

# Resumption versus discontinuation of direct oral anticoagulation after an episode of gastrointestinal bleeding: a systematic review and meta-analysis of rebleeding episodes

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## Keywords

bleeding, oral anticoagulation, gastrointestinal bleeding, DOAC

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## Abstract

### Introduction

Background. Direct oral anticoagulants (DOACs) have become standard of care in long term anticoagulation. Extensive research has focused on this new class of drugs that despite their benefits, have an associated risk of bleeding with lack of evidence for management following an episode of gastrointestinal bleeding (GIB). Our meta-analysis and systematic review provide an updated perspective on the rate of rebleeding in patients with an episode of GIB while on DOACs.

### Material and methods

Materials and methods. A systematic search of PubMed, EMBASE and Cochrane databases was performed for all comparative studies examining outcomes in patients that resumed versus withheld DOACs after a baseline episode of GIB. The initial search found 1823 studies. After excluding duplicates and unrelated studies based on abstract triage, 29 full texts were assessed for eligibility, out of which five matched the inclusion criteria and were systematically reviewed.

### Results

Results. Five studies containing data comparing clinical outcomes between patients were included. All studies were retrospective including a total of 2837 patients with a case control design. Both groups showed similar rebleeding rates with lower GIB as the primary site of rebleeding. Type of DOAC, timing of anticoagulation resumption and patients characteristics may influence rebleeding rates.

### Conclusions

Conclusions: Looking at the overall risk/benefit ratio of anticoagulation post GIB, we suggest there is a benefit for oral anticoagulation continuation. Further large scale studies are needed to provide optimal management strategies in this population.

## 1. Introduction

Direct oral anticoagulants (DOACs) have become standard of care in long term anticoagulation [1]. The primary indication is to lower the risk of systemic embolism or stroke in patients with non-valvular atrial fibrillation (AF). Oral anticoagulation use has demonstrated long-term benefits in significantly reducing all-cause and stroke mortality [2]. Patients with AF experience a fivefold increase in the risk of thromboembolic stroke which is associated with longer admission time, higher morbidity and mortality than other types of strokes. Moreover, approximately 25% of elderly patients develop AF-related stroke [3,4]. It is estimated that by 2060, around 19.9 million people will be diagnosed with AF [5]. This trend is the result of increased life expectancy, with associated higher burden of lifestyle risk factors and comorbidities, better survival rates after major cardiovascular events and improved screening of high risk population [6]. The prevalence of risk factors varies across geographical areas in Europe leading to disparities among incidence and AF associated mortality [7,8]. As such, alcohol intake, sedentary lifestyle or dyslipidaemia are more often encountered in Western European countries in contrast to eastern European countries where diabetes mellitus and hypertension have higher rates. However, in developed countries AF-related mortality seems to be higher in developed countries. Prevention or treatment of venous thromboembolism (VTE) represents another indication of DOAC use in clinical practice. VTE is thought to affect 1-2 individuals/1000 persons-years in Europe and the United States [9]. In Europe, an estimated incidence based on a total population of 310.4 million people was approximately 296,000 cases of pulmonary embolism (PE) and 466,000 of deep vein thrombosis (DVT) [10]. VTE increases the risk of death, being associated with a threefold increased risk of all-cause mortality in patients with acute medical illness. The RIETE registry showed a 30-day mortality rate of 5.1% in patients with PE and 3.3% with DVT [11]. Hence, DOAC play a pivotal role in these two major conditions with rapidly

evolving incidence and major healthcare impact. There are two main DOAC classes, direct thrombin inhibitors and direct factor Xa inhibitors. Since approval, they were shown to be superior or non-inferior to vitamin K antagonists (VKA) causing a paradigm shift in anticoagulant prescribing and guidelines due to multiple advantages. It requires less often monitoring and follow-up, it has faster onset and offset action and decreased drug and food interaction. As a consequence, DOACs prescriptions have surpassed those of VKA. In 2017, out of 7,502 patients that started an oral anticoagulant, 78.9% were on DOACs [12].

