



Systematic Review

Radial Hemostasis Devices and Post-Procedural Arterial Occlusion: Network Meta-Analysis of Randomized Controlled Trials

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Abstract

Background/Objectives: Radial artery occlusion (RAO) following hemostasis after coronary procedures is the most common complication, with a highly variable incidence (1–33%). While it is well established that the patent hemostasis technique reduces RAO rates, it remains unclear which device should be preferred. The wide variety of available radial hemostasis devices makes it necessary to identify those associated with a lower incidence of complications. **Methods:** Literature from 2016 to 2021 was reviewed through a systematic search in PubMed, CINAHL, Cochrane, and Embase databases. Only randomized controlled trials (RCTs) involving adult patients undergoing percutaneous transradial coronary procedures were included. Devices considered included pneumatic compression devices, manual compression, elastic bandages, and hemostatic dressings. The review process followed PRISMA guidelines. Two random-effects frequentist network meta-analyses were conducted to compare the effects of 16 and 9 radial hemostasis devices on RAO incidence at 24 h and 30 days after the procedure. **Results:** A total of 17 RCTs were included. The network meta-analysis (NMA) showed a protective effect at the 24 h endpoint for both double-balloon devices and pneumatic compression devices adjusted to mean arterial pressure. At the 30-day endpoint, significant differences were observed among pneumatic compression, chitosan-based PADs, mechanical compression devices, and adjustable elastic bandages. **Conclusions:** Although some treatments with specific devices significantly differ from the reference treatment, the limited availability of data to assess RAO at 30 days and a certain heterogeneity between devices indicate the need for further investigation.

Keywords: coronary procedures; radial access; radial hemostasis; hemostasis devices; network meta-analysis; RCTs



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1. Introduction

The femoral access route has been considered the preferred method for performing invasive cardiovascular diagnostic procedures for many years, and it is still widely used today [1]. However, complications related to this access route represent a significant source of morbidity and mortality and have been associated over time with prolonged hospital

stays, leading to a notable increase in costs [2]. As a result, a diagnostic/interventional approach using radial artery access has become widespread over the past decade and is now defined by international guidelines as the preferred route [3]. This choice is mainly due to the advantageous characteristics of the radial artery, which help reduce the incidence of complications related to the access site. Additionally, transradial access is preferred because it allows for early ambulation, reduces costs, and lowers mortality [4]. The radial approach, however, also has disadvantages, including a smaller diameter than the femoral artery, a higher frequency of anatomical anomalies, and procedural difficulties [5]. Among the most common complications, radial artery occlusion (RAO) is the most frequent. Although often asymptomatic, RAO can cause permanent damage to the radial artery, limiting its future use for coronary procedures. In patients with significant comorbidities, it may even lead to arteriovenous fistulas. It is well documented in the literature that adequate hemostasis can reduce the risk of vascular complications related to the access site [6]. Focusing on the hemostasis technique, the literature seems to agree on recommending the so-called “patent hemostasis,” which involves achieving hemostasis with a compression pressure just enough to prevent hemorrhage at the access site but avoiding occlusion, thus preserving distal flow [7]. However, radial hemostasis can be achieved in various ways while applying the “patent hemostasis” principle, ranging from classic manual compression and compressive bandages to devices that promote coagulation, as well as mechanical or pneumatic radial compression devices (hemostatic compression devices, HCDs). The extensive body of evidence on the various available devices raises the objective question of which may lead to fewer patient complications. The systematic review by Fernandez and Lee [8] included a limited number of studies and focused primarily on major complications, including RAO. Therefore, it seems appropriate to expand the review following the systematic methodology used by the authors.

Objectives

As with the original systematic review by Fernandez & Lee [8], this study aimed to identify the best available evidence on the effects of radial hemostasis devices used following percutaneous coronary procedures and their incidence on RAO rates. A secondary aim was to compare the effectiveness of the different devices using a network meta-analysis (NMA).

2. Materials and Methods

Given that this systematic review serves as an update to the previous review by Fernandez & Lee [8], which already had its protocol, no specific reference protocol was drafted as it would be redundant for this update. The previous review by Fernandez and Lee [8] was adopted as a protocol framework for this work. Minor amendments to the original review structure were reported where necessary. PRISMA guidelines were followed for reporting.

