimental and clinical data suggest that shunting the vein, as performed in this case, provides better outflow, reducing vascular resistance and improving the arterial shunt function. There are many commercial shunts available. They can be either inserted in a "loop" or "in-line" fashion. Looping shunts are easier to insert, but the in-line configuration tends to offer better flow [15].

Fixation is usually obtained by Rummel tourniquets or by inflating balloons at the extremities, simultaneously occluding the vessel's edges and avoiding bleeding [16].

There are two important limitations regarding the use of commercial TVS models in damage control: the diameter of many shunts may be unsuitable for fitting the lumen of larger vessels, commonly injured in scenarios like the one reported in this paper, and commercial models are frequently unavailable at hospitals located in underserved areas.

Any material with adequate length and diameter can be used to improvise a TVS [17,18] and nasogastric tubes come in a variety of diameters that suit most of the injured vessels.

When using TVSs, some technical steps should be kept in mind:

(1) Shunts should be inserted into unobstructed vessels. If patency cannot be assured by antegrade and retrograde bleeding from the vessel's edges, a Fogarty catheter of appropriate size (usually 3 or 4 Fr for extremity injuries) may be used for arterial thrombectomy, while venous thrombectomy (because of venous valves) is usually obtained by manual compression or by using elastic bandages [16].
(2) After patency has been confirmed, the vessels' edges should be flushed with saline and heparin to prevent early re-occlusion. The literature is not unanimous on how to do this, but many surgeons dilute 1 mL (5.000 IU) of heparin in 250 mL of saline and flush each vascular stump with approximately 20 mL of that solution [16,19].

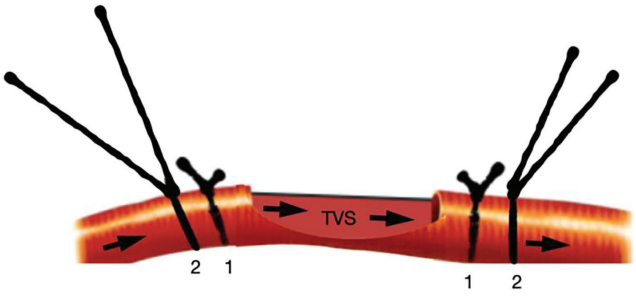

Figure 4 Temporary vascular shunt insertion: the arrows refer to the vascular flow direction; 1 and 2 represent cerclage knots. Notice the long lengths left on purpose, to help identify the structures during reoperation. TVS: temporary vascular shunt.

(3) Larger TVS diameters tend to offer better flow and longer patency, but they should comfortably fit the vascular lumen, avoiding excessive endothelial damage. The vein is usually compatible with a larger shunt than its corresponding artery. If any residual vessel wall remains, it can be kept, preventing vessel edge retractions [16,20].
(4) For fixing improvised TVS, external cerclage knots should be applied. Two independent cerclages on each vascular edge provide additional security, preventing TSV dislodgement and hemorrhage. Leaving a long length on these cerclages helps identify the structures during reoperation [20] (Figure 4).
(5) The presence of a TVS, partially filling the vessel's lumen, limits the flow, and thus prophylactic fasciotomies should be performed; this favors TVS function and reduces compartmental syndrome consequences [18,21].

CONCLUSION

REBOA and temporary vascular shunts have become essential tools for vascular damage control. Unfortunately, access to proper commercial devices is uneven around the globe.

When dealing with severe vascular injuries, especially in rural or underserved areas where access to appropriate devices is not possible, surgeons may need to improvise materials to accomplish certain surgical strategies and deliver the best possible treatment they can. The practical key points presented in this paper may be helpful in such scenarios.

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.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Author Contributions

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

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Tips and Techniques

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A Pilot Study of Proactive Team REBOA to Avoid Delays to Definitive Care

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As experience using resuscitative endovascular balloon occlusion of the aorta (REBOA) has expanded over the past few years, best practices for implementing a REBOA program have emerged. Early practice was single-surgeon focused, but we have learned that a team approach to REBOA practice is common in successful programs. Key components of our contemporary team approach are defining a patient selection algorithm, uniform acceptance of early CFA access, full team training, regular case reviews, and implementation of a process improvement program. This team approach to REBOA has resulted in numerous benefits for trauma patients with, most importantly, a significantly decreased time to definitive hemorrhage control. Here, we describe our experience and outcomes as a Level 1 Trauma Center implementing a REBOA program, shifting our hemorrhage control paradigm from reactive to proactive, and subsequently improving time to both temporary and definitive hemorrhage control maneuvers.