Despite their benefits, DOACs have an associated risk of bleeding. Critical sites include intracranial and gastrointestinal bleeding which may develop in up to 6.62 DOAC users per treatment years [13]. Compared to VKA, DOACs have a reduced risk of intracranial haemorrhage (ICH) [14], but several studies found an increased risk of gastrointestinal bleeding (GIB). Risk of major GIB is between 0.35% to 2.09%, while that of ICH is between 0.09% to 0.51% [1,12,14]. There is, however, a certain degree of variation among studies. Firstly, the severity of bleeding should be clearly established by using the International Society on Thrombosis and Haemostasis (ISTH) definition. Fatal bleeding arises in a critical area or organ (e.g. intracranial, intraspinal, intraocular), or requires transfusion of 2 or more units of red blood cells or a decrease of 2 g/dL in haemoglobin or causes hemodynamic instability [15,16]. The incidence of major bleeding seems to be increased in patients with risk factors for bleeding having an incidence of 1.1% to 4%. Life-threatening bleeding is slightly lower in incidence with an estimated 0.1 to 1% per year [17]. Secondly, the drug and the dose are additional factors. ROCKET [18], ENGAGE-AF-TIMI [19] and RE-LY [20] trials showed a higher risk of GIB for rivaroxaban, edoxaban and dabigatran 150 mg and equal risk of GIB in the ARISTOTLE trial for apixaban when compared to VKA [21]. Thirdly, there is little evidence regarding management of DOAC after an episode of bleeding. Extensive evidence showed benefits for using reversal agents, but subsequent anticoagulant

use is a matter of debate. Previous data based on warfarin treated cohorts showed significant reduction of all-cause mortality and thromboembolism if warfarin is restarted after a major GIB. This approach may however increase the risk of rebleeding, and some experts advise to reinitiate the drug around 14 days after resolution of GIB [19-25]. Although increasingly used in clinical practice, there is less evidence for management of DOACs after an episode of GIB. Previous studies have included mixed cohorts, on DOACs and warfarin or other antithrombotic drugs. Our meta-analysis and systematic review provide an updated perspective on the rate of rebleeding while on DOACs.

## **2. Materials and methods**

### **2.2 Literature Search and Study Selection**

The study was registered with PROSPERO (International Prospective Register of Systematic Reviews). The study ID is CRD42023466346. A systematic search of PubMed and EMBASE databases was performed for all comparative studies examining outcomes in patients that withheld versus resumed DOACs after a baseline episode of GIB. The following search algorithm was used: gastrointestinal AND (bleeding OR haemorrhage) AND (oral anticoagulation OR oral anticoagulant). Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used as search protocol and the PRISMA checklist was followed to conduct the methodology [26] (Figure 1). Inclusion criteria were used according to the Problem, Intervention, Comparison and Outcome (PICO) formula. The latest search was performed on 1<sup>st</sup> August 2023. Two authors (BCM and SM) assessed the titles and abstracts of studies found in the search and the full texts of potentially eligible trials were reviewed. Disagreements were resolved by consensus-based discussion. The Newcastle-Ottawa scale (Table I) and the ROBINS-I tool (Figure 2) were used to quantify quality of eligible studies. The references of full texts reviewed were further screened for additional

eligible studies. The corresponding author was contacted to clarify data extraction if additional information was necessary.

### **2.3. Eligibility Criteria**

Studies written in English including comparative clinical data between patients which held versus patients which continued DOAC after index GIB were assessed for eligibility. The main end points were rate of rebleeding, thrombosis and mortality. Studies including patients on warfarin or antiplatelets were excluded. Studies without comparative data were not included. Studies in which DOAC was not the only anticoagulant used were excluded. Case reports, case series, conference papers, reviews, editorials, letters to editor and single group cohort studies were excluded. Studies written in other languages were excluded.

