广东省药学会
GuangDong Pharmaceutical Association

Perioperative Management of VTE

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Content

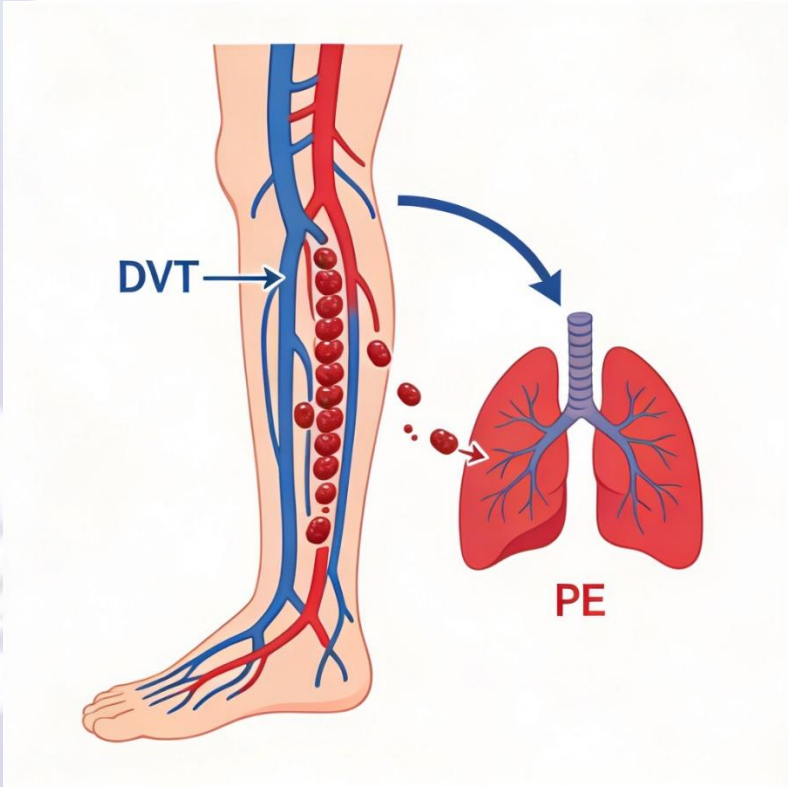
01

Background Introducion

- VTE refers to the abnormal coagulation of blood within veins, resulting in partial or complete obstruction of the venous lumen. It includes deep vein thrombosis (DVT) and pulmonary embolism (PE). DVT and PE represent different stages of VTE.

- Worldwide, nearly 10 million people are diagnosed with VTE each year, with an annual incidence ranging from 41.7 to 269 per 100,000 population. The incidence of VTE continues to rise annually.

- Following ischemic heart disease and stroke, VTE ranks as the third leading cause of death among cardiovascular diseases worldwide.

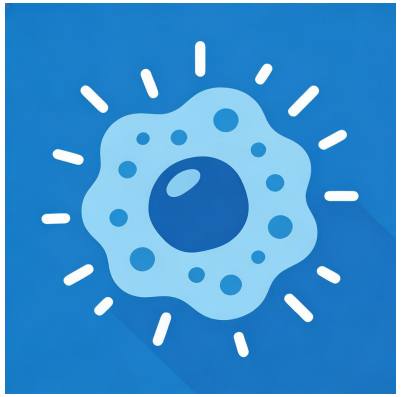


Vascular Wall Damage

Factors such as surgical trauma, inflammatory stimulation, and central venous catheterization can directly damage the vascular endothelium, creating the initial conditions for thrombosis.

Stasis

Stagnant blood flow leads to local accumulation of coagulation factors, increasing the risk of thrombosis. Common in patients with prolonged bed rest, surgery, long-distance travel, or heart failure.



Hypercoagulability

Surgical stress, anesthetic agents, advanced age, obesity, tumors and other factors predispose the blood to a hypercoagulable state.

Virchow and his triad: a question of attribution. Br J Haematol. 2008, 143(2):180-190.

Basic Prophylaxis

- Elevate the affected limb postoperatively.
- Provide patient education on venous thrombosis; encourage frequent repositioning, early ambulation, early functional exercise, as well as deep breathing and coughing exercises.
- Maintain adequate fluid intake and hydration to prevent postoperative dehydration.
- Promote healthy lifestyle modifications, including smoking cessation, alcohol restriction, and control of blood glucose and lipid levels.

Mechanical Prophylaxis

- By mechanical principles to accelerate venous blood flow in the lower extremities, reduce venous stasis, and lower the risk of postoperative DVT.
- Mechanical modalities include plantar venous pumps, intermittent pneumatic compression devices, and graduated compression elastic stockings.

Pharmacological Prophylaxis

- Medications should be selected and adjusted according to the patient's disease condition, surgical type, drug contraindications, and other relevant factors.

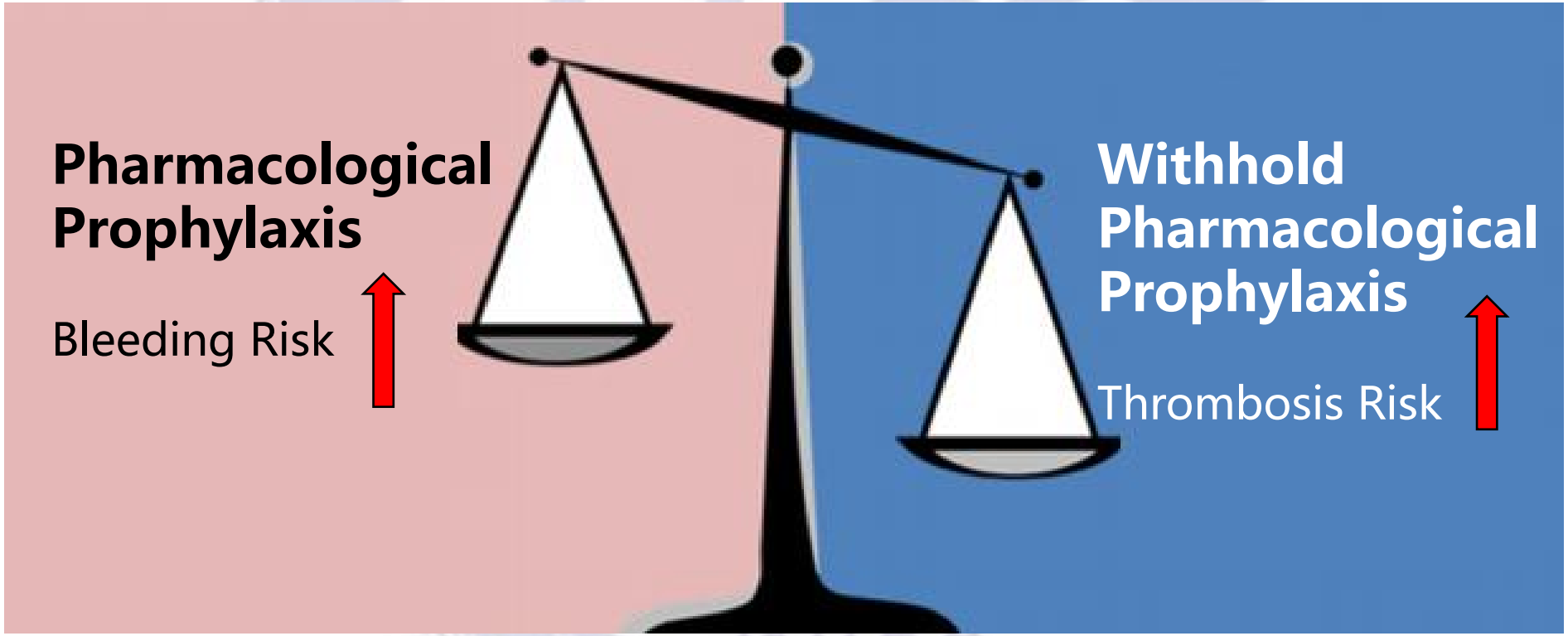
Chinese guidelines for the diagnosis, treatment, prophylaxis and management of pulmonary thromboembolism (2025 edition). Natl Med J China. 2025, 105(26): 2162-2194.
Guidelines for prevention of perioperative venous thromboembolism in Chinese orthopedic trauma patients(2021). Chin J Orthop Trauma. 2021, 23(3): 185-192.