Keywords: *REBOA; Process Improvement; Time to Intervention*

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INTRODUCTION

The broad implementation of Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) in trauma has evolved rapidly in the past decade. Over-the-wire, 12 Fr occlusion balloons were initially used in a small number of centers to develop experience that was foundational to broader implementation when devices designed for trauma became available early in 2016 [1]. Devices specifically created for trauma were followed by procedural improvements which shifted REBOA use from solely being an alternative to a resuscitative thoracotomy to a procedure used proactively in noncompressible torso hemorrhage. Common femoral arterial (CFA) access shifted toward being ultrasound guided, and has been recognized as an independent intervention to guide resuscitation rather than as merely the first step in REBOA. These early devices were time limited to 30 min of occlusion in aortic Zone 1 secondary to the risks of increased ischemia as the only option was complete aortic occlusion. More recently, a purpose-built partial REBOA catheter has enabled the routine implementation of partial occlusion to achieve further refinements such as reduced distal ischemia and prolonged safe partial occlusion time [2,3].

In the process of launching and sustaining a REBOA program, our center has continued to implement a process improvement initiative to maximize the utility and minimize the risks of endovascular aortic occlusion. In doing so we have observed a dramatic change in our REBOA use and team dynamics during this procedure. We have clearly differentiated between REBOA practiced as we first implemented it and our current use of endovascular hemorrhage control. We sought to quantify these differences to enumerate the change from reactive to proactive, and from REBOA that delayed definitive care to REBOA that was part of an efficient and effective trauma bay, which does not delay surgical or other resuscitative interventions. To quantify these changes and promulgate best practices, we reviewed trauma bay videos, direct observations, and operative records to compare our early experience with contemporary performance.

METHODS

As part of an ongoing process improvement, we conducted a video review of procedures performed in the trauma bay and grouped them according to an early cohort and a contemporary cohort consisting of the first

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10 cases and more recent 10 cases. We created a relative timeline with the start of the first procedure set as $T = 0$ and examined the following procedures: collection of belongings, attachment to monitors, measurement of blood pressure (BP), REBOA, thoracotomy, blood product transfusion, splinting/reduction, wound exploration, diagnostic peritoneal aspiration (DPA), chest tube placement, extended focused assessment with sonography for trauma (EFAST), pelvic x-ray, chest x-ray, blood draw, urine drug screen (UDS) sampling, urine pregnancy test, extremity imaging, common femoral artery percutaneous line placement, open exposure of the common femoral artery for placement of sheath access, intraosseous (IO) access, trauma line (large bore venous access), peripheral access, Foley catheter placement, rectal examination, spine/back examination, lower extremity examination, upper extremity examination, pelvis examination, chest and abdomen examination, head and neck examination, removal of patient clothing (exposure), Glasgow coma scale (GCS) assessment, circulation assessment, breathing assessment, airway assessment, transition of the patient from the emergency medical services (EMS) cart to the trauma evaluation cart, and EMS timeout. We examined time as an independent variable and time from arrival to initiation of REBOA, time from initiation of REBOA to completion of occlusion, number of concurrent procedures, and time to definitive control of hemorrhage as dependent variables.

RESULTS

We observed a significant improvement in our performance of the REBOA procedure, with overall efficiency improved in several key metrics. Key to these improvements was a focus not only on REBOA training and experience, but a shift in our approach to early CFA access. At our institution, early CFA access occurs when the initial non-invasive systolic blood pressure (SBP) reading is less than 90 mmHg, the patient has received ongoing blood product resuscitation to maintain an SBP > 90 mmHg, or the patient had a previous traumatic cardiac arrest prior to arrival and spontaneous circulation was achieved (Table 1). The majority of early CFA access cases do not progress to a REBOA placement. In the minority of cases where hypotension is confirmed and response to initial resuscitation is not satisfactory, time from arrival to initiation of REBOA decreased from a mean of 11.1 min to 7.5 min, a reduction of one third (32%) (Table 2). The improved speed in decision making contributed to improvements in proficiency in insertion of a 7 Fr sheath, preparation and insertion of a REBOA catheter, and balloon inflation which decreased by 48% overall (7.1 min to 3.7 min). These improvements reflect a successful process which were matched by other impactful benefits to the process of care, with the number of procedures performed concurrently with REBOA increased by 360% (from 3 to 11) (Figure 1). These incremental improvements in decision making, REBOA technique, team organization, and performance combined to improve overall time to proceed to definitive control by 52% from 32.3 min to 15.6 min.

