Pharmacy practice in cardiac surgery

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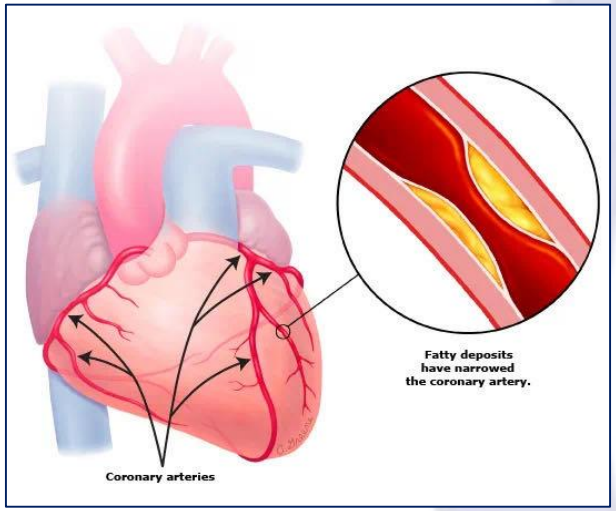
- She specializes in cardiovascular disease pharmacotherapy, with a focus on conditions like hypertension, coronary heart disease, and dyslipidemia. She dedicates herself to promoting pharmaceutical sciences, effectively engaging with the public through educational programs, seminars, and media communication, raising awareness on proper medication use and health issues.
- She has led and participated in numerous research projects supported by the National Natural Science Foundation of China, as well as provincial and municipal scientific research funds. She has published over 20 academic articles in both domestic and international journals, including the "British Journal of Pharmacology."

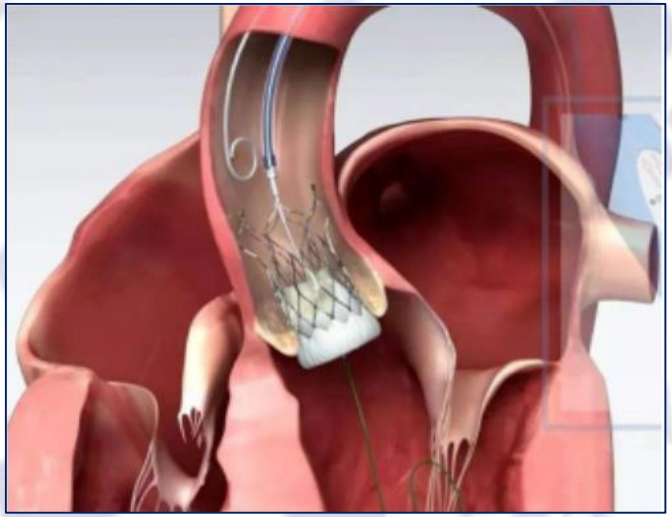
Cardiac Surgery

- Cardiac diseases have a high prevalence and are associated with significant morbidity and mortality. Cardiac surgery is the standard treatment for many heart diseases. Most of these surgeries are performed under cardiopulmonary bypass (CPB).
- Cardiac surgery is associated with postoperative morbidity and mortality that can vary from 5% to 75% depending on the surgery performed, the comorbidities of the patients and their frailty.

