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Resuscitative Endovascular Balloon Occlusion of the Aorta 'REBOA': Indications – Advantages and Challenges of Implementation in Traumatic Non-Compressible Torso Hemorrhage: A Scoping Review Protocol

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Keywords:	TRAUMA MANAGEMENT, ACCIDENT & EMERGENCY MEDICINE, Resuscitative Endovascular Balloon Occlusion of the Aorta, Damage control measures in trauma, therapeutic aortic occlusion, Trauma resuscitation

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6 **Resuscitative Endovascular Balloon Occlusion of the Aorta ‘REBOA’: Indications –**
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8 **Advantages and Challenges of Implementation in Traumatic Non-Compressible**
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10 **Torso Hemorrhage: A Scoping Review Protocol**
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14 Omar Bekdache ¹ MD; Tiffany Paradis ² BSc.; Yu Bai He Shen ² BSc.; Aly Elbahrawy ^{1,3}
15 MD; Jeremy Grushka ¹ MD, MSc ; Dan L. Deckelbaum ¹ MD, MPH ; Kosar Khwaja ¹
16 MD, MSc ; Paola Fata ¹ MD ; Tarek Razek ¹ MD, FRCSC, FACS and Andrew Beckett ^{1,4}
17 MD, FRCSC, MSc.
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23
24 ⁽¹⁾ Department of Trauma and Acute Surgical Care, MUHC
25

26 ⁽²⁾ McGill University. Faculty of Medicine
27

28 ⁽³⁾ Medical Research Institute, Alexandria University, Egypt
29

30 ⁽⁴⁾ Royal Canadian Medical Services
31
32

33 Correspondence to be sent to: Omar Bekdache MD. McGill University Health Center.
34 Montreal. Canada. (omar.bekdache@mail.mcgill.ca)
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37
38 **Abstract:**
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40 **Introduction:**
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42 Hemorrhage remains the leading cause of preventable death in trauma. Damage control
43 measures applied to patients in extremis in order to control exsanguinating bleeding from
44 non-compressible torso injuries use different techniques to limit blood flow from the
45 Aorta to the rest of the body. Resuscitative Endovascular Balloon Occlusion of the Aorta
46 - ‘REBOA’ - is regaining momentum recently as an adjunct measure that can provide the
47 same results using less invasive approaches. This scoping review aims to provide a
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3 comprehensive understanding of the existing literature on REBOA. The objective is to
4 analyze evidence and non-evidence-based medical reports and to describe current gaps in
5 the literature about the best indication and implementation strategies for REBOA.
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10 **Methods and Analysis:**

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12 Using the five-stage framework of Arksey and O'Malley's scoping review methodology
13 as a guide, we will perform a systematic search in the following databases: MEDLINE,
14 EMBASE, BIOSIS, COCHRANE CENTRAL, PUBMED and SCOPUS from the earliest
15 available dates till January 15, 2018. The aim is to identify diverse studies related to the
16 topic of REBOA. For a comprehensive search, we will explore organizational websites,
17 key journals, and hand-search reference lists of key studies. Data will be charted and
18 sorted using a descriptive analytical approach.
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28 **Ethics and Dissemination:**

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30 Ethics approval is not necessary as the data are collected from publicly available sources
31 and there will be no consultative phase. The results will be disseminated through
32 presentations at local, national, clinical and medical education conferences and through
33 publication in a peer-reviewed journal.
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41 **Keywords:** Balloon occlusion of the Aorta – REBOA – therapeutic aortic occlusion -
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43 Damage control measures in trauma – Trauma resuscitation
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Article Summary

Strengths and limitations of this study

- This scoping review is a novel review approach applied for the first time to this topic and will offer an overarching picture on the variety of clinical indications, application, and implementation of REBOA.
- Findings will have implications on researchers for recognizing the pearls, pitfalls, and contextual variations in implementation strategies.
- This review will comprise broad inclusion criteria (peer review journal and Grey literature) without assessing the quality of the articles included which gives the breadth and comprehensiveness of the research protocol while respecting the scoping review guidelines
- Findings will be limited to articles written in English
- Contacts of researchers and experts for additional complementary information will be limited

