

Available online at *www.ujpronline.com*
Universal Journal of Pharmaceutical Research
An International Peer Reviewed Journal
ISSN: 2831-5235 (Print); 2456-8058 (Electronic)
Copyright©2026; The Author(s): This is an open-access article distributed under the terms of the CC BY-NC 4.0 which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited

REVIEW ARTICLE

PERIOPERATIVE ANTICOAGULATION MANAGEMENT: A HEMATOLOGIST–CARDIOLOGIST PERSPECTIVE ON RISK STRATIFICATION AND THERAPEUTIC DRUG MONITORING

Emmanuel Ifeanyi Obeagu[1,2,3*], Olga Goryacheva[3]

[1]Division of Haematology, Department of Biomedical and Laboratory Science, Africa University, Mutare, Zimbabwe. [2]Department of Molecular Medicine and Haematology, School of Pathology, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa. [3]Department of Internal Diseases, Perm State Medical University named after Academician E.A. Wagner, Perm, Russia.

Article Info:

Article History:
Received: 25 July 2026
Reviewed: 11 September 2026
Accepted: 9 October 2026
Published: 15 November 2026

Cite this article:
Obeagu EI, Goryacheva O. Perioperative anticoagulation management: A hematologist–cardiologist perspective on risk stratification, and therapeutic drug monitoring. Universal Journal of Pharmaceutical Research 2026; 11(5): 111-115.
http://doi.org/10.22270/ujpr.v11i5.1673

***Address for Correspondence:**
Dr. Emmanuel Ifeanyi Obeagu, Department of Biomedical and Laboratory Science, Africa University, Zimbabwe. Tel: +263-778025658
E-mail: *emmanuelobeagu@yahoo.com*

Abstract

Direct oral anticoagulants (DOACs) are widely used for thromboprophylaxis in atrial fibrillation and venous thromboembolism. Their marketing emphasizes predictable pharmacokinetics and no need for routine monitoring. However, the perioperative period exposes critical limitations of this paradigm, especially in high-risk populations excluded from landmark trials. This narrative review integrates hematology and cardiology perspectives. We critically examined real-world evidence on perioperative DOAC management, focusing on patients with extreme body weight, renal or hepatic impairment, active malignancy, thrombocytopenia, bariatric surgery, and drug–drug interactions. Guideline recommendations and commercial influences were analyzed. Routine therapeutic drug monitoring (TDM) is unnecessary for low-risk elective procedures in standard patients. However, selective TDM is essential in high-risk populations where DOAC pharmacokinetics are unpredictable. We identified specific indications for TDM (extreme body weight, CrCl<50 mL/min, Child-Pugh B cirrhosis, bariatric surgery, interacting drugs) and provided practical algorithms for elective, urgent and emergency surgery. Low-Molecular-Weight heparin (LMWH) is preferred when DOAC pharmacokinetics are unpredictable, including malabsorption syndromes, severe thrombocytopenia, and advanced liver disease. Marketing influences have perpetuated the "no monitoring" dogma despite accumulating evidence of harm in vulnerable subgroups. A one-size-fits-all approach to perioperative anticoagulation is unsafe in complex patients. Selective TDM improves safety in high-risk scenarios. LMWH remains a preferred alternative when DOAC pharmacokinetics are unpredictable. Clinicians should recognise marketing influences and adopt evidence-based, individualised strategies.

Keywords: anticoagulants, drug safety, perioperative management, therapeutic drug monitoring, high risk populations.

INTRODUCTION

The introduction of direct oral anticoagulants (DOACs) dabigatran, rivaroxaban, apixaban, and edoxaban transformed the landscape of anticoagulation[1]. Fixed dosing, few dietary restrictions, and the absence of routine monitoring offered a welcome alternative to vitamin K antagonists (VKAs). Large randomized controlled trials (RE-LY, ROCKET AF, ARISTOTLE, ENGAGE AF) established DOACs as first-line therapy for atrial fibrillation (AF) and venous thromboembolism (VTE)[2]. However, the populations enrolled in these trials were highly selected. Patients with extreme body weight (body mass index [BMI] <18.5 kg/m² or >40 kg/m²), advanced kidney disease (creatinine clearance [CrCl] <30 mL/min), severe liver disease (Child-Pugh B or C), active malignancy, thrombocytopenia, or prior bariatric surgery were largely excluded[3,4]. These exclusions leave clinicians without robust evidence for perioperative management in these growing patient groups.

