REVIEW

CME MOC

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Direct oral anticoagulants: Challenging prescribing scenarios in everyday practice

ABSTRACT

Direct oral anticoagulants (DOACs) are preferred to vitamin K antagonists for treating venous thromboembolism and nonvalvular atrial fibrillation, primarily because of comparable efficacy, consistent dosing, and fewer drug-drug interactions. However, major trials that led to the approval of DOACs excluded subsets of patients who are challenging to treat in the primary care setting, including patients with extreme body weight, advanced kidney disease, and advanced cirrhosis, and those who have undergone bariatric surgery. The authors review the available evidence and outline current recommendations to help guide the appropriate use of DOACs in these patients.

KEY POINTS

- Apixaban and rivaroxaban are safe in patients with a body mass index less than 50 kg/m^2 or weight less than 150 kg. Data are limited for other extreme body weights.
- All DOACs can be used in patients with mild to moderate kidney impairment, but safety and efficacy varies in those with severe impairment or end-stage kidney disease.
- DOACs can be used in patients with Child-Pugh class A or B liver cirrhosis, except for rivaroxaban, which may be avoided in Child-Pugh B disease. All DOACs should be avoided in patients with Child-Pugh C disease.
- In those who have had bariatric surgery, the type of procedure determines which DOAC can be used, if at all.

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Direct oral anticoagulants (DOACs) have replaced vitamin K antagonists as the oral anticoagulants of choice for treatment of venous thromboembolism (VTE) and nonvalvular atrial fibrillation. Direct factor Xa inhibitors (apixaban, edoxaban, and rivaroxaban) and direct thrombin inhibitors (dabigatran) are preferred to vitamin K antagonists because these agents have comparable efficacy, fixed dosing with no need for monitoring, fewer drug-drug interactions, and better adverse effect profiles.[1] However, the phase 3 randomized controlled trials that led to the approval of DOACs excluded several patient populations whose comorbidities are commonly encountered in daily clinical practice, including those with extreme body weight, advanced kidney disease, and advanced liver disease, and those who have undergone bariatric surgery. Because available evidence is limited, selecting anticoagulants for these patients can be challenging, and cautious decision-making is warranted.

EXTREME BODY WEIGHT

Populations with extreme body weight, including severe obesity (> 120 kg or body mass index [BMI] ≥ 40 kg/m^2) and those who are underweight (< 60 kg or BMI < 18.5 kg/m^2), have been underrepresented in clinical trials evaluating DOACs in VTE and atrial fibrillation. This is problematic because the pharmacokinetics and pharmacodynamics of DOACs are variable in patients with extreme obesity.[2] Studies have shown that body weight has minimal impact on

the pharmacokinetic and pharmacodynamic profiles of rivaroxaban and apixaban, and has a modest effect on the profile of dabigatran.[2,3] For dabigatran, weight had an inverse correlation with peak and trough concentrations. Data on edoxaban are lacking.

Evidence in VTE

Without clinical trial data, numerous single-centered retrospective cohort studies have evaluated the use of DOACs (predominantly apixaban and rivaroxaban) in patients with severe obesity and VTE or atrial fibrillation and have shown comparable safety and efficacy with vitamin K antagonists.[4–6] In a real-world study with more than 8,600 patients in the rivaroxaban arm and more than 5,900 in the warfarin arm (approximately 41% of all participants had BMI ≥ 40 kg/m^2), those taking rivaroxaban had a significantly lower risk of VTE recurrence (7.0% vs 8.2%, hazard ratio [HR] 0.85, 95% confidence interval [CI] 0.75–0.97) and a similar risk of major bleeding (4.1% vs 3.6%, HR 1.11, 95% CI 0.89–1.37) compared with those taking a vitamin K antagonist.[7]

Recent observational prospective data from the START-Register (Survey on Anticoagulated Patients Register) study, which included patients with both VTE and atrial fibrillation, showed no difference in VTE recurrence, stroke, and systemic embolism between DOACs and vitamin K antagonists in those with severe obesity (mean BMI 42 kg/m^2).[8] A retrospective database analysis of patients on apixaban, dabigatran, or rivaroxaban for VTE found no difference in VTE recurrence in patients weighing 120 kg or more (mean BMI 41.2 kg/m^2) compared with patients weighing less than 120 kg (mean BMI 28.7 kg/m^2).[9]

Despite these encouraging data, retrospective data from the Mayo Clinic VTE Registry, which included more than 2,500 patients with weights ranging from 27 kg to 263 kg, showed that treatment with DOACs was associated with a higher incidence of major bleeding in patients weighing less than 60 kg vs those weighing 60 to 120 kg and more than 120 kg.[10] Moreover, patients with cancer weighing more than 120 kg who were treated with rivaroxaban had a higher VTE recurrence rate compared with the other weight groups.