Introduction

Mortality resulting from hemorrhage remains the leading cause of preventable death. In the case of an abdominal trauma with exsanguinating - life-threatening - injuries, laparotomy followed by rapid abdominal aortic clamping has been an important initial step to prevent hemorrhagic death. Recently, there has been a movement towards less invasive techniques to manage non-compressible hemorrhage, such as resuscitative endovascular balloon occlusion of the aorta (REBOA). The actual concept of endovascular aortic occlusion for transient hemorrhagic control is not new. This technique was originally reported in 1954 by Lieutenant Colonel Carl W. Hughes who performed the procedure on two critically ill soldiers ¹. Although both patients did not survive, the potential of its use as a resuscitative measure was proven. Later on, a study comparing REBOA to the standard method of laparotomy and abdominal aortic clamping revealed a higher survival rate amongst the REBOA group ². However, it is important to note that REBOA is not a permanent solution; rather it is a temporary hemodynamic stabilization of the patient prior to surgical management. A recent systematic review examining the outcomes of REBOA in the literature discusses the importance of a maximum aortic occlusion time of 60 minutes. This study also draws attention to the fact

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3 that most studies report on mortality outcomes with little information on the occlusion
4 zone and complications ³.

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8 Our scoping review will provide a snapshot of the old and current, evidenced and non-
9 evidenced based guidelines used in REBOA. It will identify empirical facts that inform
10 researchers on the current practices of REBOA and possible gaps in knowledge. The
11 primary objective of this research is to map the available evidence on the techniques and
12 protocols of REBOA found in peer reviewed and Grey literature. Additionally, this
13 scoping review will contribute to defining the challenges of implementation, as well as
14 the clear setup of comprehensive quality indicators and competency assessment of the
15 technique.
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28 **Methods and Analysis:**

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31 To the authors' best knowledge, there is no existing published evaluation of the new
32 generation of REBOA catheter in the trauma settings, which make a scoping review
33 interestingly pertinent to this topic area. This scoping review follows the scoping review
34 framework developed by Arksey and O'Malley ⁴, which has been enhanced further by
35 Levac et al. ⁵ and Joanna Briggs Institute (JBI) ⁶. The results will be reported following
36 the Preferred Reporting Items for Systematic Reviews and Meta-Analysis for Protocols
37 (PRISMA-P) guidelines ⁷. This method includes the following five steps: (1) identifying
38 the research question; (2) identifying relevant studies balancing breadth and
39 comprehensiveness; (3) study selection using an iterative team approach; (4) charting the
40 data; and (5) collating, summarizing and reporting the results as they relate to the study
41 purpose and implications of the study findings for policy, practice, and research.
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Stage 1- identifying the research question

Based on our described objectives, this primary review seeks to identify the following parameters:

- Benefits of REBOA – What are the clear indications, pitfalls, and advantages of its use compared to other available modalities?
- Application of REBOA – Which selective population will benefit the most from its application through comprehensively designed algorithms?
- Implementation of REBOA – What are the challenges of the adoption of the technique into the armamentarium of advanced trauma centers? Special attention will be paid to the credentialing, quality indicators, and competency assessment parameters.

In addition, emphasis will be focused on the following points:

1. Mapping the existing literature on REBOA technique
2. Identifying features needed for the successful implementation of REBOA into trauma programs
3. Clarifying the important variables necessary for the evaluation of the technique, its outcome, and its efficacy
4. Reporting the complications and long-term outcomes associated with REBOA
5. Identifying areas for future development

We hypothesized that the current literature could be categorized in order to identify critical knowledge gaps and help in guiding future research activities.

Stage 2- Identifying relevant studies

A comprehensive review was developed with the help of an experienced health sciences

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3 librarian at the University of McGill using specific Medical Subject Headings (MeSH)
4 terms and keywords related to REBOA to capture the relevant literature accurately. The
5 search strategy follows the three-step approach recommended by JBI scoping review
6 guidelines ⁵. The search was initially conducted using Medline electronic database and
7 saved to ensure reproducibility of the search results (Table 1). Second, we will identify
8 relevant related terms and keywords (“balloon occlusion”, “embolization, therapeutic”,
9 “therapeutic occlusion”, “aorta”, “aorta occlusion”, or “artificial embolization”,
10 combined with “resuscitation”, as well as “REBOA”). The quest will be supplemented by
11 a vast grey literature search through Google Scholar, organizational websites of various
12 relevant organizations, our institutional database, conference abstract or reviews to
13 identify any related studies. Finally, we will screen the bibliography of selected articles to
14 identify articles relevant to this scoping review. We will frequently seek feedback from
15 our research team to refine our search strategy, and we will contact authors of relevant
16 primary studies or reviews for further information if needed. We will also assess the
17 quality of our search protocol using the PRESS 2015 Evidence-based checklist guidelines
18 ⁸. All references will be imported into an online bibliographic management program
19 (EndNote^R Library) ensuring the removal of duplicates. We will also report the search
20 strategy for the databases in the online supplementary appendix as outlined in a Preferred
21 Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement ⁹.

