Supplemental table. The list of high-risk perioperative medications for elders in China

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **medications or medication classes** | **conditions** | **potential risks** | **recommendations** |
| **Nervous system medications** | | | | |
| 1 | Estazolam | —— | Increases risk of delirium, fall and cognitive impairment | Use with caution during the perioperative period |
| 2 | Lorazepam | —— | Increases risk of delirium, fall and cognitive impairment | Use with caution during the perioperative period |
| 3 | Diazepam | —— | Increases risk of delirium, fall, cognitive impairment and hypotension | Use with caution during the perioperative period; monitor blood pressure |
| 4 | Clonazepam | —— | Increases risk of delirium, fall and cognitive impairment | Use with caution during the perioperative period |
| 5 | Midazolam | —— | Increases risk of delirium | Use with caution during the perioperative period |
| ≥80 years old | Delay in anesthesia recovery | Use with caution during the surgery |
| 6 | Zolpidem | —— | Increases risk of delirium, fall and cognitive impairment | Use with caution during the perioperative period |
| 7 | Zopiclone | —— | Increases risk of delirium and fall | Use with caution during the perioperative period |
| 8 | Zaleplon | —— | Increases risk of delirium and fall | Use with caution during the perioperative period |
| 9 | Dexmedetomidine | —— | Increases risk of hypotension and non-fatal cardiac arrest | Closely monitor blood pressure and pulse |
| 10 | Phenytoin | —— | Increases risk of delirium and fall | Continue to use during the perioperative period, pay attention to monitoring |
| 11 | Levodopa and Benserazide | Halothane anesthesia | Increases intraoperative blood pressure fluctuations and risk of arrhythmia | Stop 12-48h before surgery |
| 12 | Donepezil,Rivastigmine, Huperzine A，Galantamine | —— | Increases risk of neuromuscular blockade and postoperative delirium | Avoid new prescriptions during the perioperative period; continue long-term medication with close monitoring; after evaluation, if you need to stop, donepezil stopped 2-3w pre-op, galantamine stopped 24h pre-op |
| **Anesthetics or anesthesia-assisted medications** | | | | |
| 13 | Propofol | Serious heart disease (ejection fraction <50%) | Increases risk of serious cardiovascular adverse reactions | Closely monitor circulatory function during the perioperative period |
| 14 | Rocuronium Bromide | Impaired liver function | Mainly excreted by bile, prone to accumulation | Avoid using drugs that aggravate liver damage during the surgery |
| 15 | Pethidine | —— | Increases risk of fall，seizure and delirium | Avoid using during the perioperative period |
| 16 | Tramadol | —— | Increases risk of seizure and delirium | Use with caution during the perioperative period |
| Chronic seizures or epilepsy | Increases risk of seizure | Avoid using during the perioperative period or discretion according to the specialist situation |
|  | **medications or medication classes** | **conditions** | **potential risks** | **recommendations** |
| **Psychiatric medications** | | | | |
| 17 | Phenothiazines (perphenazine / fluphenazine / chlorpromazine), butyrophenone (haloperidol), risperidone, olanzapine | —— | Can enhance CNS depression, lower seizure threshold, cause ECG abnormalities, arrhythmias, hypotension, neuroleptic malignant syndrome; discontinuation associated with withdrawal dyskinesia and rebound agitation | Continue to use with caution during the perioperative period，pay attention to monitoring |
| 18 | Chlorpromazine | —— | Increases risk of delirium | Use with caution during the perioperative period |
| General anesthesia | Increases risk of postural hypotension and bradycardia | 1.Closely monitor blood pressure during the surgery 2.Use with caution after surgery |
| Chronic seizures or epilepsy | Increases risk of seizure | Avoid using during the perioperative period or discretion according to the specialist situation |
| Parkinson disease | Worsens parkinsonian symptoms | Use with caution during the perioperative period |
| 19 | Clozapine | Chronic seizures or epilepsy | Increases risk of seizure | Avoid using during the perioperative period or discretion according to the specialist situation |
