Mount Sinai Health System

Perioperative Medication Management Guidelines

(See Appendix A for Guidelines for Anticoagulation and Neuraxial Anesthesia and Appendix B for Dual Antiplatelet Therapy Policy)

CARDIAC MEDICATIONS	Recommendation	Considerations	References
Beta-blockers	• Continue therapy up to and including day of surgery • Substitute IV beta blocker during NPO state	• Patients who take beta blockers are at chronic risk for ischemia with abrupt withdrawal • Discontinuing beta blockers immediately after vascular surgery may increase the risk of postoperative cardiovascular morbidity and mortality • Perioperative beta blockade is associated with a reduction in 30-day and 1-year mortality • Do not start within 24 hours of surgery and use caution if starting within 7 days preoperatively (as there is an increased risk of stroke and mortality).	*Am Heart J* 2001;141:148 *Anesthesiology* 2010;113:794-805
Alpha 2 Agonists	• Continue therapy up to and including day of surgery • Substitute transdermal clonidine if impaired absorption	• Large studies have found that preoperative initiation of low dose clonidine resulted in increased harm • For patients already taking these agents, abrupt withdrawal can precipitate rebound hypertension • Recommend continuing therapy if already on an agent, but not initiating preoperatively	*N Engl J Med* 2014;370:1504 *Arch Intern Med* 1981;141:1125
Calcium Channel Blockers	• Continue therapy up to and including day of surgery • No IV substitution necessary unless poor hemodynamics (hypertension or arrhythmia)	• Conflicting data available regarding benefit of agents during surgery • Small trials have shown more stable intraoperative hemodynamic profile in patients treated with continuous diltiazem • Potential for increased risk of bleeding, more data needed for conclusions • Recommend continuing therapy if already on an agent, but not initiating preoperatively	*J Cardiothorac Vasc Anesth* 1992;6:424 *Arch Intern Med* 2001;161:1145 *Ther Drug Monit*1992;14:485
ACE Inhibitors & Angiotensin Receptor Blockers (ARBs)	• Should not be taken on the morning of surgery or the night before surgery • Resume as soon as possible postoperatively.	• ACE Inhibitors and ARBs should not be taken on the morning of surgery or the night before surgery • Majority consensus is that the routine risk of this medication taken on the day of surgery far outweighs the risk of it being held even in patients with hypertension or CHF • Failure to resume within 48 postop has been associated with increased 30-day mortality.	*Anesthesiology* 1994;81:299 *Anesth Analg* 2001;92:26 *J Cardiothorac Vasc Anesth* 2008;22:180 *J Hosp Med*. 2014 May;9(5):289-96.

Diuretics	• Should not be taken on the morning of surgery • Use parenteral forms as needed in postoperative period	• No consensus on whether diuretics should be discontinued prior to elective surgery • Concerns for hypokalemia and hypovolemia if continued, which may increase the risk of arrhythmia • Diuretics may increase the risk of hypotension • If patients require diuretics for heart failure, decision should be individualized	*South Med J* 1998;91:358 *Anesth Analg* 1998;67:131 *Heart Lung* 1996;25:31
Statins	• Continue statins up to and including day of surgery	• Systematic review of observational studies found an association between perioperative statin use and a reduction in postoperative acute coronary syndrome and mortality • Randomized trials have also supported use of statins for patients undergoing vascular surgery and patients at risk of cardiovascular complications	*BMJ* 2006;333:1149 *N Engl J Med* 2009;361:980 *Ann Surg* 2009;249:921 *J Vasc Surg* 2004;39:967
Non-statin Lipid-lowering Agents	• Discontinue day before surgery • Resume with oral intake	• Niacin and fibric acid derivatives can cause myopathy and rhabdomyolysis; surgery may also increase the risk of myopathy • Discontinuation is likely to be safe since these agents are given for the goal of long-term reduction in vascular morbidity	Farmer JA, Gotto AM. Dyslipidemia and other risk factors for coronary artery disease. In: A Textbook of Cardiovascular Medicine, Braunwald E (Ed), W.B. Saunders, Philadelphia 1997 *Med J Aust* 2001;175:486