Table 1: Trauma center CFA access guidelines and REBOA guidelines.

Procedure	*Indications*
CFA access	• Cuff SBP < 90 mmHg, or • Transient responder to transfusion, or • Profound, refractory shock, or • OHCA with ROSC
REBOA	• Blunt or penetrating injury, and • SBP < 90 mmHg, and • Transient responder to 1–2 units whole blood or • Profound hypotension or • Arrested but not beyond salvage (ATLS Guidelines)

CFA: common femoral access, SBP: systolic blood pressure, mmHg: millimeter of mercury, OHCA: out of hospital cardiac arrest, REBOA: resuscitative endovascular balloon occlusion of the aorta, ROSC: return of spontaneous circulation, ATLS: advanced trauma life support.

Table 2: Comparison between early and experienced REBOA cases.

	First 10 REBOAs	*Last 10 REBOAs*	*p value*
Initiation time (min)	11.1	7.5	0.032
REBOA time (min)	7.1	3.7	0.027
Concurrent procedures (*n*)	3	11	0.014
Time to OR/IR (min)	32.3	15.6	0.021

"Initiation time" is the time from patient presentation to start of the REBOA procedure. "REBOA time" is the length of time to perform the REBOA procedure. "Concurrent Procedures" is the number of overlapping procedures the team was performing during the REBOA procedure. "Time to OR/IR" is the time from patient presentation when the decision was made to proceed to definitive hemorrhage control.

DISCUSSION

We observed significant changes in the use of REBOA at our institution as a result of deliberate process improvement and the intangible improvements inherent in the accumulation of experience over time. These improvements accumulated due to a team focused on improving efficiency of care, but are not the result of a single-minded focus on REBOA; the procedure remains relatively infrequent for an individual provider. We observed a striking improvement in the most important metric, time to definitive hemorrhage control. This metric has been previously shown to be impactful for survival [4]. This important metric reflects improvements

