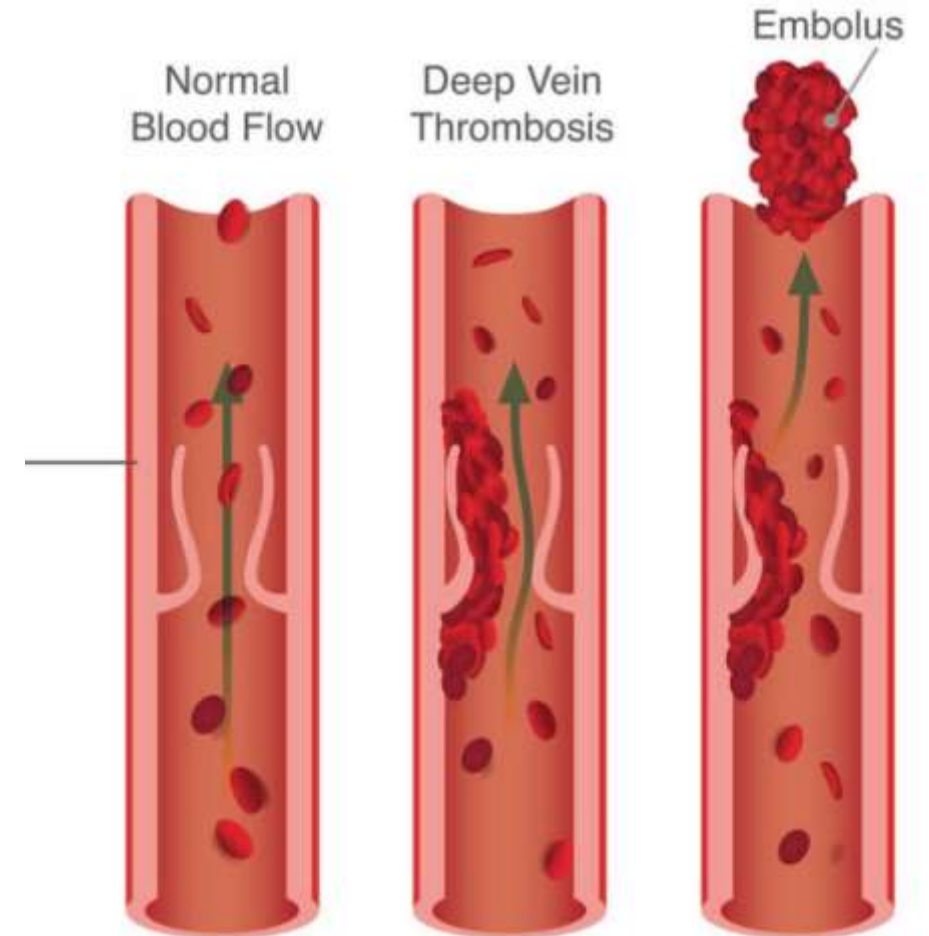


# Deep Venous Thrombosis Prophylaxis

# Deep vein thrombosis (DVT)

- Development or presence of a thrombus in the deep veins
- Occurs mostly in the lower extremities



- Pulmonary embolism (PE) is an obstruction of the pulmonary artery or its branches by a thrombus. The most likely source of thrombus in pulmonary arteries is an embolization from deep veins of the legs (1/3 of patients with DVT).
- Prevention of DVT thereby decreases the incidence of PE, a serious and life-threatening condition.

# incidence

- DVT and PE account for 60,000 to 100,000 deaths annually in the United States
- More than half of all hospitalized patients are at risk for VTE, with a higher risk in surgical patients than in medical patients

Venous thromboembolism risk and prophylaxis in the acute hospital care setting (ENDORSE study): a multinational cross-sectional study.  
Cohen AT, Tapson VF, Bergmann JF, Goldhaber SZ, Kakkar AK, Deslandes B, Huang W, Zayaruzny M, Emery L, Anderson FA Jr, ENDORSE Investigators.

Lancet. 2008 Feb 2; 371(9610):387-94.