ANTIPLATELETS	**Recommendation**	**Considerations**	**References**
Aspirin	• Hold ASA for 1 week prior to surgery when being given for primary and secondary prevention for CAD • For patients with coronary stents who are only on ASA (no longer on DAPT), ASA should be continued except for neurosurgical, spine or non-cataract ophthalmologic surgery • For patients on dual antiplatelet therapy with coronary stents please refer to the system DAPT policy included as Appendix B at the end of this document.	• In cases if the surgeon feels there is a high bleeding risk on ASA, a consensus regarding whether to hold ASA should be reached by the surgeon and anesthesiologist	Devereaux PJ. *NEJM.* 2014; 370:1494-1503

P2Y12 Receptor Antagonists	• If necessary to hold and there is no contraindication to holding:
	  ○ Hold ticagrelor for 3 days
	  ○ Hold clopidogrel for 5 days
	  ○ Hold prasugrel for 7 days
	• For patients on dual antiplatelet therapy with coronary stents please refer to the system DAPT policy included as Appendix B at the end of this document.
		• In cases where the surgeon feels there is a high bleeding risk on P2Y12 receptor antagonist, a consensus regarding whether to hold the medication should be reached by the surgeon and anesthesiologist	2016 ACC/AHA Guideline Focused Update on Duration of Dual Antiplatelet Therapy in Patients with Coronary Artery Disease. *JACC.* 2016.03/513.

ANTICOAGULANTS	Recommendation	Considerations	References
Unfractionated Heparin	• Hold heparin 4 hours prior to surgery.		*CHEST*. 2012;141:e326S-e350S.
Low Molecular Weight Heparin	• Daily dosing: administer half the daily dose in the morning of the day prior to surgery. • Q12h dosing: hold evening dose the day prior to surgery.		*CHEST*. 2012;141:e326S-e350S.
Warfarin	• Hold warfarin at least five days before surgery when indicated. • Consider checking INR within 24 hours of surgical procedure to ensure that INR goal has been attained.	• Consider 6-7 days with advanced age or higher INR goals. • Consider low dose phytonadione if not at goal. An INR in the normal range is especially important in patients undergoing surgery associated with a high bleeding risk (e.g., intracranial, spinal, urologic) or if neuraxial anesthesia is to be used (see below).	*CHEST*. 2012;141:e326S-e350S.

Direct Oral Anticoagulants

Renal Function	Low Bleeding Risk Procedure	High Bleeding Risk Procedure
GFR > 50	Pre-op: Hold 1 day prior to OR; Post-op: Resume 1 day after OR	Pre-op: Hold 2 days prior to OR Post-op: Resume 2-3 days after OR
GFR < 50	Pre-op: Hold 2 days prior to OR Post-op: Resume 1 day after OR	Pre-op: Hold 3-5 days prior to OR Post-op: Resume 2-3 days after OR

- **Duration of withholding and restarting direct oral anticoagulants needs to be decided upon based on patient (i.e. renal dysfunction), surgical, and anesthetic factors (i.e. regional anesthesia).**