46 **Stage 3- Study Selection:**

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49 Two independent reviewers (TP & YB) will apply a two-step approach screening to
50 determine the eligibility of articles according to their inclusion and exclusion criteria. The
51 eligibility criteria will be developed in consensus by the research team and serve as a
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3 filter for relevant sources. The first step will consist of a title and abstract scan and the
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5 second will entail a full-text review of all identified citations from step one. A second
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7 reviewer (OB) will intervene in case of skepticism of the first reviewers about inclusion
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9 eligibility of specific titles and abstracts. A sample of the retrieved articles (i.e., 20
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11 percent) will be screened by the second reviewer (OB) to ensure a consistent application
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13 of the eligibility criteria for inclusion in the review. Disagreements about study eligibility
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15 of the sampled articles will be discussed between the three reviewers until a consensus is
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17 reached and we will confer to a third reviewer (AB) if no agreement is reached.
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24 **Inclusion criteria:**

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26 The inclusion criteria are formulated based on the ‘Population- Intervention- Comparison
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28 - Outcome (PICO)’ framework - recommended by Schardt, C et al. to improve searching
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30 PubMed for clinical questions ¹⁰.
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33 **Exclusion criteria:**

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35 The following were excluded:
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- 38 1. Studies describing the outcomes of REBOA use in non-trauma cases.
- 39 2. Studies including pediatric cases
- 40 3. Animal studies
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46 Inclusions and exclusions criteria are summarized in table 2.
47

48 **Stage 4- Data Charting**

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50 The research team will develop a data-charting form (Table 3). Since a scoping review
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52 aims to provide a comprehensive view of the literature, data extracted from relevant
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54 studies will include general information about each article such as author, publication
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3 year, country, study purpose, settings, methodology, outcomes, key findings, reported
4 challenges and limitations.
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8 In addition, we will extract information specific to areas of REBOA indication and
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10 protocol implementation. Data will include the topic of the article, the type of study
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12 (review, commentary, primary research), paper design and study settings. The data
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14 charting form will be refined during the full-text screening to capture all pertinent
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16 information from each study. Articles that meet the eligibility criteria will be organized in
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18 data charting form using Microsoft Excel database. Three reviewers (TP, YB & OB) will
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20 pilot the data extraction form to answer the relevant research question.
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26 **Stage 5- Synthesizing**

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28 The fifth stage described by Arksey and O'Malley framework⁸ for collating and
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30 summarizing data will involve a descriptive numerical summary. We will summarize the
31
32 quantitative data in a table outlining the overall number of studies, countries, topics, type,
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34 year of publication, and study designs. Next, we will organize, stratify and analyze the
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36 themes identified from all studies. Our research team will constantly refine the data
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38 analysis.
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44 **Ethics and Dissemination:**

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47 This review will be the first scoping review to examine the literature 'At Large' in
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49 relation to the topic of REBOA. We anticipate that the results will identify the different
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51 modalities of the application of REBOA through designated trauma centers.
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22 [Methodology- for- JBI- Scoping- Reviews_ 2015_ v2.pdf](https://joannabriggs.org/assets/docs/sumari/Reviewers-Manual-Methodology-for-JBI-Scoping-Reviews_2015_v2.pdf)
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Authors' Contribution - Author Statement:

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3 OB, TP, YBS, and AB contributed to the project idea and the conceptual design of the
4 protocol. OB, AE, and AB supervised the research protocol. OB, TP, YBS conducted the
5 literature review and the search strategy. OB drafted the protocol. AE, JG, DD, PF, kk,
6 and TR contributed to editing and supervising of the search design. All authors approved
7 the final manuscript. AB and TR are the guarantors of the review.
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15 **Acknowledgment of additional contribution:**