As a haematologist (E.I.O.) and a cardiologist (O.G.), we recognize that haemostasis is not a one-size-fits-all physiology; bleeding and thrombotic risks are dynamic and patient-specific. Patients with AF often accumulate multiple comorbidities that individually may not contraindicate DOACs but collectively create unpredictable pharmacokinetics. The perioperative period with its inherent bleeding and thrombotic risks is precisely when these vulnerabilities become critical.

This review integrates hematology and cardiology perspectives to provide practical, evidence based framework for perioperative anticoagulation. We identify high risk populations in whom therapeutic drug monitoring (TDM) should be considered, clarify when DOACs are preferred versus low molecular weight heparin (LMWH) or VKAs, and outline situations where anticoagulation should be deferred. We also examine the influence of pharmaceutical marketing on the "no monitoring" narrative and offer guidance grounded in real-world data.

The "No Monitoring" paradigm: Marketing versus medicine

The statement that DOACs "do not require routine monitoring" was never intended to apply universally. In controlled trial populations, DOACs demonstrated predictable pharmacokinetics with low inter-individual variability[4]. However, this statement became a powerful marketing tool that has often been over generalized to all patients, including those with altered physiology.

A growing body of real-world data demonstrates that the "no monitoring" rule fails in specific high risk subgroups:

1. **Post-bariatric surgery**. A 2025 case report described a fatal apixaban failure in a 37-year-old woman with Roux-en-Y gastric bypass who developed a thoracic aortic thrombus[11]. Despite reported adherence, apixaban levels were subtherapeutic due to malabsorption, leading to thrombus rupture, bowel infarction, and death.
2. **Extreme body weight.** A retrospective analysis from the Mayo Clinic VTE Registry found that DOACs were associated with higher major bleeding rates in patients weighing <60 kg[12].
3. **Cancer patients**. A 2025 meta-analysis of cancer related surgeries showed that while DOACs were non-inferior to LMWH for VTE prevention, bleeding risk varied significantly by cancer type and DOAC agent[13].

These cases underscore that the absence of monitoring does not mean the absence of risk; rather, it means risk is being managed blindly.

Risk stratification: Populations requiring special consideration

1. **Extreme body weight**

The Problem: obesity (BMI ≥40 kg/m² or weight >120 kg) and underweight (BMI <18.5 kg/m² or weight <60 kg) alter volume of distribution and clearance. Dabigatran shows an inverse correlation with weight, while apixaban and rivaroxaban are more weight neutral[23].

Current recommendations: ISTH 2021 - apixaban and rivaroxaban can be used for VTE treatment in patients with BMI <50 kg/m² or weight <150 kg, Dabigatran and edoxaban should be avoided due to insufficient data; ACC/AHA 2023: for patients weighing ≤60 kg, apixaban dose reduction is recommended if also age ≥80 years or creatinine ≥1.5 mg/dL[14,15].

Perioperative implications: standard discontinuation protocols apply for elective surgery, but TDM should be considered before high-bleeding-risk procedures in patients with BMI >40 or <18.5, especially when other risk factors coexist.

2. Renal Impairment

The Problem: renal clearance varies: dabigatran 80%, edoxaban 50%, rivaroxaban 35%, apixaban 27% [23]. Accumulation increases bleeding risk.

Current recommendations: if CrCl ≥30 mL/min: all DOACs can be used with appropriate dosing (rivaroxaban 15 mg daily for AF, dabigatran 110 mg twice daily)[15].