02

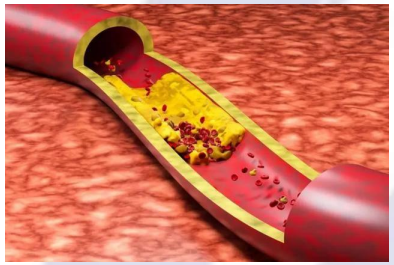
Medication management

- **Perioperative VTE Management Strategy**
- Perioperative Commonly Used Anticoagulants and Pharmaceutical Monitoring

Perioperative VTE Pharmacological Prophylaxis: The Dilemma of Bleeding vs. Thrombosis

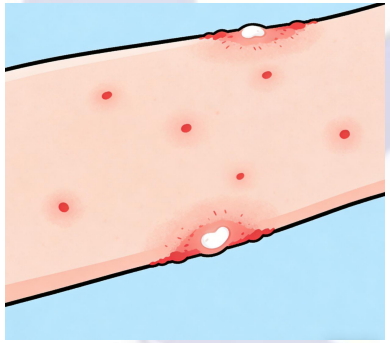


Determine Perioperative VTE Management Strategy Based on Risk Stratification



1-Assess VTE risk

2-Evaluate bleeding risk



3-Screen for contraindications to relevant preventive measures

4-Determine the optimal VTE prophylaxis strategy

VTE risk assessment

Patient-related factors:
01
Advanced age, obesity, thrombophilia, and history of previous VTE.

Disease-related factors:
02
Malignant neoplasms, immobilization due to various causes, infection, trauma, and fractures.

Surgical and procedural factors:
03
Surgery (duration, type, location, approach), estrogen therapy, central venous catheterization.

VTE risk assessment

Caprini

A simple and comprehensive tool for thrombus risk assessment;

Recommended for risk assessment in surgical patients。

Padua

Primarily used for assessing hospitalized medical patients;

Includes 11 risk factors.

Wells

Used for the assessment of patients with suspected acute PTE and for early warning of deep vein thrombosis.

RAPT

Primarily used to assess the risk of VTE in trauma patients.

Autar

Mainly applied to patients with one of the three major risk factors (venous stasis, hypercoagulability, vascular endothelial injury) and patients on long-term bed rest or absolute bed rest during the acute phase of illness.

Khorana

Adopted by the ASCO as part of its guidelines for the management of venous thromboembolism.

VTE risk assessment

EVANSTON NORTHWESTERN HEALTHCARE

Thrombosis Risk Factor Assessment

Joseph A. Caprini, MD, MS, FACS, RVT
Louis W. Biegler Professor of Surgery,
Northwestern University
The Feinberg School of Medicine;
Professor of Biomedical Engineering,
Northwestern University;
Director of Surgical Research,
Evanston Northwestern Healthcare
Email: j-caprini@northwestern.edu
Website: venousdisease.com

Patient's Name:_____ Age: ___ Sex: ___ Wgt:___lbs

Choose All That Apply

Each Risk Factor Represents 1 Point

- ❑ Age 41-60 years
- ❑ Minor surgery planned
- ❑ History of prior major surgery (< 1 month)
- ❑ Varicose veins
- ❑ History of inflammatory bowel disease
- ❑ Swollen legs (current)
- ❑ Obesity (BMI > 25)
- ❑ Acute myocardial infarction
- ❑ Congestive heart failure (< 1 month)
- ❑ Sepsis (< 1 month)
- ❑ Serious lung disease incl. pneumonia (< 1 month)
- ❑ Abnormal pulmonary function (COPD)
- ❑ Medical patient currently at bed rest
- ❑ Other risk factors_____

Each Risk Factor Represents 2 Points

- ❑ Age 60-74 years
- ❑ Arthroscopic surgery
- ❑ Malignancy (present or previous)
- ❑ Major surgery (> 45 minutes)
- ❑ Laparoscopic surgery (> 45 minutes)
- ❑ Patient confined to bed (> 72 hours)
- ❑ Immobilizing plaster cast (< 1 month)
- ❑ Central venous access

Each Risk Factor Represents 5 Points

- ❑ Elective major lower extremity arthroplasty
- ❑ Hip, pelvis or leg fracture (< 1 month)
- ❑ Stroke (< 1 month)
- ❑ Multiple trauma (< 1 month)
- ❑ Acute spinal cord injury (paralysis)(< 1 month)

Each Risk Factor Represents 3 Points

- ❑ Age over 75 years
- ❑ History of DVT/PE
- ❑ **Family history of thrombosis***
- ❑ Positive Factor V Leiden
- ❑ Positive Prothrombin 20210A
- ❑ Elevated serum homocysteine
- ❑ Positive lupus anticoagulant
- ❑ Elevated anticardiolipin antibodies
- ❑ Heparin-induced thrombocytopenia (HIT)
- ❑ Other congenital or acquired thrombophilia

If yes:
Type_____
***most frequently missed risk factor**

For Women Only (Each Represents 1 Point)

- ❑ Oral contraceptives or hormone replacement therapy
- ❑ Pregnancy or postpartum (<1 month)
- ❑ History of unexplained stillborn infant, recurrent spontaneous abortion (≥ 3), premature birth with toxemia or growth-restricted infant

Total Risk Factor Score ☐

TABLE 2. Prophylaxis regimen

Total Risk Factor Score	Incidence of DVT	Risk Level	Prophylaxis Regimen
0–1	<10%	Low	No specific measures; early ambulation
2	10–20%	Moderate	ES or IPC or LDUH, or LWMH
3–4	20–40%	High	IPC or LDUH, or LMWH alone *or* in combination with ES or IPC
5 or more	40–80% 1–5% mortality	Highest	Pharmacological: LDUH, LMWH,* Warfarin,* or Fac Xa* alone *or* in combination with ES or IPC

Thrombosis risk assessment as a guide to quality patient care. Dis Mon. 2005, 51(2-3): 70-8.

Bleeding risk assessment

High-bleed-risk surgery/procedure† (30-day risk of major bleed ≥2%)	Major surgery with extensive tissue injury Cancer surgery, especially solid tumor resection (lung, esophagus, gastric, colon, hepatobiliary, pancreatic) Major orthopedic surgery, including shoulder replacement surgery Reconstructive plastic surgery Major thoracic surgery Urologic or gastrointestinal surgery, especially anastomosis surgery Transurethral prostate resection, bladder resection, or tumor ablation Nephrectomy, kidney biopsy Colonic polyp resection Bowel resection Percutaneous endoscopic gastrostomy placement, endoscopic retrograde cholangiopancreatography Surgery in highly vascular organs (kidneys, liver, spleen) Cardiac, intracranial, or spinal surgery Any major operation (procedure duration >45 minutes) Neuraxial anaesthesia¶ Epidural injections
Low/moderate-bleed-risk surgery/procedure‡ (30-day risk of major bleed 0%–2%)	Arthroscopy Cutaneous/lymph node biopsies Foot/hand surgery Coronary angiography by femoral artery approach Gastrointestinal endoscopy ± biopsy§ Colonoscopy ± biopsy§ Abdominal hysterectomy Laparoscopic cholecystectomy Abdominal hernia repair Hemorrhoidal surgery Bronchoscopy ± biopsy
Minimal-bleed-risk surgery/procedure¶ (30-day risk of major bleed ~0%)	Minor dermatologic procedures (excision of basal and squamous cell skin cancers, actinic keratoses, and premalignant or cancerous skin nevi) Ophthalmological (cataract) procedures Minor dental procedures (dental extractions, restorations, prosthetics, endodontics), dental cleanings, fillings Pacemaker or cardioverter-defibrillator device implantation Coronary angiography by radial artery approach Selected patients requiring screening gastrointestinal endoscopy and colonoscopy ± biopsy‖

HAS-BLED Score	
Variable	S
Age ≥ 65 years	1
Hypertension (Systolic Blood Pressure ≥ 160mmHg)	1
Abnormal renal function	1
Abnormal liver function	1
Stroke in past	1
Bleeding	1
Labile INRs	1
Taking other drugs as well	1
Alcohol intake at the same time	1

Perioperative Management of Anticoagulant and Antiplatelet Therapy. NEJM Evid. 2023, 2 (6): EVIDra2200322.
Guidelines for the management of atrial fibrillation: the Task Force for the Management of Atrial Fibrillation of the European Society of Cardiology (ESC). Eur Heart J. 2010, 31(19):2369-429.