Research Question: What hemostatic device, used after a transradial percutaneous coronary procedure, exposes patients to a lower incidence of RAO?

Inclusion Criteria: The study followed the same inclusion criteria of Fernandez and Lee [8]:

Sample: Studies involving adult patients (>18 years) who underwent a transradial percutaneous coronary procedure were included (excluding procedures performed via other arterial access sites).

Hemostatic Devices Considered: Pneumatic compression devices, manual compression, elastic bandages, and hemostatic dressings were considered, excluding all other interventions (e.g., pharmacological administration).

Type of Studies: The search considered only randomized controlled trials (RCTs) (with any randomization technique). All other study types were excluded. **Outcomes:** The primary outcome was the incidence of RAO within 24 h post-procedure. Only studies where RAO incidence was assessed using objective measures, such as the Allen test, Barbeau test, ultrasound Doppler, or angiographic evidence, were considered. The secondary outcome was the incidence of RAO 30 days after the coronary procedure.

Search Strategy and updates: The search strategy involved updating the evidence through consultation with the major biomedical databases previously used by Fernandez & Lee [8] on 25 May 2016:

- CINHAL;
- Embase;
- PubMed;
- Cochrane Central Register of Controlled Trials.

The last update of the search was conducted on 19 July 2021, using the search strategy defined by the authors of the original review [8], with the only difference being the application of filters for age restrictions (adults > 18 years), the study type sought (RCT), language (English or Italian), and publication date (from 2016 to 2021). Two researchers (GC, MB) independently assessed the records retrieved; in the case of disagreement, the opinion of a third researcher (MBe) was sought. The search initially identified 425 records. After removing duplicates ($n = 150$), the titles and abstracts of the remaining studies were screened, and their availability in full-text format was verified. Articles not directly accessible were requested through the Biomedicine Libraries Service of Lombardy (SBBL), and if not retrievable, additional requests were made through the national interlibrary system. Nineteen studies were assessed for eligibility. After further exclusions, six from the updated search and three from the original review (reasons detailed in Appendix A), a total of 17 articles were included in the final analysis. The PRISMA Flow Diagram outlining the selection process is provided in Supplementary Figure S1.

2.1. Data Extraction

Qualitative and quantitative data extraction was conducted according to the fields defined by the JBI-MAStARI “Data Extraction Tool” used in the original review. All fields were transferred into a spreadsheet, which was completed independently by two researchers for each included study.

2.2. Quality Assessment

The methodological quality of the included RCTs was evaluated by two independent reviewers using the “Standardized Critical Appraisal Checklist” from the Joanna Briggs Institute Meta-analysis of Statistics Assessment and Review Instrument (JBI-MAStARI) [9], the same tool used in the 2017 review. Disagreements were resolved through discussion.

The included studies received scores ranging from 6/10 to 8/10. Six papers [10–15] scored 8/10, six received a rating of 7/10 [7,16–20], and five were rated 6/10 [21–25]. Considering that one element of the checklist evaluated patients’ blinding to treatment (which was not possible in this case) and that the average score of the studies was 7/10, the overall quality of the studies can be considered satisfactory. The table in Appendix B summarizes the quality assessment.

2.3. Statistics

A frequentist random-effects NMA was performed using the DerSimonian and Laird method to compare the efficacy of the different treatments. When not reported by the original authors, relative risk (RR) estimates and 95% confidence intervals (CIs) were

calculated. Heterogeneity was assessed using the tau-squared (τ^2) statistic, representing between-study variance. Treatment rankings were calculated using the netranking method, which has been shown by Rücker and Schwarzer [26] to be equivalent to the SUCRA method in Bayesian network meta-analyses.

2.4. Data Analysis

Data analyses were performed using the online version of MedCalc® for basic statistics calculations (RR, CI, SE) and R software V.4.4.2 with the *netmeta* [26] and *gemtc* [27] packages to conduct network meta-analysis.

