clinics and practice

MDPI

Review

Perioperative Discontinuation and Resumption of Anticoagulation Therapy with Focus on Procedures in an Internal Medicine Department—A Practical Guide for Junior Clinicians

Kilian Metz [1,2] and Christian Sebesta [2,*]

[1] Medical University of Vienna, Spitalgasse 23, 1090 Vienna, Austria
[2] 2nd Medical Department, Klinik Donaustadt, Science Center Donaustadt, Vienna Cancer Center (VCC), 1220 Vienna, Austria
* Correspondence: christian.sebesta@gesundheitsverbund.at

Abstract

Background: The management of perioperative discontinuation and resumption of anticoagulation therapy requires careful evaluation of the balance between bleeding and thromboembolic risk in patient care. In clinical routine, this responsibility often falls to residents or junior clinicians during the daily ward round, where time is short. As a result, reading long comprehensive guidelines regarding anticoagulation management is not practicable during working shifts in physicians in their early years of training. Even though there is a large body of evidence on this topic, little material exists for practical clinical usage as a bedside reference. To address this gap, this paper aims to provide an evidence-based quick reference tool, printable on one page, as well as a short summary of the most important aspects regarding perioperative anticoagulation management listed, presented in a clear and accessible manner. **Objective:** The aim of this study was to bridge the gap between the breadth of high-quality clinical evidence and its practical, time-efficient application in the clinical setting. **Study design:** A targeted literature search was conducted to identify current guidelines and recent evidence-based recommendations regarding perioperative management of anticoagulation therapy. **Results:** As result of this work, two well-structured and easily readable tables were developed to support junior clinicians in a practical clinical setting. One table summarizes anticoagulation management for all clinical disciplines, categorized by major bleeding risk within 30 days after the procedure. The second table depicts 10 of the most important procedures in an Internal Medicine setting and the recommendations regarding discontinuation and resumption of anticoagulation therapy. Current evidence indicates that bridging anticoagulation therapy for standard treatment is not recommended for both DOACs and VKAs. Routine laboratory testing is only required in specific clinical situations such as very high-risk procedures, renal insufficiency, or emergency intervention. Reversal options for antithrombotic therapy in emergency and urgent procedures were outlined and should be known by practicing clinicians. The results presented are based on the most recent and highly regarded guidelines available in the literature. Both international and German-speaking guidelines were considered. The resulting tables have not yet been prospectively validated or tested for usability and clinical impact. Therefore, they should serve as an educational and orientation aid rather than a validated decision tool, pending future studies assessing their effect on periprocedural antithrombotic management.

Keywords: perioperative anticoagulation; anticoagulant management; anticoagulation interruption; anticoagulation resumption; surgical bleeding risk; heparin bridging; clinical practice guideline

Check for updates

Received: 23 June 2026
Revised: 25 October 2026
Accepted: 17 November 2026
Published: 26 November 2026

Copyright: © 2026 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license.

1. Background

Antithrombotic therapy—including vitamin K antagonists (VKAs), direct oral anticoagulants (DOACs), and antiplatelet agents (APAs)—is among the most widely prescribed medication classes worldwide, used for indications such as atrial fibrillation, venous thromboembolism, mechanical heart valves, coronary artery disease, and peripheral arterial disease [1]. Approximately 15% to 20% of patients receiving anticoagulant therapy require a surgical or invasive procedure annually, and 10% to 15% of patients with coronary stents undergo surgery within two years of implantation [1]. Perioperative management of patients under these medications requires careful evaluation in the balancing of two competing risks: thromboembolism from premature or prolonged drug interruption, and hemorrhage from insufficient drug cessation [1,2].

In routine clinical practice, the perioperative management of antithrombotic therapy (i.e., decisions on its initiation and discontinuation) is predominantly handled by residents who are typically less experienced than the specialists performing the underlying procedure. Therefore, this highly important responsibility frequently falls to junior doctors in the early stages of their clinical training. Despite the availability of comprehensive clinical practice guidelines—most notably the 2022 American College of Chest Physicians (ACCP/CHEST) guideline addressing 43 PICO questions across four drug categories [1], the 2024 & 2026 ACC/AHA Guideline for Perioperative Cardiovascular Management for Noncardiac Surgery [3], and the 2023 ACC/AHA/ACCP/HRS Guideline for the Diagnosis and Management of Atrial Fibrillation [2]—the complexity and length of these documents can overwhelm physicians in training and they are not suitable for rapid clinical decision-making.

The aim of this study was to offer a structured, evidence-based summary of the comprehensive guidelines available regarding intervals for discontinuation and resumption of antithrombotic therapy. The results of the thorough literature search were summarized in two well-structured tables for quick assessment during routine clinical practice. While the primary emphasis was placed on procedures typical of an internal medicine department, the overview is designed to function as a practical aid across all clinical disciplines (Table 1). In this way, the study aims to make high-quality clinical evidence more accessible and readily applicable in time-constrained clinical environments.

2. Material and Methods

2.1. Study Design

This project was designed as a guideline synthesis and clinical tool development study. The objective was to create two condensed, evidence-based quick-reference tables for the perioperative management of antithrombotic therapy, intended for use by junior clinicians in an internal medicine department and ward physicians at the point of care. No patient-level data were collected, and no ethics committee approval was required.

2.2. Source Selection and Guideline Identification

A targeted review of the current literature on perioperative antithrombotic management was conducted. The primary sources were selected based on their authority, recency, and scope of coverage. The following core documents were chosen as the evidence foundation for the reference tables:

1. The 2022 American College of Chest Physicians (ACCP/CHEST) Clinical Practice Guideline on Perioperative Management of Antithrombotic Therapy, which addresses 43 PICO questions across four drug categories (VKA, heparin bridging, DOAC, and

antiplatelet agents) and provides an empiric procedure-related bleeding-risk classification [1].

2. The 2024 & 2026 AHA/ACC/ACS/ASNC/HRS/SCA/SCCT/SCMR/SVM Guideline for Perioperative Cardiovascular Management for Noncardiac Surgery, which provides updated recommendations on oral anticoagulant and antiplatelet management, including endorsement of the PAUSE protocol for DOACs [3,4].
3. The 2023 ACC/AHA/ACCP/HRS Guideline for the Diagnosis and Management of Atrial Fibrillation, which addresses periprocedural anticoagulation management in the context of atrial fibrillation, including recommendations against routine heparin bridging [2].
4. The BRIDGE trial (Douketis et al., NEJM 2015), a randomized controlled trial of 1884 patients with atrial fibrillation on warfarin, which demonstrated that forgoing perioperative bridging was noninferior for thromboembolism prevention and significantly reduced major bleeding [5].
5. The PAUSE study (Douketis et al., 2019), a prospective cohort management study of 3007 DOAC-treated patients with atrial fibrillation, which validated a standardized, pharmacokinetic-based DOAC interruption protocol without heparin bridging [6].
6. The 2024 JAMA review by Douketis and Spyropoulos, which synthesized the current evidence for perioperative DOAC management and highlighted the role of standardized protocols and point-of-care clinical decision support tools [7].
7. The 2023 NEJM Evidence review by Douketis and Spyropoulos on perioperative management of anticoagulant and antiplatelet therapy, which provided pharmacokinetic data on antiplatelet agents including onset and offset of action for ASA, clopidogrel, prasugrel, and ticagrelor [8].