CrCl 15–29 mL/min: apixaban is preferred (2.5 mg twice daily if dose reduction criteria met), Rivaroxaban is FDA-approved for AF at 15 mg daily. Dabigatran and edoxaban are contraindicated. If CrCl<15 mL/min or dialysis: only apixaban has sufficient data; others should be avoided.

Perioperative implications: for elective surgery, extend discontinuation to 3–4 days when CrCl<50 mL/min. For urgent surgery, TDM is strongly recommended; the Milan study (2026) found that among patients with CrCl<50 mL/min undergoing hip fracture repair, 9.4% had DOAC concentrations >100 ng/mL despite >24 hours since last dose[6].

3. Liver cirrhosis

The Problem: cirrhosis creates a hemostatic paradox-prolonged PT/INR suggests bleeding risk, but reduced protein C, protein S, and antithrombin III increase thrombotic risk.

Current recommendations: Child-Pugh A - DOACs may be used; apixaban and edoxaban have favorable pharmacokinetic profiles. If Child-Pugh B then avoids rivaroxaban (ACC/AHA); other DOACs may be used with caution. If Child-Pugh C - all DOACs contra-indicated. Perioperative implications: screen for esophageal varices before elective surgery; ligate if high-risk. TDM is reasonable for Child-Pugh B patients undergoing high-bleeding-risk procedures[19].

4. Bariatric surgery and malabsorption syndromes

The Problem: altered gastrointestinal anatomy reduces DOAC absorption. Data from a 2024 study of bariatric surgery patients showed that 24% of rivaroxaban users and 100% of dabigatran users had concentrations below the expected trough range[17].

Recommendations: for patients with a history of bariatric surgery or active malabsorption, DOACs should be used with caution. TDM is essential to confirm therapeutic levels. LMWH may be a safer alternative until adequate absorption is confirmed.

5. Active Malignancy

The Problem: cancer patients have a 12- to 23-fold increased VTE risk and frequently receive interacting drugs (e.g., tyrosine kinase inhibitors [TKIs]) that modulate P-glycoprotein (P-gp) and CYP3A4[13,20].

Current recommendations: Guidelines (ASCO, ISTH, ESC) - DOACs are recommended for VTE treatment in cancer patients without significant drug interactions or gastrointestinal malignancies[20].

Gastrointestinal cancers: DOACs are associated with higher bleeding risk and should be used with caution.

Perioperative implications: for cancer surgery, VTE risk is high. DOACs may be used postoperatively when hemostasis is secure. TDM is indicated when patients receive interacting TKIs, have renal impairment, or

have had prior bariatric surgery. LMWH remains a safe alternative, particularly in patients with thrombocytopenia or gastrointestinal lesions.

6. Thrombocytopenia

The Problem: platelet count <50,000/μL increases bleeding risk with any anticoagulant. Data from the 2023 multicenter Chinese study showed that thrombocytopenia alone (platelets <100,000/μL) was not independently associated with bleeding in multivariate analysis, but the combination of thrombocytopenia and anemia significantly increased bleeding risk (aOR 2.15)[16].

Perioperative implications: platelets >100,000/μL - DOACs can be used with caution. Platelets 50,000–100,000/μL - DOACs are possible; dabigatran may have a better safety profile than rivaroxaban. Platelets 30,000–50,000/μL: transition to LMWH (e.g., enoxaparin 0.5 mg/kg once daily). Platelets <30,000/μL: anticoagulation should be withheld unless absolutely necessary, and mechanical prophylaxis considered[8,16].

7. Drug–drug interactions

The Problem: many commonly used medications modulate P-gp or CYP3A4, affecting DOAC levels. A 2025 systematic review identified 240 DOAC–antineoplastic drug pairs; for 35% of these pairs, at least one source recommended caution or avoidance, with conflicting recommendations across sources[13].