Bleeding risk assessment

01 Patient Factors:
Age, coagulation dysfunction, platelet abnormalities, etc.

02 Underlying Diseases:
Active bleeding, history of previous intracranial hemorrhage or other major bleeding, uncontrolled hypertension, intracranial diseases that may lead to severe bleeding, severe craniocerebral or acute spinal cord injury, malignant tumors, severe renal failure or liver failure, etc.

03 Concomitant Medications:
Concurrent use of anticoagulants, antiplatelet agents, or thrombolytic drugs, etc..

04 Invasive Procedures, etc.

Chinese guidelines for the diagnosis, treatment, prophylaxis and management of pulmonary thromboembolism (2025 edition). Natl Med J China. 2025, 105(26): 2162-2194.

Determine the optimal VTE prophylaxis strategy

VTE Risk Level (Caprini Score)	Bleeding Risk	Prophylaxis Measures
Very Low Risk (Caprini 0)	–	Early ambulation; no mechanical or pharmacological anticoagulation required
Low Risk (Caprini 1–2)	–	Mechanical prophylaxis; intermittent pneumatic compression (IPC) is recommended
Moderate Risk (Caprini 3–4)	No high bleeding risk	LMWH, UFH, or IPC
	High bleeding risk	IPC
High Risk (Caprini ≥5)	No high bleeding risk	LMWH, UFH; combined mechanical prophylaxis (e.g., compression stockings or IPC) is recommended
	High bleeding risk	IPC; pharmacological prophylaxis may be initiated qd bleeding risk resolves

Expert Consensus on Perioperative Strategies of VTE Prevention and Treatment, and Pharmaceutical Care. Herald of Medicine. 2025, 44(11): 1717-1735.

Non-ambulatory orthopaedic surgery

Preoperative

Pre-operative evaluation of the risk of VTE and bleeding according to the type of procedure and the planned post-operative course (fast-track or standard post-operative procedure) *Grade 2B*

Postoperative

Routine fast-track procedures (including early ambulation and joint mobilization) over timing of procedures based on convenience *Grade 1B*

	LOW THROMBOSIS RISK		HIGH THROMBOSIS RISK	
	LOW BLEEDING RISK	HIGH BLEEDING RISK	LOW BLEEDING RISK	HIGH BLEEDING RISK
No patient-related risk factors	No pharmacological prophylaxis *(2B)*		Pharmacological prophylaxis with LMWH or DOACs over no VTE prophylaxis *(2B)*	Mechanical VTE prophylaxis over pharmacological prophylaxis *(2C)*
Patient-related risk factors	Pharmacological prophylaxis with LMWH or DOACs over no prophylaxis *(2B)*	Mechanical prophylaxis over no VTE prophylaxis *(2B)*		

- Previous or family history of venous thromboembolism
- Major thrombophilia
- Age > 70 years
- Obesity
- Hypoalbuminemia
- Active cancer
- Estrogenic oral contraception and oral hormone therapy for menopause
- Renal insufficiency

- Surgery on the lower limb
  - pelvic, hip, knee
- Long duration surgery
- Cast immobilization
- Allogenic blood transfusion
- Use of tourniquet

THA
TKA
Hip fractures

Pharmacological prophylaxis
over no prophylaxis *Grade 1A*

LMWH or DOACs
over no prophylaxis *Grade 1A*

Fast-track THA, TKA, hip fracture

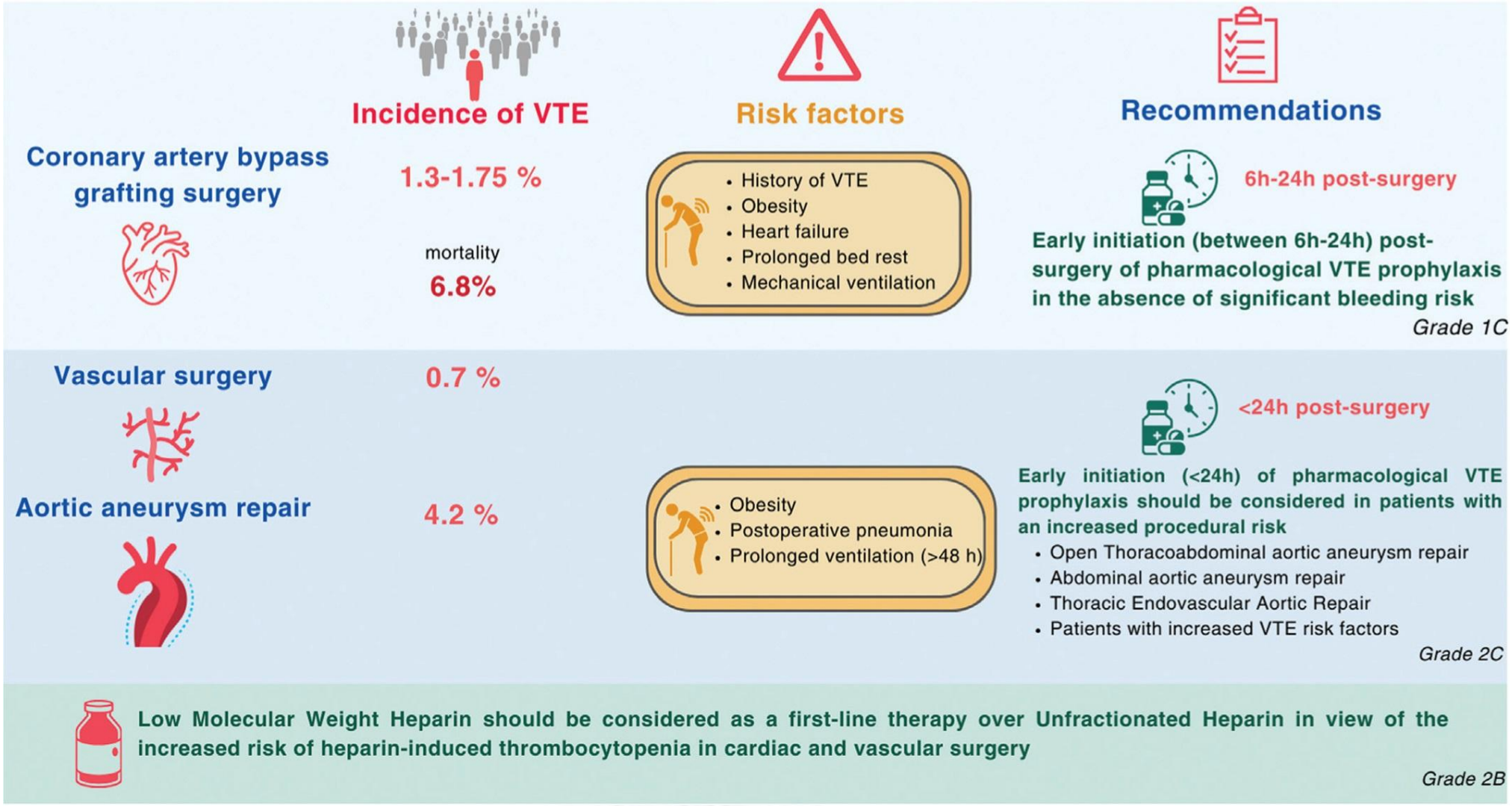
Pharmacological VTE prophylaxis with either

LMWH *Grade 1B*
DOACs *Grade 1B*
Aspirin *Grade 1C*
over no prophylaxis

THA: Total Hip Arthroplasty
TKA: Total Knee Arthroplasty

European guidelines on peri-operative venous thromboembolism prophylaxis: first update.: Chapter 13: Nonambulatory orthopaedic surgery. Eur J Anaesthesiol. 2024, 41(8):622-626.

Cardiovascular Surgery



European guidelines on peri-operative venous thromboembolism prophylaxis: first update.: Chapter 1: Cardiovascular Surgery. Eur J Anaesthesiol. 2024, 41(8):570-572.