This structured, targeted literature review was performed in PubMed/MEDLINE and the websites of relevant professional societies (CHEST/ACCP, ESC, EHRA, ACC/AHA, ESGE/BSG, SIR, ÖGARI, ÖGGH, AWMF). The search covered publications from January 2012 to October 2026. Search terms combined the following keywords and MeSH terms: "anticoagulants," "platelet aggregation inhibitors," "direct oral anticoagulants," "vitamin K antagonists," "perioperative care," "periprocedural management," "interruption," "bridging," "bleeding risk," and "reversal," together with procedure-specific terms such as "bone marrow biopsy," "liver biopsy," "thoracentesis," "paracentesis," "central venous catheter," "chemoembolization," and "endoscopy."

Inclusion criteria were:

- Current clinical practice guidelines, consensus statements, or position papers from national or international societies.
- Randomized controlled trials and large prospective cohort studies on periprocedural antithrombotic management (e.g., BRIDGE, PAUSE).
- Systematic reviews and narrative reviews in high-impact journals.

Exclusion criteria were:

- Cardiac surgery-specific recommendations.
- Case reports.
- Non-English and non-German publications.

2.3. Reconciliation of Recommendations

A hierarchical approach was used to derive the intervals shown in the tables:

1. Primary reference. The 2022 ACCP/CHEST guideline was used for all drug-specific interruption, resumption, and bridging recommendations it covers.

2. Gaps in the ACCP guideline. Where the ACCP guideline gives no explicit recommendation, the most recent applicable specialty guideline or consensus statement was used. Examples are the SIR consensus for image-guided and interventional procedures (e.g., liver biopsy, TACE, thoracentesis, paracentesis, central venous access), ESGE/BSG for endoscopic procedures, and the EHRA practical guide for renal function-adjusted DOAC intervals.
3. Conflicting sources. Where sources disagreed, the more recent recommendation and the one with the higher level of evidence was preferred. If the evidence was comparable, the more conservative interval was adopted (i.e., longer interruption for high-bleeding-risk procedures). Relevant discrepancies are reported in the text, including differences from the ÖGARI/ÖGGH recommendations.
4. Procedure-specific bleeding risk. Where risk classifications differed between societies, procedures were assigned to the higher bleeding-risk category.

In addition to the major international guidelines, a targeted search was conducted to identify key publications from the German-speaking medical community, given that this study was conducted in Austria and intended for use in Austrian clinical practice. The 2022 review by Aulinger et al. published in the Deutsches Ärzteblatt International—the official journal of the German Medical Association and one of the most widely read medical journals in the German-speaking world—was identified as a particularly relevant source, as it synthesizes current evidence on the perioperative management of antiplatelet and anticoagulant therapy specifically for gastroenterological and visceral surgical procedures in the context of German-speaking clinical practice [9]. This review was included to ensure that the recommendations presented in this paper reflect not only international consensus but also the standards and conventions familiar to physicians practicing in Austria, Germany, and Switzerland. Furthermore, the 2011 joint position paper by the ÖGARI Working Group on Perioperative Coagulation, the German Society on Thrombosis and Haemostasis Research (GTH), and the ESC Working Group Thrombosis was reviewed to capture the Austrian national perspective on perioperative antiplatelet management [10]. As no standalone, recently indexed ÖGARI or ÖGGH guideline on perioperative DOAC management was identified, it was noted that Austrian clinical practice largely follows the European Society of Cardiology (ESC) and European Society of Gastrointestinal Endoscopy (ESGE) guidelines for anticoagulant-specific recommendations, consistent with the broader European framework.

Supplementary Sources included the 2021 AHA/ASA Scientific Statement on Perioperative Neurological Evaluation, the 2017 ACC Expert Consensus Decision Pathway for Periprocedural Management of Anticoagulation, and relevant FDA prescribing information for individual antithrombotic agents [11].

2.4. Bleeding Risk Classification

Procedures were classified into three bleeding-risk categories based on the empiric classification system described in the 2022 ACCP guideline, which stratifies procedures by the expected 30-day postoperative risk of major bleeding: minimal risk (approximately 0%), low-to-moderate risk (0–2%), and high risk (≥2%) [1]. The specific procedures included in the reference tables were selected to reflect the procedural spectrum most commonly encountered on internal medicine wards and in consultation settings, including bone marrow biopsy, paracentesis, thoracentesis, liver biopsy, central venous catheter placement (PICC, port, CVC), gastrointestinal endoscopy (diagnostic and therapeutic), ERCP, and transarterial chemoembolization (TACE). Each procedure was assigned a bleeding-risk category based on the ACCP classification and, where applicable, cross-referenced with

the 2024 & 2026 ACC/AHA perioperative guideline and procedure-specific endoscopy guidelines [1].

The definition of major bleeding used in the perioperative anticoagulation literature is based on the International Society on Thrombosis and Haemostasis (ISTH) criteria. Major bleeding is defined as overt bleeding meeting any one of the following [12,13]:

1. Fatal bleeding.
2. Bleeding in a critical anatomical site:
    a. Intracranial, intraspinal, intraocular, retroperitoneal, intra-articular, pericardial, or intramuscular with compartment syndrome.
3. Hemoglobin drop ≥2 g/dL (or ≥20 g/L).
4. Transfusion of ≥2 units of packed red blood cells or whole blood.
5. Surgical site bleeding requiring reoperation.

2.5. Table Construction

Two reference tables were constructed:

Table 1 was designed as a practical aid across all clinical disciplines organized by drug class and bleeding-risk. For each drug, the recommended preoperative interruption interval was listed for minimal, low-to-moderate, and high bleeding risk procedures, along with the recommended postoperative resumption timing. Example procedures were listed for better orientation during clinical practice [1].

Table 2 was organized by procedure. For each procedure, the assigned bleeding-risk category was listed alongside the recommended preoperative interruption interval and postoperative resumption timing for each of the three antithrombotic drug classes: antiplatelet agents (APAs), subdivided into aspirin and P2Y12 inhibitors (clopidogrel, prasugrel, ticagrelor); direct oral anticoagulants (DOACs: apixaban, rivaroxaban, edoxaban, dabigatran); and vitamin K antagonists (VKAs: warfarin, phenprocoumon). Drug-specific interruption intervals were derived from the pharmacokinetic properties of each agent, including elimination half-life, mechanism of platelet inhibition (reversible vs. irreversible), renal clearance, and time to onset of full anticoagulant or antiplatelet effect after resumption [7].

Both tables were designed to fit on a single printed page, to facilitate lamination or integration into pocket reference cards. Hyperlinks, excessive citations, and cross-references were intentionally avoided to keep the layout as simple as possible and to fulfill the purpose of a quick reference guide. Recommendations were presented as concise, actionable statements. Where guideline recommendations differed between sources, the ACCP 2022 guideline was used as the primary reference.