3. Results

3.1. General Results

This systematic review included 17 studies [7,10–25] with a total sample size of 16,117 patients (mean 948). The studies were conducted in countries from around the world, including Brazil [14,16,17], USA [24], UK [15,21], China [20,22], Canada [12], Belgium [10], Turkey [18], India [23], Greece [13], and Spain [19]. Only one study was multicentric [12].

Devices and approaches:

A total of 14 different devices were used: TR-Band [10,14–19,21–25], compressive dressing with sterile gauge [22], RadAR [11], StatSeal [21], Helix Compression Device [21], elastic dressing [17], custom compressive dressing [7,16,18,22], Ankaferd blood stopper [18], VasoBand [23], Vitatech Pressure Bondage [13], work device [22], chitosan-based PAD [20], RadiStop [15] and also manual compression [13,24]. The hemostasis methods achieved through device-applied compression can be classified as pneumatic [10,13–15,17–20,22–25], mechanical [11,12,15,21,22], elastic [7,14,17,20], Customized Compressive Dressing [7,16,18,22], manual [13,24], or a combination of these with some chemical pads or topic [18,20,21]. The most commonly used type of device was pneumatic compression.

There was considerable heterogeneity in the application protocols of these devices. Even when the same device was used, the method and duration of application varied across studies, making it difficult to assess and compare the impact of device type and compression strategy on RAO outcomes in a narrative synthesis.

Compression Times

Radial compression durations varied significantly, ranging from 1 to 4 h. Shorter compression times appeared effective in maintaining hemostasis [13,25], with no significant increase in RAO rates compared to other approaches. Conversely, longer compression durations did not demonstrate additional benefits [10,11,16,19,20], and one study reported a higher incidence of hematoma with extended compression times [24].

A summary of the main data from each study is provided in Supplementary Material, Table S1.

3.2. Network Meta-Analysis

The NMA concerning the incidence of RAO within 24 h compared 12 [7,10,14–16,18–20,22–25] of the 17 studies included in the review. The NMA concerning the incidence of RAO at 30 days was conducted on a subset of 7 studies [7,14,16,17,20,22,24] that reported such data. Where not already stated in the records, the relative risk was calculated for each study included in the quantitative data synthesis and reported in an electronic table. Across the systematic review, 27 distinct hemostasis methods for radial artery access were identified. It is important to note that variations in the use of the same device—such as differing compression durations—were considered separate treatment arms in the network meta-analysis. A summary of all treatments extracted from the literature is provided in Appendix C. Of these, 16 hemostasis methods were included in the 24 h RAO analysis, while 9 methods were analyzed for the 30-day RAO incidence.

RAO within 24 h:

Using the *gemtc* 0.8-4 R package, an initial network graph was generated to visually map the treatment comparisons across studies. In Figure 1, each letter represents a distinct treatment, and each connecting line denotes the presence of direct evidence. The figure shows only two closed loops (AHI and INO), each derived from a single three-arm study. This indicates that the network is primarily composed of direct comparisons, with minimal or no overlapping indirect evidence.

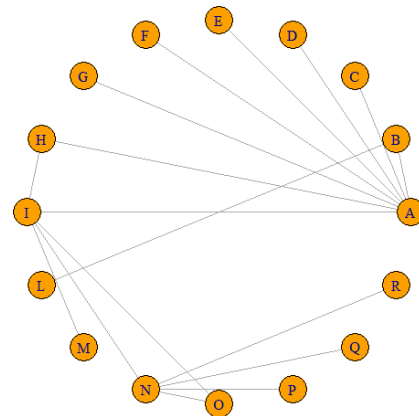


Figure 1. Treatments network of the NMA within 24 h.

Based on this graph, treatment “A” (which corresponds to the use of a commonly adopted pneumatic device kept in place for 2 h using the “patent hemostasis” technique) was selected as the reference treatment for the network meta-analysis. A frequentist random-effects NMA was then conducted (see Tables 1 and 2).

Table 1. Random model effects results.