Surgery during pregnancy and the immediate postpartum period

Personalized evaluation of VTE risk factors *Grade 1C*

- Multidisciplinary scores
- Personal and family history of thrombosis
- Bed rest, obesity, other clinical conditions
- Preeclampsia, postpartum haemorrhage

Adapt the scores to the local epidemiology

Update in the postpartum period regardless of the mode of delivery *Grade 1C*

Rationale

VTE is rare but potentially fatal during pregnancy and postpartum

Within a year following delivery

Caesarean surgery

Postoperative prophylaxis is recommended except for elective low-risk patients *Grade 1C*

At least 6 weeks for high-risk patients

At least 7 days for the other patients requiring anticoagulation *Grade 1C*

Non-obstetric surgery

Prophylaxis following surgery during pregnancy or the postpartum period when they imply, as a consequence, bed rest until full mobility is recovered *Grade 1C*

No change compared to the 2018 guideline

Pharmacological prevention

Adjust LMWH dosing to weight if the BMI > 40kg/m² *Grade 2C*

Personal history of VTE for surgery during pregnancy and postpartum: thromboprophylaxis with either a low dose or an intermediate dose of LMWH *Grade 2B*

Compression stockings can be used, although there is no evidence that they prevent perioperative VTE

European guidelines on peri-operative venous thromboembolism prophylaxis: first update.: Chapter 9: Surgery during pregnancy and the immediate postpartum period. Eur J Anaesthesiol. 2024, 41(8):604-606.

Other Surgical Procedures

Surgery	Recommendation
Thoracic oncology surgey	◆ Conditional recommendations for use of parenteral anticoagulation for VTE prevention, in combination with mechanical methods, over no prophylaxis for cancer patients undergoing lobectomy, segmentectomy, pneumonectomy, or oesophagectomy. ◆ For patients at high risk of VTE, pharmacological prophylaxis should be initiated preoperatively, withheld 12 h prior to surgery, and resumed as soon as possible postoperatively ◆ Conditional recommendation for using extended prophylaxis for 28 to 35 days over inhospital prophylaxis only for patients at moderate or high risk of thrombosis.
Neurosurgery	◆ In patients at high risk of thrombosis, a combination of mechanical and pharmacological prophylaxis is suggested, starting LMWH or UFH in the first 24 h postoperatively and no later than 72 h, provided that the risk of bleeding is ruled out and haemostasis is correct. ◆ After nontraumatic intracerebral haemorrhage, provided the volume of intracranial blood is not expanding and haemostasis is correct, it is suggested to start pharmacological prophylaxis 2 to 4 days after the bleeding.
Urologic Surgery	◆ In all patients undergoing ambulatory day surgery (e.g. circumcision, vasectomy, hydrocoelectomy and ureteroscopy), the use of pharmacological prophylaxis or mechanical prophylaxis is not recommended. ◆ In all patients undergoing open radical cystectomy, or open radical prostatectomy with extended lymphadenectomy, the use of pharmacological prophylaxis is recommended. ◆ Starting thromboprophylaxis (LMWH or DOACs) on post operative day 1. Continuing thromboprophylaxis for 2-4 weeks when pharmacological thromboprophylaxis is used.

European guidelines on peri-operative venous thromboembolism prophylaxis: first update.: Introductory chapter. Eur J Anaesthesiol. 2024, 41(8):549-560.
Expert Consensus on Perioperative Strategies of VTE Prevention and Treatment, and Pharmaceutical Care. Herald of Medicine. 2025, 44(11): 1717-1735.
Guideline for the prevention and management of perioperative venous thromboembolism in thoracic malignancies in China (2022 version). Chin J Surg. 2022, 60(8): 721-731.

Other Surgical Procedures

Surgery	Recommendation
Gynaecological Surgery	◆ Either LMWH or low-dose UFH is recommended as the first choice for pharmacological thromboprophylaxis in most cases. ◆ For patients undergoing gynaecological surgery for benign disease, postoperative low-dose UFH should be administered every 12 h. For patients undergoing gynaecological surgery for malignant disease, postoperative low-dose UFH should be administered every 8 h. ◆ For patients at high risk for VTE, continued dosing for 4 weeks postoperatively is recommended
Bariatric surgery	◆ VTE prophylaxis with LMWH, UFH or fondaparinux over no prophylaxis in patients with high VTE risk and low risk for bleeding is recommended. ◆ For patients at high risk of VTE, extending pharmacological prophylaxis with LMWH, UFH, or fondaparinux for at least 10 days is recommended over prophylaxis limited to the hospital stay.
Oral and maxillofacial surgery	◆ Pharmacological prophylaxis is not routinely recommended for patients undergoing minor to moderate procedures, fracture fixation, orthognathic surgery, treatment of space infections, or pedicled flap surgery.

Guideline No. 417: Prevention of Venous Thromboembolic Disease in Gynaecological Surgery. J Obstet Gynaecol Can. 2022, 44(1):82-96.e1.
The American Society for Metabolic and Bariatric Surgery (ASMBS) updated position statement on perioperative venous thromboembolism prophylaxis in bariatric surgery. Surg Obes Relat Dis. 2022, 18(2):165-174.
European guidelines on peri-operative venous thromboembolism prophylaxis: first update.: Chapter 10: Surgery in the obese patient. Eur J Anaesthesiol. 2024, 41(8):607-611.
Expert Consensus on Perioperative Strategies of VTE Prevention and Treatment, and Pharmaceutical Care. Herald of Medicine. 2025, 44(11): 1717-1735.

Perioperative VTE treatment strategies

- For patients with acute perioperative VTE, anticoagulant therapy should be initiated immediately. Commonly used agents include LMWH, fondaparinux, rivaroxaban, or apixaban, with selection individualized based on the patient’ s clinical condition.
- Anticoagulation therapy should be administered for at least 3 months. For VTE patients with unprovoked events or persistent thrombotic risk, extended anticoagulation therapy is required to reduce the recurrence rate.
- For isolated distal DVT: If severe symptoms or risk factors for thrombus progression are present, immediate initiation of routine anticoagulation therapy is recommended. If no severe symptoms or risk factors for thrombus progression are present, serial imaging surveillance for 2 weeks is recommended. If there is no progression of thrombosis, routine anticoagulation therapy is not recommended.

Expert Consensus on Perioperative Strategies of VTE Prevention and Treatment, and Pharmaceutical Care. Herald of Medicine. 2025, 44(11): 1717-1735.
Antithrombotic therapy for vte disease: compendiumand review of CHEST Guidelines 2012-2021. Chest. 2024,166(2): 388-404.
Antithrombotic therapy for VTE disease: second update ofthe chest guideline and expert panel report. Chest. 2021,160(6): e545-e608.