3. Results

3.1. Tables

After a thorough comprehensive literature research, the two following tables were created during this study. The main purpose of these tables is to provide a clear and rapidly applicable reference for junior clinicians in daily clinical practice. Table 1 summarizes the discontinuation and resumption intervals categorized by the risk of major bleeding within 30 days postoperatively. Example procedures are given and should therefore make this table useful for doctors in any medical specialty.

Table 2 shows 10 of the most commonly performed procedures in internal medicine departments, stratified by bleeding risk and drug class. As in Table 1, both timing of discontinuation and resumption for antithrombotic therapy are shown for the three big medication groups DOACs, VKAs and APTs. Example agents are given in Table 1.

Table 1. Overview of discontinuation and resumption intervals for antithrombotic therapy in adult patients, categorized by risk of major bleeding within 30 days postoperatively. (DOAC = direct oral anticoagulant; VKA = vitamin K antagonist; APT = antiplatelet therapy) [1,7–9].

Bleeding Risk	Example Procedures	DOAC Pre-Procedural	DOAC Resumption	VKA Pre-Procedural	VKA Resumption	APT (Aspirin) Pre-Procedural	APT (Aspirin) Resumption	APT (P2Y12) Pre-Procedural	APT (P2Y12) Resumption
Minimal (~0% major bleeding)	Dental extraction, cataract surgery, minor skin procedures, pacemaker implantation	Continue (omit daily dose if required) **	Immediate (not interrupted)	Continue	Immediate (not interrupted)	Continue	Immediate (not interrupted)	Continue	Immediate (not interrupted)
Low-Moderate (0–2% major bleeding)	Cholecystectomy, hernia repair, arthroscopy, diagnostic endoscopy ± biopsy, bronchoscopy ± biopsy, coronary angiography	Discontinue 1 day before **	Day 1 post-op	Discontinue 5 days before	12–24 h post-op (evening of procedure day)	Continue	Immediate (not interrupted)	Continue (low risk) or 5–7 days interruption	Immediate or Day 1 post-op
High (≥2% major bleeding)	Major oncological surgery, joint replacement, liver biopsy, TACE, neurosurgery, colonoscopy + large polypectomy, ERCP + sphincterotomy, neuraxial anaesthesia	Discontinue 2 days before **	Day 2–3 post-op (48–72 h)	Discontinue 5 days before; INR ≤1.5	12–24 h post-op (evening of procedure day)	Continue (or 7–10 days interruption if very high bleeding risk without prior PCI)	Day 1 post-op	5–7 days interruption (Clopidogrel ≥5 d, Prasugrel ≥7 d, Ticagrelor ≥3–5 d)	Day 1 post-op (without loading dose)
Example agents		Apixaban (Eliquis), Rivaroxaban (Xarelto), Edoxaban (Lixiana), Dabigatran (Pradaxa)		Phenprocoumon (Marcumar), Warfarin (Coumadin), Acenocoumarol (Sintrom)		Aspirin (Thrombo ASS)		Clopidogrel (Plavix/Iscover), Prasugrel (Efient), Ticagrelor (Brilinta)	

** check for renal impairment CrCl < 30 mL/min and Dabigatran CrCl < 50 mL/min

Note: All recommendations should be adapted to individual patient risk (thrombotic vs. bleeding) and discussed with the responsible specialist where appropriate. Resumption intervals apply to elective procedures and assume adequate hemostasis. Timing should be individualized according to bleeding risk, hemostasis and thromboembolic risk, and agreed with the proceduralist [1,2,7]. INR = international normalized ratio; PCI = percutaneous coronary intervention; TACE = Transarterial Chemoembolisation; ERCP = Endoscopic Retrograde Cholangiopancreatography.

Table 2. Overview of 10 of the most commonly performed (elective) procedures in internal medicine departments and the recommended discontinuation and resumption intervals for antithrombotic therapy in adult patients, stratified by drug class. (DOAC = direct oral anticoagulant; VKA = vitamin K antagonist; APT = antiplatelet therapy) [1,9,11,14–19].

Procedure	Bleeding Risk	DOAC Pre-Procedural **	DOAC Resumption	VKA Pre-Procedural	VKA-Resumption	APT Pre-Procedural	APT Resumption
ERCP without sphincterotomy	Minimal	Continue	Immediate	Continue	Immediate (not interrupted)	Aspirin + P2Y12: continue	Immediate (not interrupted)
Pleural puncture (thoracocentesis)	Minimal-low	Continue or omit on procedure day	Immediate	Continue	Immediate (not interrupted)	Aspirin + P2Y12: continue	Immediate (not interrupted)
Ascites puncture (paracentesis)	Low	Continue or omit on procedure day	Immediate	Continue	Immediate (not interrupted)	Aspirin + P2Y12: continue	Immediate (not interrupted)
PICC/Central venous catheter/ Port insertion	Low	Continue or omit on procedure day	Immediate	Continue	Immediate (not interrupted)	Aspirin + P2Y12: continue	Immediate (not interrupted)
Gastroscopy/Colonoscopy-diagnostic ± small biopsy	Low	Continue or omit on procedure day	Immediate	Continue	Immediate (not interrupted)	Aspirin + P2Y12: continue	Immediate (not interrupted)
Bone marrow biopsy (iliac crest)	Low	Discontinue 1 day before	≥24 h post-op	Continue or discontinue 5 days before	Evening of procedure day	Aspirin + P2Y12: continue	Immediate (not interrupted)
Gastroscopy/Colonoscopy + therapeutic intervention (polypectomy, EMR, ESD, band ligation, PEG)	Moderate-high	Discontinue 1–2 days before	≥24–72 h post-op (depending on procedure)	Discontinue 5 days before	Evening of procedure day	Aspirin: continue, P2Y12: 5–7 days interruption	Aspirin: immediately, P2Y12: ≤24 h post-op
ERCP with sphincterotomy	Moderate-high	Discontinue 2 days before	48–72 h post-op	Discontinue 5 days before	Evening of procedure day	Aspirin: continue, P2Y12: 5–7 days interruption	Aspirin: immediately, P2Y12: ≤24 h post-op
Liver biopsy (percutaneous)	Moderate-high	Discontinue 2 days before	48–72 h post-op	Discontinue 5 days before; INR ≤ 1.5	Evening of procedure day	Aspirin + P2Y12: 5–7 days interruption	Aspirin + P2Y12: ≤24 h post-op
TACE (transarterial chemoembolisation)	High	Discontinue 2 days before	48–72 h post-op	Discontinue 5 days before; INR ≤ 1.5	Evening of procedure day	Aspirin + P2Y12: 5–7 days interruption	Aspirin + P2Y12: ≤24 h post-op

** check for renal impairment CrCl < 30 mL/min and Dabigatran CrCl < 50 mL/min

Note: All recommendations should be adapted to individual patient risk (thrombotic vs. bleeding) and discussed with the responsible specialist where appropriate. The recommendations in Table 2 derive from society consensus guidelines and observational cohort/registry data rather than randomized trials, as no RCT has defined a coagulation threshold or interruption interval that reliably predicts procedural bleeding for these interventions. The ACCP systematic review and the Society of Interventional Radiology both explicitly acknowledge that their periprocedural thresholds rest on limited-quality studies and expert consensus [20,21]. Bone marrow biopsy, central venous catheter placement, thoracentesis, and paracentesis are consistently graded low risk, supported by observational series showing very low major-bleeding rates even at elevated INR; liver biopsy and tunneled-catheter/port insertion carry genuine inter-guideline discordance that the table preserves, and TACE has the thinnest evidence, managed by extrapolation from arterial-access consensus [18,21,22]. Table 2 should therefore be read as a pragmatic, consensus-based reference, with its individual evidence-grades as described here and footnote making this limitation apparent when used standalone by junior clinicians [20,21]. INR = international normalized ratio; EMR = endoscopic mucosal resection; ESD = endoscopic submucosal dissection; PEG = Percutaneous endoscopic gastrostomy.