ID	Treat1	Treat2	RR	IC 95%
Dangoisse, 2017	A	B	0.8597	[0.2163; 3.4169]
Dangoisse, 2017 (2)	A	C	3.1229	[0.1963; 49.6759]
Dos Santos, 2020	A	D	1.2548	[0.7024; 2.2415]
Patel, 2020	A	E	6.4488	[1.4855; 27.9961]
Sanghvi, 2018	A	F	0.6155	[0.2292; 1.6527]
Shah, 2019	A	G	0.517	[0.1394; 1.9174]
Gorgulu, 2018	A	H	1.9614	[0.1792; 21.4643]
Gorgulu, 2018	H	I	0.5074	[0.0464; 5.5501]
Gorgulu, 2018	A	I	0.9952	[0.1415; 6.9985]
Cubero, 2009	B	L	10.56	[2.5139; 44.3580]
Campos, 2018	I	M	1.1038	[0.6084; 2.0025]
Cong, 2016	I	N	0.4066	[0.2753; 0.6005]
Cong, 2016	N	O	3.1101	[2.0215; 4.7849]
Cong, 2016	I	O	1.2646	[0.7591; 2.1066]
Pancholy, 2008	N	R	2.4321	[1.2377; 4.7790]
Rathore, 2010	N	P	1.0857	[0.7010; 1.6815]
Dai, 2015	N	Q	2.0588	[1.1797; 3.5930]
Number of studies:			k = 13	
Number of treatments:			n = 16	
Number of pairwise comparisons:			m = 17	
Number of designs:			d = 13	

Table 2. Random effects model—treatment estimate. (Comparison: other treatments vs. ‘A’).

ID	RR	IC	z	p-Value
A				
B	1.1632	[0.2927; 4.6232]	0.21	0.83
C	0.3202	[0.0201; 5.0937]	−0.81	0.4198
D	0.7969	[0.4461; 1.4236]	−0.77	0.4432
E	0.1551	[0.0357; 0.6732]	−2.49	0.0128
F	1.6247	[0.6051; 4.3624]	0.96	0.3355
G	1.9342	[0.5215; 7.1734]	0.99	0.3239

Table 2. *Cont.*

ID	RR	IC	z	p-Value
H	0.5098	[0.0466; 0.5784]	−0.55	0.5811
I	1.0048	[0.1429; 7.0662]	0	0.9961
L	0.1102	[0.015; 0.8066]	−2.17	0.0299
M	0.9103	[0.1184; 6.997]	−0.09	0.9281
N	2.4713	[0.3381; 18.0625]	0.89	0.3727
O	0.7946	[0.1058; 5.967]	−0.22	0.8231
P	2.2762	[0.297; 17.4468]	0.79	0.4286
Q	1.2003	[0.1521; 9.4706]	0.17	0.8624
R	1.0161	[0.1243; 8.3033]	0.01	0.9881

It is noteworthy that this NMA did not capture heterogeneity or inconsistency due to the lack of overlap. Therefore, a netranking analysis (Table 3) was performed to determine the ranking of treatments; this method is equivalent to SUCRA.

Table 3. Netranking.

ID	P-Score
L	0.9157
E	0.8925
C	0.7121
H	0.6497
O	0.6071
D	0.5654
M	0.5352
R	0.4856
I	0.4841
A	0.47
B	0.4161
Q	0.4084
F	0.2977
G	0.2592
P	0.168
N	0.133

The results were then presented in a forest plot (in Figure 2) to facilitate their interpretation.

Most treatments do not differ significantly from the reference treatment (treatment A). However, two treatments appear to exert a protective effect against the incidence of RAO: treatment E (corresponding to the use of the “Vasoband” device) and treatment L (corresponding to the MAP-guided Tr Band™ device).

Clinical specifics: It is important to analyze the hemostasis methods that yielded significant results in more detail.

VasoBand: According to the authors, the VasoBand device (VASOInnovations, Inc., South Pasadena, CA, USA) is secured to the arm using a Velcro strap. It differs from conventional pneumatic compression devices due to its dual-balloon design, which is intended to compress both the radial and ulnar arteries. The ulnar balloon was inflated with 15 mL of air, while the radial balloon was inflated with 15–20 mL of air. After removal of the introducer sheath, the radial balloon was deflated until a small amount of blood was observed at the skin puncture site, and then reinflated with the minimal air volume needed to achieve dry hemostasis. The ulnar balloon was deflated 60 min after compression was initiated by the support team. No further adjustments to the hemostatic pressure were made. After 120 min, following the institutional protocol, the compression pressure was gradually reduced over 15 min, and the band was removed. A dry dressing with minimal pressure was then applied to the puncture site. Any inadequate hemostasis was managed by adjusting the hemostatic pressure at any point during the process [23].