### **2.4. Data Extraction and Outcomes**

For each eligible study the following data was recorded: author's names, journal, year of publication, study type, total number of patients and number of patients included in each group, mean age, gender, type of DOAC used, source of initial bleeding, rebleeding episode (Table I).

### **2.5. Statistical Analysis**

Random-effects models were used to measure all pooled outcomes as described by Der Simonian and Laird [27] and the odds ratio (OR) was estimated with its variance and 95% confidence interval (CI). The random effects analysis weighed the natural logarithm of each study's OR by the inverse of its variance plus an estimate of the between-study variance in the presence of between-study heterogeneity. As described previously [28], heterogeneity between ORs for the same outcome between different studies was assessed using the  $I^2$  inconsistency test and chi-square-based Cochran's Q statistic test [29] in which  $p < 0.05$  is taken to indicate the presence of significant heterogeneity. For the main outcomes, publication bias was addressed using the trim and fill method. Computations were carried out

using Comprehensive Meta-Analysis Version 4.

### **3. RESULTS**

#### **3.1. Eligible studies**

Five studies [30-34] containing data comparing clinical outcomes between patients which held or resumed DOAC after GI bleeding were included (Table I). The initial search found 1823 studies. After excluding duplicates and unrelated studies based on abstract triage, 29 full texts were assessed for eligibility, out of which five matched the inclusion criteria and were systematically reviewed (Figure 1). The year of publication of included studies ranged from 2017 to 2021. All studies were retrospective with a case control design. The total number of patients included was 2837, split into two groups: study group (SG, n=1290) and control group (CG, n=1547). In the study group patients were restarted on DOAC after their GIB episode has resolved. In the control group anticoagulation **was stopped after the index GIB episode**. Patients in the CG did not receive an alternative anticoagulant/antiplatelet treatment. **Baseline characteristics were provided in 2 (Sengupta et al. and Valanejad et al.) out of the 5 studies included. Patients in the CG had similar associated comorbidities as the SG, with coronary artery disease and diabetes mellitus being the most frequent ones. More patients in the CG required blood transfusion and ICU admission.** Lower GIB was the most frequent site of bleeding. Rivaroxaban is the main DOAC used in most cohorts, followed by dabigatran (Table I). The mean age in the SG was 77.2 vs 77.9 in the CG. Mean follow-up period ranged from 3 to 13.2 months (Table II).

#### **3.2. Rebleeding rate**

Five studies describing 2837 patients included data on rebleeding episodes. Both groups showed similar rebleeding rates with a mean effect size of 1.087, 95% CI: 0.772-1.531,  $p=0.632$ ,  $Q=0.865$ ,  $I^2=0\%$  (Figure 3).

Egger's regression intercept showed significant publication bias,  $p=0.02$ . Publication bias was addressed via the trim and fill method on a fixed effect model by which 2 missing studies were imputed. Using trim and fill the imputed point estimate is 1.061 (0.757-1.487), without changing the overall significance of the results (Figure 4).

#### **4. DISCUSSION**

Given the variability among prospective trials and meta-analysis concerning DOACs associated GIB, we performed an updated meta-analysis and systematic review on DOACs management after an episode of index GIB. Resumption versus discontinuation of oral anticoagulation results in similar rates of GI rebleeding among the population studied.

The cohorts in our meta-analysis include patients on oral anticoagulation for atrial fibrillation (AF). Only one study included a mixed population, with indication of anticoagulation for both AF and venous thromboembolism (VTE). Comparative studies evaluating the incidence of GIB in patients taking DOACs versus VKAs showed no difference in major GIB risk, for both upper major (adjusted HR: 0.94; 95% CI: 0.76-1.11) and lower (adjusted HR: 1.25; 95% CI: 0.97-1.53) GIB [35]. Risk factors associated with GIB seem to be advanced age ( $\geq 75$  years), concomitant therapy with antiplatelets or NSAIDs, reduced body weight or renal impairment [36,37]. Mean age in our cohort is 77.2 years which confirms increased risk of GIB in this age group. In two of our studies (Yanagisawa and Sengupta [34,31]), associated treatment with antiplatelets provided an increased risk of index GIB, while congestive heart failure, left ventricular assist device and end stage renal disease were noted in the study by Tapaskar [32].