Chapter Summary

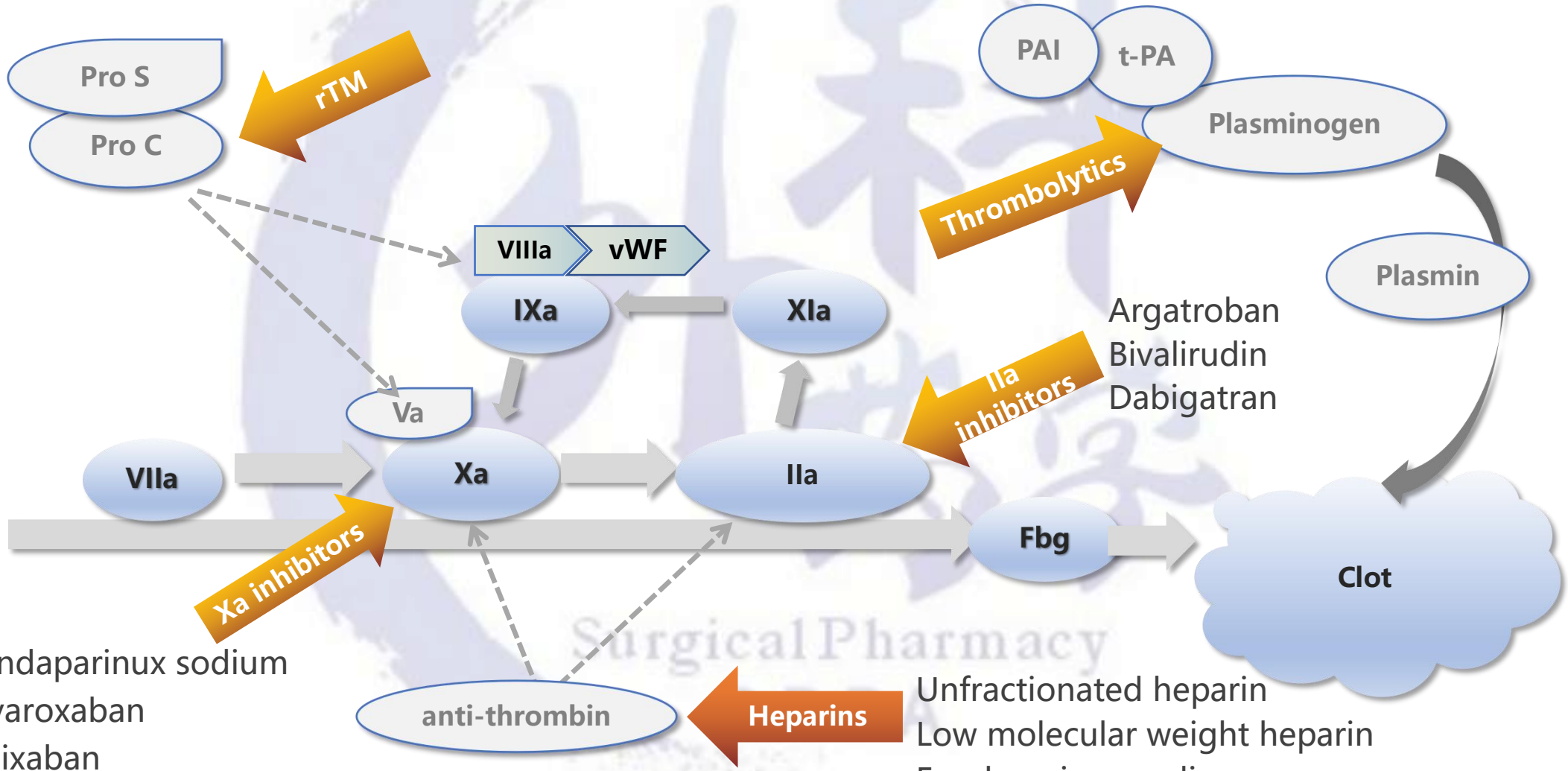
- Evaluate VTE and bleeding risk for surgical inpatients based on surgical type, patient comorbidities, and clinical conditions.
- Exclude patients with contraindications to mechanical prophylaxis and pharmacological prophylaxis.
- Develop a personalized VTE prevention plan in accordance with relevant clinical guidelines, based on the above assessments.
- For patients with acute perioperative VTE, timely anticoagulation therapy is indicated, except in those with isolated distal DVT.

02

Medication management

- Perioperative VTE Management Strategy
- **Perioperative Commonly Used Anticoagulants and Pharmaceutical Monitoring**

Anticoagulants, thrombolytics, and hemostatic agents act on their respective targets



Fondaparinux sodium
Rivaroxaban
Apixaban
Edoxaban

Unfractionated heparin
Low molecular weight heparin
Fondaparinux sodium

Anticoagulant Drugs for VTE Prophylaxis: Dosage & Monitoring

Agent	Prophylaxis Dosage & Administration	Therapeutic Dosage & Administration	Monitoring Parameters
UFH	5000 U, q12h	Initial: 80 $U \cdot kg^{-1}$ iv, followed by 18 $U \cdot kg^{-1} \cdot h^{-1}$ ivgtt	APTT: 1.5–2.5 ULN
Nadroparin	2850 U, ih, qd	85 $U \cdot kg^{-1}$, ih, q12h	Anti-Xa activity: 0.5–1.0 $U \cdot ml^{-1}$
Enoxaparin	2000 or 4000 U, ih, qd	1 $mg \cdot kg^{-1}$, ih, q12h	Anti-Xa activity: 0.6–1.0 $U \cdot ml^{-1}$
Dalteparin	2500 or 5000 U, ih, qd	100 $U \cdot kg^{-1}$, ih, bid or 200 $U \cdot kg^{-1}$, ih, qd	Anti-Xa activity: 0.5–1.0 $U \cdot ml^{-1}$
Fondaparinux Sodium	2.5 mg, ih, qd	5–10 mg, ih, qd	Anti-Xa activity: 0.46–0.62 $U \cdot ml^{-1}$
Warfarin	Initial dose: 1–3 mg, qd	Initial dose: 1–3 mg, qd; overlap with parenteral anticoagulants until INR is therapeutic	INR 2.0–3.0
Rivaroxaban	10 mg, qd	15 mg, bid for the first 3 weeks, then 20 mg, qd	-
Apixaban	2.5 mg, bid	10 mg, bid for 7 days, then 5 mg, bid	-
Edoxaban	60 mg, qd	Initiate after at least 5 days of initial parenteral anticoagulation; 60 mg, qd	-
Dabigatran	150 mg, bid	Initiate after at least 5 days of initial parenteral anticoagulation; 150 mg, bid	-

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Anticoagulant Drugs for VTE Prophylaxis: Dosage & Monitoring

- For prophylactic medication, except for warfarin with a target INR range of 2.0-3.0, routine monitoring is not required for other drugs;
- LNWH, rivaroxaban, apixaban, and edoxaban generally do not require routine coagulation monitoring. However, anti-Xa monioring may be performed fot special patienls such as those with renal insufficiency, obesity, or pregnancy. Anti-Xa activity is lypically measured 3~4 h after administration;
- During the use of UFH, APTT should be monitored every 4-6 h;
- Rivaroxaban is only used for VTE prophylaxis in patients undergoing elective hip or knee replacement surgery, as well as in patients with persistent VTE risk after completing at least 6 months of standard anticoagulation therapy;
- Apixaban is only used for VTE prophylaxis in patients undergoing electivehip or knee replacement surgery;
- The dose of edoxaban should be adjusted to 30 mg qd in the following situations: moderate to severe renal impaimnent (Ccr 15- 50 ml/min), low body weight (60 kg), or concomitant use with P-gp inhibitars;
- The dose of dabigaran should be adjusted to 110 mg bid in the following situations: age ≥ 80 years old or concurrent use with verapamil.

Expert Consensus on Perioperative Strategies of VTE Prevention and Treatment, and Pharmaceutical Care. Herald of Medicine. 2025, 44(11): 1717-1735.

Dose adjustment of anticoagulants for perioperative patients with liver dysfunction

Anticoagulant	Child-Pugh Class	Dosage Adjustment	Anticoagulant	Child-Pugh Class	Dosage Adjustment
LMWH	A	Preferred agent; no dosage adjustment required	**Dabigatran**	A	No dosage adjustment required; not recommended if AST/ALT >2× ULN or liver disease
	B			B	
	C			C	Contraindicated
Fondaparinux Sodium	A	No dosage adjustment required	**Apixaban**	A	No dosage adjustment required; use with caution if AST/ALT >2× ULN or TBIL ≥1.5× ULN
	B			B	Not recommended
	C			C	Contraindicated
Warfarin	A	No dosage adjustment required	**Edoxaban**	A	No dosage adjustment required; use with caution if AST/ALT >2× ULN or TBIL ≥1.5× ULN
	B	Not recommended		B	Not recommended
	C			C	Contraindicated
			Rivaroxaban	A	No dosage adjustment required
				B	Contraindicated
				C	

Expert Consensus on Perioperative Strategies of VTE Prevention and Treatment, and Pharmaceutical Care. Herald of Medicine. 2025, 44(11): 1717-1735.