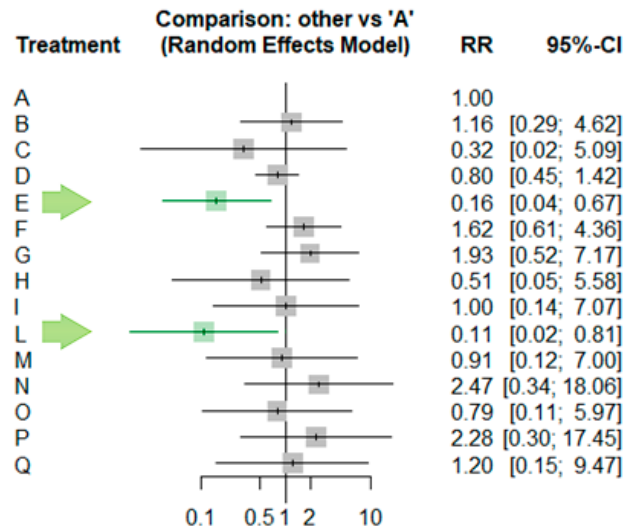


Figure 2. Forest plot—network meta-analysis of RAO within 24 h: treatment effect vs. treatment “A”.

This hemostasis procedure involved the use of the Terumo® TR Band™ (a bracelet with an inflatable balloon) guided by mean arterial pressure (MAP). In the study, the arterial introducer was removed immediately after the procedure, and the TR Band™ was applied, remaining in place for 3 h in both study groups. A custom inflator was developed using readily available tools commonly found in any catheterization laboratory to inflate the pneumatic device in the MAP-guided group. Using this inflator, researchers were able to measure the pressure exerted by the pneumatic device on the radial artery and inflate it with the amount of air required to reach the MAP value. MAP was measured through continuous invasive blood pressure monitoring using the “Calysto” monitoring system. The target pressure was the last recorded MAP value [19].

RAO AT 30 DAYS:

A subset of the studies included in the review reported data on the incidence of RAO at 30 days. Therefore, a second NMA was performed. Using the gemtc package, a network graph was generated (Figure 3).

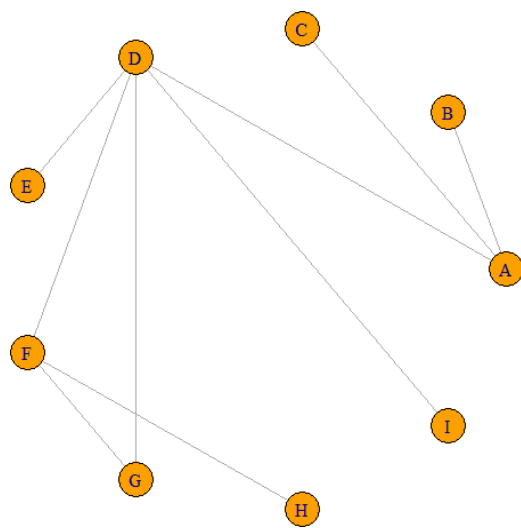


Figure 3. Studies network of the NMA at 30 days.

It is a smaller network compared to the previous one, featuring a single closed loop (DFG) corresponding to the direct evidence from a single three-arm study. Therefore, a frequentist random-effects NMA was conducted (Tables 4 and 5).

Table 4. Random model effect network meta-analysis.