| 20 | Olanzapine | General anesthesia | Increases risk of postural hypotension and bradycardia | 1.Closely monitor blood pressure during the surgery 2.Use with caution after surgery |
| Chronic seizures or epilepsy | Increases risk of seizure | Avoid using during the perioperative period or discretion according to the specialist situation |
| Parkinson disease | Worsens parkinsonian symptoms | Use with caution during the perioperative period |
| 21 | TCAs (Amitriptyline/doxepin/imipramine etc.) | —— | May increase risk of arrhythmia in combination with some volatile anesthetics or sympathomimetics；increases the sedation effect during operation | Gradually stop before surgery or discretion according to the specialist situation |
| 22 | Amitriptyline | General anesthesia | Increases risk of postural hypotension | 1.Closely monitor blood pressure during the surgery 2.Use with caution after surgery |
| 23 | Fluoxetine, sertraline, citalopram, fluvoxamine | High bleeding risk surgery | Increases risk of bleeding | Stop ≥ 5 half-life before surgery |
| Lower risk of bleeding was assessed | Increases risk of bleeding | Use with caution during the perioperative period |
| 24 | Fluoxetine | —— | Nervous system adverse reactions (insomnia, dizziness，unconsciousness，upset and agitation） | Pay attention to the symptoms of the nervous system |
| 25 | Fluvoxamine | —— | Nausea, vomiting and anticholinergic adverse reactions | Pay attention to closely monitoring |
|  | **medications or medication classes** | **conditions** | **potential risks** | **recommendations** |
| 26 | Paroxetine | —— | Increases the sedation effect during operation；increases risk of bleeding | Stop before surgery or discretion according to the specialist situation |
| Hypoproteinemia (ALB≤25g/L) | High protein binding rate, may compete with intraoperative drugs (such as: methylprednisolone 77%, propofol 98%, bupivacaine 95%, midazolam 96%-98%, parecoxib sodium 98%, sufentanil 92.5%) for binding to albumin | Pay attention to adjusting dosage of intraoperative medications with high protein binding rates |
| MAOI (Linezolid, methylene blue) | Increases risk of 5-HT syndrome | Can not be used within 2w before and after using MAOI |
| 27 | Duloxetine | —— | Increases risk of bleeding due to inhibition of platelet aggregation | Use with caution during the perioperative period，pay attention to the symptoms of bleeding |
| Ccr <30ml/min | Increases risk of nausea and vomiting | Avoid using |
| 28 | MAOIs: selegiline etc. | —— | Increases risk of hypertension, hyperthermia, convulsions and coma | Stop 2w before surgery or discretion according to the specialist situation |
| Sympathomimetic (dopamine, ephedrine, phenylephrine) | Increases risk of hypertensive crisis | Avoid using together |
| Meperidine | Increases risk of 5-HT syndrome | Avoid using together |
| 29 | Lithium | —— | Increases risk of arrhythmia and renal diabetes insipidus; prolongs action of neuromuscular blockers | 1.Stop 24h before minor surgery 2.Stop 48h before major surgery 3.Pay attention to monitoring electrolyte levels |
| **Cardiovascular system medications** | | | | |
| 30 | Beta blockers: propranolol / metoprolol / atenolol / bisoprolol | —— | Withdrawal increases the risk of angina exacerbation, myocardial infarction or even sudden death; Continued using can reduce the incidence of postoperative atrial fibrillation and avoid withdrawal syndrome | 1.Continue to use during the perioperative period 2.Pay attention to monitoring blood pressure and pulse |
| 31 | Nifedipine, immediate release | —— | Increases risk of hypotension and precipitation myocardial ischemia | Consider changing to other CCBs before surgery |
| 32 | CCB (except nifedipine, immediate release) | Non-cardiac surgery: vasospasm angina | Withdrawal increases the risk of unstable intraoperative circulatory function | Continue to use on the day of surgery, closely monitor |
| 33 | ACEI/ARB | —— | Increases the risk of kidney damage | Use other drugs that aggravate kidney damage with caution during the surgery |
| Cardiac surgery | Increases risk of perioperative hypotension and vasodilation shock | Stop 1d before or on the day of surgery, depending on the drug |
| Non-cardiac surgery | Potential hypotension risk during induction of anesthesia | Use with caution during the perioperative period, pay attention to monitoring blood pressure and electrolyte levels |