Despite this information, management of DOAC therapy after a GIB remains controversial. While resumption of anticoagulation reduces thromboembolic risk and all-cause mortality, it may also increase the risk of recurrent GIB. Previous meta-analysis included either VKA predominant population, or mixed population of VKA, DOACs

plus/minus antiplatelets which led to increased baseline heterogeneity. Furthermore, these results cannot be extrapolated to DOACs population as VKAs have different pharmacologic profile and particular indications, such as mechanical valve [38,25]. Our study focused on DOAC treated patients with 1290 individuals with different DOAC agents, predominantly with Rivaroxaban and Dabigatran. Although both groups showed similar rebleeding rates, there is a tendency for less events in the control group. When considering the absolute numbers, it seems there is a higher risk of rebleeding events in patients with DOAC resumption after index GIB. There are several factors involved. Firstly, 48% of the study population was treated with Rivaroxaban on their index GIB and approximately 42% of those with a rebleeding episode. It seems that Rivaroxaban is associated with an increased risk of GI rebleeding in comparison with the other DOACs. Previous large-scale studies and meta-analysis showed similar less favorable gastrointestinal safety [39,40], especially at a dose of 20 mg. The other DOACs, dabigatran, edoxaban and apixaban, do not significantly increase the risk of recurrent GIB, on the contrary, apixaban has a reduced risk of recurrent GIB [36,41]. It is worth mentioning, however, that in patients with previous GIB, Dabigatran should be used at a dose of 110 mg twice daily [42]. Hence, the general recommendation is to switch to another DOAC if a patient suffers an episode of GIB while on Rivaroxaban. Secondly, the time of anticoagulant resumption plays a key role. Data on Warfarin studies showed an increased risk of recurrent GIB if restarted within 7 days of index GIB, but with favorable outcome when restarted within 15 or even 30 days [24]. **The European Society of Gastroenterology (ESGE) provides recommendations for anticoagulation resumption according to the type of bleeding (variceal versus non-variceal) within 7 days considering bleeding control and thrombotic risk. In case of non-variceal upper GIB, anticoagulation can be restarted after 7 days or sooner if the bleeding source is appropriately controlled. In patients with variceal GI bleed and high thrombotic risk, anticoagulation could be restarted**



within 3 days using heparin bridging, or within 7 days in patients with low thrombotic risk upon successful hemostasis [43,44]. In our analysis, two of the included studies resumed DOAC within 7 days of index GIB. The percentage of patients in the SG is higher (5.5%, 11.6%, respectively) compared to the one in the CG (2.7%, 0%, respectively). This trend does not apply when analyzing the same data for the studies resuming anticoagulation within 40 days, where we observe similar rebleeding rates between groups. Despite these observations, the data needs to be interpreted with caution as there is no statistically significant difference in between groups. This may be secondary to the high heterogeneity of included studies and lack of uniform data among the studied population. Large cohort prospective studies should be further performed. Similar observations have been made in another meta-analysis where resumption of anticoagulation within a week from index GIB showed a 11% rate of rebleeding and 8-9% in the following 2 weeks [45]. Thirdly, there are several factors that may influence decision to withhold anticoagulation [46] at index bleeding, including severity of bleeding, prior history of bleeding, need for intensive care unit admission, blood transfusion, concomitant antiplatelet drugs use and endoscopy intervention. It worth noting that CHA<sub>2</sub>DS<sub>2</sub>-VASC and HAS-BLED scores did not impact anticoagulation resumption. Further large scale studies are needed to assess the optimal timing of anticoagulation resumption, the appropriate dose as well as short term and long term outcomes.

