Perioperative Anticoagulation Guideline

Management of anticoagulation before and after invasive procedures requires careful, patient-specific evaluation of the risk of bleeding weighed against the patient's risk of thromboembolism. The patient's underlying disease process determines the thromboembolic risk. This patient specific risk determines the need for bridging anticoagulation therapy. Coordination between primary care, anticoagulation clinic, surgeon, anesthesiologist and when indicated, a specialist, is recommended. Based on American College of Chest Physicians 2008 Practice Guidelines and updated 2012 Clinical Practice Guidelines, extensive literature review and examination of clinical practice guidelines, we suggest a 4 step process as outlined below. Steps 1-3 are preoperative. Step 4 is postoperative.

Step 1: **Determine if anticoagulation can be continued without interruption**

Consider bleeding risk of the procedure. For low bleeding risk procedures warfarin can be continued without interruption.

Procedures that can be performed on anticoagulants*

Ophthalmic	Dental	Dermatologic	Gastrointestinal
Cataract surgery Trabeculectomy	Restorations Uncomplicated extractions Endodontics Prosthetics Periodontal therapy Dental hygiene	Mohs surgery Simple excisions	Diagnostic esophagogastroduodenoscopy Colonoscopy without biopsy Diagnostic endoscopic retrograde cholangiopancreatography Biliary stent without sphincterotomy Endoscopic ultrasonography without biopsy Push enteroscopy

Jaffer AK, Perioperative Management of Warfarin and Antiplatelet Therapy, Cleveland Clinic Journal of Medicine, Vol 76, Suppl 4, Nov 2009.

*refer to Appendix A for more extensive list

Step 2: Determine thromboembolic risk and need for bridging therapy

	HIGH Thrombotic Risk: Bridging Required	**LOW Thrombotic Risk: Bridging *Not* Required**
Mechanical Heart Valves	▪ All mitral valve prosthesis ▪ Older mechanical aortic valve prosthesis (caged ball/tilting disk) ▪ Recent (< 6 months)stroke/TIA ▪ Bi-leaflet aortic valve prosthesis ***with*** ≥ 1 stroke risk factors[1] (see below) ▪Two or more mechanical valves	▪ Bi-leaflet aortic valve prosthesis ***without*** stroke risk factors[1] (see below)
Atrial Fibrillation (A fib)	▪ CHADS2* Score 4-6 ▪ Prior stroke or TIA ▪ Rheumatic mitral valvular heart disease ▪ Cardiac thrombus	▪ CHADS2 Score 0-3 with ***no prior*** stroke/TIA
Venous Thromboembolism (VTE)	▪ Recent VTE (within 6 months)[2,3] ▪ Prior VTE and ≥ 1 other risk factor[4] ▪ Recurrent VTE[5]	▪ Single unprovoked VTE > 6 months ago ***and*** no other risk factors[4]

1. Stroke Risk Factors: A fib, congestive heart failure, hypertension, age ≥ 75 years, diabetes, and history of stroke or TIA.
   *(These are the risk factors used for a-fib and CHAD2 stroke risk assessment: 1 point for congestive heart failure, hypertension, age ≥ 75 years, diabetes, 2 points for previous stroke or TIA)
2. Elective procedures should be postponed in patient with VTE < 3 months.
3. Patients with a single provoked VTE should not be on warfarin > 6 months.
4. VTE Risk Factors: Protein C or S deficiency, antithrombin III, antiphospholipid antibody syndrome, homozygous factor V Leiden mutation or active cancer (treated within the last 6 months or palliative care).
5. Patients with recurrent VTE > 12 months ago with no other risk factors may not need bridging with therapeutic dose of enoxaparin routinely; may consider prophylactic dose if necessary.