ENDOCRINE	Recommendation	Considerations	References
Oral Hypoglycemics and Insulin	• Oral agents should be held on the day of the procedure and while the patient is NPO • Hold short-acting insulin while the patient is NPO • Reduce dose of long-acting insulin by 25-50% for patients with Type II DM while NPO • Always continue basal insulin for patients Type I DM • Consider endocrine consult for patients with an insulin pump	• Diabetes and malnutrition are significant preoperative risk factors for infection and may help to determine a patient's cardiac risk • Studies have shown good preoperative glycemic control is associated with a decrease in infectious complications • Optimal evidence-based perioperative blood glucose control in patients undergoing surgery remains controversial, recommendations are made based on general principles of blood glucose control and data from inpatient surgical populations	*J Surg Res* 2002;103:89 *Circulation* 1999;100:1043 *Arch Surg* 2006;141:375 *Anesth Analg* 2010;111:1378 *Exp Clin Endocrinol Diabetes* 1995;103:213
Glucocorticoids	• For patients who have been taking exogenous glucocorticoids of any dose for less than 3 weeks, continue same glucocorticoid regimen perioperatively • For patients taking prednisone > 5 mg/day for three weeks or more, consider additional perioperative steroid dosing. • Minor procedures: Take usual morning steroid dose. No supplement. • Moderate surgical stress: Take usual morning steroid dose. Give hydrocortisone 50mg IV immediately prior to the procedure and hydrocortisone 25mg every 8 hours for 24 hours, then resume usual dose. • Major surgical stress: Take usual morning steroid dose. Give hydrocortisone 100mg immediately prior to surgery and 50mg every 8 hours for 24 hours, then taper dose by half per day to maintenance dose.	• Chronic glucocorticoid therapy can suppress the hypothalamic-pituitary-adrenal (HPA) axis • During times of stress, such as surgery, the adrenal glands may not respond appropriately • Chronic glucocorticoid therapy can cause significant problems in the perioperative period to be aware of such as impaired wound healing, increased friability of skin, an increased risk of fracture • Consult with Endocrinology if the patient has known adrenal insufficiency	*Anesthesiology 2017; 127:1: 166-172* *UpToDate The management of the surgical patient taking glucocorticoids.* *Ann Surg* 1994;219:416 *Eur J Intern Med* 2008;19:461-7 *Med Clin North Am* 2001;85:1311-7 *J Clin Endocrinol Metab* 1987;64:986
Oral Contraceptives	• Continue up to and including the day of surgery for procedures with low to moderate risk of VTE • Stop 4-6 weeks before surgery for procedures with high risk for VTE • Instruct on alternate forms of contraception and obtain pregnancy test immediately before surgery	• Oral contraceptives are the most frequent cause of thrombosis in young women • Surgery itself is a risk factor for thrombosis and compounds the risk associated with oral contraceptives • Greater estrogen content is associated with a higher risk • When possible, oral contraceptives should be held 4-6 weeks prior to surgery and alternate forms of contraception can be used	*Clin Otolaryngol Allied Sci* 1990;15:525 *N Engl J Med* 2001:344:1527 *BMJ* 2009;339:2890 *BMJ* 2009;339:2921

Hormone Replacement Therapy	• Continue up to and including the day of surgery for procedures with low to moderate risk of VTE • Stop 4-6 weeks before surgery for procedures with high risk for VTE • Resume when tolerating oral medications and period of elevated risk has resolved	• Estrogen content is generally lower than oral contraceptives, however still associated with risk for VTE • Risks associated with temporary discontinuation of hormone therapy are minimal • A case-control study did not find an increased risk of thromboembolism in women undergoing arthroplasty who received hormone therapy • Therapy can be continued in procedures that have a low risk for VTE	*Ann Intern Med* 2000;132:689 *Ann Intern Med* 2002;136:680 *Thromb Haemost* 2004;92:337
Selective Estrogen Receptor Modulators (SERMs)	• Continue for surgeries with low risk of VTE • Discontinue for surgeries with moderate to high risk for VTE • If stopped, should be stopped 4-6 weeks before surgery • Resume when tolerating oral medications	• Selective estrogen receptor modulators increase the risk of VTE • Brief discontinuation of SERMs for prevention of cancer or osteoporosis is unlikely to result in harm • If being used for treatment of cancer, recommend consulting an oncologist before discontinuing	*JAMA* 1999;281:2189 *J Natl Cancer Inst* 1998;90:1371

GI MEDICATIONS	**Recommendation**	**Considerations**	**References**
H2 Blockers & Proton Pump Inhibitors	• Continue therapy up to and including day of surgery • Substitute IV forms available for prolonged NPO state	• The stress of surgery and other conditions can increase the risk of stress-related mucosal damage • Gastric aspiration during anesthesia can lead to severe pulmonary injury; H2 blockers and PPIs decrease gastric volume and raise gastric pH • H2 blockers have the risk to cause rare CNS side effects; increased risk of *C. diff* has been associated with use of PPIs • Recommend continuation based on potential benefits and lack of contraindications	*Anesth Analg* 2000;90:717 *Br J Anaesth* 1989;96:536 *Ann Intern Med* 1991;114:1027