Evidence in atrial fibrillation

In a post hoc analysis of the ARISTOTLE (Apixaban for Reduction in Stroke and Other Thromboembolic Events in Atrial Fibrillation) trial, in 982 patients who weighed more than 120 kg, including 258 patients with weight greater than 140 kg, risk of stroke, systemic embolism, and major bleeding were comparable in those receiving apixaban and vitamin K antagonists.[11] Post hoc analysis of other prospective atrial fibrillation studies that included patients with a BMI greater than 40 kg/m^2 showed no evidence of inferior safety or efficacy with DOACs compared with vitamin K antagonists.[12]

Numerous retrospective observational studies have, in fact, demonstrated DOACs have better safety and efficacy (apixaban had the best safety and efficacy, followed by rivaroxaban and dabigatran) than warfarin in patients with atrial fibrillation at the extremes of body weight (BMI < 18.5 kg/m^2 and > 40 kg/m^2).[13] In a meta-analysis of 18 studies involving 387,205 patients with obesity and atrial fibrillation, compared with vitamin K antagonists, DOACs were associated with significant reductions in ischemic stroke (odds ratio [OR] 0.70, 95% CI 0.66–0.75), hemorrhagic stroke (OR 0.47, 95% CI 0.35–0.62), systemic embolism(OR 0.67, 95% CI 0.54–0.83), and major bleeding (OR 0.62, 95% CI 0.54–0.72).[14]

A subanalysis of the ELDERCARE-AF (Edoxaban Low-Dose for Elder Care Atrial Fibrillation Patients) trial showed that low-dose edoxaban (15 mg once daily) resulted in a lower stroke or systemic embolism rate compared with placebo in patients 80 years or older with atrial fibrillation who weighed 45 kg or less (HR 0.36, 95% CI 0.16–0.80); however, this benefit was accompanied by a numerically higher rate of major bleeding (HR 3.05, 95% CI 0.84–11.11).[15]

The Ascension Health registry, which included more than 2,500 adult patients with low body weight (weight ≤ 60 kg or BMI < 18.5 kg/m^2) receiving treatment for atrial fibrillation or VTE, compared vitamin K antagonists with DOACs (apixaban or rivaroxaban) and found no difference in thromboembolism (P = .38), composite major plus clinically relevant nonmajor bleeding (P = .18), and all-cause mortality (P = .12).[16]

Guideline recommendations

In 2021, the International Society on Thrombosis and Haemostasis (ISTH) updated its recommendations to suggest using rivaroxaban or apixaban for VTE treatment in patients with BMI greater than 40 kg/m^2 or weight greater than 120 kg, but recommended avoiding dabigatran and edoxaban due to lack of sufficient data.[3] However, the ISTH guidance statements do highlight the paucity of data for higher BMIs (ie, 50 kg/m^2 or greater and weight greater than 150 kg), and DOACs should ideally be avoided in this subset of patients. ISTH also suggests not monitoring drug-specific DOAC peak or trough levels to guide management decisions because of the lack of data.

TABLE 1
Direct oral anticoagulant use in extreme body weight

Condition	Body mass index or weight		
	≥ 50 kg/m² or > 150 kg	40–49 kg/m² or 120–150 kg	< 18.5 kg/m² or < 60 kg
Venous thromboembolism	Data limited	Apixaban and rivaroxaban may preferably be used	Data scarce, but DOACs may be used
Atrial fibrillation	Data limited	Apixaban, rivaroxaban, and dabigatran can be used	Apixaban is preferred; reduce dose to 2.5 mg twice daily if creatinine clearance > 1.5 mg/dL or age > 80, or both; other DOACs may also be considered

Based on information from references 3 and 17.

The 2023 American College of Cardiology and American Heart Association guideline[17] neither favors nor discourages the use of DOACs for atrial fibrillation in those with severe obesity. In patients weighing 60 kg or less, apixaban use is safe, and dose reduction is recommended when a patient is also older than 80 years or has serum creatinine greater than 1.5 mg/dL, or both.