The risk of recurrent venous thromboembolism after discontinuing anticoagulation in patients with acute proximal deep vein thrombosis or pulmonary embolism. A prospective cohort study in 1,626 patients.

Prandoni P, Noventa F, Ghirarduzzi A, Pengo V, Bernardi E, Pesavento R, Iotti M, Tormene D, Simioni P, Pagnan A  
Haematologica. 2007 Feb; 92(2):199-205.

# Triad of Virchow

- **Venous stasis** (immobility and congestive heart failure)
- **Endothelial injury** (surgery and trauma)
- **Hypercoagulability** (cancer, thrombophilia)

### **Deep Veins of Lower Extremities**

- Common femoral vein
- Deep femoral vein
- Superficial femoral vein
- Popliteal vein
- Anterior tibial vein
- Posterior tibial vein
- Peroneal vein

### **Deep Veins of Upper Extremities**

- Paired radial vein
- Paired ulnar vein
- Interosseous vein
- Brachial vein
- Axillary vein
- Subclavian vein

# DVT

- Hospitalized patients are at increased risk of DVT when compared to patients in the community.
- Full history and physical examination are warranted to assess the risk.
- It is very important to consider DVT prophylaxis in every hospitalized patient.

# DVT prophylaxis

- Primary – the preferred method with the use of medications and mechanical methods to prevent DVT.
- Secondary – less commonly used method that includes early detection with screening methods and the treatment of subclinical DVT.



# DVT risk

- Procedure-related
- Patient-related

✓The optimal approach to assess risk of venous thromboembolism in hospitalized medical patients is unknown

✓A linear association between the Caprini risk assessment model and risk of DVT

## Modified Caprini risk assessment model for VTE in general surgical patients

Risk score			
1 point	2 points	3 points	5 points
Age 41 to 60 years	Age 61 to 74 years	Age ≥75 years	Stroke (<1 month)
Minor surgery	Arthroscopic surgery	History of VTE	Elective arthroplasty
BMI >25 kg/m <sup>2</sup>	Major open surgery (>45 minutes)	Family history of VTE	Hip, pelvis, or leg fracture
Swollen legs	Laparoscopic surgery (>45 minutes)	Factor V Leiden	Acute spinal cord injury (<1 month)
Varicose veins	Malignancy	Prothrombin 20210A	
Pregnancy or postpartum	Confined to bed (>72 hours)	Lupus anticoagulant	
History of unexplained or recurrent spontaneous abortion	Immobilizing plaster cast	Anticardiolipin antibodies	
Oral contraceptives or hormone replacement	Central venous access	Elevated serum homocysteine	
Sepsis (<1 month)		Heparin-induced thrombocytopenia	
Serious lung disease, including pneumonia (<1 month)		Other congenital or acquired thrombophilia	
Abnormal pulmonary function			
Acute myocardial infarction			
Congestive heart failure (<1 month)			
History of inflammatory bowel disease			
Medical patient at bed rest			
Interpretation			
Surgical risk category*	Score	Estimated VTE risk in the absence of pharmacologic or mechanical prophylaxis (percent)	
Very low (see text for definition)	0	<0.5	
Low	1 to 2	1.5	
Moderate	3 to 4	3.0	
High	≥5	6.0	

VTE: venous thromboembolism; BMI: body mass index.

Using the Caprini score, patients undergoing surgical procedures are classified according to their estimated baseline risk (EBR) for venous thromboembolism in the absence of thromboprophylaxis as:

- **Very low risk:** Caprini score **0**; corresponding to an EBR <0.5%
- **Low risk:** Caprini score **1 to 2**; corresponding to an EBR of about 1.5%
- **Moderate risk:** Caprini score **3 to 4**; corresponding to an EBR of about 3%
- **High risk:** Caprini score **≥5**; corresponding to an EBR of at least 6%

The rate of bleeding associated with pharmacologic prophylaxis:

✓ injection site bruising (7%)

✓ wound hematoma (6%)

✓ drain site bleeding (2%)