ID	Treat1	Treat2	RR	95% IC
Dos Santos, 2020	A	B	0.8333	[0.2623;2.6473]
Sanghvi, 2018	A	C	0.7737	[0.176;3.4015]
Barbiero, 2018	A	D	1.5833	[0.7101;3.5303]
Campos, 2018	D	E	0.6835	[0.2729;1.7119]
Cong, 2016	D	F	4.4485	[2.5252;7.8365]
Cong, 2016	F	G	1.3047	[0.5978;2.8473]
Cong, 2016	D	G	5.8038	[3.0942;10.886]
Pancholy, 2008	D	I	3.9635	[1.3467;11.665]
Dai, 2015	F	H	2.1794	[1.1268;4.2153]
Number of studies			k = 7	
Number of treatments			n = 9	
Number of pairwise comparisons:			m = 9	
Number of designs:			d = 7	

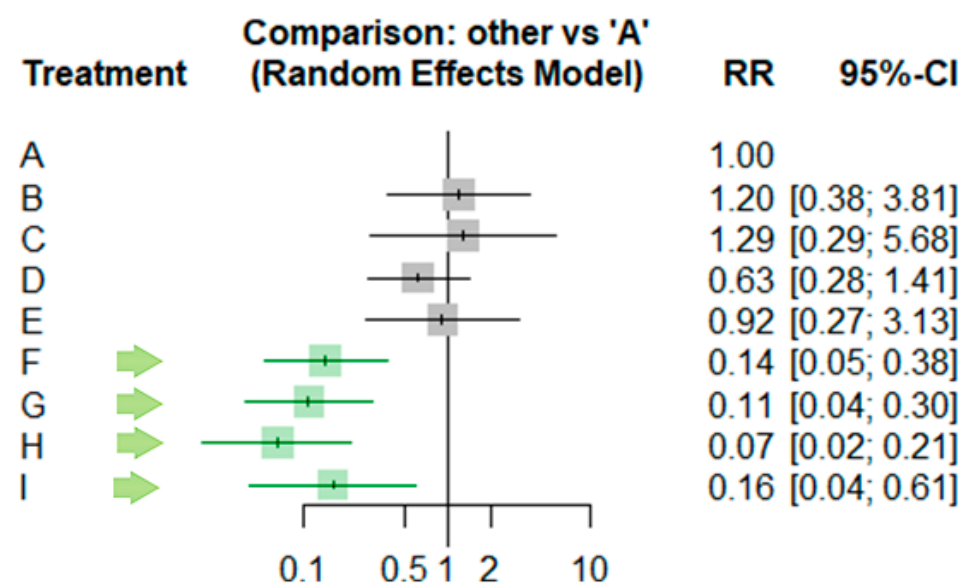
Table 5. Treatment estimation (other treatments vs. 'A').

ID	RR	95% CI	z	p-Value
A	1			
B	1.2	[0.3777;3.8124]	0.31	0.7572
C	1.2925	[0.294;5.6823]	0.34	0.7342
D	0.6316	[0.2833;1.4083]	−1.12	0.2614
E	0.9241	[0.2731;3.1269]	−0.13	0.8989
F	0.142	[0.0532;0.3789]	−3.9	<0.0001
G	0.1088	[0.0393;0.3015]	−4.27	<0.0001
H	0.0651	[0.02;0.2126]	−4.53	<0.0001
I	0.1594	[0.0415;0.6114]	−2.68	0.0074

A new netranking [26] was then performed (Table 6), and results were plotted in a new forest plot (Figure 4).

Table 6. Netranking for RAO at 30 days.

ID	P-Score
H	0.9654
G	0.8289
F	0.7282
I	0.7192
D	0.4099
E	0.2526
A	0.2298
B	0.1865
C	0.1795

**Figure 4.** Forest plot of the 30-day Network meta-analysis: treatment effect vs. treatment “A”.

As previously observed, some hemostasis treatments are associated with a lower incidence of RAO at 30 days compared to the reference treatment. These treatments include F (TR Band™ for 1 h before deflation), G (hemostasis with compression and use of chitosan-based PAD), H (WORK™ mechanical compression device), and I (the “patent hemostasis” technique achieved with a hemoband).

Clinical specifics:

Analyzing how these devices were used within their respective procedures is essential.

The TR Band™ and the WORK™ device were used according to the “patent hemostasis technique” [7], employing the minimal pressure necessary to maintain hemostasis and ensure the patency of the radial artery at the insertion site [22]. The devices remained in place for 1 h, after which hemostasis was assessed every 30 min. Once complete hemostasis was confirmed, the device was removed.