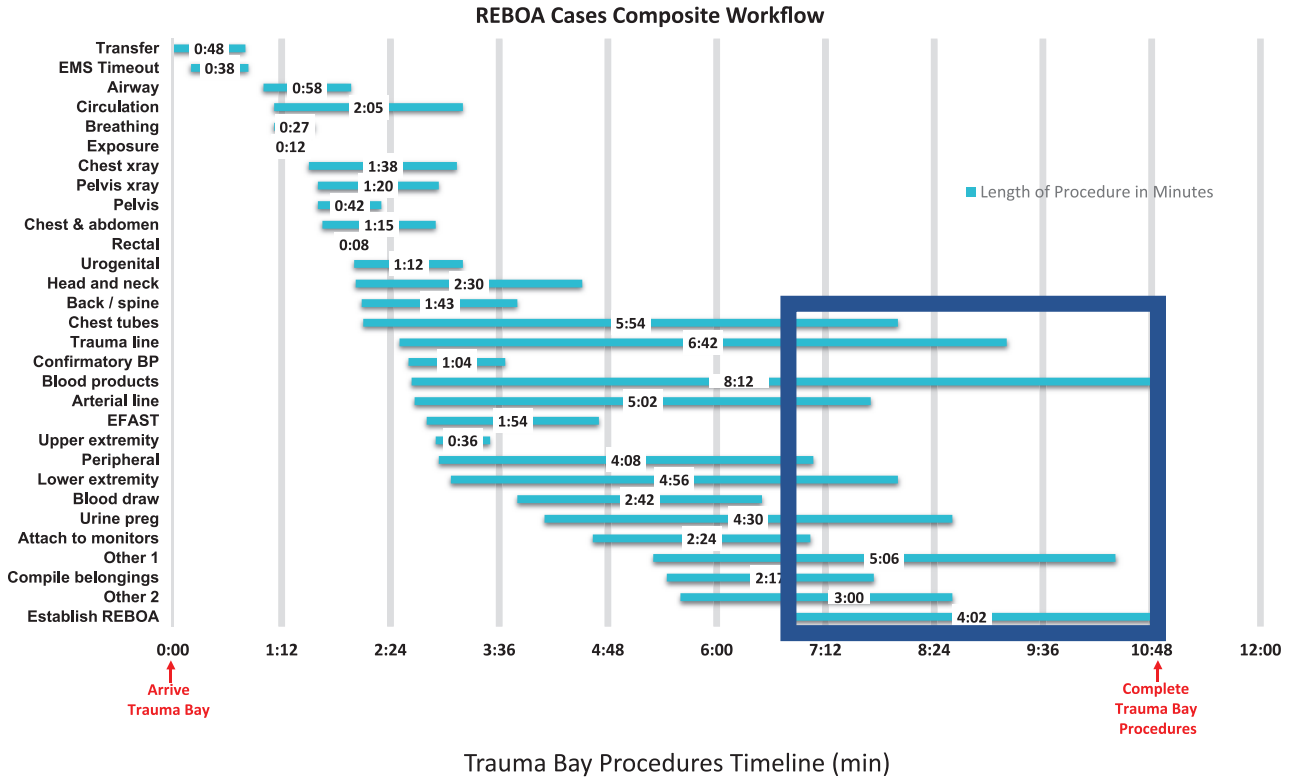

Figure 1 Trauma bay procedures in the 10 most recent cases where REBOA was performed. All procedure times are relative to the first trauma bay procedure. Procedures that were initiated or concluded within the period between REBOA initiation and REBOA completion were counted as concordant. This parallel performance of procedures reflects the development of improved proficiency and improved team coordination, which differs from the initial cases of REBOA where other procedures were delayed while REBOA was performed.

in several sub-steps which were measured in this process improvement review. These include faster initial decision to perform REBOA, procedural proficiency, and a dramatic increase in parallel treatment. Key to effective patient selection was our institution's development and adoption of a patient selection algorithm and uniform acceptance of early CFA access as a measure to assist in the treatment of patients presenting with traumatic hemorrhage. This transformation to CFA access and REBOA performed concurrently with other necessary diagnostic and resuscitative procedures is particularly noteworthy. In the early days of our REBOA program, the decision to perform the procedure was often followed by the trauma team lead becoming engrossed in CFA access and catheter manipulation while the rest of the team stopped to watch this novel procedure. Contemporary practice has access delegated to other members of the team (usually senior residents or advanced practice providers) while the rest of the team continues with their responsibilities and the trauma surgeon continues to lead and manage care.

Key to these improvements was gaining consensus on patient selection [5], and clinical adoption of this consensus. While patient selection guidelines vary, there is broad consensus and ample evidence that following guidelines results in improved outcomes [6]. As has been widely noted, CFA access is a key to success, and provides actionable physiologic information independent of its use for REBOA. More recently, our institution joined a group of centers implementing a next-generation partial REBOA (pREBOA) catheter. This process of implementing the pREBOA-PRO was guided by the observations above. Namely, a consensus guideline was developed, key steps such as catheter preparation deployment and removal were rigorously trained, and reviews of each case were conducted to improve these processes. This process improvement program has now become institutional and has contributed to the rapid refinement of partial REBOA implementation through monthly multicenter case reviews. These multicenter process improvement efforts led to the rapid dissemination of best practices. The refinements in procedure evolved alongside refinements in device design and treatment guidelines. Key recommendations from these efforts can be applied by anyone seeking to implement a REBOA program: start with a consensus among providers regarding early CFA access and patient selection guidelines; develop and implement realistic simulation-based team

training along with arterial pressure monitoring and sheath management checklists to minimize avoidable complications; finally, conduct timely process improvements to yield improved outcomes.

Our observations are concordant with prior studies of the evolution of REBOA, with registry studies of REBOA in Japan [7] and the USA [8] both identifying better outcomes as REBOA procedures and devices continue to improve. Another consistent finding is the impact of case volume on success, with several studies documenting the value of moderate to high case volume [9,10]. We perform approximately two REBOA cases a month along with 10 CFA procedures, which we have found to be sufficient to enable meaningful process improvement. Our results provide insight into specific enhancements, which contribute to this broad improvement in REBOA, including better team dynamics evidenced by the increase in concurrent procedures and enhanced procedural capabilities evidenced by faster times to occlusion and faster times to definitive hemorrhage control.

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

M Chance Spalding is a member of the Prytime Medical Devices Speaker's Bureau and has received support for travel, food and beverage during speaking engagements. He does do not have any financial interests or support from Prytime outside of the Speaker's Bureau.

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Author Contributions

MCS conceived of the original study idea. Both MCS and UP compiled and analyzed data and wrote the manuscript with support.