16
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29 commercial or not-for-profit sectors.
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33 **Competing / Conflicts of interest statement:**

34
35 The research has no competing interest or any conflicts of interest to disclose.
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38 **Word Count:** 1530
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45 **Table 1. Search Strategy developed for MEDLINE using PICO Frame**

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47 Identify key concepts and provide synonyms of the following:
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49 Population: Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA)

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51 procedure data
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54 Intervention: Data collected on the implementation of REBOA, complications, and
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the variables used to evaluate its efficacy

Comparison: Successful REBOA performance and implementation versus non-successful

Outcomes: Identify key features needed to implement the REBOA technique, and identify important variables to collect in order to evaluate its efficacy.

Table 2. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
<i>Studies describing the implementation of REBOA at the facility level</i>	<i>Studies describing the outcomes of REBOA use in non-trauma cases such as orthopedic and post-partum hemorrhage</i>
<i>Studies reviewing the outcomes of REBOA use in trauma care including</i>	<i>Studies describing the use of REBOA in the setting of limb amputation or solely for orthopedic indications</i>
<i>Studies describing REBOA use in trauma and emergency medicine</i>	<i>Pediatric studies</i>
<i>Studies reporting complications of REBOA usage</i>	<i>Animal studies</i>
<i>Studies reporting junctional bleeding at the groin level</i>	<i>Elective procedures</i>
<i>Studies reporting REBOA insertion in zones one and three</i>	
<i>Studies describing REBOA use in non-compressive hemorrhage</i>	

Table 3. Draft Charting form

Study Characteristics	First Author last name Publication year Country
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	Topic Purpose Publication type Study Design Institutional academic status Funding
Technical Analysis	Location of insertion Catheter size Time to deployment Artery accessed Type of access Guided insertion Type of guidance Zone of deployment Imaging to confirm the position Volume Partial occlusion Intermittent occlusion Occlusion time Deflation time Time of sheath removal Location of sheath removal CFA repair CFA imaging
Mechanism and severity	Mechanism ISS – Injury Severity Score Injury location Type of injury Subsequent surgical procedure Operation Performed
Major Outcome	Blood and blood product use Follow Up Complications Incidence of complications Type of complications Mortality Cause of death

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Complete List of Authors:	Bekdache, Omar; McGill University Health Centre, Surgery Paradis, Tiffany; McGill University Faculty of Medicine Shen, Yu Bai; McGill University Faculty of Medicine Elbahrawy, Aly; McGill University Health Centre Grushka, Jeremy; McGill University Health Centre Deckelbaum, Dan; McGill University Faculty of Medicine, Khwaja, Kosar; McGill University Health Centre Fata, Paola; McGill University Health Centre Razek, Tarek; McGill University Health Centre Beckett, Andrew; McGill University Health Centre
Primary Subject Heading:	Surgery
Secondary Subject Heading:	Emergency medicine, Intensive care, Surgery
Keywords:	TRAUMA MANAGEMENT, ACCIDENT & EMERGENCY MEDICINE, Resuscitative Endovascular Balloon Occlusion of the Aorta, Damage control measures in trauma, therapeutic aortic occlusion, Trauma resuscitation

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31
32
33

34
35 Omar Bekdache: omar.bekdache@mail.mcgill.ca
36

37 Tiffany Paradis: tiffany.paradis@mail.mcgill.ca
38

39 Yu bai He Shen: yu.b.shen@mail.mcgill.ca
40

41 Aly Elbahrawy: aly.elbahrawy@mail.mcgill.ca
42

43 Jeremy Grushka: jeremy.grushka@mcgill.ca
44

45 Dan Deckelbaum: dan.deckelbaum@mcgill.ca
46

47 Kosar Khwaja: dr.k.khwaja@mcgill.ca
48

49 Paola Fata: paola.fata@mcgill.ca
50

51 Tarek Razek: tarek.razek@mcgill.ca
52

53 Andrew Beckett: andrew.beckett@mcgill.ca
54
55
56
57
58
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1
2
3 Correspondence to be sent to:
4

