ANTICOAGULATION

In patients who receive chronic anticoagulation, we must weigh the risks of cessation of anticoagulation against the surgical bleeding risk of maintaining anticoagulation. We must also assess the risk of delaying surgery versus the benefit of extending preoperative anticoagulation. All cases need to be individualized using the patient's own risks and benefits.

Recommendations by indication for anticoagulation, for major noncardiac surgery:

Indication	**Usual anti-thrombotic therapy**	**Preoperative management***	**Postoperative management**
Mechanical Prosthetic Heart Valves			
Mechanical bileaflet aortic valve without other risk factors	Warfarin adjusted to INR 2.0-3.0	Withhold warfarin 48-72 hours prior to procedure to allow INR to fall to < 1.5.	Prophylactic dose heparin. Restart warfarin when surgically acceptable.
Mechanical mitral valve	Warfarin adjusted to INR 2.5-3.5	Withhold 4 doses of warfarin. IV heparin when INR falls below 2.0.** Stop IV heparin 4-6h prior to procedure.	IV heparin, start as soon as possible after surgery. Start warfarin when surgically acceptable.
Mechanical aortic valve with additional risk factor(s)***	Warfarin adjusted to INR 2.5-3.5	Withhold 4 doses of warfarin. IV heparin when INR falls below 2.0.** Stop IV heparin 4-6h prior to procedure.	IV heparin, start as soon as possible after surgery. Start warfarin when surgically acceptable.
Bioprosthetic heart valves†			
Bioprosthetic aortic valve with risk factors***	Warfarin adjusted to INR 2.0-3.0	Withhold 4 doses of warfarin. IV heparin when INR falls below 2.0.** Stop IV heparin 4-6h prior to procedure.	IV heparin, start as soon as possible after surgery. Start warfarin when surgically acceptable.
Bioprosthetic mitral valve with risk factors***	Warfarin adjusted to INR 2.5-3.5	Withhold 4 doses of warfarin. IV heparin when INR falls below 2.0.** Stop IV heparin 4-6h prior to procedure.	IV heparin, start as soon as possible after surgery. Start warfarin when surgically acceptable.

Notes:
*May need longer time period to withhold warfarin, depending on the patient's baseline dose.
**Typically patients will need IV heparin 2d prior to procedure if INR falls as expected. There is practice variation with the use of LMWH instead of IV heparin. Use of LMWH is a class IIB recommendation per the ACC/AHA guidelines
***Risk factors: Atrial fibrillation, previous thromboembolism, LV dysfunction, hypercoagulable state
†Note that for bioprosthetic valves without risk factors some centers treat with warfarin adjusted to an INR of 2.0-3.0 for the first 3 months post valve surgery. If procedures requiring reversal of warfarin are required within this time period, it is best to discuss with the cardiac surgeon.

Indication	Preoperative management	Postoperative management	Comment
Non-valvular atrial fibrillation without prior embolic disease	Withhold 4 doses of warfarin.	Prophylactic dose heparin. Restart warfarin when surgically acceptable.	Typically the short-term risk of embolic disease with atrial fibrillation is low, and no bridge therapy is indicated.
Non-valvular atrial fibrillation with prior embolic disease	Withhold 4 doses of warfarin, consider LMWH to bridge.	Consider therapeutic dose IV UFH or SC LMWH until warfarin can be restarted.	
Heart Failure	Discuss with the patient's cardiologist.	Discuss with the patient's cardiologist.	In general, warfarin is withheld without bridge therapy if there is no history of prior thromboembolic events.
Pulmonary Hypertension	Discuss with the patient's pulmonologist.	Discuss with the patient's pulmonologist.	Patients requiring warfarin for pulmonary hypertension are likely high risk surgical candidates apart from risk of thromboembolism.
Hypercoagulable state	Consider bridge therapy on an individual basis.	Consider bridge therapy on an individual basis.	Generally the more severe hypercoagulable states (e.g. antiphospholipid antibody syndrome with prior arterial event) merit bridge therapy.
Venous Thrombo-embolism—please see "**Venous Thromboembolic Disease**"			

Minor procedures

Procedure	Recommendation
Cataract surgery	Stopping warfarin is usually not indicated.
Other ophthalmologic procedures	Generally not indicated to stop warfarin, but should be decided on a case by case basis
Dermatology	Stopping warfarin is usually not indicated
Dental surgery	Stopping warfarin is usually not indicated except in very large cases or bone excision

Note that one should check an INR to ensure that it is not supratherapeutic.

Strategies to reverse warfarin effect

Consider whether the indication is for active bleeding, reversal for surgery, and the time period you wish to reverse anticoagulation for.

IV Vitamin K: Acts quickly, and reverses quickly. Useful if you seek to reverse warfarin effect within 24 hrs. There is a risk of anaphylaxis to the IV form.

PO or SC Vitamin K: There is reasonable data showing that low dose vitamin K may be used to reverse warfarin effect with similar efficacy as IV vitamin K (note different dosing) at 24 hrs., although IV administration acts more quickly in the first few hours. Be careful not to overdose PO vitamin K if reversing with the intention of re-establishing therapeutic anticoagulation with warfarin in the near future. The data for SC vitamin K is sufficiently mixed that PO or IV is preferred.

FFP: Acts quickly, but also has relatively short duration. Useful to use immediately prior to procedure, e.g. less than 12 hrs, or for any indication where rapid reversal is required. Note it may

have to be redosed or vitamin K concurrently administered if prolonged reversal of anticoagulation is required.

INR	CLINICAL SETTING	THERAPEUTIC OPTIONS
< 5	No bleeding	Hold warfarin until INR in therapeutic range +/- vitamin K 2.5mg PO.
	Rapid reversal required	Hold warfarin and give vitamin K 1mg IV or 2.5mg PO.
5.0-8.9	No bleeding	Hold warfarin until INR in therapeutic range +/- vitamin K 2.5mg PO.
	Rapid reversal required	Hold warfarin and give vitamin K 1-2mg IV or 2.5-5mg PO.
> 9	No bleeding	Hold warfarin until INR in therapeutic range and give vitamin K 2.5-5mg PO or 1-2mg IV. Repeat q24h as necessary
	Rapid reversal required	Hold warfarin and give vitamin K 1-10mg IV. Repeat q6-24h as necessary
Any INR	Serious or life threatening bleeding	Hold warfarin and give vitamin K 10mg IV and supplement with FFP or PPC or recombinant VIIa. Repeat as necessary guided by INR.

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References

1. Kearon C, Hirsh J. Management of anticoagulation before and after elective surgery. N Engl J Med. 1997;336:1506-1511.
2. Bonow RO, Carabellow BA, Chatterjee K, et al. 2008 Focused Update Incorporated Into the ACC/AHA 2006 Guidelines for the Management of Patients With Valvular Heart Disease. J Am Coll Cardiol. 2008;52:e1-142.
3. http://www.uwmcacc.org/ (UWMC Anticoagulation Clinic website)
4. Lubetsky A, Yonath H, Olchovsky D, et al. Comparison of oral vs intravenous phytonadione (vitamin K1) in patients with excessive anticoagulation: a prospective randomized controlled study. Arch Intern Med. 2003;163:2469-2474.