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Images of interest

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Endovascular Embolization of a Bleeding Liver

Resident Corner

Anna Stene Hurtsén

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

Keywords: *Liver Bleeding; Endovascular Coiling*

Received: 20 August 2023; Accepted: 2 October 2023

We present the case of a 37-year-old patient admitted after a motorcycle crash. He was hemodynamically stable. On computer tomography angiography (CTA) a 13 × 12 × 8 cm^3 low-attenuated area within the right lobe of the liver with signs of contrast leakage was found, appearing as a large liver laceration with hematoma and active extravasation (Figure 1). Also, a 5 mm subcapsular free fluid was detected. On the basis of the hemodynamic conditions, we opted for an endovascular approach and embolization for bleeding control was proposed. We used a 2.7 Fr microcatheter (Progreat™, Terumo, Tokyo, Japan). Embolization was performed by delivering seven 2 mm microcoils (Penumbra Ruby® Soft Coil, Alameda, CA, USA) (Figures 2–6). The patient remained hemodynamically stable after the procedure. Postoperative CTA after 12 hours did not show signs of ongoing bleeding, free air or intra-abdominal free fluid. No abscesses in the liver were found on follow-up CTA on days 2, 8 and 11, and no ischemic damage could be seen radiologically on day 29. The patient was monitored in the Intensive Care Unit for 11 days. Liver enzymes were normalized after 12 days and the patient was discharged after 16 days.

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Email: annasteneh@gmail.com

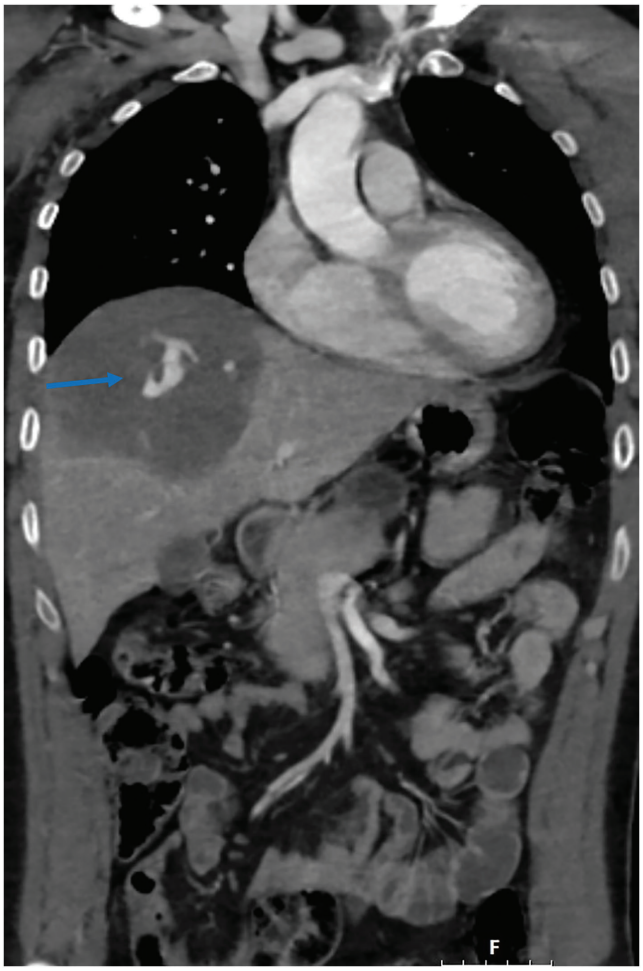

Figure 1 CTA performed in the emergency setting revealed active extravasation in the liver (arrow).

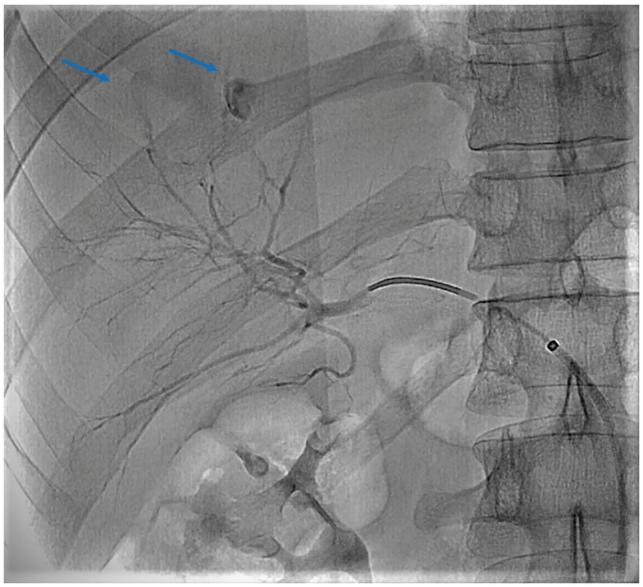

Figure 2 Selective angiography revealed an active blush from two separate arterial branches (arrows).