Dose adjustment of anticoagulants for perioperative patients with renal dysfunction

Anticoagulant	Indication	50 ml•min⁻¹ ≤CrCl ≤70 ml•min⁻¹	30 ml•min⁻¹ ≤CrCl <50 ml•min⁻¹	15 ml•min⁻¹ ≤CrCl <30 ml•min⁻¹	CrCl <15 ml•min⁻¹	Monitoring Parameters & Target Range
UFH	VTE Prophylaxis	5000 U, bid–tid, ih	No dosage adjustment required			—
	VTE Treatment	Initial: 80 U·kg⁻¹ iv, then 18 U·kg⁻¹·h⁻¹ ivgtt	Adjust dose based on APTT or anti-Xa activity		Loading dose: 60 U·kg⁻¹; maintenance: 12 U·kg⁻¹·h⁻¹, then adjust based on APTT	APTT: 1.5–2.5× ULN
Nadroparin	VTE Prophylaxis	2850–5700 U (0.3–0.6 ml), qd, ih	Reduce by 25–33%	Not recommended		—
	VTE Treatment	85 U·kg⁻¹, q12h, ih	Reduce by 25–33%	Not recommended		Anti-Xa activity: 0.5–1.0 U·ml⁻¹
Enoxaparin	VTE Prophylaxis	2000–4000 U, qd, ih	2000 U, qd, ih		Not recommended	—
	VTE Treatment	1 mg·kg⁻¹, q12h, ih	1 mg·kg⁻¹, q12h, ih; adjust based on anti-Xa activity	1 mg·kg⁻¹, qd, adjust based on anti-Xa activity	Not recommended; if necessary, 1 mg·kg⁻¹, qd, adjust based on anti-Xa activity	Anti-Xa activity: 0.6–1.0 U·ml⁻¹
Dalteparin	VTE Prophylaxis	2500–5000 U, qd, ih	No dosage adjustment required	Monitor anti-Xa levels		Anti-Xa activity: 0.2–0.4 U·ml⁻¹
	VTE Treatment	100 U·kg⁻¹, q12h, ih or 200 U·kg⁻¹, qd, ih	No dosage adjustment required	Use with caution; reduce dose, adjust based on anti-Xa activity		Anti-Xa activity: 0.5–1.0 U·ml⁻¹
Fondaparinux Sodium	VTE Prophylaxis	2.5 mg, qd, ih	1.5 mg, qd, ih	Not recommended if CrCl <20 ml·min⁻¹	Not recommended	Anti-Xa activity: 0.2–0.3 U·ml⁻¹
Argatroban	HIT/Heparin Resistance	1.2–2.0 μg·kg⁻¹·min⁻¹; adjust based on APTT		0.8 μg·kg⁻¹·min⁻¹; adjust based on APTT		APTT: 1.5–3.0× ULN
Bivalirudin	HIT/Heparin Resistance	1.75 mg·kg⁻¹·h⁻¹; adjust based on APTT		1 mg·kg⁻¹·h⁻¹; adjust based on APTT		APTT: 1.5–2.0× ULN

Expert Consensus on Perioperative Strategies of VTE Prevention and Treatment, and Pharmaceutical Care. Herald of Medicine. 2025, 44(11): 1717-1735.
Microcirculation Expert Consensus for Anticoagulation Strategy in Patients with Venous Thromboembolism and Chronic Kidney Disease. Journal of Vascular and Endovascular Surgery. 2021,7(01):1-13

Dose adjustment of anticoagulants for perioperative patients with renal dysfunction

Anticoagulant	Indication	50 ml•min^{-1} ≤CrCl ≤70 ml•min^{-1}	30 ml•min^{-1} ≤CrCl < 50 ml•min^{-1}	15 ml•min^{-1} ≤CrCl < 30 ml•min^{-1}	CrCl <15 ml•min^{-1}
Warfarin	VTE Prophylaxis/Treatment	Adjust dose based on INR			
Dabigatran	VTE Prophylaxis	110 mg 1d, then 220 mg qd, po (administered on the day of surgery); or 220 mg qd, po (if not used on the day of surgery)	No dosage adjustment required	Not recommended	
	VTE Treatment	150 mg, bid, po	110 mg, bid, po	Not recommended	
Rivaroxaban	VTE Prophylaxis	10 mg, qd, po	No dosage adjustment required	Not recommended	
	VTE Treatment	15 mg, bid, po for 21 d; then 20 mg, qd, po	15 mg, bid, po for 21 d; then 15 mg, qd, po	Use with caution, 15 mg qd, monitor anti-Xa activity or drug concentration	Not recommended (dialysis patients: 10 mg, qd, po)
Apixaban	VTE Prophylaxis	2.5 mg, bid, po	No dosage adjustment required		
	VTE Treatment	10 mg, bid, po for 5 d; then 5 mg, bid, po	No dosage adjustment required	2.5 mg, bid, po	Not recommended (dialysis patients: 2.5 mg, bid, po)
Edoxaban	VTE Treatment	60 mg, qd, po	30 mg, qd, po		

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Microcirculation Expert Consensus for Anticoagulation Strategy in Patients with Venous Thromboembolism and Chronic Kidney Disease. Journal of Vascular and Endovascular Surgery. 2021,7(01):1-13

Pharmaceutical care for anticoagulant drugs

- Embolism
- Bleeding
- Liver Function
- Drug Interactions
- Renal Function
- INR Level
- HIT
- Etc.

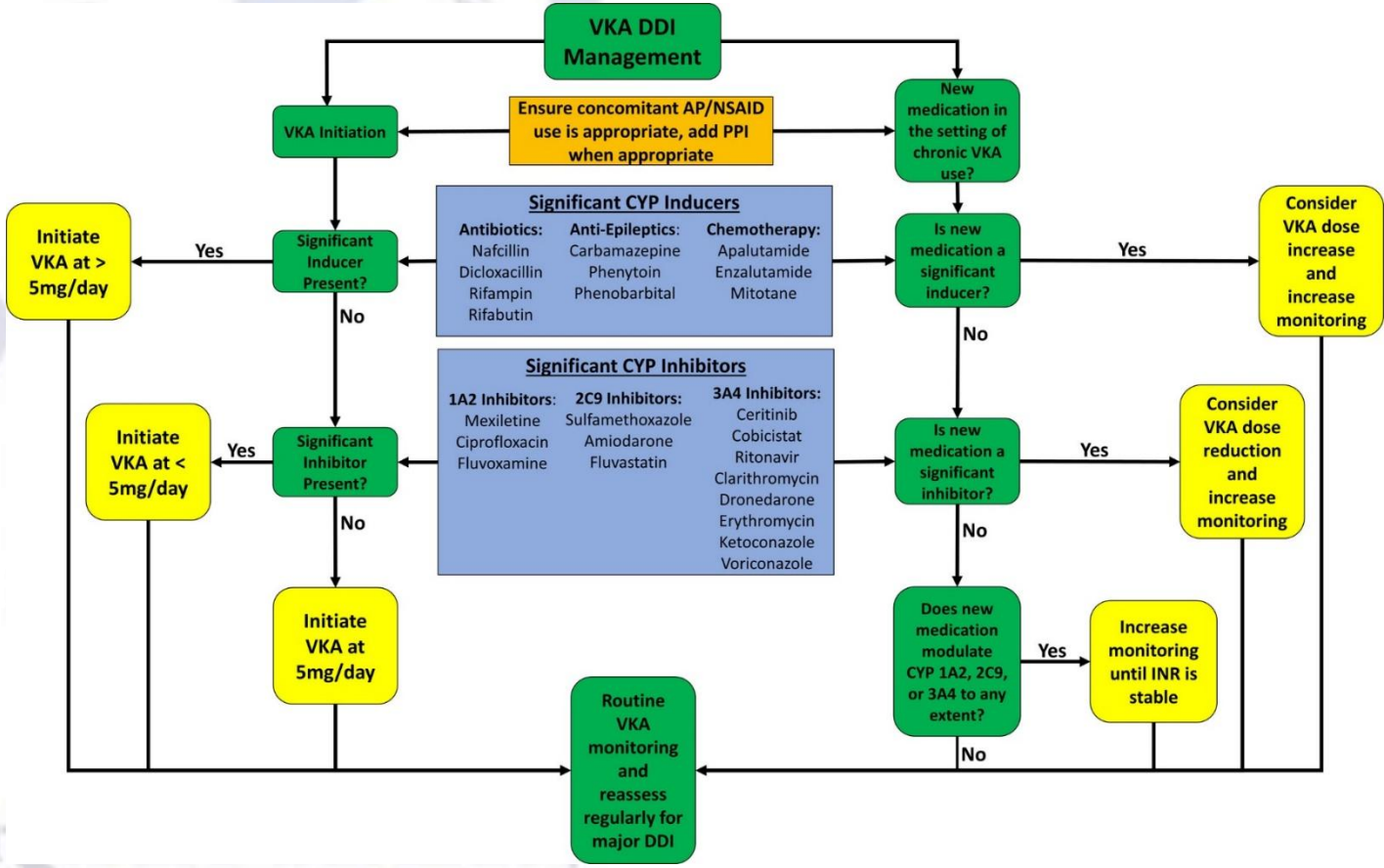
Pharmaceutical care for anticoagulant drugs