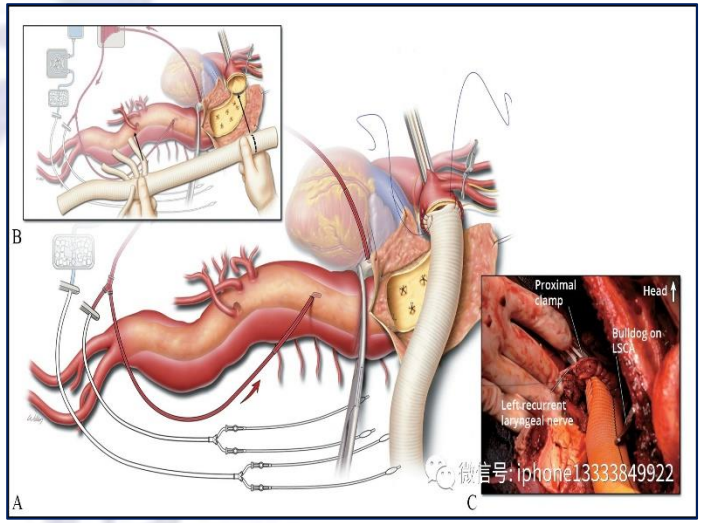
Cardiac Surgery



Coronary artery bypass grafting（**CABG**）



Valve repair or replacement



Aortic dissection surgery

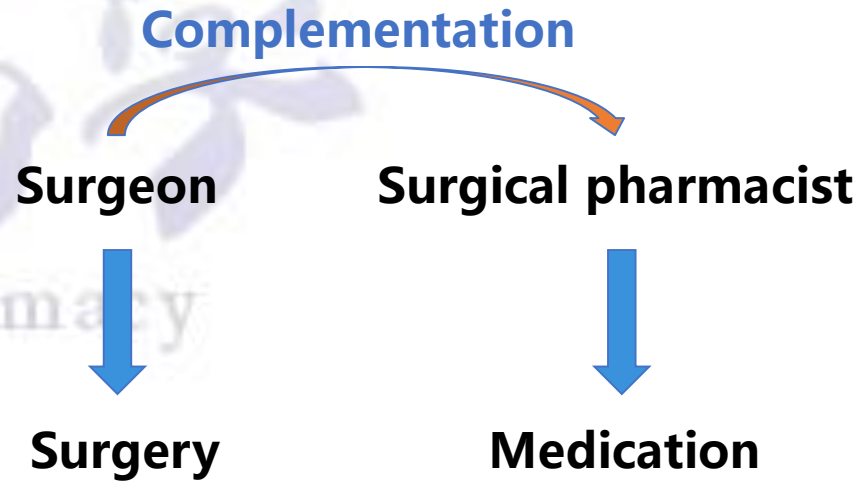
These surgeries not only correct structural issues but also aim to restore the heart's rhythm and efficiency, thereby improving the quality of life for patients afflicted with cardiac conditions.

The role of surgical pharmacists in the perioperative Cardiac Surgery

Surgical pharmacy is a discipline that studies the special medication of perioperative patients, finds the most suitable therapeutic regimen for perioperative patients, solves the drug-related problems of perioperative patients to improve the clinical outcome of perioperative patients. Different from surgical pharmacy care proposed by the American Society of Health System Pharmacists (ASHP), surgical pharmacists should pay special attention to perioperative drug therapy in addition to the work proposed by ASHP.

- Reduce complications and length of stay
- Promote an earlier return to normal activities

Perioperative pathophysiological changes are complex, and drug management should be considered comprehensively



Surgical pharmacy in Zhujiang Hospital of Southern Medical University

Surgeon - anesthesiologist - surgical pharmacist and nursing collaborative integrated diagnosis and treatment model

- Established the first domestic medical institution “surgeon-anesthesian-surgical pharmacist and nursing collaborative integrated diagnosis and treatment model and organizational system”, officially recognized the key role of surgical pharmacists in the surgical treatment team for the first time at the hospital level, marking the important position of surgical pharmaceutical care in medical practice has been officially recognized.
- The surgical pharmacists have achieved remarkable results in the department of orthopedics, hepatobiliary surgery and cardiac surgery in our hospital.
- Taking the orthopaedic department as an example, after the implementation of the surgical pharmacist service mode, the DDD value of the orthopaedic department decreased from 36.34 to 25.10, the rational utilization rate of antibacterial drugs increased from 46.67% to 91.67%, the rational utilization rate of proton pump inhibitors increased from 18% to 72%, and the rational utilization rate of traditional Chinese medicine injections increased from 13.33% to 75%.

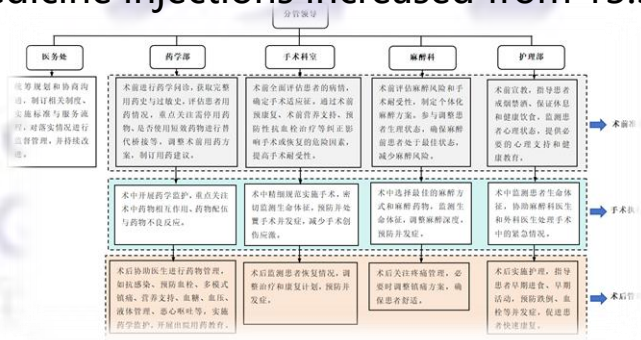

南方医科大学珠江医院文件

院字〔2024〕141号

南方医科大学珠江医院关于印发《外科医师-麻醉医师-外科药师与护理协同一体化诊疗模式和组织制度》的通知


广东省药学会 GuangDong Pharmacological Association

南方医科大学珠江医院构建首个医疗机构“外科医师-麻醉医师-外科药师与护理协同一体化诊疗模式”