Perioperative management of antiplatelet therapy also depends largely on the indication. In patients taking aspirin for primary prevention, interruption carries little thrombotic risk and may be done without multidisciplinary consultation [3]. In patients with a recent acute coronary syndrome or coronary stent, interruption is associated with a substantially higher risk of stent thrombosis and major adverse cardiovascular events [1]. Elective procedures should therefore be deferred, ideally ≥ 6 months after PCI for chronic coronary disease and ≥12 months after PCI for ACS. After that period, low-dose aspirin should generally be continued, and only the P2Y12 inhibitor should be paused [3,23]. The interruption intervals in our tables apply mainly to primary and stable secondary prevention. In patients with recent coronary events or stenting, decisions should be made jointly with cardiology specialists.

Resuming antithrombotic therapy after a procedure also needs an individual decision. The resumption intervals in the presented tables are standard intervals for elective procedures: generally, ≥24 h after low-to-moderate bleeding-risk procedures and 48–72 h after high bleeding-risk procedures, as in the ACCP 2022 guideline and the PAUSE study [1,5,7]. They apply only once adequate hemostasis has been achieved. That judgment includes surgical-site findings such as blood loss through dressings and drains [7,24]. Resumption may need to be delayed further in some cases, for example ongoing hematuria after intervention or concern about bleeding after cardiac, intracranial or spinal surgery [7]. DOACs reach peak effect 1–3 h after intake, so they should be restarted with particular care [1]. Warfarin takes several days to become therapeutic and can often be restarted on the evening of the procedure [2]. Patients at high thromboembolic risk who have high bleeding-risk procedures may receive prophylactic-dose LMWH until full anticoagulation is resumed [7]. Timing should therefore balance procedural bleeding risk, hemostasis and the patient's thromboembolic risk, and should be agreed with the proceduralist [2,24].

This paper additionally aims to provide junior clinicians with a concise overview of the most relevant aspects of perioperative antithrombotic management. To this end, the following sections address routine preoperative assessment, bridging and interruption strategies, as well as the management of urgent procedures.

3.2. Routine Preoperative Coagulation Testing

Routine preoperative coagulation testing is not necessary and therefore not recommended for DOAC patients undergoing elective procedures [1]. For patients treated with VKA, routine INR measurement in the immediate preoperative period is also not routinely needed after a standard 5-day interruption, though it is warranted in selected situations [1].

Laboratory testing is indicated for DOAC-patients in following situations:

- Emergency surgery (<24 h) [1,7]
    - DOAC level < 50 ng/mL may allow surgery to proceed without a reversal agent.
    - DOAC-level ≥ 50 ng/mL may necessitate reversal with Idarucizumab (Dabigatran) or prothrombin complex concentrate (PCC) for factor Xa inhibitors.
    - CAVE: Routine coagulation tests (INR, aPTT) are insensitive for detecting residual DOAC effect—DOAC-specific assays are required.
- Severe renal impairment (CrCl < 30 mL/min) [1]
    - DOAC clearance can be significantly prolonged.
    - Longer preoperative interruption interval may be required.
    - DOAC-level testing to confirm adequate drug clearance.
    - Particularly for Dabigatran (80% renal elimination).
- Severe hepatic dysfunction [1,2,25]

- DOACs are contraindicated in Child–Pugh C (severe) cirrhosis and should be used with caution in Child–Pugh B (moderate).
- Impaired hepatic metabolism may delay DOAC clearance, making preoperative testing advisable.

- CYP3A4 or P-glycoprotein inhibitors [1,2]
  - Concomitant use of strong CYP3A4/P-gp inhibitors (e.g., ketoconazole, itraconazole, ritonavir) can significantly increase DOAC plasma levels and delay clearance.

Laboratory testing for VKA patients is recommended 5–7 days before the procedure to identify patients with supratherapeutic levels (INR > 3.0) who may need earlier interruption or vitamin K administration. Preoperative INR re-check within 24 h of the procedure is recommended particularly when a normal INR is desired for the procedure according to the 2017 ACC Expert Consensus Decision Pathway [26]. Additionally, hepatic dysfunction can delay warfarin metabolism beyond the standard 5-day interruption, warranting preoperative INR measurement [2,25].

3.3. Emergency and Urgent Procedures: Reversal of Antithrombotic Therapy

When timely preoperative discontinuation of antithrombotic therapy is not feasible, as in emergency surgery (<6 h) or urgent procedures (6–24 h), pharmacological reversal or hemostatic support is required. The 2024 AHA/ACC Perioperative Guideline emphasizes that time-based reversal ("time reversal") is always preferred. Only when time-based reversal is not feasible should rapid reversal with specific agents be pursued [3]. In urgent or emergency procedures, reversal should be reserved for procedures that cannot be delayed and carry a moderate or high bleeding risk. Where available, it should be guided by coagulation tests or drug levels, because reversal may be unnecessary if no relevant residual drug effect is detectable. Life-threatening or major bleeding is a separate clinical situation. It requires discontinuation of the anticoagulant, local and supportive measures, and a reversal agent where appropriate. Its management is beyond the scope of this paper [4,27]. Patients on DOACs who require emergent or urgent surgery experience significantly elevated rates of bleeding (17–23%) and thromboembolism (7–16%), underscoring the importance of prompt and appropriate reversal [7]. Within the scope of this paper, only the drug class and its corresponding reversal agent are listed. Should reversal therapy be required, decisions must be made in consultation with an experienced specialist or the operating surgeon and guided by current evidence-based recommendations.

If timely discontinuation is not possible before an urgent or emergency procedure, the following reversal strategies may be considered:

- Warfarin (VKA): Vitamin K (10 mg i.v.) + 4-factor PCC (25–50 IU/kg, dosed by INR and body weight (25 IU/kg for INR 2–<4, 35 IU/kg for INR 4–6, 50 IU/kg for INR > 6)) [2,24,28].
- Dabigatran (direct thrombin inhibitor): Idarucizumab (Praxbind) 5 g i.v. alternative: 4F-PCC or aPCC 50 IU/kg (maximum 4000 IU) if unavailable [24,29,30].
- Factor Xa inhibitors (rivaroxaban, apixaban, edoxaban): 4-factor PCC (25–50 IU/kg); andexanet alfa (Andexxa) where still available (withdrawn from U.S. market). Local availability and approval status should be checked (off-label use) [23,24,28].
- Antiplatelet agents (ASA, clopidogrel, prasugrel, ticagrelor): no specific antidote available; platelet transfusion (2–4 units) may be considered ≥ 6 h after the last clopidogrel or prasugrel dose and ≥24 h after the last ticagrelor dose. Note: platelet transfusion has little effect against ticagrelor due to reversible binding. Desmopressin can be considered only as an adjunct; 0.4 µg/kg is the dose studied in intracranial hemorrhage [11,23,31–34].