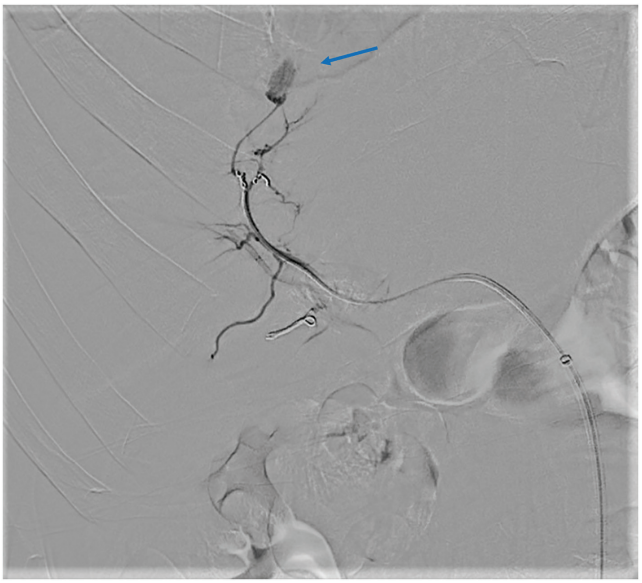

Figure 4 Super selective angiography of the first branch (arrow) reveals persistent extravasation after delivery of two microcoils.

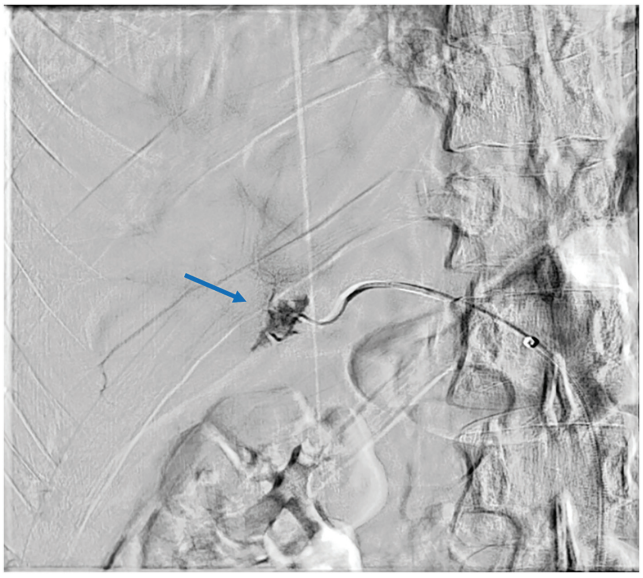

Figure 3 Extravasation (arrow) after advancement of a guidewire and microcatheter, with possible iatrogenic injury.

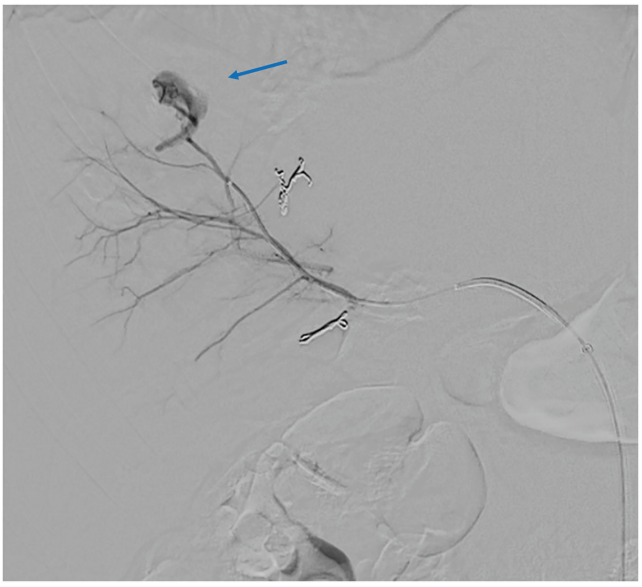

Figure 5 Super selective angiography of the arterial branch causing the second extravasation (arrow).