Anticoagulant	Pharmacological Monitoring Points					Specific Antidote
	Bleeding	Liver Function	Renal Function	HIT	Drug Interactions (CYP3A4/P-gp Inhibitors)	
UFH	✓	✓		✓		Protamine
LMWH	✓	✓	✓	✓		Protamine
Fondaparinux Sodium	✓	✓	✓			—
Warfarin	✓	✓			✓	Vitamin K
Rivaroxaban	✓	✓	✓		✓	Andexanet alfa
Apixaban	✓	✓	✓		✓	Andexanet alfa
Edoxaban	✓	✓	✓		✓	Andexanet alfa
Dabigatran	✓	✓	✓		✓	Idarucizumab

Expert Consensus on Perioperative Strategies of VTE Prevention and Treatment, and Pharmaceutical Care. Herald of Medicine. 2025, 44(11): 1717-1735.

Pharmaceutical care for anticoagulant drugs

- All anticoagulant drugs can be nonspecifically antagonized by prothrombin complex concentrate, fresh frozen plasma or recombinant coagulation factor VIIa;
- Rivaroxaban 10 mg can be taken with or without food, while rivaroxaban 15 mg or 20 mg tablets should be taken with food ;
- Dabigatran should be taken orally with water, swallowed whole, and can be administered during or after meals;
- Warfarin has numerous drug interactions (strong inducer/inhibitor of CYP, etc.)



Expert Consensus on Perioperative Strategies of VTE Prevention and Treatment, and Pharmaceutical Care. Herald of Medicine 2025, 44(11): 1717-1735
Drug Interactions Affecting Oral Anticoagulant Use. Circ Arrhythm Electrophysiol. 2022, 15(6): e007956.

Chapter Summary

- Pharmacists should provide personalized monitoring for patients on anticoagulants, considering their clinical condition, drug type, and dosage regimen.
- The content of pharmaceutical care encompasses the occurrence of bleeding or thromboembolic events, the hepatic and renal function, etc.
- Special attention must be paid to drug–drug interactions, especially for patients taking warfarin.

03

Case Analysis

Case Introduction

01

Patient

Female，68 years old

02

Chief Complaint

Left knee joint pain with limited movement for over 5 years, worsened in the past 2 months.

03

Current Medical History

Left knee pain with restricted movement for over 5 years. Has undergone multiple intra-articular injections of hyaluronic acid at local hospitals, the most recent one a year ago. Symptoms persisted, with limited left knee movement, a limping gait while walking, and was admitted for “knee osteoarthritis”.

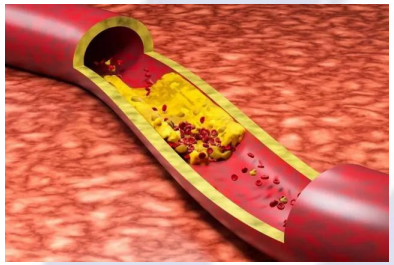
04

Previous History

CKD began 3 years ago but has not taken medication regularly (CrCl: 33.5 ml/min) . Denies any other significant medical history.

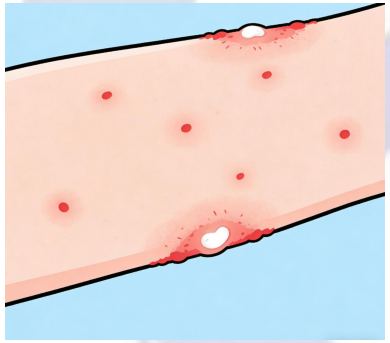
The patient is scheduled for knee replacement surgery.
Consult the Department of Pharmacy for perioperative VTE management.

Determine Perioperative VTE Management Strategy Based on Risk Stratification



1-Assess VTE risk

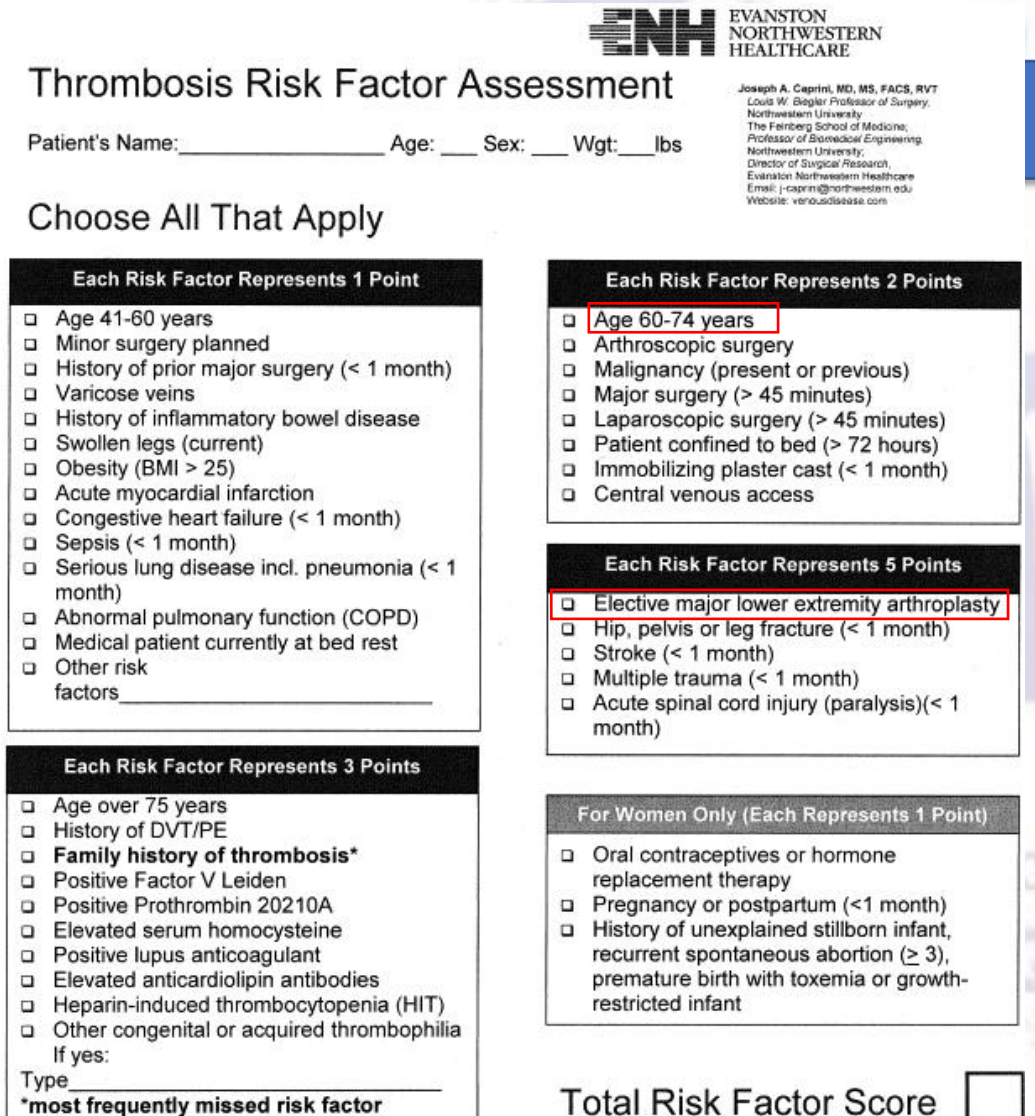
2-Evaluate bleeding risk



3-Screen for contraindications to relevant preventive measures

4-Determine the optimal VTE prophylaxis strategy

Assess VTE risk



EVANSTON NORTHWESTERN HEALTHCARE

Thrombosis Risk Factor Assessment

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Patient's Name:_____ Age: ___ Sex: ___ Wgt:___lbs

