Deep Venous Thrombosis Prophylaxis in the Surgical Patient

Diana Boleac

Deep vein thrombosis (DVT)

- Is the formation or presence of a thrombus in the deep veins.
- Occurs mostly in the lower extremities and to a lesser extent in the upper extremities.
- Pulmonary embolism (PE) is an obstruction of the pulmonary artery or its branches by a thrombus (sometimes due to fat or air). 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.

DVT

- 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
- The cumulative ten-year incidence of recurrent VTE reaches 39.9% (35.4% to 44.4%)

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^2	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.

From: Gould MK, Garcia DA, Wren SM, et al. Prevention of VTE in nonorthopedic surgical patients: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical practical guidelines. Chest 2012; 141:e227S.

Using the Caprini score, patients undergoing surgical procedures are classified according to their **estimated baseline risk** (EBR) for venous tromboembolism 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
✓ patients undergoing general surgery ✓ abdominal-pelvic surgery ✓ bariatric surgery ✓ vascular surgery ✓ thoracic surgery that is uncomplicated, tend to have lower rates of bleeding (<2 percent) when compared with other patients	✓ patients undergoing cardiac surgery and patients with major trauma, especially involving the brain and spine, are at highest risk of bleeding (>3 percent) ✓ 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 ✓ patients undergoing plastic/reconstructive surgery where thromboprophylaxis may result in failed reconstruction

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/microL, or < 100,000/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% (Examples include healthy young patients undergoing minor outpatient procedure (eg, cataract removal, skin biopsy, benign breast biopsy, diagnostic endoscopy, nasal polyp removal, dilatation and curettage, colposcopy, fluid removal from joint effusion).
- 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%
  (Examples: undergoing minor elective abdominal-pelvic surgery (eg, appendectomy, laparoscopic cholecystectomy) or minor thoracic surgery (eg, diagnostic thoracoscopy, video-assisted biopsy, minor vascular procedures (eg, vein ablation), and 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).

Although IPC devices may be superior and are preferred by the ACCP, experts generally choose IPC or GCS since the data comparing one device over the other is fundamentally flawed

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

- GCS alone are effective at preventing DVT but may be less effective than pharmacologic agents.
- GCS combined with other prophylactic methods appears to improve rates of DVT prevention.
- In general, GCS 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

- patients undergoing general or abdomen/pelvic surgery with a Caprini score of 3 to 4
- patients undergoing plastic/reconstructive surgery with a Caprini score of 5 to 6
- patients undergoing major gynecologic and urologic surgery usually fall into the moderate risk category
- 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

- patients undergoing general or abdominal/pelvic surgery with a Caprini score of 5 or more
- patients undergoing 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.**

Duration

- 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. The optimal duration of extended prophylaxis is unknown but is typically recommended beyond 10 days and for a period of three to four weeks for high-risk patients who undergo major abdominal and/or pelvic surgery for cancer.

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 (a reduction in pulmonary embolism but an increase in the rate of lower extremity deep venous thrombosis (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)

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

- Patient-related:

Inherited thrombophilia
Factor V Leiden mutation
Prothrombin G20210A mutation
Protein S deficiency
Protein C deficiency
Antithrombin deficiency
Other disorders and risk factors
Presence of a central venous catheter
Malignancy
Surgery, especially orthopedic
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 (≥65 years)
Obesity
Severe liver disease
Myeloproliferative neoplasms
Polycythemia vera
Essential thrombocythemia
Paroxysmal nocturnal hemoglobinuria

VTE risk

- **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
Hip replacement
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

Low bleeding risk

- 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)
- for those with severe renal insufficiency (eg, creatinine clearance <20 to 30 mL/min), unfractionated heparin
- 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.
- a similar strategy in patients who have a hip fracture in whom surgery is delayed or not feasible (eg, for a medical reason)

High bleeding risk:

- 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
- however, mechanical methods are typically less effective than LMW heparin or warfarin but have a lower bleeding risk
- switching to or adding a pharmacologic agent, such as LMW heparin, should be done 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 (eg, within four hours preoperatively and within four hours postoperatively).

✓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

Duration

- 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.

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)
- Aspirin ?

THA, TKA, or HFS

- with contraindications to pharmacologic prophylaxis or patients at high risk of bleeding (eg, severe trauma, coagulopathy), we prefer mechanical methods rather than no prophylaxis.
- in whom LMW heparin is indicated, we prefer administration at least 12 hours or more preoperatively and/or 12 hours or more postoperatively.
- pharmacologic prophylaxis is administered for a minimum of 10 to 14 days
- THA, we suggest that pharmacologic prophylaxis is continued for up to 35 days after surgery
- TKA, shorter courses at the 10 to 14 day end of the spectrum may be preferred.
- For low risk patients receiving prophylaxis with rivaroxaban, we suggest a hybrid strategy that involves switching to daily aspirin (81 mg) at day 5 (Grade 2B) and continuing aspirin for the remaining duration of prophylaxis.

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)

Interruption of anticoagulation

- temporarily increases thromboembolic risk, and continuing anticoagulation increases the risk of bleeding associated with invasive procedures;
- both of these outcomes adversely affect mortality;

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_2DS_2-VASc score of ≥6 ($CHADS_2$ 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 of following risk factors: atrial fibrillation, prior stroke or transient ischemic attack, hypertension, diabetes, congestive heart failure, age >75 years	CHA_2DS_2-VASc score of 4-5 or $CHADS_2$ 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_2DS_2-VASc score of 2-3 or $CHADS_2$ 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; $CHADS_2$: congestive heart failure, hypertension, age ≥75 years, diabetes mellitus, and stroke or transient ischemic attack; CHA_2DS_2-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_2DS_2-VASc score <6 (or $CHADS_2$ 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 interruptio 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

Bridging

- Use - for selected patients on warfarin (eg, mechanical mitral valve; stroke, systemic embolism, or transient ischemic attack within the previous 12 weeks; mechanical aortic valve and additional stroke risk factors; atrial fibrillation and very high risk of stroke [eg, CHADS2 score of 5 or 6]; venous thromboembolism within the previous 12 weeks; recent coronary stenting; previous thromboembolism during interruption of chronic anticoagulation)
- Avoid – for most other patients on warfarin with atrial fibrillation or VTE – the lower the baseline thromboembolic risk and the higher the bleeding risk.

Agent

- LMW heparin for most patients. An exception is an individual with renal insufficiency and/or hemodialysis requirement, for whom intravenous or subcutaneous unfractionated heparin can be used more easily.
- do not use dabigatran, rivaroxaban, apixaban, or edoxaban for bridging.

Timing

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

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]).

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

Indication	Before surgery	After surgery
Venous thromboembolism		
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 LWMH
Arterial thromboembolism		
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.