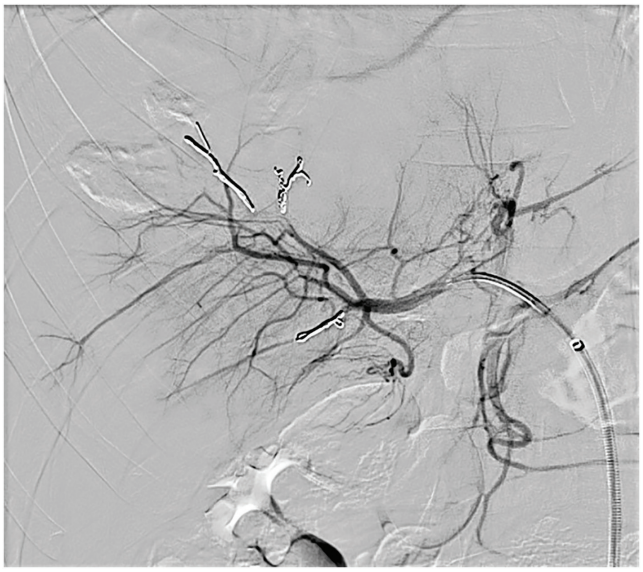

Figure 6 The final angiogram post coiling shows no further blood extravasation.

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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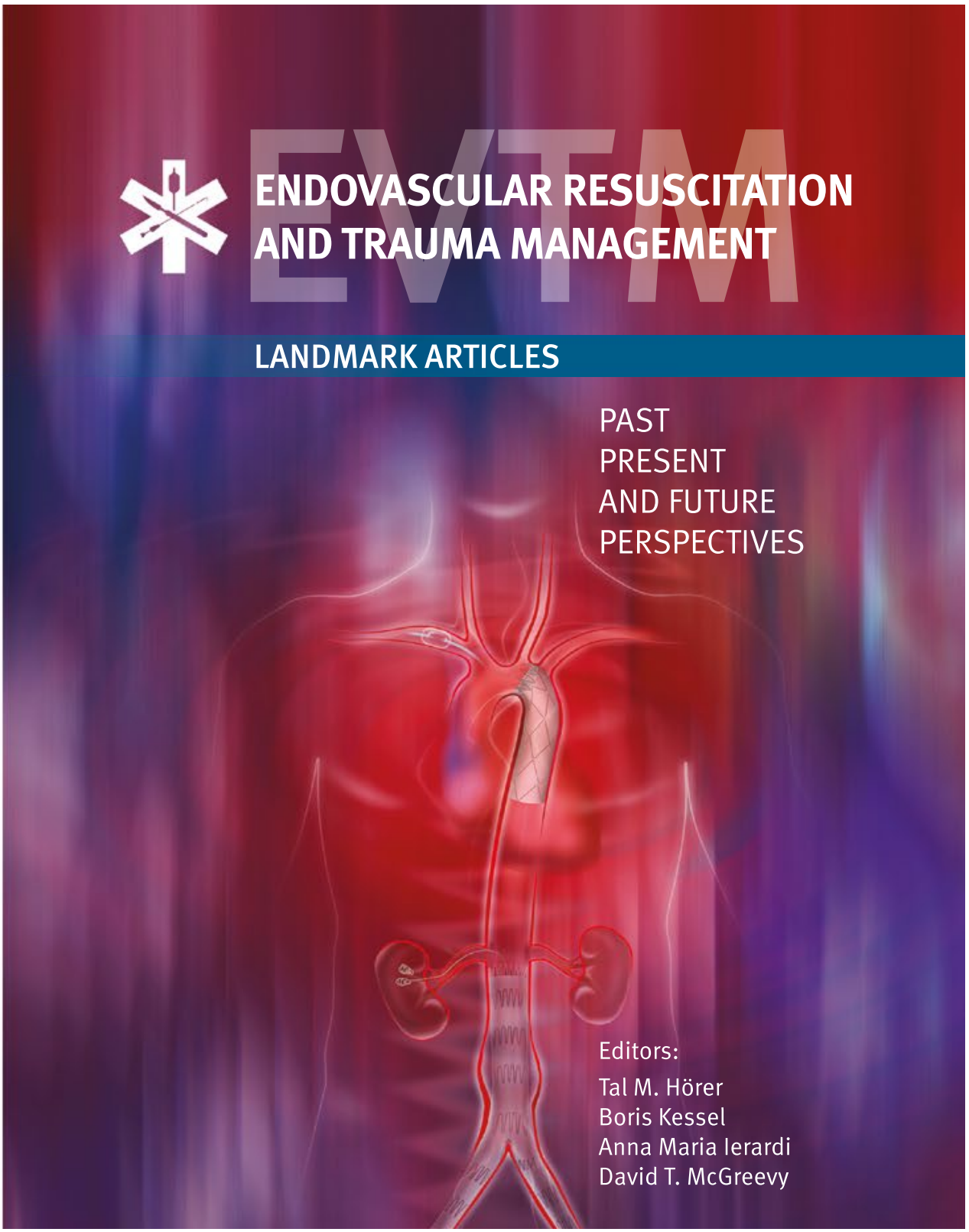
EVTM Landmark Articles