The strength of this meta-analysis is the relatively large size of study population treated with DOAC. This removes the significant influence of VKAs on the investigated outcomes. Previous similar research included studies which focused on warfarin-based populations and/or with a significant number of associated antiplatelet treatment.

There are some limitations. We had to exclude many studies to decrease population heterogeneity, but this has translated into a low number of studies (n=5) with a small sample size limiting the statistical power of our analysis. Included studies have notable differences in

terms of inclusion criteria, baseline population characteristics, description of primary and secondary endpoints. We did not have access to raw data, despite contacting the authors, as such subgroup analysis could not be performed. Most of the data was based on insurance or prescription claims which lacks appropriate treatment follow-up, compliance, and other important data such as laboratory work-up. Another limitation is related to the retrospective nature of the studies increasing the risk of selection and confounding bias; however, it does reflect real world clinical practice and it excludes performance bias. Publication bias was present, as smaller studies (Valanejad et al. and Yanagisawa et al.) had a larger effect size, favouring discontinuation of DOAC based on the higher rebleeding rate in the SG. This assumption should be taken with caution given the low number of included studies. Performance of Egger's test and trim and fill is low when less than ten studies are analysed. By performing trim and fill, two studies were imputed favouring the CG, thus excluding the possibility of publication bias (i.e., studies that might have shown a smaller effect size may have not been published due to their small cohort and insignificant results).

## **5. CONCLUSION**

We provide an updated meta-analysis looking at DOAC resumption versus discontinuation after an episode of GIB among patients taking oral anticoagulation. The rates of gastrointestinal rebleeding were similar in both cohorts, with a tendency for less events in the discontinuation group. Certain risk factors such as advanced age, renal impairment, timing of anticoagulant resumption and type of DOAC may influence rebleeding rates. Looking at the overall risk/benefit ratio of anticoagulation post GIB, we suggest there is a benefit for oral anticoagulation continuation. Further validation in large cohort studies is needed.

### **Conflict of interest statement**

No funding or financial assistance was received by the authors. The authors have no conflicts of interest to disclose.