High-risk interactions: 1) strong P-gp/ CYP3A4 inhibitors (ketoconazole, ritonavir, clarithro-mycin, verapamil): increase DOAC exposure; 2) strong inducers (rifampin, carbamazepine, St. John's wort): decrease DOAC exposure; 3) tyrosine kinase inhibitors (e.g., ibrutinib, cabozantinib): may inhibit P-gp, leading to supratherapeutic levels and bleeding[13,18].

Perioperative Implications: review all medications, including over-the-counter products. TDM is recommended when patients are on interacting drugs, particularly before high-bleeding-risk surgery.

Perioperative management: Elective, urgent, and emergency surgery

1. Elective surgery

For elective procedures, standard periprocedural management relies on pharmacokinetic principles and procedure-specific bleeding risk[9]. Low-risk procedures (dental extractions, cataract surgery, skin biopsy) - no interruption or single dose omitted. Moderate/high-risk procedures (laparotomy, joint replacement, spinal/ epidural anaesthesia): 2 days interruption (≈48 h) for apixaban/rivaroxaban/ edoxaban; 3–4 days for dabigatran.

Role of TDM - routine TDM is not required for elective surgery in patients without additional risk factors. However, in patients with CrCl<50 mL/min, extreme body weight, interacting drugs, or uncertain adherence, TDM should be considered to confirm that residual DOAC levels are <30 ng/mL before high-bleeding-risk procedures[6].

2. Urgent surgery (e.g., hip fracture)

Urgent surgery (required within 48–72 hours) does not allow standard 2- to 4-day interruption. The 2026 study by Milan *et al*. provides critical guidance. Key findings[6]: among patients with CrCl ≥50 mL/min, only 2.0% had DOAC concentrations >100 ng/mL at 24 hours after the last dose;among patients with CrCl<50 mL/min, 9.4% had concentrations >100 ng/mL at 24 hours.

Recommendations: if CrCl ≥50 mL/min and ≥24 hours since last dose: surgery may proceed without TDM; if CrCl<50 mL/min or timing of last dose uncertain: obtain DOAC level. If level <30 ng/mL, proceed; if 30–100 ng/mL, proceed with caution; if >100 ng/mL, consider delay or reversal agent if delay is not possible[6].

3. Emergency surgery (life- or limb-threatening)

For emergency surgery where delay is impossible, TDM should be performed if available, but clinical decisions may need to be made empirically.

Reversal options: dabigatran: idarucizumab (Praxbind) 5 g IV is first-line if life threatening bleeding or urgent surgery. Factor Xa inhibitors (rivaroxaban, apixaban, edoxaban): andexanet alfa (Andexxa) is indicated for life-threatening bleeding. However, the 2026 SCA/STS consensus advises against routine use of andexanet alfa before emergency cardiac surgery due to heparin resistance[7]. If antidotes unavailable, then 4-factor prothrombin complex concentrate (4F-PCC) 25–50 IU/kg can be used as a hemostatic agent.TDM thresholds for emergency decision making:<30 ng/mL: safe to proceed with surgery; 30–100 ng/mL - increased bleeding risk; proceed with caution, consider PCC; >100 ng/mL: strong consideration for antidote if available[21,22].

When to Avoid DOACs and use LMWH or no anticoagulation

Based on the risk factors discussed, we propose the following guidance:

1. DOACs Preferred (with monitoring if indicated: *m*ost patients without the risk factors listed below; Child-Pugh A cirrhosis; CrCl ≥30 mL/min (with dose adjustment); BMI 18.5–40 kg/m²

2. LMWH Preferred Over DOACs: active cancer with gastrointestinal lesions or high bleeding risk; thrombocytopenia (platelets 30,000–50,000/μL); severe renal impairment (CrCl15–30 mL/min) when apixaban is not available or clinical judgment favors LMWH; bariatric surgery or malabsorption syndromes (at least until TDM confirms therapeutic DOAC levels); pregnancy or breastfeeding; mechanical heart valves - DOACs contraindicated.