✓ hematuria (2%)

✓ gastrointestinal tract bleeding (0.2%)

✓ retroperitoneal bleeding (<0.1%)

# Bleeding risk categories

Low bleeding risk	High bleeding risk
<ul style="list-style-type: none"><li>✓ patients undergoing general surgery</li><li>✓ abdominal-pelvic surgery</li><li>✓ bariatric surgery</li><li>✓ vascular surgery</li><li>✓ thoracic surgery that is uncomplicated, tend to have lower rates of bleeding (&lt;2 percent) when compared with other patients</li></ul>	<ul style="list-style-type: none"><li>✓ patients undergoing cardiac surgery and patients with major trauma, especially involving the brain and spine, are at highest risk of bleeding (&gt;3 percent)</li><li>✓ those in whom the consequences of bleeding are considered potentially devastating; for example patients undergoing neurosurgical procedures where thromboprophylaxis may result in spinal or intracranial hemorrhage</li><li>✓ patients undergoing plastic/reconstructive surgery where thromboprophylaxis may result in failed reconstruction</li></ul>

# Individual risk factors for bleeding

- active bleeding as an indication for surgery (eg, gastrointestinal bleeding, trauma, ruptured aneurysm)
- intracranial hemorrhage
- moderate or severe coagulopathy (eg, patients with liver disease)
- underlying bleeding disorder or thrombocytopenia (eg, platelet count  $<50,000/\text{microL}$ , or  $<100,000/\text{microL}$  plus additional risk factors for bleeding)
- recurrent bleeding from multiple gastrointestinal telangiectasias
- epistaxis and menstrual bleeding are not contraindications to pharmacologic thromboprophylaxis

# SELECTING THROMBOPROPHYLAXIS

- Options for primary VTE prophylaxis include early ambulation, pharmacologic and/or mechanical methods.

VTE prevention strategies should be individualized according to the **risk of DVT (very low, low, moderate, and high)** as well as the **risk and consequences of major bleeding.**

The approach is consistent with international guidelines including the *American College of Chest Physicians (ACCP)*, the *Asian Venous Thrombosis Forum*, *Korean guidelines for the Prevention of Venous Thromboembolism*, *European guidelines on perioperative venous thromboembolism prophylaxis: Executive summary*, and the *International Consensus Statement on the Prevention and Treatment of Venous Thromboembolism*



Thromboprophylaxis **reduces but does not eliminate**  
VTE events and VTE-related mortality

## Very low thrombosis risk:

- **Ability to early ambulation** —the baseline risk in the absence of prophylaxis is estimated to be less than 0.5%
- **For nonorthopedic surgical patients at very low risk of VTE, is recommended early and frequent ambulation rather than pharmacologic or mechanical methods of prophylaxis.**
- The risk of VTE **is lowered by 70%** in those who ambulate on or before the second postoperative day

# Low VTE risk:

- Mechanical methods — the risk of VTE is considered low when the baseline risk in the absence of prophylaxis is estimated to be 1.5%
  - undergoing minor elective abdominal-pelvic surgery (eg, appendectomy, laparoscopic cholecystectomy)
  - minor thoracic surgery (eg, diagnostic thoracoscopy, video-assisted biopsy, minor vascular procedures (eg, vein ablation)
  - elective spine surgery (eg, spinal fusion)

# Mechanical methods of thromboprophylaxis

- intermittent pneumatic compression (IPC)
- graduated compression stockings (GCS, also known as elastic stockings)
- the venous foot pump (VFP)

# Intermittent pneumatic compression and venous foot pump

- IPC use is superior to no prophylaxis and to GCS, and may offer additive benefit to surgical patients on low molecular weight (LMW) heparin.
- IPC is contraindicated in patients with evidence of leg ischemia (eg, peripheral artery disease).
- IPC should be started as soon as possible, preferably just before surgery or in the operating room and continued with few interruptions until discharge.