The chitosan-based pad was applied directly to the puncture site, maintaining pressure on the proximal area. Afterward, pressure was released to allow a small amount of blood to contact the pad, followed by the reapplication of constant pressure for approximately 10 min. A measurable elastic compression bandage was then applied and loosened every hour (as specified in the study protocol) until final removal.

Regarding the “patent hemostasis” technique achieved with a hemoband, the authors describe placing a plastic hemoband around the forearm at the insertion site. A 4×4 gauze pad wrapped around the cap of a needle was positioned over the entry point. A pulse oximeter was attached to the patient’s index finger, and the hemoband was tightened. With the introducer still in place, the ipsilateral ulnar artery was occluded, and the hemoband was gradually loosened until the plethysmographic signal returned, confirming radial artery patency. The dressing was then left in place for two hours.

4. Discussion

Despite the finding of statistical significance in the use of specific devices, clinical significance must also be considered. First, it should be explicitly stated that no device has demonstrated superiority in reducing RAO rates both within 24 h and at 30 days. The devices found to be significantly more effective belong to various categories, including pneumatic compression, mechanical compression, dual radial–ulnar compression, customized compression dressings, chitosan-based pads, and elastic bands, with the only exception being simple manual compression. This observation, while supporting the use of external compression devices, also indicates that none of them clearly stand out in preventing post-procedural RAO, either early or late, based on the current evidence. Moreover, it is noteworthy that all studies reporting a significantly better effect employed methodologies that maintained arterial flow during compression, thereby supporting the concept and clinical value of patent hemostasis.

Within the first 24 h post-procedure, two different methods using distinct pneumatic compression devices were employed to achieve hemostasis. One followed the recommended patent hemostasis technique [7], while the other used the patient’s mean arterial pressure (MAP) as a guide, which is an alternative approach to achieving patent hemostasis.

It is also important to consider differences in the timing of RAO assessment. For instance, Patel et al. [20] evaluated RAO presence only 1 h after achieving hemostasis, while Cubero et al. [25] assessed it 24 h post-procedure. Nonetheless, both control groups reported similar RAO incidence rates (12% vs. 10.2%), in line with other literature estimates suggesting an acute RAO incidence of up to 12% [7]. The lack of overlap between the studies and the consequent inability to assess the heterogeneity of this NMA is a significant limitation of this study. However, this also highlights the potential for future research. New studies employing standardized protocols, particularly regarding timing and methods of device

application, are needed to draw more definitive conclusions. Another relevant limitation concerns the temporal range of the included studies, all published up to 2021. Therefore, an updated NMA in the coming years is warranted. In light of these considerations, the results of the present NMA should be interpreted with caution.

5. Conclusions

The evidence found in the literature supports a personalized hemostasis approach based on the patient's clinical condition, moving away from overly standardized techniques. In this regard, the "patent hemostasis" technique is reconfirmed as essential. Although alternative methods, such as the MAP-guided approach, may yield comparable results in reducing the incidence of post-procedural RAO within 24 h, the lack of data at 30 days warrants caution in interpreting these findings. While some treatments using specific devices showed significantly different outcomes compared to the reference treatment, no substantial differences were observed among device types (pneumatic compression, mechanical compression, manual compression, chitosan-based pads, or elastic bands), provided that "patent hemostasis" is maintained for an adequate duration (between 1 and 2 h). The number of designs in a 1:1 ratio to the number of studies included in the network meta-analysis, along with the inability to assess heterogeneity, suggests that it may be more appropriate to extend the review to include a more significant number of studies and consider the use of additional NMA techniques. Further RCTs with standardized protocols are urgently needed to provide more robust evidence and inform clinical practice.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/jvd4030025/s1>, Figure S1: PRISMA flow chart; Table S1: Synoptic Table. Reference [28] is cited in the supplementary materials.