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Education

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

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

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

please email: david.mcgreevy@regionorebrolan.se

Coming Meetings

Paris Vascular Insights (PVI), 8–10 November 2023, Carrousel du Louvre, Paris
https://www.paris-vascular-insights.com/?gclid=Cj0KCQiA-oqdBhDfARIsAO0TrGFoe51P3UW8bzwWUkw68fh_HshDIR-wN6n2O8FTrI5ZYf9nTc4ws-egaAlOYEALw_wcB

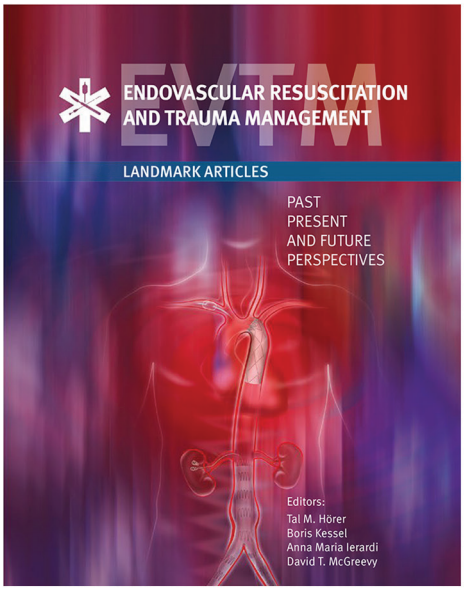
VEITH Symposium, 14–18 November 2023, New York
https://www.veithsymposium.org/index.php

EndoVascular resuscitation and Trauma Management (EVTM), Hands-on Workshop, 25–26 January 2024, Örebro University Hospital, Sweden

23rd European Congress of Trauma and Emergency Surgery (ECTES), 28–30 April 2024, Lisbon, Portugal
https://estes-congress.org/

EVTM Round Tables Symposium, 3–5 or 17–19 October 2024 (TBA), Örebro University Hospital, Sweden

Books



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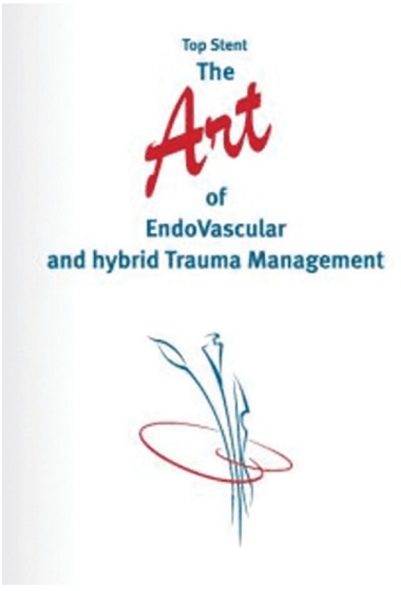

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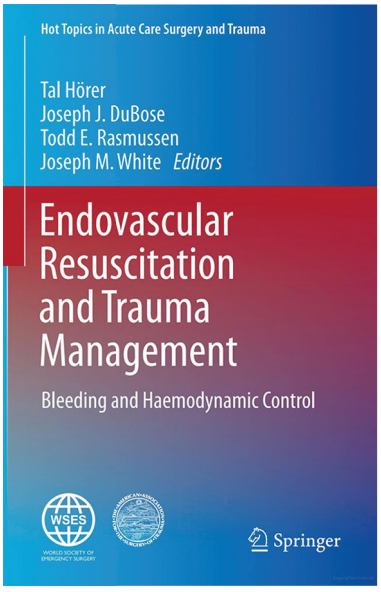

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EndoVascular resuscitation *and* Trauma Management (EVTM)

Hands-on Workshop 25–26 January 2024

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: 25–26 January 2024

Workshop Directors: Tal Hörer and David McGreevy

Workshop Registration: asa.strandberg@regionorebrolan.se
david.mcgreevy@regionorebrolan.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.

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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. 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

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

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

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