3.4. Bridging Anticoagulation: Evidence from the BRIDGE and PAUSE Studies

"Bridging" anticoagulation refers to the perioperative administration of a short-acting parenteral anticoagulant (typically low-molecular-weight heparin (LMWH)) during the interruption of oral anticoagulation with the intent of minimizing the time a patient spends without therapeutic anticoagulation. Historically, this practice was widely applied to VKA-treated patients, whose prolonged offset (warfarin half-life ~36–42 h, requiring ≥ 5 days of interruption) and slow onset of action (3–5 days to therapeutic INR) create a perioperative window of several days without effective anticoagulation [1,26].

The BRIDGE trial [5] (Bridging Anticoagulation in Patients Who Require Temporary Interruption of Warfarin Therapy for an Elective Invasive Procedure or Surgery), published in 2015, was a landmark randomized, double-blind, placebo-controlled study that enrolled 1884 patients with atrial fibrillation on warfarin who required an elective procedure [5,35]. The results of this study established that routine bridging in patients with atrial fibrillation at low-to-moderate thromboembolic risk causes harm without measurable benefit. The PERIOP-2 trial subsequently confirmed these findings, showing no significant difference in thromboembolism or major bleeding between bridged and non-bridged groups, even in a population where approximately two-thirds underwent high bleeding-risk procedures [1,2,5].

Based on this evidence, current guidelines recommend against routine bridging for most VKA-treated patients with atrial fibrillation [1,2,9]. Bridging may still be considered in selected patients at very high thromboembolic risk, such as those with mechanical mitral valves or recent stroke/TIA (<3 months), where management should be individualized [2,9,36].

For patients on DOACs, the question of bridging is fundamentally different. The short half-lives of DOACs (8–14 h) allow for rapid offset and rapid onset of anticoagulant effect, resulting in a perioperative interruption window of only 1–2 days (far shorter than the ≥5 day window required for VKA) [7,8]. The PAUSE study [6] (Perioperative Anticoagulation Use for Surgery Evaluation), published in 2019, was a prospective, multicenter cohort study that enrolled 3007 patients with atrial fibrillation receiving apixaban ($n = 1257$), dabigatran ($n = 668$), or rivaroxaban ($n = 1082$) who required an elective procedure [7,8]. The study applied a standardized, pharmacokinetically based interruption protocol without heparin bridging: DOACs were held for 1 day before low-to-moderate bleeding-risk procedures and 2 days before high bleeding-risk procedures. This approach yielded low 30-day rates of arterial thromboembolism (0.16–0.60%) and major bleeding (0.9–1.85%), depending on the specific DOAC [2,8]. Notably, 98.8% of patients achieved a preoperative DOAC level < 50 ng/mL without laboratory monitoring, confirming that a time-based approach alone is sufficient for safe perioperative management [2,6,8].

The ACCP 2022 guideline explicitly recommends against perioperative heparin bridging during DOAC interruption (conditional recommendation), citing evidence that LMWH bridging in DOAC-treated patients was associated with a significantly increased risk of major bleeding (6.8% vs. 1.8%; $p < 0.001$) without reducing arterial thromboembolism (0.5% vs. 0.3%; $p = 0.46$) [1,7]. The 2024 JAMA review by Douketis and Spyropoulos further emphasizes that the rapid pharmacokinetic profile of DOACs obviates the need for bridging entirely, and that bridging-related bleeding may paradoxically delay DOAC resumption, thereby increasing thromboembolic risk [7].

In summary, the BRIDGE and PAUSE studies have collectively established two key principles of modern perioperative anticoagulation management: (1) heparin bridging is not beneficial and is potentially harmful for most VKA-treated patients with atrial fibrillation, and (2) a simple, time-based DOAC interruption strategy without bridging or laboratory monitoring is safe and effective [1,2,7,8].

3.5. Special Populations

Older adults. Advanced age is consistently associated with a higher risk of bleeding on anticoagulation, together with comorbidities such as renal insufficiency, liver disease, cancer, and concomitant antiplatelet use [37]. Current perioperative guidelines therefore recommend that age, renal function, bleeding history, and drug interactions be included in the individual perioperative plan, with multidisciplinary assessment where feasible [4]. The ESC Working Group on Thrombosis consensus on antithrombotic therapy in older adults emphasizes tailoring drug choice, dose, and duration to age, weight, renal function, comedication, and procedure, as well as bleeding-avoidance strategies and deprescribing [38].

Age is not a reason to change the interruption intervals in our tables. Its main effect is through renal function. Because creatinine clearance often declines with age, renal function should be measured before every elective procedure, and the renal function-adjusted DOAC intervals (particularly for dabigatran) applied [1,2]. Heparin bridging, which increases bleeding without reducing thromboembolism, should be avoided, especially in this population [2,20].

Children. The tables were developed for adults and should not be applied to pediatric patients. No formal consensus guidelines exist for periprocedural DOAC management in children [39]. Pediatric DOAC dosing is weight-based, and elimination half-lives differ from those in adults. Rivaroxaban, in particular, has a markedly shorter half-life in children, whereas apixaban and dabigatran are similar to adults and edoxaban has not been sufficiently characterized [39]. Pragmatic, pharmacokinetics-based proposals suggest holding two doses before low-risk procedures and three to four doses before high-risk procedures or with reduced renal function. For patients >12 years or >50 kg, adult guidance may be followed [39]. These proposals are expert opinion based on phase I/II pharmacokinetic data [39]. Perioperative management of children on antithrombotic therapy should therefore be coordinated with pediatric hematology.

4. Discussion

The information and findings presented in this paper constitute an evidence-based guide that is clearly structured and readily applicable in clinical practice. As such, it serves as an important bridge between comprehensive, elaborately developed guidelines and the need for rapid, practical decision-making at the bedside. Due to its emphasis on readability and conciseness, the results presented here do not represent an exhaustive guideline accounting for all relevant factors. The resulting limitations are outlined in the following section.

4.1. Limitations of Methodology

This study has several methodological limitations inherent to guideline synthesis projects. First, the bleeding-risk classification used is empiric and has not been prospectively validated for all listed procedures. Second, the tables are designed for elective procedures in hemodynamically stable patients; emergent and urgent procedures require individualized management that cannot be captured in a simplified reference tool. Third, the tables do not account for all patient-specific factors that may modify bleeding or thrombotic risk, such as active cancer, recent thromboembolism (<3 months), concomitant antiplatelet and anticoagulant therapy (triple therapy), or severe hepatic or renal impairment. Fourth, the evidence base for several procedure-specific recommendations (e.g., liver biopsy, TACE) is derived from expert consensus and observational data rather than randomized controlled trials. Finally, the tables are intended to complement, not replace, individualized clinical judgment and multidisciplinary consultation, as recommended by the ACCP guideline.