Step 3: Preoperative management of bridging and warfarin:

Bridging	Check INR 7 days prior to surgery Last dose of warfarin **6** days prior to procedure (for INR 2-3, if INR 3-4.5, last dose warfarin 7 days prior) If CrCl>30, initiate enoxaparin* 1 mg/kg SQ 36 hrs after last warfarin dose and continue q12 hrs or 1.5mg/kg q 24hrs If CrCl<30, initiate enoxaparin* 1 m/kg SQ 36 hrs after last warfarin dose and continue q24hr. Last dose SQ LMWH 1mg/kg 24 hours prior to procedure Check INR in the morning on the day of surgery
No Bridging	Last dose of warfarin 6 days prior to procedure for INR<3 (INR 3-4.5: Last dose of warfarin 7 days prior to procedure) Check INR the morning of the procedure

*See table “Drugs for Bridging” for alternatives.

Drugs for Bridging

Drug	Therapeutic Dose	Prophylaxis Dose	Pre-Surgery Regimen
Dalteparin (Fragmin)	200 units/kg SQ daily	5000 units SQ daily	d/c 24hr prior to surgery
Dalteparin for **Obese Patients**	100 units/kg SQ BID **when >99kg**	7500 units SQ daily **when >150kg**	d/c 24hr prior to surgery
Dalteparin for **Renally Impaired**	Monitor anti-Xa levels 4-6 hr post dose to target range of 0.5-1.5 IU/ml **when CrCl < 30 ml/min**	5000 units SQ daily	d/c 24hr prior to surgery
Enoxaparin (Lovenox)	1 mg/kg SQ BID or 1.5mg/kg SQ daily	30 mg SQ BID	d/c 24hr prior to surgery
Enoxaparin for **Renally Impaired**	1mg/kg SQ daily **when CrCl < 30 ml/min**	30mg SQ daily **when CrCl < 30 ml/min**	d/c 24hr prior to surgery
UFH	250 IU/kg SQ BID	5000 IU SQ BID	d/c 4hr prior/ surgery
Fondaparinux (Arixtra)	• 5mg SQ daily when < 50kg. • 7.5mg SQ daily when 50-100kg. • 10mg SQ daily when >100kg.	2.5mg SQ daily	d/c 36-48hr prior to surgery
Fondaparinux for **Renally Impaired**	Contraindicated when CrCl < 30 ml/min	Contraindicated when CrCl < 30 ml/min	

Post Operative Anticoagulation Algorithm

Step 4: Resume Anticoagulation
See appendix A for extensive list of procedures

	Low Bleeding Risk Procedure	**Moderate Bleeding Risk Procedure**	**High Bleeding Risk Procedure**
	Dental extraction Skin Biopsy/Mohs Cataracts Colonoscopy, no biopsy	Endoscopy with biopsy CT or US guided biopsy Most surgical procedures (i.e. cholecystectomy, orthopedic, low risk urological).	Neurosurgery (intracranial, spinal cord) High risk urological Other closed space procedures (post chamber eye)
Low risk of thrombosis Bileaflet Aortic Valve, no risk factors* Atrial fibrillation with CHADS2** ≤ 3 and no prior stroke VTE > 6 months, no risk factors***	Continue full dose anticoagulation	Resume warfarin 12-24 hours post procedure at usual dose (No bridging therapy) once hemostasis achieved	Resume warfarin 3-7 days post procedure at usual dose (No bridging therapy)
Elevated risk thrombosis Mechanical mitral valve Older mechanical aortic valve Atrial fibrillation with CHADS2** 4-6 or prior stroke or TIA Bileaflet aortic valve, with risk factors* Recent VTE <6 months VTE>6 months and risk factors***	Continue full dose anticoagulation	Resume full dose LMWH 24 hours post procedure (Can consider prophylactic dose LMWH for 1-3 days before initiating full dose) Resume warfarin 12-24 hours post procedure at usual dose Stop LMWH when INR ≥ 2	Consider starting prophylactic dose LMWH post-op when hemostasis achieved and increase to full dose at surgeon's discretion (goal 48-72hrs postop) Resume Warfarin at usual dose once hemostasis achieved If utilized, stop LMWH when INR ≥ 2

* Risk Factors: A fib, congestive heart failure, hypertension, age ≥ 75 years, diabetes, and history of stroke or TIA.
**CHADS2 score 1 point for risk factors, congestive heart failure, hypertension, age ≥ 75 years, diabetes, 2 points for stroke or TIA
***VTE risk factors: Protein C or S deficiency, antithrombin III, antiphospholipid antibody syndrome, homozygous factor V Leiden mutation or active cancer (treated within the last 6 months or palliative care).