Summary

Table 1 outlines which DOACs can be used for treatment of VTE or atrial fibrillation in patients with extreme body weight.[3,17] For patients with severe obesity and VTE or atrial fibrillation, the use of DOACs should be based on informed decision-making between clinicians and their patients. Apixaban and rivaroxaban can be used to treat both as long as BMI is less than 50 kg/m² or weight is less than 150 kg, beyond which data are limited and DOACs should be avoided. While DOACs may be used for both VTE and atrial fibrillation in patients weighing less than 60 kg, given the scarcity of data and lack of guidance recommendations, individualized decision-making based on patient preference is warranted.

KIDNEY DYSFUNCTION

All DOACs are eliminated by the kidneys to some degree, with dabigatran being the most dependent on kidney function (80%), followed by edoxaban (50%), rivaroxaban (35%), and apixaban (27%).[18] In patients with creatinine clearances of 50 to 80 mL/min, 30 to 50 mL/min, and 30 mL/min or less, DOAC area under the plasma drug concentration–time curves are higher than for those with normal kidney function, as follows[19]:

- Dabigatran: 1.5, 3.2, and 6.3 times higher
- Rivaroxaban: 1.4, 1.5, and 1.6 times higher
- Apixaban: 1.16, 1.29, and 1.38 times higher
- Edoxaban: 1.32, 1.74, and 1.72 times higher.

Evidence

Moderate kidney impairment. In patients with creatinine clearance of 30 to 50 mL/min and VTE or atrial fibrillation, DOACs are preferred to vitamin K antagonists due to similar efficacy and lower rates of major bleeding, particularly intracranial bleeding.[20]

Severe kidney impairment (creatinine clearance 15–29 mL/min) data are limited to retrospective or manufacturer-provided reports measuring plasma drug levels without prospective clinical outcomes.[20,21] The phase 3 randomized controlled trials that led to the approval of DOACs for VTE and atrial fibrillation excluded patients with creatinine clearance less than 30 mL/min (for dabigatran, edoxaban, and rivaroxaban) and creatinine clearance less than 25 mL/min (for apixaban).[22–29] Although the US Food and Drug Administration labels for apixaban and rivaroxaban have not entirely excluded their use in severe kidney disease based on pharmacokinetic and pharmacodynamic data, their safety and efficacy in this setting are currently unknown.[21]

Patients on dialysis. Clinical data from a meta-analysis of 3 randomized trials that included 383 patients with atrial fibrillation on hemodialysis found that the use of DOACs was associated with a significant reduction in stroke (relative risk 0.42; 95% CI 0.18–0.97; $P = .04$) and a numeric, but statistically nonsignificant, trend toward a lower incidence of major bleeding compared with vitamin K antagonists (relative risk 0.75, 95% CI 0.45–1.28, $P = .29$).[30]

Apixaban use in patients on dialysis is based on limited pharmacokinetic and pharmacodynamic

data.[31,32] In a study involving patients on hemodialysis, the standard dose of apixaban (5 mg twice daily) led to supratherapeutic trough levels (ie, above the 90th percentile of the predicted levels for this same dose in patients with preserved kidney function).[31] A reduced dose of apixaban (2.5 mg twice daily) also resulted in significant drug accumulation at steady state, but the drug exposure was comparable with that of the standard dose of apixaban in patients with preserved kidney function.[31] Data from a study of patients on peritoneal dialysis have also shown wide variation in apixaban concentration range.[32] The area under the plasma drug concentration–time curve was significantly higher in patients on peritoneal dialysis compared with those on hemodialysis, and supratherapeutic trough levels were observed even with the reduced dose of apixaban.

Recommendations based on kidney function

In patients with acute VTE and creatinine clearance of 15 to less than 30 mL/min, updated manufacturer information recommends rivaroxaban based on clinical pharmacologic data and post hoc analysis by kidney function from phase 3 clinical trials.[33] However, the safety of this approach has never been demonstrated by prospective randomized controlled trial data. There are also emerging data from small-scale retrospective studies on the safety and efficacy of apixaban compared with warfarin in patients with kidney failure and on dialysis, but consensus guidelines have not recommended apixaban in this subset of patients.[34]

In patients with atrial fibrillation and creatinine clearance of 15 to 30 mL/min, the American College of Cardiology and American Heart Association 2023 guideline[17] recommends using a standard or reduced dose of apixaban (a dose reduction is indicated if any 2 of the following are present: serum creatinine ≥ 1.5 mg/dL, age ≥ 80 years, or body weight ≤ 60 kg), reduced dose of rivaroxaban (15 mg once daily), standard dose of dabigatran (75 mg twice daily), and standard dose of edoxaban (30 mg once daily). For patients with creatinine clearance less than 15 mL/min or on hemodialysis, standard or a reduced dose of apixaban (same reduction criteria as above) or reduced dose of rivaroxaban can be considered, while dabigatran and edoxaban are contraindicated.