5 Omar Bekdache MD
6

7
8 1650 Cedar Avenue.
9

10 Montreal General Hospital.
11

12 H3G1A4
13

14 McGill University Health Center.
15

16
17 Montreal, Canada. (omar.bekdache@mail.mcgill.ca)
18
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20
21 **Abstract:**
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24 **Introduction:**
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26 Hemorrhage remains the leading cause of preventable death in trauma. Damage
27 control measures applied to patients in extremis in order to control exsanguinating
28 bleeding from non-compressible torso injuries use different techniques to limit blood
29 flow from the Aorta to the rest of the body. Resuscitative Endovascular Balloon
30 Occlusion of the Aorta - 'REBOA' - is regaining momentum recently as an adjunct
31 measure that can provide the same results using less invasive approaches. This
32 scoping review aims to provide a comprehensive understanding of the existing
33 literature on REBOA. The objective is to analyze evidence and non-evidence-based
34 medical reports and to describe current gaps in the literature about the best indication
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Article Summary

Strengths and limitations of this study

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- Findings will have implications on researchers for recognizing the pearls, pitfalls, and contextual variations in implementation strategies.
- This review will comprise broad inclusion criteria (peer review journal and Grey literature) without assessing the quality of the articles included, which gives the breadth and comprehensiveness of the research protocol while respecting the scoping review guidelines
- Scoping reviews are primarily descriptive in nature, and therefore quantitative data analyses are considered to be one of the relevant limitations
- Findings will be limited to articles written in English
- Contacts of researchers and experts for additional complementary information will be limited

Introduction

Mortality resulting from hemorrhage remains the leading cause of preventable death. In the case of an abdominal trauma with exsanguinating - life-threatening - injuries, laparotomy followed by rapid abdominal aortic clamping has been an important initial step to prevent hemorrhagic death. Recently, there has been a movement towards less invasive techniques to manage non-compressible hemorrhage, such as resuscitative endovascular balloon occlusion of the aorta (REBOA). The actual concept of endovascular aortic occlusion for transient hemorrhagic control is not new. This technique was originally reported in 1954 by Lieutenant Colonel Carl W. Hughes who performed the procedure on two critically ill soldiers ¹. Although both patients did not survive, the potential of its use as a resuscitative measure was proven. Later on, a study comparing REBOA to the standard method of laparotomy and abdominal aortic clamping revealed a higher survival rate amongst the REBOA group ². However, it is important to note that REBOA is not a permanent solution; rather it is a temporary hemodynamic stabilization of the patient prior to surgical management. A recent systematic review examining the outcomes of REBOA in the literature discusses the importance of a maximum aortic occlusion time of 60 minutes. This study also draws attention to the fact that most studies report on mortality outcomes with little information on the occlusion zone and complications ³.

Our scoping review will provide a snapshot of the old and current, evidenced and non-evidenced based guidelines used in REBOA. It will identify empirical facts that inform researchers on the current practices of REBOA and possible gaps in knowledge. The primary objective of this research is to map the available evidence on the techniques and protocols of REBOA found in peer reviewed and Grey literature. Additionally, this scoping review will contribute to defining the challenges

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2
3 of implementation, as well as the clear setup of comprehensive quality indicators and
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5 competency assessment of the technique.
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7 **Methods and Analysis:**

8 Patient and public involvement:

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11 Patients and/or public were not involved in this study. The results will be
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13 disseminated through presentations at local, national, clinical and medical education
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15 conferences and through publication in a peer-reviewed journal.
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19 To the authors' best knowledge, there is no existing published evaluation of the new
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21 generation of REBOA catheter in the trauma settings, which make a scoping review
22
23 interestingly pertinent to this topic area. We will perform a systematic search in the
24
25 following databases: MEDLINE, EMBASE, BIOSIS, COCHRANE CENTRAL,
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27 PUBMED and SCOPUS from the earliest available publications. Start date of data
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29 collection was January 2018. End date of the study is November 2018.. This scoping
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31 review follows the scoping review framework developed by Arksey and O'Malley ⁴,
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33 which has been enhanced further by Levac et al. ⁵ and Joanna Briggs Institute (JBI) ⁶.
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35 The results will be reported following the Preferred Reporting Items for Systematic
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37 Reviews and Meta-Analysis for Protocols (PRISMA-P) guidelines ⁷. This method
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39 includes the following five steps: (1) identifying the research question; (2) identifying
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41 relevant studies balancing breadth and comprehensiveness; (3) study selection using
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43 an iterative team approach; (4) charting the data; and (5) collating, summarizing and
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45 reporting the results as they relate to the study purpose and implications of the study
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47 findings for policy, practice, and research.
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53 **Stage 1- identifying the research question**