Appendix A:
Bleeding Risk Associated with Different Procedure Types

	Moderate/High Moderate Bleeding Risk unless noted as (**HIGH**) (usually considered as ≥2.0% risk of major bleed or in vulnerable area)	**Low** (usually considered as < 2.0% risk of major bleed)
Anesthesiology	▪ Neuraxial anesthesia (spinal and epidural, facet, stellate ganglion and selective nerve root blocks)[5] (**HIGH**)	▪ Peripheral nerve blocks[1,2] ▪ Pump refills[1,2] ▪ Endotracheal intubation[5]
Cardiac surgery	▪ Coronary bypass surgery[1,2,4,5] (**HIGH**) ▪ Valve replacement surgery[1,2,4,5](**HIGH**)	
Cardiology - General	▪ Cardiac catheterization[1,2] ▪ Electrophysiology studies[5](**HIGH**) ▪ Coronary interventions[5] (**HIGH**)	
Cardiology - EP	▪ Pacemaker implantation(**HIGH**) ▪ Pacemaker adjustment/battery replacement ▪ AICD implantation(**HIGH**)	
Dentistry	▪ Extensive reconstructive procedures	▪ Simple dental extractions[4] ▪ Tooth extractions[5] ▪ Multiple tooth extractions[4] ▪ Endodontic procedures (root canal)[5]
Dermatology		▪ All dermatologic procedures are considered low risk including Mohs surgery and simple excisions[1,2]
Endocrinology		▪ Thyroid aspiration or biopsy[4,7]
ENT	▪ All head and neck surgeries[4](**HIGH**) ▪ Any sinus surgery[5] ▪ Thyroidectomy[5] ▪ Parathyroidectomy[5] ▪ Nasal polyp biopsy[5]	▪ Diagnostic sinus, laryngeal or nasopharyngeal fiberoptic exam[5] ▪ FNA[5] ▪ Vocal cord injection[5] ▪ Excision of benign and malignant lesions of the face, scalp and neck
Gastroenterology	▪ EGD with variceal procedures[1] (**HIGH**) ▪ Colonoscopy with polypectomy[1] ▪ Large polypectomy (>1 cm) (**HIGH**) ▪ ERCP with sphincterotomy[1] ▪ Laser ablation[1]	▪ Flex sigmoidoscopy[2,6] ▪ EGD with or without biopsy[4,6] ▪ Colonoscopy without biopsy[5,6] ▪ Biliary/pancreatic stent placement4 ▪ EUS without biopsy[4]