Management for Perioperative Care in Cardiac Surgery

Intraoperative Strategies

Conduct pharmaceutical monitoring, with a focus on drug interactions, drug compatibility, and adverse drug reactions during surgery

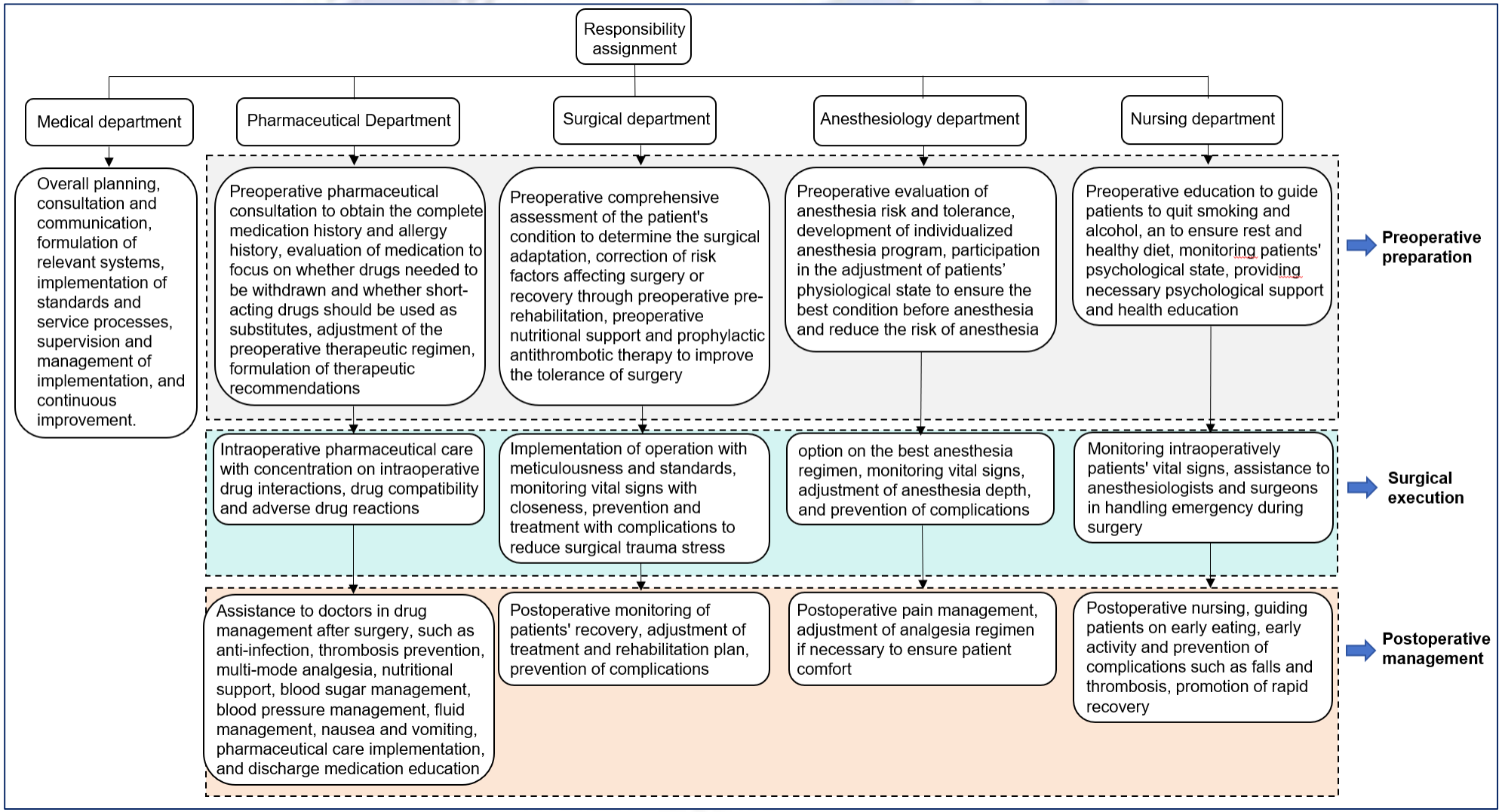
Preoperative Strategies

Through pharmaceutical interviews, obtain a complete medication history and drug allergy history, assess the patient's medication status, and adjust the preoperative medication regimen

Postoperative Strategies

For common postoperative complications, including postoperative pain, nausea and vomiting, and venous thromboembolism, carry out necessary postoperative medication adjustments; and provide discharge medication guidance and patient follow-up