Choose All That Apply

Each Risk Factor Represents 1 Point

- ☐ Age 41-60 years
- ☐ Minor surgery planned
- ☐ History of prior major surgery (< 1 month)
- ☐ Varicose veins
- ☐ History of inflammatory bowel disease
- ☐ Swollen legs (current)
- ☐ Obesity (BMI > 25)
- ☐ Acute myocardial infarction
- ☐ Congestive heart failure (< 1 month)
- ☐ Sepsis (< 1 month)
- ☐ Serious lung disease incl. pneumonia (< 1 month)
- ☐ Abnormal pulmonary function (COPD)
- ☐ Medical patient currently at bed rest
- ☐ Other risk factors_____

Each Risk Factor Represents 2 Points

- ☐ Age 60-74 years
- ☐ Arthroscopic surgery
- ☐ Malignancy (present or previous)
- ☐ Major surgery (> 45 minutes)
- ☐ Laparoscopic surgery (> 45 minutes)
- ☐ Patient confined to bed (> 72 hours)
- ☐ Immobilizing plaster cast (< 1 month)
- ☐ Central venous access

Each Risk Factor Represents 3 Points

- ☐ Age over 75 years
- ☐ History of DVT/PE
- ☐ **Family history of thrombosis***
- ☐ Positive Factor V Leiden
- ☐ Positive Prothrombin 20210A
- ☐ Elevated serum homocysteine
- ☐ Positive lupus anticoagulant
- ☐ Elevated anticardiolipin antibodies
- ☐ Heparin-induced thrombocytopenia (HIT)
- ☐ Other congenital or acquired thrombophilia
  If yes:

Type_____

***most frequently missed risk factor**

Each Risk Factor Represents 5 Points

- ☐ Elective major lower extremity arthroplasty
- ☐ Hip, pelvis or leg fracture (< 1 month)
- ☐ Stroke (< 1 month)
- ☐ Multiple trauma (< 1 month)
- ☐ Acute spinal cord injury (paralysis)(< 1 month)

For Women Only (Each Represents 1 Point)

- ☐ Oral contraceptives or hormone replacement therapy
- ☐ Pregnancy or postpartum (<1 month)
- ☐ History of unexplained stillborn infant, recurrent spontaneous abortion (≥ 3), premature birth with toxemia or growth-restricted infant

Total Risk Factor Score ☐

7 points

high risk

Patient-related VTE risk factors include (but are not limited to):

previous or family history of venous thromboembolism[1,2]
major thrombophilia[3]
age >70 years[4]
obesity[5]
hypoalbuminaemia[6]
active cancer[7]
oestrogenic oral contraception and oral hormone therapy for the menopause[8]
renal insufficiency[9]

Patient-related risks can increase the risk of bleeding

HAS-BLED Score	
Variable	Score
Age ≥ 65 years	1
Hypertension (Systolic Blood Pressure ≥ 160mmHg)	1
Abnormal renal function	1
Abnormal liver function	1
Stroke in past	1
Bleeding	1
Labile INRs	1
Taking other drugs as well	1
Alcohol intake at the same time	1

2 points
Low bleeding risk

Patient-related bleeding risk factors include (but are not limited to):

coagulopathy[15]
anticoagulant medication[16]

Bleeding risk factors related to the procedure performed are (but are not limited to):

duration of procedure[17]
length of skin incision[18]
use of drains[19]

Perioperative VTE Management Strategy

(3) High VTE risk surgery:

(a) No high risk of bleeding: We suggest VTE prophylaxis with either LMWH or DOAC rather than no VTE prophylaxis for procedures with high VTE risk without high risk of bleeding (Grade 2B). We are unable to make a recommendation for or against the use of aspirin.

(b) High risk of bleeding: We suggest mechanical VTE prophylaxis rather than pharmacological prophylaxis for procedures with high VTE risk with high risk of bleeding (Grade 2C).

2.2. For patients undergoing major orthopedic surgery (THA, TKA, HFS) and receiving LMWH as thromboprophylaxis, we recommend starting either 12 h or more preoperatively or 12 h or more postoperatively rather than within 4 h or less preoperatively or 4 h or less postoperatively (Grade 1B).

European guidelines on peri-operative venous thromboembolism prophylaxis: first update.: Chapter 13: Nonambulatory orthopaedic surgery. Eur J Anaesthesiol. 2024, 41(8):622-626.
Antithrombotic therapy for VTE disease: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest. 2012, 141(2 Suppl): e419S-e496S.

Periprocedural Management of Patients on Direct Oral Anticoagulants

Anticoagulant	Indication	50 ml•min⁻¹ ≤CrCl ≤70 ml•min⁻¹	30 ml•min⁻¹ ≤CrCl < 50 ml•min⁻¹	15 ml•min⁻¹ ≤CrCl < 30 ml•min⁻¹	CrCl <15 ml•min⁻¹	Monitoring Parameters & Target Range
UFH	VTE Prophylaxis	5,000 U, bid–tid, ih	No dosage adjustment required			—
	VTE Treatment	Initial: 80 U·kg⁻¹ IV bolus, then 18 U·kg⁻¹·h⁻¹ IV infusion	Adjust dose based on APTT or anti-Xa activity		Loading dose: 60 U·kg⁻¹; maintenance: 12 U·kg⁻¹·h⁻¹, then adjust based on APTT	APTT: 1.5–2.5× ULN
Nadroparin	VTE Prophylaxis	2,850–5,700 U (0.3–0.6 ml), qd, ih	Reduce by 25–33%	Not recommended		—
	VTE Treatment	85 U·kg⁻¹, q12h, ih	Reduce by 25–33%	Not recommended		Anti-Xa activity: 0.5–1.0 U·ml⁻¹
Enoxaparin	VTE Prophylaxis	2,000–4,000 U, qd, ih	2,000 U, qd, ih		Not recommended	—
	VTE Treatment	1 mg·kg⁻¹, q12h, ih	1 mg·kg⁻¹, q12h, ih; adjust based on anti-Xa activity	1 mg·kg⁻¹, qd, adjust based on anti-Xa activity	Not recommended; if necessary, 1 mg·kg⁻¹, qd, adjust based on anti-Xa activity	Anti-Xa activity: 0.6–1.0 U·ml⁻¹
Dalteparin	VTE Prophylaxis	2,500–5,000 U, qd, ih	No dosage adjustment required	Monitor anti-Xa levels		Anti-Xa activity: 0.2–0.4 U·ml⁻¹
	VTE Treatment	100 U·kg⁻¹, q12h, ih or 200 U·kg⁻¹, qd, ih	No dosage adjustment required	Use with caution; reduce dose, adjust based on anti-Xa activity		Anti-Xa activity: 0.5–1.0 U·ml⁻¹
Fondaparinux Sodium	VTE Prophylaxis	2.5 mg, qd, ih	1.5 mg, qd, ih	Not recommended if CrCl <20 ml·min⁻¹	Not recommended	Anti-Xa activity: 0.2–0.3 U·ml⁻¹

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Summary

Risk Stratification as Decision Basis

- VTE risk； Bleeding risk.

Comprehensive Consideration

- The formulation of a perioperative VTE prevention strategy requires comprehensive consideration of surgical type, patient condition, drug characteristics, and evidence-based medicine.

Multidisciplinary Collaboration & Monitoring Focus

- Dynamic hepatic/renal function monitoring； Drug-drug interactions; bleeding/thromboembolic events, etc.

Q1: (single choice) For patients with a CrCl < 15 ml•min^{-1}, which anticoagulant can be selected for perioperative VTE prophylaxis?

A. Warfarin
B. Apixaban
C. Enoxaparin
D. Nadroparin

Q2: (single choice) For patients undergoing cardiac and vascular surgery, which anticoagulant is recommended for VTE prophylaxis?

A. UFH
B. LMWH
C. Apixaban
D. Warfarin

Q3: (multiple choice) 1. When formulating perioperative VTE management strategies for patients, we need to consider?

A. Assessing the risk of VTE

B. Assessing the risk of bleeding

C. Hepatic function of patient

D. Drug interactions

E. Renal function of patient

Your constructive criticism and guidance are greatly appreciated!