4.2. Limitations and the Role of Individualized Decision-Making

While the tables presented in this paper provide a standardized, evidence-based framework for perioperative antithrombotic management, it is essential to recognize that guideline recommendations serve as a foundation, not a rigid protocol. The ACCP 2022 guideline explicitly states that its perioperative care pathways are intended to "inform individual patient management and to develop standardized care paths for clinics or institutions," acknowledging that institutional adaptation is expected [1]. Similarly, the 2024 JAMA review by Douketis and Spyropoulos emphasizes that perioperative anticoagulant management involves multiple disciplines—including internists, surgeons, anesthesiologists, and pharmacists—and that "facilitating communication and management consensus among members of the health care team can help prevent surgical or nonsurgical procedure cancellations and improve patient understanding." The 2023 ACC/AHA/ACCP/HRS Atrial Fibrillation Guideline further underscores that "input from the proceduralist should always be incorporated into decisions" regarding the timing of anticoagulation resumption [2,7].

In clinical practice, surgeon preference, institutional agreements, and individual patient factors may lead to deviations from the standard interruption intervals. For example, when a proceduralist has bleeding concerns or prefers a shorter anticoagulation-free interval for a low-to-moderate bleeding-risk procedure, the following practical DOAC dose-timing adjustments may be considered:

- Once-daily DOAC (e.g., rivaroxaban, edoxaban): The morning dose on the day of the procedure can be shifted to the evening after the procedure, effectively creating a ~24 h drug-free interval without missing a full day of anticoagulation.
- Twice-daily DOAC (e.g., apixaban, dabigatran): The morning dose on the day of the procedure can be omitted, with the evening dose taken as scheduled, resulting in a ~12 h extended interval.
- Alternatively: The DOAC can be held entirely on the day of the procedure and resumed the following day.

These adjustments are consistent with the pharmacokinetic rationale outlined in the ACCP guideline, which notes that for minimal bleeding-risk procedures, "DOACs may be continued, or if there is concern about excessive bleeding, DOACs may be discontinued on the day of the procedure." The PAUSE study protocol similarly allowed for same-day omission in the lowest-risk category [1,3,7].

Although the ACCP guideline generally recommends VKA continuation for minimal bleeding-risk procedures (e.g., simple dental extractions, small skin excisions), the guideline implementation considerations explicitly acknowledge situations where VKA interruption may be preferred. VKA-specific considerations where standard "continuation" may also require modification [1,26]:

- Multiple tooth extractions in patients with poor periodontal status.
- Larger skin excisions (>3 cm) or procedures requiring skin graft.
- Complex dental procedures such as reconstructive oral surgery.
- INR > 3.0.

These examples demonstrate that even within the "minimal bleeding-risk" category, a spectrum of procedural complexity exists that requires clinical judgment. Ultimately, the tables in this paper should be viewed as a decision-support tool—a starting point for the multidisciplinary conversation that must occur before every procedure in an anticoagulated or antiplatelet-treated patient. Local institutional protocols, the proceduralist's assessment of surgical hemostasis, and patient-specific factors (renal function, bleeding history, thrombotic risk) should always be integrated into the final perioperative plan [1,7].

The designed reference tables are a synthesis of current guideline recommendations and key studies and have not been validated prospectively. Neither formal usability testing with the intended users nor an evaluation of their impact on clinical decision-making, guideline adherence, or patient outcomes such as periprocedural bleeding or thromboembolic events has been performed. Accordingly, no claim of proven clinical effectiveness can be made, and the tables should be regarded as an educational and orientation aid rather than a validated decision tool. Future studies should assess their usability, for example through user surveys or simulated clinical scenarios, and evaluate prospectively whether they improve the consistency and accuracy of periprocedural antithrombotic management in clinical practice.

Author Contributions: K.M.: Conceptualization, methodology, writing—original draft, writing—review and editing. C.S.: Supervision, writing—review and editing. All authors have read and agreed to the published version of the manuscript.

Funding: No external funding was received for the preparation of this work. The authors conducted all research, writing, and editorial activities independently and without financial support. This work was undertaken voluntarily in the authors' personal time with the sole purpose of contributing to scientific knowledge and medical education.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Acknowledgments: The author wants to express sincere gratitude to Christian Sebesta for making this project possible, his invaluable guidance, continuous support, and critical review of this manuscript. His expertise and encouragement were instrumental in the completion of this work. Artificial intelligence tools (ChatGPT (OpenAI, GPT-5.5) and Claude (Anthropic, Sonnet 4.6)) were used exclusively for language editing and proofreading purposes during the writing process of this manuscript. The AI tools were provided with explicit instructions to review only the English language, grammar, wording, readability, and sentence structure. They were never used to generate, modify, interpret, or contribute any scientific content, ideas, arguments, analyses, results, or conclusions. All intellectual content, the conceptualization, the literature analysis, study selection, interpretation of findings, structure of the paper and conclusions were developed solely by the author. Any suggestions provided by the AI tools were carefully reviewed and the author retained full control over all revisions.

Conflicts of Interest: All authors declare that they have no financial, personal, or professional conflicts of interest that could have influenced the work reported in this paper.

References

1. Douketis, J.D.; Spyropoulos, A.C.; Murad, M.H.; Arcelus, J.I.; Dager, W.E.; Dunn, A.S.; Fargo, R.A.; Levy, J.H.; Samama, C.M.; Shah, S.H.; et al. Perioperative Management of Antithrombotic Therapy: An American College of Chest Physicians Clinical Practice Guideline. *CHEST* **2022**, *162*, e207–e243. [PubMed]
2. Joglar, J.A.; Chung, M.K.; Armbruster, A.L.; Benjamin, E.J.; Chyou, J.Y.; Cronin, E.M.; Deswal, A.; Eckhardt, L.L.; Goldberger, Z.D.; Gopinathannair, R.; et al. 2023 ACC/AHA/ACCP/HRS Guideline for the Diagnosis and Management of Atrial Fibrillation: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation* **2024**, *149*, e1–e156. [CrossRef] [PubMed]
3. Thompson, A.; Fleischmann, K.E.; Smilowitz, N.R.; Ldl, F.; Mukherjee, D.; Aggarwal, N.R.; Ahmad, F.S.; Allen, R.B.; Altin, S.E.; Auerbach, A.; et al. 2024 AHA/ACC/ACS/ASNC/HRS/SCA/SCCT/SCMR/SVM Guideline for Perioperative Cardiovascular Management for Noncardiac Surgery. *JACC* **2024**, *84*, 1869–1969. [CrossRef] [PubMed]
4. Thompson, A.; Fleischmann, K.E.; Smilowitz, N.R.; de Las Fuentes, L.; Mukherjee, D.; Aggarwal, N.R.; Ahmad, F.S.; Allen, R.B.; Altin, S.E.; Auerbach, A.; et al. 2026 AHA/ACC/ACS/ASNC/HRS/SCA/SCCT/SCMR/SVM Guideline for Perioperative Cardiovascular Management for Noncardiac Surgery: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *J. Am. Coll. Cardiol.* **2026**, *88*, 1543–1643. [PubMed]