Summary

DOAC recommendations based on kidney impairment are listed in **Table 2**.[17,19,27,28,31,33,34] For acute VTE in kidney disease, avoiding all DOACs for patients with end-stage renal disease and patients who are on dialysis is warranted given the absence of robust prospective data. Reduced-dose edoxaban and standard-dose apixaban may be used for patients with severe kidney impairment, but avoid rivaroxaban and dabigatran. The creatinine clearance thresholds vary for each DOAC.

In patients with atrial fibrillation and end-stage renal disease or on dialysis, a standard or reduced dose of apixaban or reduced dose of rivaroxaban can be used, while dabigatran and edoxaban are not advised. For severe kidney impairment, a standard or reduced dose of apixaban and edoxaban could be used.

All DOACs can be used in patients with VTE or atrial fibrillation and mild to moderate kidney impairment (creatinine clearance ≥ 30 mL/min).

LIVER CIRRHOSIS

Liver cirrhosis increases the risk of both thrombosis and bleeding, making effective anticoagulation very challenging.[35] All DOACs are metabolized in part by the liver, and hepatic dysfunction can potentially amplify the risk of bleeding.

Evidence

DOAC trials excluded patients with advanced liver disease, and specific randomized controlled trials of any DOACs in chronic liver disease are lacking.[17] Therefore, evidence supporting the use of DOACs in liver cirrhosis is limited.

Guideline recommendations based on Child-Pugh class

Child-Pugh class helps assess the severity of liver disease and is essential to determine appropriate anticoagulation therapy for patients with cirrhosis. Class A indicates mild hepatic impairment, B indicates moderate impairment, and C indicates severe liver disease.[35]

The ISTH 2024 guidance[36] offers recommendations on anticoagulation for VTE and atrial fibrillation in patients with cirrhosis, based on the limited available evidence. For patients with Child-Pugh A or B cirrhosis and VTE, a DOAC, low-molecular-weight heparin, or vitamin K antagonist is suggested. For patients with Child-Pugh C cirrhosis, low-molecular-weight heparin alone or as a bridge to vitamin K antagonist in those with a normal baseline international normalized ratio should be used.

The ISTH statement also emphasizes that anticoagulants should not be withheld in patients with moderate thrombocytopenia secondary to advanced liver disease. Instead, when the platelet count falls below 50×10^9/L, ISTH[36] advises case-by-case decison-making, considering factors such as the thrombosis location, size, and extension risk; the presence of active bleeding or other bleeding risk factors; and patient preference.

TABLE 2
Direct oral anticoagulant recommendations and dosages based on kidney function

Condition and direct oral anticoagulant	Creatinine clearance, mL/min			
	< 15 or on hemodialysis	15 to < 30	30 to < 50	≥ 50
Nonvalvular atrial fibrillation				
Apixaban	Not studied[a]	5 mg twice daily or 2.5 mg twice daily[b]	5 mg twice daily or 2.5 mg twice daily[b]	5 mg twice daily or 2.5 mg twice daily[b]
Edoxaban	Recommendations cannot be provided	30 mg once daily[c]	30 mg once daily[c]	60 mg once daily[d]
Rivaroxaban	Not studied[e]	Treat as moderate impairment; 15 mg once daily (not studied)	15 mg once daily	20 mg once daily
Dabigatran	Recommendations cannot be provided	75 mg twice daily[f]	150 mg twice daily	150 mg twice daily
Venous thromboembolism				
Apixaban	No prospective clinical data on efficacy and safety	No prospective clinical data on efficacy and safety	10 mg twice daily; transition to 5 mg twice daily after 7 days	10 mg twice daily; transition to 5 mg twice daily after 7 days
Edoxaban	Recommendations cannot be provided	30 mg once daily[c]	30 mg once daily[c]	60 mg once daily[d]
Rivaroxaban	Avoid	No prospective clinical data on efficacy and safety	15 mg twice daily; transition to 20 mg once daily after 21 days	15 mg twice daily; transition to 20 mg once daily after 21 days
Dabigatran	Recommendations cannot be provided	Recommendations cannot be provided	150 mg twice daily	150 mg twice daily

Note: Additional adjustments needed for concomitant use of P-glycoprotein or cytochrome P450 3A4 inhibitors, or both, are not included.