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55 Based on our described objectives, this primary review seeks to identify the following
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57 parameters:
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- 3 • Benefits of REBOA – What are the clear indications, pitfalls, and advantages
- 4 of its use compared to other available modalities?
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- 8 • Application of REBOA – Which selective population will benefit the most
- 9 from its application through comprehensively designed algorithms?
- 10
- 11
- 12 • Implementation of REBOA – What are the challenges of the adoption of the
- 13 technique into the armamentarium of advanced trauma centers? Special
- 14 attention will be paid to the credentialing, quality indicators, and competency
- 15 assessment parameters.
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22 In addition, emphasis will be focused on the following points:

- 23 1. Mapping the existing literature on REBOA technique
- 24
- 25 2. Identifying features needed for the successful implementation of REBOA into
- 26 trauma programs
- 27
- 28 3. Clarifying the important variables necessary for the evaluation of the
- 29 technique, its outcome, and its efficacy
- 30
- 31 4. Reporting the complications and long-term outcomes associated with REBOA
- 32
- 33 5. Identifying areas for future development
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40 We hypothesized that the current literature could be categorized in order to identify

41 critical knowledge gaps and help in guiding future research activities.

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45 **Stage 2- Identifying relevant studies**

46 A comprehensive review was developed with the help of an experienced health

47 sciences librarian at the University of McGill using specific Medical Subject

48 Headings (MeSH) terms and keywords related to REBOA to capture the relevant

49 literature accurately. The search strategy follows the three-step approach

50 recommended by JBI scoping review guidelines⁵. The search was initially conducted

51 using Medline electronic database and saved to ensure reproducibility of the search

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3 results (Table 1). Second, we identified relevant related terms and keywords (“balloon
4 occlusion”, “embolization, therapeutic”, “therapeutic occlusion”, “aorta”, “aorta
5 occlusion”, or “artificial embolization”, combined with “resuscitation”, as well as
6
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10 “REBOA”). The quest will be supplemented by a vast grey literature search through
11
12 Google Scholar, organizational websites of various relevant organizations, our
13
14 institutional database, conference abstract or reviews to identify any related studies.
15
16 Finally, we will screen the bibliography of selected articles to identify articles
17
18 relevant to this scoping review. We will frequently seek feedback from our research
19
20 team to refine our search strategy, and we will contact authors of relevant primary
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22 studies or reviews for further information if needed. We will also assess the quality of
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24 our search protocol using the PRESS 2015 Evidence-based checklist guidelines ⁸. All
25
26 references will be imported into an online bibliographic management program
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28 (EndNote^R Library) ensuring the removal of duplicates. We will report the search
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30 strategy for the databases as outlined in the Preferred Reporting Items for Systematic
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32 Reviews and Meta-Analyses (PRISMA) statement ⁹.
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40 **Stage 3- Study Selection:**

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42 Two independent reviewers (TP & YB) will apply a two-step approach screening to
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44 determine the eligibility of articles according to their inclusion and exclusion criteria.
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46 The eligibility criteria will be developed in consensus by the research team and serve
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48 as a filter for relevant sources. The first step will consist of a title and abstract scan
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50 and the second will entail a full-text review of all identified citations from step one.
51
52 A second reviewer (OB) will intervene in case of skepticism of the first reviewers
53
54 about inclusion eligibility of specific titles and abstracts. A sample of the retrieved
55
56 articles (i.e., 20 percent) will be screened by the second reviewer (OB) to ensure a
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3 consistent application of the eligibility criteria for inclusion in the review.
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5 Disagreements about study eligibility of the sampled articles will be discussed
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7 between the three reviewers until a consensus is reached and we will confer to a third
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9 reviewer (AB) if no agreement is reached.
10

11 **Inclusion criteria:**

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13 The inclusion criteria are formulated based on the 'Population- Intervention-
14
15 Comparison - Outcome (PICO)' framework - recommended by Schardt, C et al. to
16
17 improve searching PubMed for clinical questions ¹⁰.
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20 **Exclusion criteria:**