5. Douketis, J.D.; Spyropoulos, A.C.; Kaatz, S.; Becker, R.C.; Caprini, J.A.; Dunn, A.S.; Garcia, D.A.; Jacobson, A.; Jaffer, A.K.; Kong, D.F.; et al. Perioperative Bridging Anticoagulation in Patients with Atrial Fibrillation. *N. Engl. J. Med.* **2015**, *373*, 823–833. [CrossRef] [PubMed]
6. Douketis, J.D.; Spyropoulos, A.C.; Duncan, J.; Carrier, M.; Le Gal, G.; Tafur, A.J.; Vanassche, T.; Verhamme, P.; Shivakumar, S.; Gross, P.L.; et al. Perioperative Management of Patients with Atrial Fibrillation Receiving a Direct Oral Anticoagulant. *JAMA Intern. Med.* **2019**, *179*, 1469–1478. [CrossRef] [PubMed]
7. Douketis, J.D.; Spyropoulos, A.C. Perioperative Management of Patients Taking Direct Oral Anticoagulants: A Review. *JAMA* **2024**, *332*, 825–834. [CrossRef] [PubMed]
8. Douketis, J.D.; Spyropoulos, A.C. Perioperative Management of Anticoagulant and Antiplatelet Therapy. *NEJM Evid.* **2023**, *2*, EVIDra2200322. [CrossRef] [PubMed]
9. Aulinger, B.A.; Saner, F.H.; Stark, K.; Mayerle, J.; Lange, C.M. Platelet Aggregation Inhibitors and Anticoagulants in Gastroenterological and Visceral Surgical Procedures. *Dtsch. Arztebl. Int.* **2022**, *119*, 851–860. [CrossRef] [PubMed]
10. Korte, W.; Cattaneo, M.; Chassot, P.G.; Eichinger, S.; von Heymann, C.; Hofmann, N.; Rickli, H.; Spannagl, M.; Ziegler, B.; Verheugt, F.; et al. Peri-operative management of antiplatelet therapy in patients with coronary artery disease: Joint position paper by members of the working group on Perioperative Haemostasis of the Society on Thrombosis and Haemostasis Research (GTH), the working group on Perioperative Coagulation of the Austrian Society for Anesthesiology, Resuscitation and Intensive Care (ÖGARI) and the Working Group Thrombosis of the European Society for Cardiology (ESC). *Thromb. Haemost.* **2011**, *105*, 743–749. [PubMed]
11. Benesch, C.; Glance, L.G.; Derdeyn, C.P.; Fleisher, L.A.; Holloway, R.G.; Messé, S.R.; Mijalski, C.; Nelson, M.T.; Power, M.; Welch, B.G.; et al. Perioperative Neurological Evaluation and Management to Lower the Risk of Acute Stroke in Patients Undergoing Noncardiac, Nonneurological Surgery: A Scientific Statement From the American Heart Association/American Stroke Association. *Circulation* **2021**, *143*, e923–e946. [CrossRef] [PubMed]
12. Castellucci, L.A.; Chen, V.M.; Kovacs, M.J.; Lazo-Langner, A.; Greenstreet, P.; Kahn, S.; Côté, B.; Schulman, S.; de Wit, K.; Douketis, J.; et al. Bleeding Risk with Apixaban vs. Rivaroxaban in Acute Venous Thromboembolism. *N. Engl. J. Med.* **2026**, *394*, 1051–1060. [CrossRef] [PubMed]
13. Eikelboom, J.W.; Bosch, J.J.; Connolly, S.J.; Shestakovska, O.; Dagenais, G.R.; Hart, R.G.; Leong, D.P.; O'dOnnell, M.; Fox, K.A.; Bhatt, D.L.; et al. Major Bleeding in Patients with Coronary or Peripheral Artery Disease Treated with Rivaroxaban Plus Aspirin. *J. Am. Coll. Cardiol.* **2019**, *74*, 1519–1528. [CrossRef] [PubMed]
14. Tritschler, T.; Kraaijpoel, N.; Le Gal, G.; Wells, P.S. Venous Thromboembolism: Advances in Diagnosis and Treatment. *JAMA* **2018**, *320*, 1583–1594. [PubMed]
15. Capodanno, D.; Alfonso, F.; Levine, G.N.; Valgimigli, M.; Angiolillo, D.J. ACC/AHA Versus ESC Guidelines on Dual Antiplatelet Therapy: JACC Guideline Comparison. *J. Am. Coll. Cardiol.* **2018**, *72*, 2915–2931. [CrossRef] [PubMed]
16. Abraham, N.S.; Barkun, A.N.; Sauer, B.G.; Douketis, J.; Laine, L.; Noseworthy, P.A.; Telford, J.J.; Leontiadis, G.I. American College of Gastroenterology-Canadian Association of Gastroenterology Clinical Practice Guideline: Management of Anticoagulants and Antiplatelets During Acute Gastrointestinal Bleeding and the Periendoscopic Period. *Am. J. Gastroenterol.* **2022**, *117*, 542–558. [CrossRef] [PubMed]
17. Virani, S.S.; Newby, L.K.; Arnold, S.V.; Bittner, V.; Brewer, L.C.; Demeter, S.H.; Dixon, D.L.; Fearon, W.F.; Hess, B.; Johnson, H.M.; et al. 2023 AHA/ACC/ACCP/ASPC/NLA/PCNA Guideline for the Management of Patients with Chronic Coronary Disease. *JACC* **2023**, *82*, 833–955. [CrossRef] [PubMed]
18. Abdulrehman, J.; Shaw, J.R.; Stella, S.F.; Mafeld, S.; Douketis, J.; Selby, R.; Gross, P.; Carrier, M. Peri-procedural anticoagulation management for central venous catheter insertion in persons with cancer. *Thromb. Res.* **2026**, *259*, 109620. [CrossRef] [PubMed]
19. Elmunzer, B.J.; Anderson, M.A.; Mishra, G.; Rex, D.K.; Yadlapati, R.; Shaheen, N.J. Quality Indicators Common to All Gastrointestinal Endoscopic Procedures. *Off. J. Am. Coll. Gastroenterol. ACG* **2024**, *119*, 1781–1791. [CrossRef] [PubMed]
20. Shah, S.; Nayfeh, T.; Hasan, B.; Urtecho, M.; Firwana, M.; Saadi, S.; Abd-Rabu, R.; Nanaa, A.; Flynn, D.N.; Rajjoub, N.S.; et al. Perioperative Management of Vitamin K Antagonists and Direct Oral Anticoagulants: A Systematic Review and Meta-analysis. *Chest* **2023**, *163*, 1245–1257. [PubMed]
21. Patel, I.J.; Rahim, S.; Davidson, J.C.; Hanks, S.E.; Tam, A.L.; Walker, T.G.; Wilkins, L.R.; Sarode, R.; Weinberg, I. Society of Interventional Radiology Consensus Guidelines for the Periprocedural Management of Thrombotic and Bleeding Risk in Patients Undergoing Percutaneous Image-Guided Interventions—Part II: Recommendations: Endorsed by the Canadian Association for Interventional Radiology and the Cardiovascular and Interventional Radiological Society of Europe. *J. Vasc. Interv. Radiol.* **2019**, *30*, 1168–1184.e1. [CrossRef] [PubMed]
22. Lester, W.; Bent, C.; Alikhan, R.; Roberts, L.; Gordon-Walker, T.; Trenfield, S.; White, R.; Forde, C.; Arachchillage, D.J.; the BSH Committee. A British Society for Haematology guideline on the assessment and management of bleeding risk prior to invasive procedures. *Br. J. Haematol.* **2024**, *204*, 1697–1713. [CrossRef] [PubMed]