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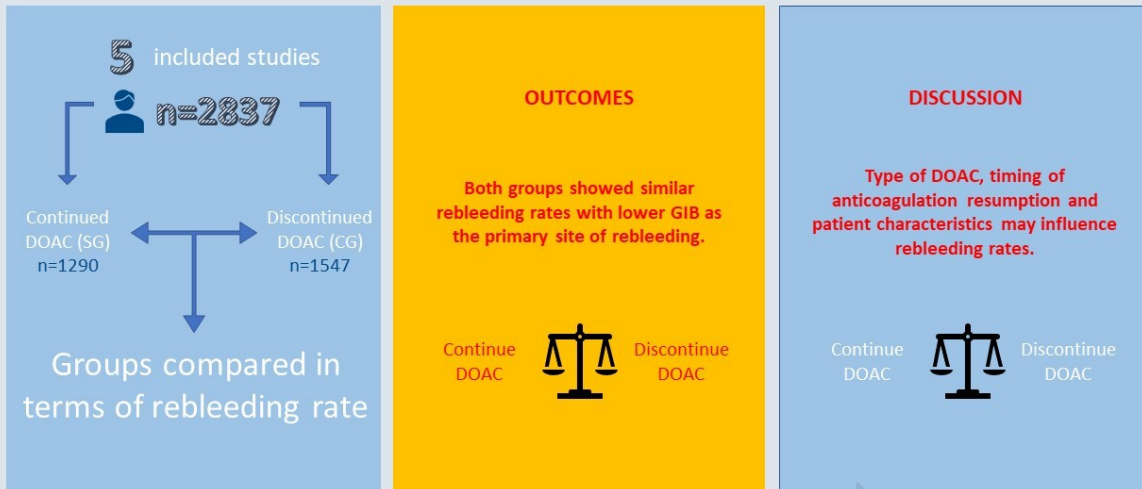
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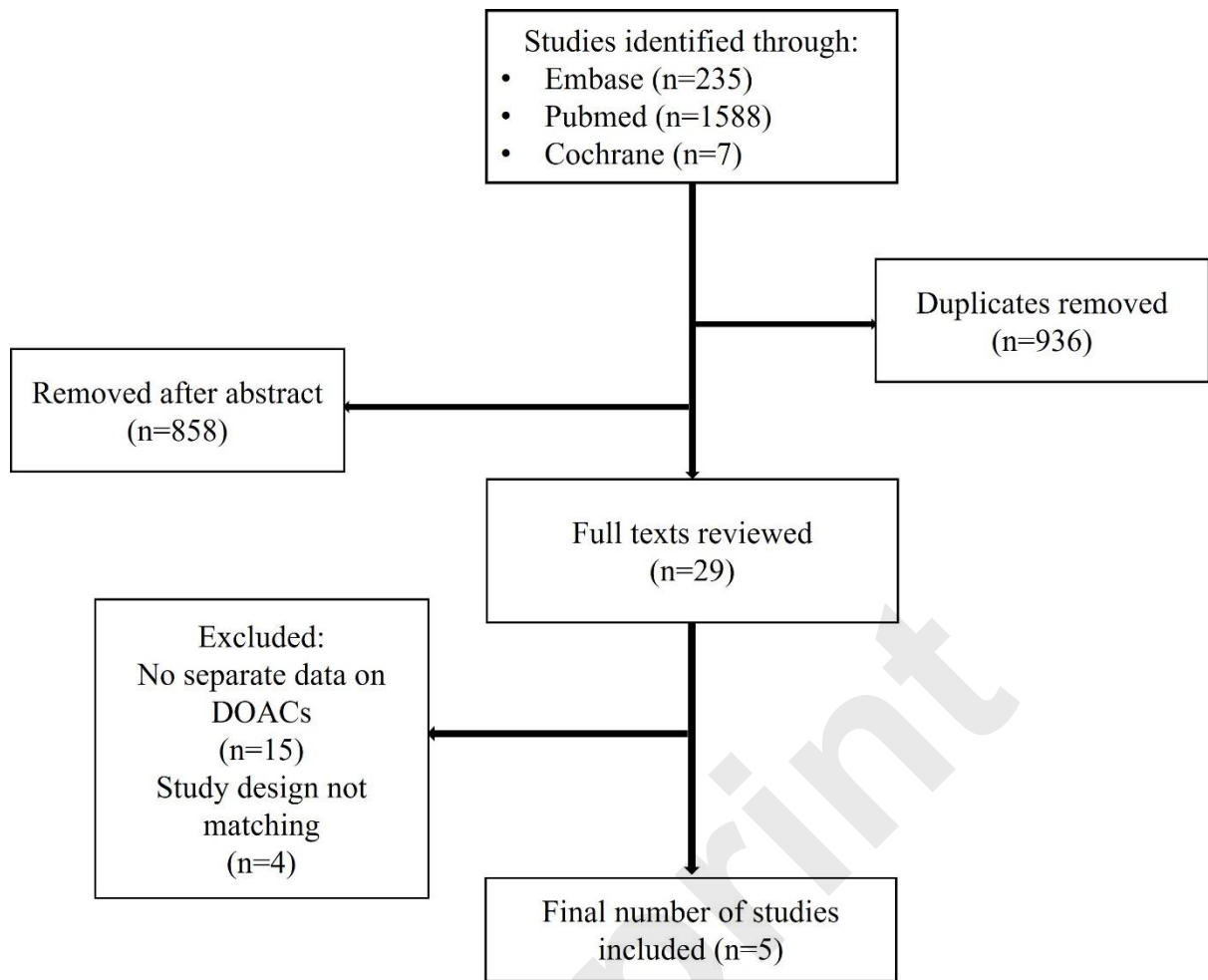


# Resumption versus discontinuation of direct oral anticoagulation after an episode of gastrointestinal bleeding: a SR and MA of rebleeding episodes