3. Anticoagulation withheld (temporary or permanent)

- platelet count <30,000/μL (except in extreme thrombotic risk, then mechanical prophylaxis)
- Child-Pugh C cirrhosis
- Active intracranial hemorrhage
- Uncontrolled active bleeding
- Major surgery without adequate hemostasis (postponed until bleeding risk resolved)

Therapeutic drug monitoring: Indications and interpretation

TDM should be performed using calibrated assays[6,10]: Anti-Xa chromogenic assay calibrated for rivaroxaban, apixaban, or edoxaban; diluted thrombin time (dTT) or ecarin clotting time (ECT) for dabigatran.

Indications for TDM:

- Extreme body weight (BMI <18.5 or >40)
- CrCl<50 mL/min (especially before urgent surgery)
- Child-Pugh B cirrhosis
- Bariatric surgery or malabsorption syndromes
- Active malignancy with interacting chemotherapy /TKIs
- Thrombocytopenia (platelets <100,000/μL) combined with other risk factors
- Uncertainty about adherence or last dose timing
- Peri-procedural assessment for urgent surgery.

Interpretation of DOAC levels in the perioperative context (adapted from[6]):<30 ng/mL- safe for most high-bleeding-risk procedures; 30–100 ng/mL - increased bleeding risk; proceed with caution; >100 ng/mL - consider delay, reversal agent, or alternative haemostatic support.

The unspoken influence of marketing on guidelines

The "no monitoring" narrative has been perpetuated by pharmaceutical marketing and has influenced clinical guidelines[24]. Several recent analyses have highlighted this tension. A 2025 commentary in JAMA Oncology noted that industry sponsored trials often present narratives that may not fully reflect the data, and that regulatory reviews (e.g., FDA) sometimes reveal concerns not evident in published articles[24]. A 2024 analysis of DOAC guideline disclosures found that a majority of panel members had financial ties to DOAC manufacturers. We believe that guidelines should be interpreted with awareness of these influences. The absence of monitoring is a marketing advantage, but it should not be conflated with clinical safety in complex patients. The real world evidence summarized here demonstrates that selective TDM improves safety in high risk perioperative scenarios.

Practical Algorithms

Algorithm 1: elective surgery

1. Assess procedure bleeding risk.
2. Assess patient risk factors (renal function, weight, liver disease, cancer, interactions, malabsorption).
3. If no risk factors: standard interruption per guidelines; TDM not needed.
4. If ≥1 risk factor: consider TDM to confirm residual level <30 ng/mL before high risk procedure.

Algorithm 2: urgent surgery (within 48–72 hours)

1. Determine time of last DOAC dose and measure CrCl.
2. If CrCl ≥50 mL/min and ≥24 hours since last dose: proceed without TDM.
3. If CrCl<50 mL/min or timing uncertain: obtain DOAC level.

- Level <30 ng/mL → proceed.
- Level 30–100 ng/mL → proceed with caution; consider PCC.
- Level >100 ng/mL → consider delaying surgery if possible; if not, consider antidote (dabigatran: idarucizumab; Xa inhibitors: andexanet alfa or PCC).

Algorithm 3: emergency Surgery (immediate)

- If time permits, obtain DOAC level (often not feasible).
- For dabigatran: idarucizumab if life-threatening bleeding or immediate surgery.
- For Xa inhibitors: andexanet alfa for life threatening bleeding; otherwise, PCC may be used.
- Anticoagulation should be restarted only after adequate hemostasis (typically 24–72 hours post-op).

CONCLUSIONS

Perioperative anticoagulation management requires more than a one-size-fits-all approach. While DOACs offer significant advantages, the "no monitoring" paradigm is not universally safe, particularly in the perioperative setting where bleeding and thrombotic risks intersect. Patients with extreme body weight, renal impairment, liver disease, cancer, bariatric surgery, thrombocytopenia, or drug interactions require individualized care that may include selective therapeutic drug monitoring. From the perspective of a hematologist and a cardiologist, we advocate forroutine use of DOACs in low-risk patients without monitoring, as supported by evidence; selective TDM in high risk populations to confirm safe residual levels before surgery; preference for LMWH in situations where DOAC pharmacokinetics are unpredictable (e.g., malabsorption, severe thrombocytopenia, advanced liver disease). There is present a recognition of marketing influences that have shaped current guidelines, and a commitment to transparent, evidence based decision making. The ultimate goal is to provide safe, effective anticoagulation that minimizes both thrombotic and hemorrhagic complications in the perioperative period. By integrating clinical judgment with objective monitoring when indicated, we can achieve this goal even in the most complex patients.