Intermittent pneumatic compression device

# Graduated compression stockings

- alone are effective at preventing DVT but may be **less** effective than pharmacologic agents
- combined with other prophylactic methods appears to improve rates of DVT prevention
- should be started as soon as possible, preferably before surgery, or in the operating room and continued with few interruptions until discharge
- contraindications against their use and local skin breakdown complications are similar to those for IPC



# Moderate DVT risk

- general or abdomen/pelvic surgery with a Caprini score of 3 to 4
- plastic/reconstructive surgery with a Caprini score of 5 to 6
- major gynecologic and urologic surgery
- in addition, patients undergoing major cardiac or thoracic surgery, bariatric surgery, and neurosurgical procedures, and patients with nonextensive trauma not involving the brain or spine are, at minimum, also considered moderate risk for VTE

# High DVT risk

- general or abdominal/pelvic surgery with a Caprini score of 5 or more
- plastic/reconstructive surgery with a Caprini score of 7 to 8

Ex. extensive thoracic or abdominal-pelvic surgery (eg, distal colorectal surgery, extensive pelvic surgery), major trauma (particularly if involving the brain or spinal cord), acute spinal cord injury, or cancer surgery



(moderate or high DVT risk) with low bleeding risk:

- **Pharmacologic alone**
- **Combined prophylaxis**
- For the particularly high risk of VTE is suggested **the addition** of mechanical to pharmacologic methods (eg, multiple risk factors, surgery for cancer)

(moderate or high DVT risk) with high bleeding risk:

- **Mechanical methods**

- for patients with contraindications to pharmacologic prophylaxis (eg, active bleeding, intracranial hemorrhage, bleeding diathesis) patients at high risk of bleeding
- patients in whom the consequences of bleeding are thought to be potentially catastrophic (eg, neurosurgical procedures)
- Switching to or adding a pharmacologic agent, such as LMW heparin, should be done as soon as the bleeding risk becomes acceptably low (eg, 48 to 72 hours following neurosurgery) or the bleeding diathesis has been reversed.

Time for initiation of mechanical and/or pharmacologic thromboprophylaxis in nonorthopedic patients (low bleeding risk)

- just before surgery and that pharmacologic agents should ideally commence within 2 to 12 hours preoperatively, exception – fondaparinux

# Anticoagulants and neuraxial anesthesia

- risk of spinal or epidural hematoma
- risk is increased in those with indwelling epidural catheters, other drugs that impair hemostasis (eg, anti-platelet agents), traumatic or repeated epidural or spinal puncture, or a history of spinal surgery
- Evidence-based guidelines from the *American Society of Regional Anesthesia (ASRA)* **suggest not administering preoperative pharmacologic agents and waiting at least six to eight hours after catheter removal before administering prophylactic anticoagulant.**

# Time

- until the patient becomes fully ambulatory or until hospital discharge (typically up to 10 days)
- patients who have prolonged periods of immobility in between ambulatory periods should receive continued or additional methods of prophylaxis
- **extended** pharmacologic VTE prophylaxis in major abdominal and/or pelvic surgery for cancer, typically with low molecular weight (LMW) heparin, is offered to this population who are at very high risk for VTE **up to 12 weeks post discharge.**

# METHODS NOT RECOMMENDED

- **Screening** — Secondary prevention with screening tests targeted at the early detection of thrombosis (eg, ultrasonography) is not recommended but can be reserved for rare patients in whom primary prophylaxis is not suitable (eg, patients with active minor bleeding);
- **Prophylactic vena cava filters** — Inferior vena cava filters should generally be avoided as prophylaxis against postoperative VTE (reduction in pulmonary embolism but an increase in the rate of lower extremity DVT).