21
22 The following were excluded:
23

- 24 1. Cadaveric studies
 - 25 2. Animal studies
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32 Inclusions and exclusions criteria are summarized in table 2.
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34 **Stage 4- Data Charting**

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36 The research team will develop a data-charting form (Table 3). Since a scoping
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38 review aims to provide a comprehensive view of the literature, data extracted from
39
40 relevant studies will include general information about each article such as author,
41
42 publication year, country, study purpose, settings, methodology, outcomes, key
43
44 findings, reported challenges and limitations.
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48 In addition, we will extract information specific to areas of REBOA indication and
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50 protocol implementation. Data will include the topic of the article, the type of study
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52 (review, commentary, primary research), paper design and study settings. The data
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54 charting form will be refined during the full-text screening to capture all pertinent
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56 information from each study. Articles that meet the eligibility criteria will be
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58 organized in data charting form using Microsoft Excel database. Three reviewers (TP,
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3 YB & OB) will pilot the data extraction form to answer the relevant research
4
5 question.
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8 **Stage 5- Synthesizing**

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10 The fifth stage described by Arksey and O'Malley framework⁸ for collating and
11 summarizing data will involve a descriptive numerical summary. We will summarize
12 the quantitative data in a table outlining the overall number of studies, countries,
13 the quantitative data in a table outlining the overall number of studies, countries,
14 topics, type, year of publication, and study designs. Next, we will organize, stratify
15 and analyze the themes identified from all studies. Our research team will constantly
16 refine the data analysis.
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23 **Ethics and Dissemination:**

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25 This review will be the first scoping review to examine the literature 'At Large' in
26 relation to the topic of REBOA. We anticipate that the results will identify the
27 different modalities of the application of REBOA through designated trauma centers.
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30 Ethics approval is not necessary as the data are collected from publicly available
31 sources and there will be no consultative phase. The results will be disseminated
32 through presentations at local, national, clinical and medical education conferences
33 and through publication in a peer-reviewed journal.
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17 **Authors' Contribution - Author Statement:**

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19 OB, TP, YBS, and AB contributed to the project idea and the conceptual design of the
20 protocol. OB, AE, and AB supervised the research protocol. OB, TP, YBS conducted
21 the literature review and the search strategy. OB drafted the protocol. AE, JG, DD,
22 PF, kk, and TR contributed to editing and supervising of the search design. All
23 authors approved the final manuscript. AB and TR are the guarantors of the review.
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31
32
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41

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46
47
48

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50
51 The research has no competing interest or any conflicts of interest to disclose.
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54 **Word Count:** 1605
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Table 1. Search Strategy developed for MEDLINE using PICO Frame

Identify key concepts and provide synonyms of the following:

<u>Population:</u> Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) procedure data
<u>Intervention:</u> Data collected on the implementation of REBOA, complications, and the variables used to evaluate its efficacy
<u>Comparison:</u> Successful REBOA performance and implementation versus non-successful
<u>Outcomes:</u> Identify key features needed to implement the REBOA technique, and identify important variables to collect in order to evaluate its efficacy.

Table 2. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Studies describing the implementation of REBOA at the facility level	Cadaveric studies
Studies reviewing the outcomes of REBOA use in trauma care including	Animal studies
Studies describing REBOA use in trauma and emergency medicine	
Studies reporting complications of REBOA usage	
Studies reporting junctional bleeding at the groin level	
Studies reporting REBOA insertion in zones one and three	
Studies describing REBOA use in non-compressive hemorrhage	

Table 3. Draft Charting form

Study Characteristics	First Author last name Publication year Country Topic Purpose Publication type Study Design Institutional academic status Funding
Technical Analysis	Location of insertion Catheter size Time to deployment Artery accessed Type of access Guided insertion Type of guidance Zone of deployment Imaging to confirm the position Volume Partial occlusion Intermittent occlusion Occlusion time Deflation time Time of sheath removal Location of sheath removal CFA repair CFA imaging Training level of performer Accredited course vs. peer training Credentials of performer Specialty of performer
Mechanism and severity	Mechanism ISS – Injury Severity Score Injury location Type of injury Subsequent surgical procedure Operation Performed
Major Outcome	Blood and blood product use Follow Up Complications Incidence of complications Type of complications Mortality Cause of death

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For peer review only