23. Kumbhani Dharam, J.; Armbruster Anastasia, L.; Cheng Richard, K.; Chrispin, J.; Fischer, U.; Holbrook, A.M.; Joglar, J.; Sevestre, M.-A. Direct Oral Anticoagulants in Primary and Secondary Prevention of Thrombotic Events: 2026 ACC Scientific Statement. *JACC* **2026**, *88*, 1255–1283. [CrossRef] [PubMed]
24. Tomaselli, G.F.; Mahaffey, K.W.; Cuker, A.; Dobesh, P.P.; Doherty, J.U.; Eikelboom, J.W.; Florido, R.; Gluckman, T.J.; Hucker, W.J.; Mehran, R.; et al. 2020 ACC Expert Consensus Decision Pathway on Management of Bleeding in Patients on Oral Anticoagulants. *JACC* **2020**, *76*, 594–622. [CrossRef] [PubMed]
25. Bikdeli, B.; Zahedi Tajrishi, F.; Sadeghipour, P.; Talasaz, A.H.; Fanikos, J.; Lippi, G.; Siegal, D.M.; Eikelboom, J.W.; Monreal, M.; Jimenez, D.; et al. Efficacy and Safety Considerations with Dose-Reduced Direct Oral Anticoagulants: A Review. *JAMA Cardiol.* **2022**, *7*, 747–759. [CrossRef] [PubMed]
26. Doherty, J.U.; Gluckman, T.J.; Hucker, W.J.; Januzzi, J.L.; Ortel, T.L.; Saxonhouse, S.J.; Spinler, S.A. 2017 ACC Expert Consensus Decision Pathway for Periprocedural Management of Anticoagulation in Patients with Nonvalvular Atrial Fibrillation. *JACC* **2017**, *69*, 871–898. [CrossRef] [PubMed]
27. Anderson, I.; Cifu, A.S. Management of Bleeding in Patients Taking Oral Anticoagulants. *JAMA* **2018**, *319*, 2032–2033. [CrossRef] [PubMed]
28. Rocca, B.; Cate, H.T. Antidotes for Anticoagulation Reversal. *N. Engl. J. Med.* **2026**, *394*, 2235–2254. [CrossRef] [PubMed]
29. Pollack, C.V.; Reilly, P.A.; Jv, R.; Eikelboom, J.W.; Glund, S.; Bernstein, R.A.; Dubiel, R.; Huisman, M.V.; Hylek, E.M.; Kam, C.-W.; et al. Idarucizumab for Dabigatran Reversal—Full Cohort Analysis. *N. Eng. J. Med.* **2017**, *377*, 431–441. [CrossRef] [PubMed]
30. Lip, G.Y.H.; Banerjee, A.; Boriani, G.; Chiang, C.; Fargo, R.; Freedman, B.; Lane, D.A.; Ruff, C.T.; Turakhia, M.; Werring, D.; et al. Antithrombotic Therapy for Atrial Fibrillation: CHEST Guideline and Expert Panel Report. *CHEST* **2018**, *154*, 1121–1201. [PubMed]
31. Rossini, R.; Tarantini, G.; Musumeci, G.; Masiero, G.; Barbato, E.; Calabrò, P.; Capodanno, D.; Leonardi, S.; Lettino, M.; Limbruno, U.; et al. A Multidisciplinary Approach on the Perioperative Antithrombotic Management of Patients with Coronary Stents Undergoing Surgery: Surgery After Stenting 2. *JACC Cardiovasc Interv.* **2018**, *11*, 417–434. [CrossRef] [PubMed]
32. Frontera, J.A.; Lewin, J.J.; Rabinstein, A.A.; Aisiku, I.P.; Alexandrov, A.W.; Cook, A.M.; del Zoppo, G.J.; Kumar, M.; Peerschke, E.I.B.; Stiefel, M.F.; et al. Guideline for Reversal of Antithrombotics in Intracranial Hemorrhage: Executive Summary. A Statement for Healthcare Professionals From the Neurocritical Care Society and the Society of Critical Care Medicine. *Crit. Care Med.* **2016**, *44*, 2251–2257. [CrossRef] [PubMed]
33. Spahn, D.R.; Bouillon, B.; Cerny, V.; Duranteau, J.; Filipescu, D.; Hunt, B.J.; Komadina, R.; Maegele, M.; Nardi, G.; Riddez, L.; et al. The European guideline on management of major bleeding and coagulopathy following trauma: Fifth edition. *Crit. Care* **2019**, *23*, 98. [CrossRef] [PubMed]
34. Desborough, M.J.R.; Al-Shahi Salman, R.; Stanworth, S.J.; Havard, D.; Woodhouse, L.J.; Craig, J.; Krishnan, K.; Brennan, P.M.; A Dineen, R.; Coats, T.J.; et al. Desmopressin for patients with spontaneous intracerebral haemorrhage taking antiplatelet drugs (DASH): A UK-based, phase 2, randomised, placebo-controlled, multicentre feasibility trial. *Lancet Neurol.* **2023**, *22*, 557–567. [CrossRef] [PubMed]
35. Rechenmacher, S.J.; Fang, J.C. Bridging Anticoagulation: Primum Non Nocere. *J. Am. Coll. Cardiol.* **2015**, *66*, 1392–1403. [PubMed]
36. Clark, N.P.; Douketis, J.D.; Hasselblad, V.; Schulman, S.; Kindzelski, A.L.; Ortel, T.L. Predictors of perioperative major bleeding in patients who interrupt warfarin for an elective surgery or procedure: Analysis of the BRIDGE trial. *Am. Heart J.* **2018**, *195*, 108–114. [CrossRef] [PubMed]
37. Ageno, W.; Gallus, A.S.; Wittkowsky, A.; Crowther, M.; Hylek, E.M.; Palareti, G. Oral Anticoagulant Therapy: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest* **2012**, *141*, e44S–e88S. [CrossRef]
38. Andreotti, F.; Geisler, T.; Collet, J.P.; Gigante, B.; Gorog, D.A.; Halvorsen, S.; Lip, G.Y.H.; Morais, J.; Navarese, E.P.; Patrono, C.; et al. Acute, periprocedural and longterm antithrombotic therapy in older adults: 2022 Update by the ESC Working Group on Thrombosis. *Eur. Heart J.* **2023**, *44*, 262–279. [PubMed]
39. Furman, K.; Giustini, A.; Branstetter, J.; Woods, G.; Downey, L.A. A review of the perioperative management of direct oral anticoagulants for pediatric anesthesiologists. *Pediatr. Anesth.* **2024**, *34*, 1200–1212. [CrossRef] [PubMed]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.