# Prevention of venous thromboembolism in adult orthopedic surgical patients

- the risk of postoperative venous thromboembolism (VTE; deep venous thrombosis and pulmonary embolism) in orthopedic patients is among **the highest** of all surgical specialties
- risk of VTE are derived from populations of patients undergoing **major orthopedic surgeries** (typically hip or knee arthroplasty and hip fracture surgery)

# VTE risk in adult orthopedic surgical patients

- Procedure-related –the extent and duration of surgery, the type of anesthesia, and likelihood for immobilization and casting postoperatively.
- Patient-related:

<b>Inherited thrombophilia</b>
Factor V Leiden mutation
Prothrombin G20210A mutation
Protein S deficiency
Protein C deficiency
Antithrombin deficiency
<b>Other disorders and risk factors</b>
Presence of a central venous catheter
Malignancy
<u>Surgery, especially orthopedic</u>
Trauma
Immobilization
Pregnancy
Oral contraceptives
Hormone replacement therapy
Certain cancer therapies (eg, tamoxifen, thalidomide, lenalidomide, asparaginase)
Heart failure
Congenital heart disease
Antiphospholipid syndrome
Older age ( $\geq 65$ years)
Obesity
Severe liver disease
Myeloproliferative neoplasms
Polycythemia vera
Essential thrombocythemia
Paroxysmal nocturnal hemoglobinuria



# VTE risk in adult orthopedic surgical patients

- **High risk:** Hip and knee arthroplasty, hip fracture surgery, pelvic and multiple fractures
- **Low risk:** Surgery below the knee; upper extremity surgery; arthroscopy

# Assess the risk of bleeding

## Procedural bleeding risk

High bleeding risk procedure (two-day risk of major bleed 2 to 4%)
Any major operation of duration >45 minutes
Abdominal aortic aneurysm repair
Coronary artery bypass
Endoscopically guided fine-needle aspiration
Foot/hand/shoulder surgery
Heart valve replacement
<u>Hip replacement</u>
Kidney biopsy
Knee replacement
Laminectomy
Neurosurgical/urologic/head and neck/abdominal/breast cancer surgery
Polypectomy, variceal treatment, biliary sphincterectomy, pneumatic dilatation
Transurethral prostate resection
Vascular and general surgery

Adapted from research originally published in Blood. Spyropoulos AC, Douketis JD. How I treat anticoagulated patients undergoing an elective procedure or surgery. Blood 2012; 120:2954. Copyright © 2012 the American Society of Hematology.

# Assess the risk of bleeding

## Low bleeding risk procedure (two-day risk of major bleed 0 to 2%)

Abdominal hernia repair

Abdominal hysterectomy

Arthroscopic surgery lasting <45 minutes

Axillary node dissection

Bronchoscopy with or without biopsy

Carpal tunnel repair

Cataract and noncataract eye surgery

Central venous catheter removal

Cholecystectomy

Cutaneous and bladder/prostate/thyroid/breast/lymph node biopsies

Dilatation and curettage

Gastrointestinal endoscopy ± biopsy, enteroscopy, biliary/pancreatic stent without sphincterotomy, endosonography without fine-needle aspiration

Hemorrhoidal surgery

Hydrocele repair

Noncoronary angiography

Pacemaker and cardiac defibrillator insertion and electrophysiologic testing

Thoracentesis

Tooth extractions

# DVT prophylaxis with low bleeding risk

in patients undergoing orthopedic surgery

- **pharmacologic prophylaxis** with or without intermittent pneumatic compression devices rather than no prophylaxis
- as the initial agent of choice in patients with **THA and TKA, low molecular weight heparin or the direct oral anticoagulants** rather than warfarin (rivaroxaban or apixaban (rather than edoxaban or dabigatran)
- **Aspirin should not be used as a standalone agent for initial VTE prophylaxis** but may be part of a hybrid strategy that follows a short course of anticoagulation in select low risk populations.