Author Contributions: Project administration: M.P., S.T. and S.M.; formal analysis: M.P., S.T. and A.B.; methodology: M.P., P.F. and M.B. (Mattia Bozzetti); investigation: G.C., M.B. (Mattia Bozzetti), M.B. (Maria Bertuol) and F.M.; writing: S.M., P.F., A.B. and F.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: This is a secondary literature study; original data are available in the original articles. The R source code is available upon motivated request.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A. Reasons for Studies Exclusion

Original review:

The following studies from the original review by Fernandez & Lee⁸ were excluded from the NMA:

1. [29]. Reason: Small sample size with no reported RAO.
2. [30]. Reason: Small sample size with no reported RAO.
3. [31]. Reason: The article is published in Chinese and not available in a full-text version.

Current research:

Following the eligibility assessment, the following studies were excluded:

1. [32]. Reason: The operator used the TR-Band device arbitrarily without a defined inflation protocol.
2. [33]. Reason: It is unclear how the TR-Band device was used (the amount of air inflated and the duration it remained in place are not specified).
3. [34]. Reason: Small sample size; unclear how much the TR-Band was inflated.
4. [35]. Reason: Small sample size; unclear how much the TR-Band was inflated.

5. [36]. *Reason:* It is unclear how the TR-Band device was used (the amount of air inflated and the duration it remained in place are not specified).
6. [37]. *Reason:* Small sample size with no reported RAO.

Appendix B. Quality Assessment

		Was The Assignment to Treatment Groups Truly Random?	Were Participants Blinded to the Treatment Allocation?	Was Allocation to Treatment Groups Concealed from the Allocator?	Were the Outcomes of People Who Withdrew Described and Included in the Analysis?	Were Those Assessing Outcomes Blind to the Treatment Allocation?	Were The Control And Treatment Groups Comparable at Entry?	Were Groups Treated Identically Other than for the Named Interventions?	Were Out-comes Measured in the Same the Same Way for All Groups?	Were Outcomes Measured Reliably?	Was Appropriate Statistical Analysis used?	SCORE
1	Ayyaz Ul Haq et al. [21]	Unclear	No	Unclear	Yes	No	Yes	Yes	Yes	Yes	Yes	6
2	Barbiero et al. [17]	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	7
3	Campos et al. [16]	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	7
4	Cong et al. [22]	Yes	No	No	Unclear	Unclear	Yes	Yes	Yes	Yes	Yes	6
5	Dangoisse et al. [10]	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
6	Dos Santos et al. [14]	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
7	Gorgulu et al. [18]	Yes	No	Unclear	Yes	No	Yes	Yes	Yes	Yes	Yes	7
8	Lavi et al. [11]	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	8
9	Lavi et al. [12]	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	8
10	Patel et al. [23]	Unclear	No	No	yes	no	Yes	Yes	Yes	Yes	Yes	6
11	Petroglou et al. [13]	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
12	Sanghvi et al. [24]	Unclear	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	6
13	Shah et al. [25]	Unclear	No	No	Yes	no	Yes	Yes	Yes	Yes	Yes	6
14	Rathore et al. [15]	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	8
15	Cubero et al. [19]	Unclear	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
16	Dai et al. [20]	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	7
17	Pancholy et al. [6]	Unclear	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7

Appendix C. Different Devices and Protocols Included in the Review Studies

1	Tr Band™ 1 h	11	SafeGuard	21	Manual compression
2	Tr Band™, 10 cc, 4 h	12	Ankaferd Blood Stopper	22	Vitatch pressure bandage
3	Tr Band™, 15 cc, 4 h	13	WORK™ device	23	Helix device
4	Tr Band™, 2 h	14	RadAR 20 min	24	Helix device + pad
5	Tr Band™, 3 h	15	RadAr 60 min	25	Compressive dressing 30 min
6	Tr Band™, 1,5 h	16	RadAr 10 min	26	Compressive dressing 1 h
7	Tr Band™, 30 min	17	RadAr 30 min	27	Compressive dressing 2 h
8	Tr Band™ Accelerated Protocol (20 min)	18	VasoBand		
9	Tr Band™ Coagulation-based protocol	19	Chitosan-based pad		
10	Tr Band™ (MAP guided)	20	Pneumatic compression device inflated with 15 cc of air		

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