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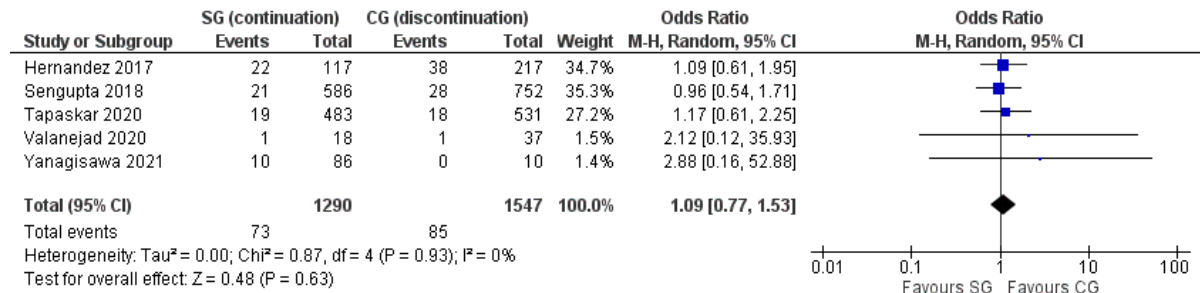
**Figure 1.** PRISMA diagram. Preferred reporting items in systematic reviews and meta-analysis.

		Risk of bias domains							Overall
		D1	D2	D3	D4	D5	D6	D7	
Study	Hernandez	⊗	-	-	⊗	+	⊗	⊗	⊗
	Sengupta	⊗	-	-	⊗	-	⊗	⊗	⊗
	Tapaskar	⊗	-	-	⊗	-	⊗	⊗	⊗
	Valanejad	⊗	-	-	⊗	-	⊗	⊗	⊗
	Yanagisawa	⊗	⊗	-	⊗	-	⊗	⊗	⊗

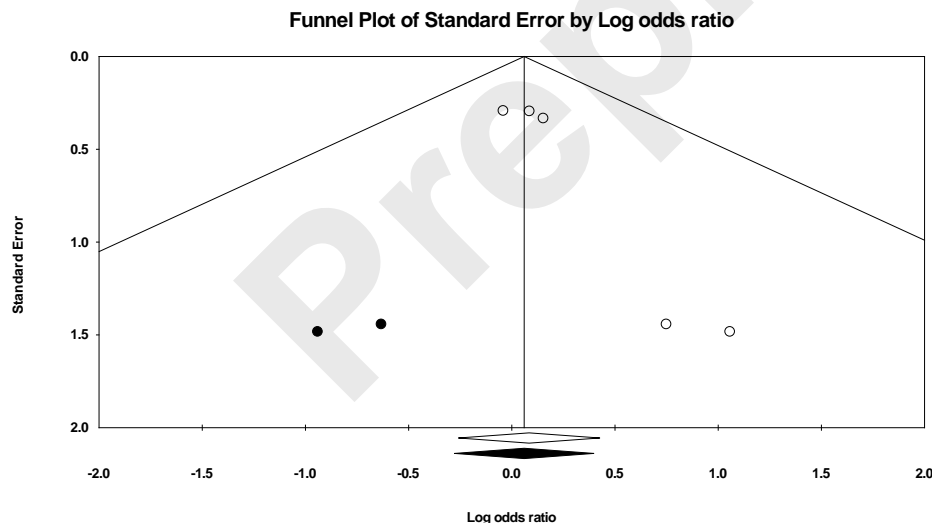
Domains:  
 D1: Bias due to confounding.  
 D2: Bias due to selection of participants.  
 D3: Bias in classification of interventions.  
 D4: Bias due to deviations from intended interventions.  
 D5: Bias due to missing data.  
 D6: Bias in measurement of outcomes.  
 D7: Bias in selection of the reported result.

Judgement  
 ⊗ Serious  
 - Moderate  
 + Low

**Figure 2.** ROBINS-I Risk of bias assessment. Assessment of risk of bias was done by two authors (BCM and SM). Each study was classified as low/moderate/serious risk for each of the seven domains. Disagreements were resolved via consensus.