# DVT prophylaxis with high bleeding risk

in patients undergoing orthopedic surgery

- intermittent pneumatic compression is typically preferred
- mechanical devices reduce the risk of asymptomatic DVT by >50 percent, mechanical devices can be applied to the contralateral leg to prevent DVT in the non-operated leg
- mechanical methods are typically less effective than LMW heparin or warfarin but have a lower bleeding risk
- switching to or adding a pharmacologic agent - as soon as hemostasis is assessed as adequate, bleeding risk becomes acceptably low, and/or the bleeding diathesis has been reversed

# Administration

- **Timing of initiation**

- ✓ Low molecular weight and unfractionated heparin should not be administered close to surgery
- ✓ 12 hours or more preoperatively and/or 12 hours or more postoperatively (bleeding risk)
- ✓ Mechanical methods – just prior to the start of surgery and used continuously postoperatively until hospital discharge or ambulation
- ✓ Oral agents – postoperatively 8 to 12 hours or more after surgery

# Time

- In patients with THA, TKA, or HFS, - pharmacologic prophylaxis for a minimum of 10 to 14 days and we suggest that it be continued for up to 35 days after surgery;
- in those undergoing TKA with longer courses (eg, 30 days);
- pharmacologic prophylaxis may be discontinued when patients become fully ambulatory or are discharged to home, provided a 10 to 14 day course has already been administered.

# KNEE ARTHROSCOPY

- thromboprophylaxis is controversial
- data do not support routine anticoagulant prophylaxis with low molecular weight

Best supporting this practice is one randomized trial of 1543 patients (POT-KAST) undergoing arthroscopy, which reported the rate of VTE was unchanged among those treated with LMW heparin (for eight days) compared with those not receiving prophylactic anticoagulation (0.7 versus 0.4 percent)



Agents that have been shown to have efficacy in the setting of extended prophylaxis include:

- **LMW heparin**
- **Direct oral anticoagulants** — Major randomized trials of rivaroxaban (RECORD2), dabigatran (RENOVATE), and apixaban all reported reductions in the rates of a composite endpoint of total VTE and all-cause mortality without an increase in the risk of major bleeding in patients with THA who received extended thromboprophylaxis for 35 days when compared with conventional 10 to 14 days of prophylaxis
- **Warfarin** — One randomized trial of 1279 patients who had undergone THA showed that compared to LMW heparin, six weeks of therapeutic warfarin resulted in a similar rate of VTE (2 versus 3 percent) but at the expense of a higher bleeding rate (6 versus 1 percent)

# Thromboembolic risk

## Perioperative thrombotic risk

Risk stratum	Indication for anticoagulant therapy		
	Mechanical heart valve	Atrial fibrillation	VTE
Very high thrombotic risk*	Any mitral valve prosthesis Any caged-ball or tilting disc aortic valve prosthesis Recent (within six months) stroke or transient ischemic attack	CHA <sub>2</sub> DS <sub>2</sub> -VASc score of ≥6 (or CHADS <sub>2</sub> score of 5-6) Recent (within three months) stroke or transient ischemic attack Rheumatic valvular heart disease	Recent (within three months) VTE Severe thrombophilia (eg, deficiency of protein C, protein S, or antithrombin; antiphospholipid antibodies; multiple abnormalities)
High thrombotic risk	Bileaflet aortic valve prosthesis and one or more of the following risk factors: atrial fibrillation, prior stroke or transient ischemic attack, hypertension, diabetes, congestive heart failure, age >75 years	CHA <sub>2</sub> DS <sub>2</sub> -VASc score of 4-5 or CHADS <sub>2</sub> score of 3-4	VTE within the past 3 to 12 months Nonsevere thrombophilia (eg, heterozygous factor V Leiden or prothrombin gene mutation) Recurrent VTE Active cancer (treated within six months or palliative)
Moderate thrombotic risk	Bileaflet aortic valve prosthesis without atrial fibrillation and no other risk factors for stroke	CHA <sub>2</sub> DS <sub>2</sub> -VASc score of 2-3 or CHADS <sub>2</sub> score of 0-2 (assuming no prior stroke or transient ischemic attack)	VTE >12 months previous and no other risk factors

Bleeding risk

Refer to UpToDate topics on perioperative anticoagulation management for details.

VTE: venous thromboembolism; CHADS<sub>2</sub>: congestive heart failure, hypertension, age ≥75 years, diabetes mellitus, and stroke or transient ischemic attack; CHA<sub>2</sub>DS<sub>2</sub>-VASc: congestive heart failure, hypertension, age ≥75 years (2 points), diabetes mellitus, prior stroke or transient ischemic attack or thromboembolism (2 points), vascular disease (peripheral artery disease, myocardial infarction, or aortic plaque), age 65-74 years, sex category female.