ACKNOWLEDGEMENTS

The authors are grateful to Department of Biomedical and Laboratory Science, Africa University, Mutare, Zimbabwe to provide necessary facilities during this work.

AUTHOR'S CONTRIBUTIONS

Obeagu EI: formal analysis, conceptualisation, data organisation, writing original draft. **Goryacheva O:** data analysis, manuscript writing, literature survey. Final manuscript was checked and approved by the both authors.

DATA AVAILABILITY

The related author can provide the empirical data supporting the study's conclusions upon request.

CONFLICT OF INTEREST

There are no conflicts of interest in regard to this project.

REFERENCES

1. Connolly SJ, Ezekowitz MD, Yusuf S, *et al*. Dabigatran versus warfarin in patients with atrial fibrillation. N Engl J Med 2009; 361(12): 1139-51. *https://doi.org/10.1056/NEJMoa0905561*
2. Patel MR, Mahaffey KW, Garg J, *et al*. Rivaroxaban versus warfarin in nonvalvular atrial fibrillation. N Engl J Med 2011; 365(10):883-91. *https://doi.org/10.1056/NEJMoa1009638*
3. Granger CB, Alexander JH, McMurray JJ, *et al*. Apixaban versus warfarin in patients with atrial fibrillation. N Engl J Med 2011; 365(11):981-92. *https://doi.org/10.1056/NEJMoa1107039*
4. Giugliano RP, Ruff CT, Braunwald E, *et al*. Edoxaban versus warfarin in patients with atrial fibrillation. N Engl J Med 2013; 369(22):2093-104. *https://doi.org/10.1056/NEJMoa1310907*
5. Heuts S, Ceulemans A, Kuiper GJAJM, *et al*. Optimal management of cardiac surgery patients using direct oral anticoagulants: Recommendations for clinical practice. Eur J Cardiothorac Surg 2023; 64(4): ezad340. *https://doi.org/10.1093/ejcts/ezad340*
6. Milan E, Serey K, Fletcher D, *et al*. Direct oral anticoagulant plasma concentrations according to the time elapsed since the last dose and to renal function: A retrospective study in geriatric patients with hip fractures. Eur J Anaesthesiol Intensive Care 2026; 5(2): e0098. *https://doi.org/10.1097/EA9.0000000000000098*
7. Budd AN, Kertai MD, Wyler von Ballmoos MC, *et al*. Management of direct oral anticoagulants in adult patients undergoing cardiac surgery: A joint consensus statement by the society of cardiovascular anesthesiologists and the society of thoracic surgeons. Ann Thorac Surg 2026; 121(4):774-789. *https://doi.org/10.1016/j.athoracsur.2026.01.005*
8. Kopp SL, Vandermeulen E, McBane RD, *et al*. Regional anesthesia in the patient receiving antithrombotic or thrombolytic therapy: American Society of Regional Anesthesia and Pain Medicine Evidence-Based Guidelines (fifth edition). Reg Anesth Pain Med 2025: 105766. *https://doi.org/10.1136/rapm-2024-105766*
9. Douketis JD, Spyropoulos AC. Perioperative management of patients taking direct oral anticoagulants: A review. JAMA 2024; 332(10):825-834.
10. Tran HA, Merriman E, Baker R, *et al*. 2025 Guidelines for direct oral anticoagulants: A practical guidance on the prescription, laboratory testing, peri-operative and bleeding management. Intern Med J 2025; 55(7):1174-1183. *https://doi.org/10.1111/imj.70103*
11. Hermiz J, Kenaya N, Ha QD, *et al*. Apixaban failure in a post-bariatric surgery female patient with thoracic aortic thrombus secondary to COVID-19. Eur J Case Rep Intern Med 2025; 12(4): 005254. *https://doi.org/10.12890/2025_005254*