PULMONARY MEDICATIONS	**Recommendation**	**Considerations**	**References**
Inhaled Bronchodilators (Beta Agonists and Anticholinergics)	• Continue therapy up to and including day of surgery • Use nebulized forms if patient unable to comply with inhalation maneuver	• Inhaled medications used to control obstructive pulmonary disease have been found to reduce the incidence of postoperative pulmonary complications in patients with asthma and COPD	*Arch Intern Med* 1995;155:1379 *Br J Anaesth* 2009;103:57-65
Leukotriene Inhibitors	• Continue therapy up to and including day of surgery • Resume when patient is able to take oral medications	• Help to maintain asthma control but are not used for acute therapy • Elimination half-life is short, but effects on asthma symptoms and pulmonary function continues for up to three weeks after cessation of therapy • No evidence of a withdrawal syndrome with interruption in therapy	*Arch Intern Med* 1998;158:1213

PSYCHIATRIC MEDICATIONS	Recommendation	Considerations	References
Antipsychotics	• Continue therapy up to and including the day of surgery • Parenteral formulations are available, and if prolonged NPO state, consider depot formulations	• Some agents are associated with QTc prolongation, and occasionally cause hypotension or arrhythmias • Short-acting, low-dose antipsychotics can be considered if necessary • Dose-related increased risk of sudden cardiac death with typical and atypical antipsychotics • Perioperative olanzapine versus placebo was associated with a significantly lower incidence of delirium	*N Engl J Med* 209;360:225 *Psychosomatics* 1995;36:66-8 *Psychosomatics* 2010;51:409
Antianxiety Agents	• Continue therapy up to and including the day of surgery • Parenteral formulations are available for NPO state	• Abrupt withdrawal can result in agitation, hypertension, delirium, and seizures • Many agents have active metabolites, and withdrawal can occur several days after discontinuation • Recommend that benzodiazepines or buspirone used chronically for antianxiety purposes be continued perioperatively	*Anesthesiology* 2009;111:110-5
Tricyclic Antidepressants	• Continue up to and including the day of surgery for patients on high doses • Resume with PO intake • Patients on low doses and in whom perioperative arrhythmia is a concern should taper to discontinue for 7 days prior to surgery	• Continuation may increase the potential for arrhythmias • Abrupt withdrawal can lead to insomnia, nausea, headache, increased salivation, and increased sweating • Evidence based guidelines for perioperative management of psychotropic drugs are lacking	Principles of Ambulatory Medicine, Barker LR, Burton JR, Zieve PD (Eds), Williams and Wilkins, Baltimore 1995\ *South Med J* 1998;91:358 *Psychosomatics* 2006;47:8
Serotonin Reuptake Inhibitors	• Continue up to and including the day of surgery	• Increased risk of bleeding • Retrospective study concluded that receiving SSRIs in the perioperative period was associated with a higher risk for adverse events • Limited data on SNRI agents	*JAMA Intern Med* 2013;173:1075-81 *Heart Lung Circ* 2012;21:206-14
Monoamine Oxidase Inhibitors (MAOIs)	• For emergency procedures, an MAO-safe anesthetic technique should be used • If medication is to be discontinued, should be done 2 weeks prior to surgery • Resume with PO intake	• If continued and direct acting sympathomimetic agents are used during anesthesia (especially meperidine/narcotics), can result in severe hypertension or serotonin syndrome • Evidence based guidelines for perioperative management of psychotropic drugs are lacking • Recommend discontinuing unless doing so will drastically exacerbate depressive symptoms	*Psychosomatics* 2006;47:8 *Medicine* 2000;79:201 *Br J Anaesth* 1988;60:222
Mood Stabilizers	• Lithium can be continued up to and including the day of surgery with close monitoring of electrolytes and volume status • Valproic acid can be continued up to and including the day of surgery • Resume with PO intake	• Continuation of lithium may prolong the effects of muscle relaxants and neuromuscular blockers • Lithium must be temporarily discontinued in patients who cannot take oral medications due to lack of parenteral formulation	*CNS Drugs* 2009;23:397-418 Drugs for treatment of bipolar disorders. In: Handbook of Psychiatric Drug Therapy, 6th ed, Lippincott Williams & Wilkins, Philadelphia 2010