\* Very high-risk patients may also include those with a prior stroke or transient ischemic attack occurring >3 months before the planned surgery and a CHA<sub>2</sub>DS<sub>2</sub>-VASc score <6 (or CHADS<sub>2</sub> score <5), those with prior thromboembolism during temporary interruption of anticoagulation, or those undergoing certain types of surgery associated with an increased risk for stroke or other thromboembolism (eg, cardiac valve replacement, carotid endarterectomy, major vascular surgery).

Modified from Douketis JD, Spyropoulos AC, Spencer FA, et al. Perioperative management of antithrombotic therapy: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest 2012; 141(2 Suppl):e326S. Copyright © 2012. Reproduced with permission from the American College of Chest Physicians.

# Timing of interruption – Perioperative management of oral direct thrombin inhibitors and factor Xa inhibitors

Anticoagulant	Renal function and dose	Interval between last dose and procedure NOTE: No anticoagulant is administered the day of the procedure		Resumption after procedure	
		High bleeding risk	Low bleeding risk	High bleeding risk	Low bleeding risk
Dabigatran	CrCl > 50 mL/minute Dose 150 mg twice daily	Give last dose three days before procedure (ie, skip four doses on the two days before the procedure)	Give last dose two days before procedure (ie, skip two doses on the day before the procedure)	Resume 48 to 72 hours after surgery (ie, postoperative day 2 to 3)	Resume 24 hours after surgery (ie, postoperative day 1)
	CrCl 30 to 50 mL/minute Dose 150 mg twice daily	Give last dose five days before procedure (ie, skip eight doses on the four days before the procedure)	Give last dose three days before procedure (ie, skip four doses on the two days before the procedure)		
Rivaroxaban	CrCl > 50 mL/minute Dose 20 mg once daily	Give last dose three days before procedure (ie, skip two doses on the two days before the procedure)	Give last dose two days before procedure (ie, skip one dose on the day before the procedure)		
	CrCl 30 to 50 mL/minute Dose 15 mg once daily				
Apixaban	CrCl > 50 mL/minute Dose 5 mg twice daily	Give last dose three days before procedure (ie, skip four doses on the two days before the procedure)	Give last dose two days before procedure (ie, skip two doses on the day before the procedure)		
	CrCl ≤ 50 mL/minute Dose 2.5 mg twice daily				
Edoxaban	CrCl 51 to 95 mL/minute Dose 60 mg once daily	Give the last dose three days before the procedure (ie, skip two doses on the two days before the procedure)	Give the last dose two days before the procedure (ie, skip one dose on the day before the procedure)		
	CrCl ≤ 50 mL/minute* Dose 30 mg once daily				

Bleeding risk is determined primarily by the type of surgery; patient comorbidities may also play a role. In patients undergoing neuraxial anesthesia or a very high bleeding risk procedure, a longer period of interruption may be warranted. In many low bleeding risk procedures, the anticoagulant does not need to be interrupted. Bridging anticoagulation may be appropriate preoperatively in patients with a very high thromboembolic risk who require more prolonged interruption of the anticoagulant (eg, for renal insufficiency) and/or postoperatively in patients who are unable to resume the anticoagulant (eg, unable to take oral medication due to intestinal ileus). Refer to the UpToDate topics on perioperative management of patients receiving anticoagulants for further details.

CrCl: creatinine clearance.

\* Product information varies in different countries regarding a lower limit of CrCl below which the drug should not be used. As an example, product information in the United States specifies avoiding use with CrCl < 15 mL/minute.

# Bridging anticoagulation

- Involves the **administration of a short-acting anticoagulant**, typically a low molecular weight (LMW) heparin, **during the interruption of a longer-acting agent**, typically warfarin. The intent is to minimize the risk of perioperative thromboembolism.
- Bridging usually is not required for individuals receiving a direct thrombin inhibitor or factor Xa inhibitor, because these agents have shorter half-lives.