Gastroenterology (continued)	▪ Pneumatic or bougie dilation[1,4,6] ▪ Percutaneous endoscopic gastrostomy (PEG)[1,4,5,6] ▪ Procedures with biopsies[2,4] ▪ Polypectomy[2,4,6] ▪ Variceal procedures[4,6] ▪ Variceal banding (controversial)[5] ▪ EUS with FNA or needle biopsy[5,6] ▪ Liver biopsy[5] (**HIGH**) ▪ Therapeutic balloon-assisted enteroscopy[6] ▪ Endoscopic hemostasis[6]	▪ ERCP without sphincterotomy[5,6] ▪ Non-thermal snare removal of small (< 6 mm) polyp[5] ▪ Self-expanding luminal stents without dilatation (controversial)[5,6] ▪ Paracentesis[5,7] ▪ Capsule endoscopy[6]
General surgery	▪ Major thoracic, abdominal or pelvic surgery (**HIGH**) ▪ Other internal procedures (e.g., hernia repair, cholecystectomy)	
Gynecology	▪ Laparoscopic surgery ▪ BTL ▪ hysterectomy	▪ Vulvar biopsy[1] ▪ Laser of vulva, vagina[1] ▪ Leep of cervix1 ▪ D and C[1,4,5] ▪ Hysteroscopy, diagnostic[1] ▪ Colposcopy, diagnostic[5] ▪ IUD placement[5] ▪ Ablation- HTA or thermachoice only (not resectoscopic)[1]
Nephrology	▪ Kidney biopsy[1,2,4] (**HIGH**)	
Neurology	▪ Lumbar puncture[5]	▪ Needle electromyograph
Neurosurgery	▪ Any intracranial and spine surgeries[1,2,4,5] (**HIGH**) ▪ Laminectomy[4] (**HIGH**)	
Ophthalmology	(all posterior chamber of the eye surgeries are **HIGH**) ▪ Trabeculectomy with/without cataract extraction[1] ▪ Trabectome Surgery[1] ▪ Bleb revision[1] ▪ Glaucoma Tube Shunt Implants[1] ▪ Ahmed Implant[1] ▪ Baerveldt Implant[1] ▪ All Oculoplastic/Reconstructive[1] ▪ Blepharoplasty[1]	▪ Cataract extraction with IOL implantation[1] ▪ Endocyclophotocoagulation[1] ▪ Glaucoma laser / other lasers[1] ▪ Refractive Laser Surgeries[1] ▪ LASIK, PRK[1] ▪ Corneal Surgeries[1] ▪ Cornea Transplant[1] ▪ DSEK, DLEK[1] ▪ Cataract and non-cataract surgery[4] ▪ Cataract surgery[5]

Ophthalmology (continued)	▪ Entropion/Ectropion Repair[1] ▪ All Orbital Surgery[1] ▪ Dacryocystorhinostomy (DCR) [1] ▪ Periorbital surgery[5] ▪ Vitreoretinal surgery[5]	▪ Intraocular injections[5]
Orthopedics	▪ Total joint replacement surgeries – hip, knee, or shoulder[1,2] (**HIGH**) ▪ Fracture repair in femur, humerus or pelvis[1,2] ▪ Athroscopy[5] ▪ Shoulder, foot or hand surgery[4] ▪ Arthroscopic surgery[4] ▪ Carpal tunnel repair[4]	▪ Joint, bursa, and tendon sheath aspirations and injections[1] ▪ Athrocentesis[5]
Plastic Surgery	▪ Major reconstructive plastic surgeries[1]	▪ Some small office procedures
Podiatry	▪ Surgical osteotomies[1] ▪ Open reduction/internal fixation foot and ankle fractures/dislocations[1] ▪ Soft tissue/mass excision[1] ▪ Arthrodesis of the toes/foot/ankle[1] ▪ Arthroscopy-foot/ankle[1] ▪ Removal foreign body (deep) [1] ▪ Tendon repair[1] ▪ Neuroma/neurectomy[1] ▪ Closed reduction – in case need to[1] convert to an open reduction; hence patients will need to be off warfarin ▪ Biopsies-skin (deep), fascia, muscle bone[1]	Office procedures are low risk including: ▪ Nail procedures[1,2] ▪ Wart removal[1,2] ▪ Foreign body (superficial)[1,2] ▪ Skin biopsy (superficial)[1,2] ▪ Removal external fixation[1]
Pulmonology	▪ Chest tube placement [5] ▪ Transbronchial biopsy [5] ▪ Stricture dilation [5] ▪ Thorocentesis[5,7] ▪ Endobronchial FNA [5] ▪ Airway stent placement [5] ▪ Bronchoscopy with or without biopsy[4,5]	▪ Central venous line removal[4]
Radiology	▪ Epidural steroid injection[1,2] ▪ Disc procedures[1,2] ▪ Liver/kidney biopsy[5,7](**HIGH**) ▪ TIPS[5,7] ▪ Percutaneous nephrostomy[5,7] ▪ Percutaneous transhepatic cholangiography[5]	▪ Trigger Point Injection[1,2] ▪ Peripheral injections[1,2] ▪ Sacroiliac joint injection[1,2] ▪ Pump refills[1,2] ▪ Joint, bursa or tendon sheath aspirations/injections[2] ▪ Simple catheter exchange in non-