[a]Expected pharmacokinetic and pharmacodynamic profile as in ARISTOTLE (Apixaban for Reduction in Stroke and Other Thromboembolic Events in Atrial Fibrillation) trial.[27]

[b]Reduce dose in patients with at least 2 of the following: age ≥ 80, body weight ≤ 60 kg, serum creatinine ≥ 1.5 mg/dL.[17]

[c]Patients with creatinine clearance < 30 mL/min were not included in randomized clinical trials.[31]

[d]Do not use in patients with creatinine clearance > 95 mL/min due to increased risk of ischemic strokes.[19]

[e]Expected pharmacokinetic and pharmacodynamic profile as in ROCKET AF (Rivaroxaban Once Daily Oral Direct Factor Xa Inhibition Compared With Vitamin K Antagonism for Prevention of Stroke and Embolism Trial in Atrial Fibrillation).[28]

[f]Not based on prospective clinical data.[17]

Based on information from references 17, 33, and 34.

For patients with Child-Pugh A or B cirrhosis and atrial fibrillation, anticoagulation with standard-dose DOACs is recommended, consistent with cardiology guidelines for patients without liver disease.[36] In patients with Child-Pugh C cirrhosis and atrial fibrillation, however, there is insufficient evidence to assess the benefit and risk of anticoagulation for stroke prevention, and all DOACs should be avoided. Furthermore, specific DOACs cannot be recommended for stroke prevention in patients with cirrhosis and atrial fibrillation because of inadequate in vivo pharmacokinetic or clinical evidence.

Note that, while ISTH does not discriminate among DOACs for use in patients with Child-Pugh A or B cirrhosis, the 2023 American College of Cardiology and American Heart Association guideline[17] specifically recommends avoiding rivaroxaban for patients with Child-Pugh B cirrhosis and atrial fibrillation. Rivaroxaban pharmacokinetic studies have shown a greater than 2-fold increase in area under the plasma drug concentration–time curve and a significant plasma concentration increase ($P < .0001$) in patients with Child-Pugh B cirrhosis vs healthy patients, potentiating bleeding risk.[37]

TABLE 3
Direct oral anticoagulant dosages and precautions in liver disease

Condition and direct oral anticoagulant	Child-Pugh class		
	A	B	C
Nonvalvular atrial fibrillation			
Apixaban	5 mg twice daily or 2.5 mg twice daily[a]	Limited clinical experience; recommendations cannot be provided	Avoid
Edoxaban	60 mg once daily	Avoid	Avoid
Rivaroxaban	20 mg once daily	Avoid[b]	No clinical data available; avoid[b]
Dabigatran	150 mg twice daily	Large intersubject variability, but no evidence of a consistent change in drug exposure; use with caution or avoid	No clinical data available; avoid
Venous thromboembolism			
Apixaban	10 mg twice daily; transition to 5 mg twice daily after 7 days	Limited clinical experience; recommendations cannot be provided	Avoid
Edoxaban	60 mg once daily	Avoid	Avoid
Rivaroxaban	15 mg twice daily; transition to 20 mg once daily after 21 days	Avoid[b]	No clinical data available; avoid[b]
Dabigatran	150 mg twice daily	Large intersubject variability, but no evidence of a consistent change in drug exposure; use with caution or avoid	No clinical data available; avoid

Note: Class A is mild hepatic impairment, B is moderate impairment, and C is severe liver disease. Additional adjustments needed for concomitant use of P-glycoprotein or cytochrome P450 3A4 inhibitors, or both, are not included.

[a]Reduce dose in patients with at least 2 of the following: age ≥ 80, body weight ≤ 60 kg, serum creatinine ≥ 1.5 mg/dL.[17]

[b]Drug exposure and bleeding risk may be increased.[17,37]

Based on information from reference 36.

Patients with cirrhosis should also be evaluated for the presence of esophageal varices before starting anticoagulation, and pharmacotherapy to minimize bleeding risk should be started.[35]

Summary

For both VTE and atrial fibrillation in liver disease, DOACs are reasonable agents to use in patients with Child-Pugh A and B disease. The only exception is rivaroxaban, which should be avoided in patients with Child-Pugh B disease due to unfavorable pharmacokinetic and pharmacodynamic profiles. DOACs should be avoided in patients with Child-Pugh C disease due to lack of data (**Table 3**[17,36,37]).