| 34 | ACEI: Captopril / fosinopril / enalapril / benazepril, etc. | Triamterene, amiloride | Increases risk of hyperkalemia | Avoid using amiloride or triamterene (except patients with hypokalemia) |
| Spironolactone | Increases risk of hyperkalemia | Monitoring potassium level |
|  | **medications or medication classes** | **conditions** | **potential risks** | **recommendations** |
| 35 | α1 receptor antagonist: prazosin / doxazosin / terazosin | Cataract surgery | Increases the risk of soft iris syndrome | Stop before surgery |
| General anesthesia | Increases risk of postural hypotension and bradycardia | 1.Closely monitor blood pressure during the surgery 2.Use with caution after surgery |
| 36 | Reserpine | —— | Increases the risk of refractory hypotension during the surgery | Stop 1-2w before surgery，for emergency/limited surgery, prepare for norepinephrine |
| 37 | Hydrazine, minoxidil | —— | Affects intraoperative blood pressure | Stop on the day of surgery |
| 38 | Amiodarone | —— | Severe arrhythmia (QT interval prolongation and torsades de pointes); Withdrawal can not control arrhythmia symptoms | Closely monitor ECG |
| Halogenated inhalation anesthetics | Risk of enhanced myocardial inhibition and conduction, increases risk of postoperative acute respiratory distress syndrome (ARDS) | Use halogenated inhaled anesthetics with caution during the surgery |
| 39 | Isosorbide dinitrate, isosorbide mononitrate | —— | Continued using helps control blood pressure and angina, but affects intraoperative blood pressure | Continue to use, pay attention to monitoring intraoperative blood pressure |
| 40 | Digoxin＞0.125mg/d | —— | Arrhythmia | Use with caution, pay attention to monitoring the concentration of digoxin and potassium level |
| 41 | Bile acid sequestrant: cholestyramine | —— | Interferes with the absorption of other drugs during the perioperative period | Stop 1d before surgery or on the day of surgery |
| 42 | Fibrates | —— | Increases risk of rhabdomyolysis | Stop 1d before surgery or on the day of surgery |
| 43 | Niacin | —— | Risk of vasodilation and itching | Stop 1d before surgery or on the day of surgery |
| **Respiratory medications** | | | | |
| 44 | Theophylline, aminophylline | —— | The therapeutic window is narrow, can cause arrhythmia and neurotoxicity if drug levels become supratherapeutic | Stop 24h before surgery or discretion according to the specialist situation |
| **Digestive system medications** | | | | |
| 45 | Calcium carbonate, aluminum hydroxide | —— | Temporary neutralization of stomach acid and cause additional matter in the stomach | Stop on the day of surgery |
| 46 | Ranitidine, famotidine | —— | Increases risk of delirium | Comprehensive assessment, use with caution during the perioperative period |
| 47 | Cimetidine | —— | Multiple drug interactions, increases risk of delirium | Avoid using during the perioperative period |
| 48 | Belladonna, scopolamine | —— | Increases risk of delirium and cognitive impairment | Use with caution during the perioperative period |
| 49 | Metoclopramide, promethazine | Parkinson disease | Worsens parkinsonian symptoms | Use with caution during the perioperative period |
| 50 | Laxatives(stimulant, Osmotic, stool softeners) | —— | Laxative requirements may change perioperatively due to reduced oral intake or opioid initiation | Stop on the day of surgery |
| **Urinary system medications** | | | | |
| 51 | Thiazines: Hydrochlorothiazide | —— | Affects electrolytes and blood volume levels | Continue to use, pay attention to monitoring blood pressure and electrolyte levels |
|  | **medications or medication classes** | **conditions** | **potential risks** | **recommendations** |
| 52 | Loop diuretics: furosemide / torasemide / bumetanide / ittanic acid | —— | Affects electrolytes and blood volume levels, increases risk of electrolyte imbalance and hypotension | Stop on the day of surgery or discretion according to the specialist situation |
| 53 | Potassium-sparing diuretics: spironolactone, triamterene | —— | Increases risk of hyperkalemia | Stop on the day of surgery or discretion according to the specialist situation, monitor Potassium levels |
| **Hematological system medications** | | | | |
| 54 | Heparin (unfractionated) | —— | Increases risk of bleeding | 1.Stop 4-6h before surgery if full anticoagulation 2.Restart at least 12h postoperatively if adequate hemostasis 3.Discretion according to the specialist situation |