**Figure 3.** Meta analysis of rebleeding events. Favors A, less events in the study group; Favors B, less events in the control group. Each study is shown by the point estimate of the odds ratio/mean difference (OR; square proportional to the weight of each study) and 95% confidence interval (CI) for the OR (extending lines); the combined ORs/mean difference and 95% CIs by random effects calculations are shown by diamonds.



**Figure 4.** Trim and fill method to address publication bias by imputing two small studies. The funnel plot is a plot of a measure of study size (usually standard error or precision) on the vertical axis as a function of effect size on the horizontal axis. Large studies appear toward the top of the graph and tend to cluster near the mean effect size. Smaller studies appear toward the bottom of the graph. Through the trim and fill method two studies were imputed to adjust for publication bias (full black circles). On the bottom of the graph, the empty diamond shows the OR and confidence interval for the original studies, while the full diamond shows the OR and confidence interval for the original and imputed studies.

Author and Year	Country	NOS (S+C+E)	Total no. of patients (SG/CG)	DOAC		Male Gender No(%)		Mean Age		Index GIB No		Upper GIB		Lower GIB	
				Agent	No. of patients	SG	CG	SG	CG	SG	CG	SG	CG	SG	CG
Hernandez 2017	USA	7 (4+1+2)	334 (117/217)	Dabigatran	334	41 (35)	68 (31.3)	79.64	81.9	92	184	NR	NR		
Sengupta 2018	USA	7 (4+1+2)	1338 (586/752)	Dabigatran	679										
				Rivaroxaban	608	294 (50)	357 (47)	78	79	379	521	150	220	229	301
				Apixaban	51										
Tapaskar 2020	USA	7 (4+1+2)	1119 (483/531)	Dabigatran	293										
				Rivaroxaban	676	554 (49.4)		78		851	-	285	-	569	-
				Apixaban	250										
Valanejad 2020	USA	7 (4+1+2)	57 (18/37)	Dabigatran	5										
				Rivaroxaban	34	10 (55.6)	14 (37.8)	74.5	75	10	27	5	21	5	6
				Apixaban	18										
Yanagisawa 2021	Japan	7 (4+1+2)	96 (86/10)	Dabigatran	22										
				Rivaroxaban	51	57 (59.3)		76		57	-	17	-	40	-
				Apixaban	18										
				Edoxaban	5										

**Table I.** Characteristics of included studies. SG, study group; CG, control group; NOS, Newcastle-Ottawa Scale; S, selection score; C, comparability score; E, exposure score; GIB, gastrointestinal bleeding.

Author	Type of anticoagulant after index GIB	Indication	Time to resumption (mean)	Follow-up months (mean)	Rebleeding rate	
					SG	CG
Hernandez 2017	Dabigatran (n=117)	AF	45 days	13.2	18.8% (n=22)	17.5% (n=38)
Sengupta 2018	Dabigatran (n=280) Rivaroxaban (n=282) Apixaban (n=24)	AF	40 days	6	3.5% (n=21)	3.7% (n=28)
Tapaskar 2020	NR	AF	NR	4	3.9% (n=19)	3.3% (n=18)
Valanejad 2020	Dabigatran (n=2) Rivaroxaban (n=10) Apixaban (n=6)	AF DVT PE	≤ 7 days	3	5.5% (n=1)	2.7% (n=1)
Yanagisawa 2021	Dabigatran (n=22) Rivaroxaban (n=51) Apixaban (n=18) Edoxaban (n=5)	AF	≤ 7 days (80% of cohort)	6	11.6% (n=10)	0%

**Table II.** Type of DOAC used in the study group after index GIB. Characteristics of main end points. AF, atrial fibrillation; SG, study group (continuation); CG, control group (discontinuation); NR, not recorded; DVT, deep vein thrombosis; PE, pulmonary embolism; GIB, gastrointestinal bleeding