BARIATRIC SURGERY

The 4 common bariatric surgeries are as follows:

- Gastric banding: an adjustable silicone band is placed around the stomach to restrict food intake
- Gastric sleeve: the stomach is resected longitudinally to reduce its volume and thereby restrict food intake
- Roux-en-Y gastric bypass: the stomach is initially stapled to create a small pouch that is subsequently connected to the jejunum, bypassing the duodenum, resulting in both caloric restriction and malabsorption
- Biliopancreatic diversion with duodenal switch: the gastric pouch is reattached more distally to the terminal ileum, causing caloric restriction and malabsorption.

Anatomic changes from bariatric surgery may alter the bioavailability of DOACs by decreasing absorptive surfaces, reducing caloric intake, or both.[38] In addition, specific DOACs are absorbed in different areas of the gastrointestinal tract. Apixaban is absorbed primarily in the duodenum, with some absorption in the stomach,

TABLE 4
Direct oral anticoagulant use for treatment of venous thromboembolism and nonvalvular atrial fibrillation after bariatric surgery

Gastric banding	All direct oral anticoagulants can be used because the gastrointestinal anatomy is preserved
Gastric sleeve	Apixaban may be a preferred option because of the intact duodenum; avoid rivaroxaban and dabigatran because they are predominantly absorbed in the stomach; edoxaban requires an acidic environment for optimal absorption, which may be altered
Roux-en-Y gastric bypass Biliopancreatic diversion with duodenal switch	All direct oral anticoagulants should be avoided due to inadequate absorption after extensive loss of the stomach and proximal small intestines

distal small bowel, and colon, whereas rivaroxaban is absorbed primarily in the stomach and, to some extent, in the proximal and distal intestines. Dabigatran is absorbed predominantly in the lower stomach and duodenum, while edoxaban is absorbed primarily in the duodenum.

Evidence

Data specific to DOAC use after bariatric surgery are limited to pharmacokinetic and pharmacodynamic studies with a small number of patients or case reports. For patients with atrial fibrillation who have undergone bariatric surgery, emerging data show comparable safety and efficacy of DOACs with vitamin K antagonists.[39] However, no formal guidelines have been published.

Recommendations based on bariatric procedure

While the American Society of Hematology 2020 guidelines[40] recommend against using DOACs in patients who have undergone bariatric surgery, the ISTH 2021 guidance statement[3] offers a more flexible approach. It suggests that DOACs may be considered in patients with VTE but should be avoided in the acute setting after bariatric surgery for at least 4 weeks due to decreased absorption. Parenteral therapy may be used instead to ensure predictable anticoagulation. This recommendation was made, however, despite the lack of robust prospective clinical data or substantial pharmacokinetic and pharmacodynamic data. In addition, ISTH[3] suggests obtaining a DOAC trough level to check drug absorption and bioavailability, even though this strategy has not been validated and standardized assays are not widely available.

All DOACs can be used in patients with gastric banding because the gastrointestinal anatomy is preserved with this surgery, so absorption is unlikely affected.

In theory, apixaban could be used in patients who have undergone gastric sleeve surgery because of the intact duodenum; however, no data support the safety and efficacy of this approach. Rivaroxaban and dabigatran should be avoided because they are predominantly absorbed in the stomach. Edoxaban requires an acidic environment for optimal absorption, which may be altered by gastrectomy.

Given the lack of prospective data, all DOACs should be avoided after Roux-en-Y gastric bypass and biliopancreatic diversion with duodenal switch due to inadequate absorption after extensive loss of the stomach and proximal small intestines.

Summary

The type of bariatric surgery determines whether, and which, DOACs could potentially be used (**Table 4**). Moreover, the decision to use DOACs to treat atrial fibrillation after bariatric surgery should be individualized and based on patient preference.

CONCLUSION

DOACs have become the preferred treatment for VTE and atrial fibrillation because of their favorable efficacy, safety, and ease of use compared with vitamin K antagonists. However, real-world use of DOACs in specific patient populations, including those with extreme body weight, advanced kidney and liver disease, and after bariatric surgery, presents unique challenges. Clinicians should rely on currently available guidelines to identify patients who may benefit from DOACs as well as those who should avoid using DOACs.

A final word of caution: it is important to consider common drug-drug interactions with DOACs because the concomitant use of P-glycoprotein or cytochrome P450 3A4 inhibitors, or both, can impact their safety and efficacy.[40]

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