| 55 | Low molecular weight heparin | —— | Increases risk of bleeding | 1.Therapeutic: stop 24h before surgery 2.Prophylaxis: stop 12h before surgery 3.Discretion according to the specialist situation |
| 56 | Fondaparinux | —— | Increases risk of bleeding | 1.Therapeutic: stop 3d before surgery 2.Prophylaxis: stop 48h before surgery |
| 57 | Warfarin | Elective surgery | Increases risk of bleeding | Stop 3-5d before surgery, monitor INR (ideally ≤1.5) and bleeding situation |
| Emergency surgery | Increases risk of bleeding | Use low-dose oral or sc vitamin K to reduce INR within 24-36h; if emergency, use fresh frozen plasma or prothrombin complex concentrate; monitor bleeding situation |
| Surgery with a higher risk of embolization | Increases risk of bleeding | Use bridging therapy with unfractionated or LMWH, monitor bleeding situation |
| 58 | Novel oral anticoagulants: dabigatran | Ccr≥50ml/min and surgery with low bleeding risk | Increases risk of bleeding | Stop at least 1-2d before surgery |
| Ccr≤50ml/min and surgery with low bleeding risk | Increases risk of bleeding | Stop at least 2-3d before surgery |
| Ccr≥50ml/min and surgery with high bleeding risk or spinal/epidural anesthesia | Increases risk of bleeding | Stop at least 2-3d before surgery |
| Ccr≤50ml/min and surgery with high bleeding risk or spinal/epidural anesthesia | Increases risk of bleeding | Stop at least 4d before surgery |
|  | **medications or medication classes** | **conditions** | **potential risks** | **recommendations** |
| 59 | Oral Xa inhibitors: rivaroxaban, apixaban | Normal renal function and surgery with low bleeding risk | Increases risk of bleeding | Stop at least 1d before surgery |
| Impaired renal function and surgery with low bleeding risk | Increases risk of bleeding | Stop at least 2d before surgery |
| Normal renal function and surgery with high bleeding risk | Increases risk of bleeding | Stop at least 2d before surgery |
| Impaired renal function and surgery with high bleeding risk | Increases risk of bleeding | Stop at least 3d before surgery |
| 60 | Aspirin(≤100mg/d) | With an arterial stent | Increases risk of bleeding | Continue to use |
| Surgery with high bleeding risk such as intracranial surgery, spinal canal surgery, posterior chamber of eye surgery, certain urologic procedures and cardiovascular surgery | Increases risk of bleeding | Stop 1w before surgery or discretion according to the specialist situation |
| Surgery (except for the above types) with low bleeding risk | Increases risk of bleeding | Use with caution and monitor bleeding situation |
| 61 | Clopidogrel | —— | Increases risk of bleeding | Comprehensive assessment, if you need to stop, stop 5-7d before surgery |
| 62 | Prasugrel | —— | Increases risk of bleeding | Comprehensive assessment, if you need to stop, stop 7d before surgery |
| 63 | Ticagrelor | —— | Increases risk of bleeding | Comprehensive assessment, if you need to stop, stop 3-5d before surgery |
| 64 | Ticlopidine | —— | Increases risk of bleeding, cause adverse reactions in the hematological system, safer and effective alternatives available | Avoid using, comprehensive assessment, if you need to stop, stop 10-14d before surgery |
| 65 | Dipyridamole | —— | Increases risk of postural hypotension and bleeding | Avoid using |
| 66 | Cilostazol | —— | Increases risk of bleeding | Comprehensive assessment, if you need to stop, stop 3-5d before surgery |
| **Endocrine system medications** | | | | |
| 67 | Methylprednisolone, dexamethasone, hydrocortisone, prednisolone | —— | Withdrawal increases the risk of Addison's crisis | Take the morning dose as usual on the day of surgery, if necessary, add hydrocortisone during surgery |
| Use NSAIDs together | Increases risk of bleeding | Monitoring bleeding situation |
| 68 | Quick-acting insulin: NovoRapid  Short-acting insulin: Insulin Injection, Novolin R, Humulin R | Surgery requiring fasting water | Increases risk of hypoglycemia | Stop on the day of surgery |
|  | **medications or medication classes** | **conditions** | **potential risks** | **recommendations** |
| 69 | Metformin | Can eat or drink after surgery | Increases risk of lactic acidosis | Stop on the day of surgery |
| Can not eat or drink within 24 hours after surgery | Increases risk of lactic acidosis | Stop 48h before surgery |