Radiology (continued)	▪ Aggressive manipulation of percutaneous drains[7] ▪ Aspiration abdominal or pelvic abscess [5] ▪ Dilation of percutaneous tracts[5] ▪ Biliary interventions (new tract)[7] ▪ Radiofrequency ablation (complex) [7] ▪ Angiography up to 7F [7] ▪ Venous interventions [7] ▪ PEG [7] ▪ Chemoembolism [7] ▪ Transjugular liver biopsy [7](**HIGH**) ▪ Tunneled central venous catheter [7] ▪ Subcutaneous port placement [7] ▪ Intra abdominal, chest wall or retroperitoneal drainage or biopsy [7] ▪ Lung biopsy [7] ▪ Percutaneous liver biopsy [7](**HIGH**) ▪ Percutaneous cholecystostomy [7] ▪ Spine procedures (vertebroplasty, kyphoplasty, lumber puncture, epidural injection, facet block – moderate but high in all other guidelines)[7] ▪ Renal cryoablation ▪ Vertebral/spine bone biopsy	vascular tract (PEG tube, nephrostomy tube)[5,7] ▪ PICC[5,7] ▪ IVC filter[5,7] ▪ Temporary dialysis catheter placment[5] ▪ Dialysis catheter interventions[7] ▪ Venography[7] ▪ Superficial chest wall or abdominal wall biopsy or drainage procedure ▪ Central line removal[7] ▪ Thoracentesis, paracentesis[7] ▪ Superficial aspiration or biopsy (thyroid, lymph nodes)[7] ▪ Superficial abscess drainage[7]
Urology	▪ Transurethral resection of the prostate[1,2,5](**HIGH**) ▪ Transurethral resection of the bladder for tumor[1,4](**HIGH**) ▪ Kidney, prostate or bladder biopsy[1,2] (**HIGH**) ▪ Partial nephrectomy[1] (**HIGH**) ▪ Ureteroscopy[1] ▪ Lithotripsy[5] ▪ Hydrocele repair[4]	▪ Cystoscopy with or without biopsy ▪ Circumcision
Vascular Surgery	▪ Aortic aneurysm repair[1,2,4,5](**HIGH**) ▪ Peripheral bypass surgery[1,2,4,5](**HIGH**) ▪ Carotid endarterectomy[5](**HIGH**) ▪ Angiogram with or without intervention	

1. Kaiser Permanente Northern California guidelines 2. Kaiser Permanente Northwest current guideline 3. Birnie D.H., Healey J.S., Wells G.A., et al. N Engl J Med 2013; 368:2084-2093. Finding: "Clinically significant device-pocket hematoma occurred in 12 of 343 patients (3.5%) in the continued-warfarin group, as compared with 54 of 338 (16.0%) in the heparin- group." 4. UptoDate. Accessed May 30, 2013. Based on individual subspecialty society recommendations. 5. Management of Antithrombotic Therapy in Patients Undergoing Invasive Procedures. Todd H. Baron, M.D., Patrick S. Kamath, M.D., and Robert D. McBane, M.D. N Engl J Med 2013; 368:2113-2124. 6. Management of antithrombotic agents for endoscopic procedures. ASGE Standards of Practice Guidelines. Gastro Endo 2009; 70:1060-1070. 7. Consensus Guidelines for Periprocedural Management of Coagulation Status and Hemostasis in Percutaneous Inage-Guided Interventions. Patrick C. Malloy, Clement J. Grassi, Sanjoy Kundu et al. J Vasc Interv Radiol 2009; 20:S240-S249.