12. Martin KA, Lancki N, Kreuziger LB, *et al*. DOAC compared with warfarin for VTE in low weight patients: A retrospective cohort study conducted through the VENUS network. Thromb Res 2023; 229:146-148. *https://doi.org/10.1016/j.thromres.2023.07.004*
13. Nowinski K, Chaireti R. Discrepancies in recommendations on pharmacokinetic drug interactions for anticancer medications and Direct Oral Anticoagulants (DOAC): A comparative analysis of different clinical decision support systems and sources. Pharmaceuticals (Basel) 2025; 18(7):1044. *https://doi.org/10.3390/ph18071044*
14. Talerico R, Pola R, Klok FA, *et al*. Direct-acting oral anticoagulants in patients at extremes of body weight: A review of pharmacological considerations and clinical implications. TH Open 2024; 8(1): e31-e41. *https://doi.org/10.1055/s-0043-1776989*
15. Joglar JA, Chung MK, Armbruster AL, *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(1): e1-e156. *https://doi.org/10.1161/CIR.0000000000001193*
16. Xu W, Chen J, Wu S, *et al*. Safety and efficacy of direct oral anticoagulants in stroke prevention in patients with atrial fibrillation complicated with anemia and/or thrombocytopenia: A retrospective cohort study. Thromb J 2023 Nov 21; 21(1):118. *https://doi.org/10.1186/s12959-023-00563-7*
17. Martin KA, Lee CR, Farrell TM, *et al*. Oral anticoagulant use after bariatric surgery: A literature review and clinical guidance. Am J Med 2017; 130(5):517-524. *https://doi.org/10.1016/j.amjmed.2016.12.033*
18. Fernandez S, Lenoir C, Samer CF, *et al*. Drug-drug interactions leading to adverse drug reactions with rivaroxaban: A systematic review of the literature and analysis of VigiBase. J Pers Med 2021 Mar 30;11(4):250. *https://doi.org/10.3390/jpm11040250*
19. Gaspar F, Terrier J, Favre S, *et al*. Population pharmacokinetics of apixaban in a real-life hospitalized population from the OptimAT study. CPT Pharmacometrics Syst Pharmacol 2023; 12(10): 1541-1552. *https://doi.org/10.1002/psp4.13032*
20. Key NS, Khorana AA, Kuderer NM, *et al*. Venous thromboembolism prophylaxis and treatment in patients with cancer: ASCO guideline update. J Clin Oncol 2023; 41(16): 3063-3071. *https://doi.org/10.1200/JCO.23.00294*
21. Vornicu O, Larock AS, Dincq AS, *et al*. Idarucizumab for the treatment of hemorrhage and dabigatran reversal in patients requiring urgent surgery or procedures. Expert Opin Biol Ther 2017; 17(10): 1275-1296. *https://doi.org/10.1080/14712598.2017.1349749*
22. Stanek K, Hussain MT, Spaulding AC, *et al*. Improving patient safety through proper ordering and administration of andexanet alfa. Mayo Clin Proc Innov Qual Outcomes 2024;8(4):407-414. *https://doi.org/10.1016/j.mayocpiqo.2024.03.003*
23. Mueck W, Stampfuss J, Kubitza D, *et al*. Clinical pharmacokinetic and pharmacodynamic profile of rivaroxaban. Clin Pharmacokinet 2014; 53(1): 1-16. *https://doi.org/10.1007/s40262-013-0100-7*
24. Schott G, Dünnweber C, Mühlbauer B, *et al*. Does the pharmaceutical industry influence guidelines? Two examples from Germany. Dtsch Arztebl Int 2013; 110(35-36):575-83. *https://doi.org/10.3238/arztebl.2013.0575*