| Renal insufficiency, intraoperative venous contrast or general anesthesia | Increases risk of lactic acidosis | 1.Stop 48h before surgery 2.Monitor renal function after 2-3 days of radiography and restart after normal results |
| Normal renal function and intraoperative venous contrast | Increases risk of lactic acidosis | 1.Stop on the day of surgery 2.Monitor renal function after 2-3 days of radiography and restart after normal results |
| 70 | Sulfonylureas: glimepiride, glibenclamide, gliclazone, glipizide, gliclazide etc. | Surgery requiring fasting water | Increases risk of hypoglycemia | Stop on the day of surgery |
| 71 | Non-sulfonylureas: nateglinide, repaglinide | Surgery requiring fasting water | Increases risk of hypoglycemia | Stop on the day of surgery |
| 72 | Thiazolidinediones: pioglitazone | —— | Increases risk of hypoglycemia and postoperative fluid retention | Stop on the day of surgery |
| 73 | Bisphosphonates: alendronate | —— | Increases risk of esophageal ulcers | Stop at least 1d before surgery and restart after patients can correctly use it |
| 74 | Colchicine | —— | The therapeutic index is narrow and can cause muscle weakness and polyneuropathy in the setting of renal impairment or drug interactions | Stop on the day of surgery |
| **Anti-infective medications** | | | | |
| 75 | Vancomycin, aminoglycosides | —— | Increases risk of kidney damage | Monitor renal function |
| **Antipyretic, analgesic, anti-inflammatory and anti-rheumatic medications** | | | | |
| 76 | NSAIDs: Aspirin>325 mg/d, ibuprofen, indomethacin, diclofenac, naproxen | —— | Increases risk of bleeding and kidney damage | 1.Comprehensive assessment, use with caution, pay attention to monitoring. If you need to stop, according to the half-life of drug.  Short-acting (ibuprofen / indomethacin / diclofenac) stopped 1d pre-op, long-acting (naproxen) stopped 4d pre-op 2.Use drugs that aggravate kidney damage with caution during the surgery |
| Major orthopedic surgery | Increases risk of bleeding and kidney damage | Stop 4-7d before surgery or discretion according to the specialist situation |
| Age＞75; taking oral or parenteral corticosteroids, anticoagulants, antiplatelet agents, antidepressants or drugs with high protein binding rates | Increases risk of upper gastrointestinal ulcers and gross bleeding (occur in approximately 1% of patients treated for 3–6 months and in ~2–4% of patients treated for 1 year) | Pay attention to monitoring and can use PPI/H2R for prevention |
|  | **medications or medication classes** | **conditions** | **potential risks** | **recommendations** |
| 77 | Indometacin | —— | More neurologic adverse reactions than other NSAIDs | Consider changing to other NASIDs |
| 78 | Cox2 inhibitors: celecoxib, meloxicam | —— | Affects renal function | Continue to use for patients with normal renal function, pay attention to monitoring renal function during the perioperative period |
| 79 | NSAIDs | Renal insufficiency | Retention of water and sodium, can aggravate or cause kidney failure | Avoid using during the perioperative period |
| 80 | Leflunomide | —— | Continued using has the risk of bone marrow and immunosuppression | Stop 2w before surgery and restart after wound healing |
| 81 | Methotrexate | —— | Hinders wound healing, increases risk of bone marrow, immunosuppression and kidney damage | Use with caution for patients with normal renal function, if you need to stop, stop 1w before surgery, monitor renal function |
| 82 | Azathioprine | —— | Major wound complications and increases risk of bone marrow cytotoxicity during the perioperative period | Stop before surgery |
| **Antiallergic medications** | | | | |
| 83 | Chlorpheniramine, cyproheptadine, diphenhydramine (oral), promethazine | —— | Increases risk of delirium and potentially enhances the sedative effect of general anesthetics | Stop 1d before surgery |
| **Other medications** | | | | |
| 84 | Rituximab, etanercept | —— | Potential risk of infection | Depending on the drug, stop at two half-lives or at least one dosing interval before surgery |
| 85 | Bevacizumab | —— | Risk of affecting wound healing or opening | Stop at least **28d before surgery** |
| 86 | Ranibizumab, conbercept | Ophthalmic surgery | Increases risk of infection and bleeding | Stop 28d before and after surgery |