# Agent

LMW heparin for most patients, exception is an individual with renal insufficiency and/or hemodialysis requirement, for whom intravenous or subcutaneous unfractionated heparin can be used more easily

# Timing

- Bridging can be used preoperatively, postoperatively, or both, depending on the underlying condition for which the patient is being anticoagulated.
- Importantly, resumption of bridging anticoagulation too early is associated with an increased risk for major bleeding.

## Recommendations for preoperative and postoperative anticoagulation in patients on a vitamin K antagonist

Indication	Before surgery	After surgery
<b>Venous thromboembolism</b>		
Within first month	IV heparin or SQ LMWH	IV heparin or SQ LMWH
Second/third month	No change*	IV heparin or SQ LMWH
≥3 months	No change*	SQ heparin or LMWH
<b>Arterial thromboembolism</b>		
Recent, within one month	IV heparin or SQ LMWH	IV heparin or SQ LMWH
Prophylaxis (eg, non-valvular AF, mechanical heart valve)	No change*	Resume oral anticoagulation †

NOTE: Warfarin should be withheld to allow the INR to fall spontaneously to 1.5 to 2 before surgery is performed.

IV: intravenous; SQ: subcutaneous; LMWH: low molecular weight heparin; AF: atrial fibrillation; INR: international normalized ratio.

\* If the patient is hospitalized, SQ heparin or LMWH should be administered, but hospitalization is not recommended solely for this purpose.

† Can use SQ heparin or SQ LMWH if the surgery carries a high risk of postoperative thromboembolism.

## Possible contraindications to anticoagulation

Possible contraindication	Factors to consider
Active, clinically significant bleeding	Site and degree of bleeding (eg, nosebleeds and menses generally are not a contraindication; active intracerebral bleeding is almost always an absolute contraindication); interval since bleeding stopped
Severe bleeding diathesis	Nature, severity, and reversibility of bleeding diathesis
Severe thrombocytopenia (platelet count <50,000/microL)	Absolute platelet count, platelet count trend, and platelet function (eg, some individuals with ITP and a platelet count in the range of 30,000 to 50,000 may tolerate anticoagulation if needed)
Major trauma	Site and extent of trauma, time interval since event (eg, for a patient with a mechanical heart valve it may be appropriate to anticoagulate sooner after trauma than a patient with a lesser indication)
Invasive procedure or obstetric delivery (recent, emergency, or planned)	Type of procedure and associated bleeding risk, interval between procedure and anticoagulation
Previous intracranial hemorrhage	Time interval since hemorrhage and underlying cause (eg, trauma or uncontrolled hypertension)
Intracranial or spinal tumor	Site and type of tumor, other comorbidities
Neuraxial anesthesia	Interval since spinal/epidural puncture or catheter removal, other alternatives for anesthesia. Traumatic procedures are more concerning.
Severe, uncontrolled hypertension	Absolute blood pressure and blood pressure trend

This list does not take the place of clinical judgment in deciding whether or not to administer an anticoagulant. In any patient, the risk of bleeding from an anticoagulant must be weighed against the risk of thrombosis and its consequences. The greater the thromboembolic risk, the greater the tolerance for the possibility of bleeding and for shortening the time interval between an episode of bleeding and anticoagulant initiation. Refer to UpToDate topics on the specific indication for the anticoagulant and the specific possible contraindication for discussions of these risks.

ITP: immune thrombocytopenia.



# Urgent/Emergency procedure

- Reversal of the patient's usual anticoagulant may be required for more urgent or emergency procedures, or to treat perioperative bleeding.
- Agents with a potential prothrombotic effect (eg, immediate reversal agents, prothrombin complex concentrates, plasma products) should be reserved for the treatment of life-threatening, severe bleeding or anticipated severe bleeding (eg, intracranial hemorrhage, emergency major surgery with elevated prothrombin time/international normalized ratio [PT/INR]).