Workflow chart for surgical pharmacists



Preoperative Strategies

01 Preoperative Measurement of Hemoglobin A1c and Albumin for Risk Stratification

02 Preoperative Correction of Nutritional Deficiency

03 Preoperative antithrombotics a and bridging

04 Preoperative education

05 Preoperative discontinuation of Renin–angiotensin–aldosterone system inhibitors

06 Preoperative atrial fibrillation prophylaxis

Preoperative Strategies

1. Preoperative Measurement of Hemoglobin A1c and Albumin

Preoperative measurement of hemoglobin A1c

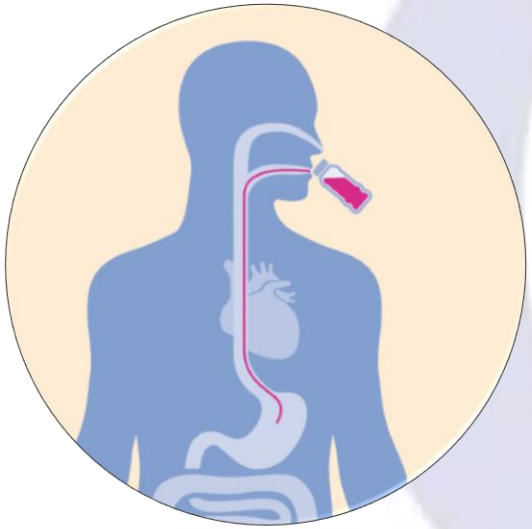
Preoperative glycemic control has been associated with wound infection and long-term survival

Preoperative measurement of albumin

Low preoperative serum albumin reflects nutrition and liver function status, which is associated with an increased risk of morbidity and mortality postoperatively

Preoperative Strategies

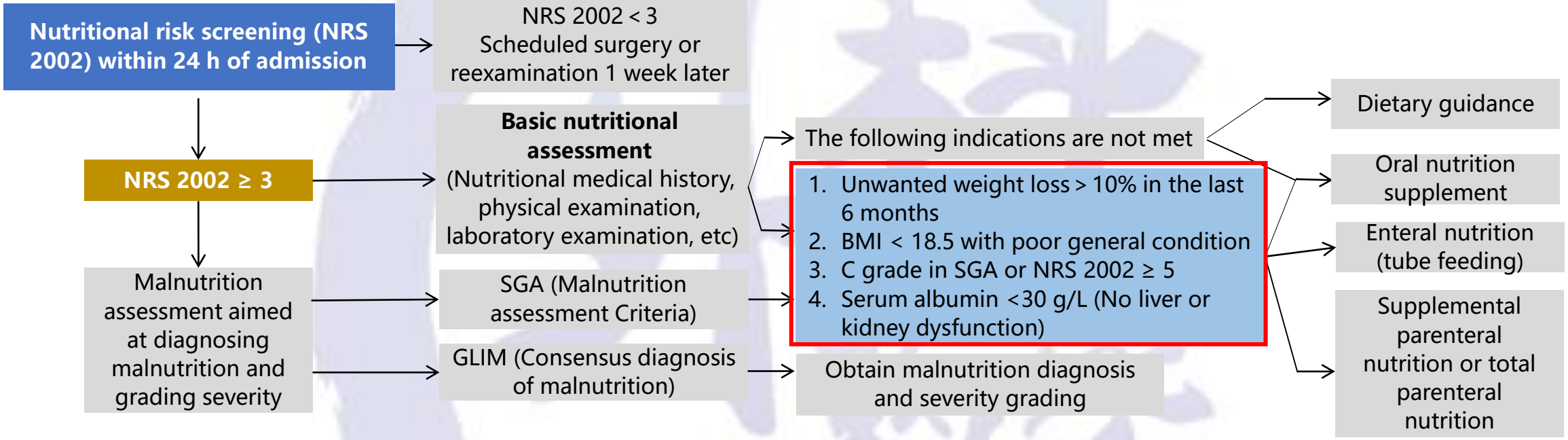
2. Preoperative Correction of Nutritional Deficiency



Correction of nutritional deficiency is recommended when feasible, as nutritional supplementation is associated with a reduction in the prevalence of infectious complications for malnourished patients

Preoperative Strategies

2. Preoperative Correction of Nutritional Deficiency



- **Identify patients at high nutritional risk:** Nutritional risk screening and assessment should be carried out on admission. Patients with severe malnutrition should be given nutritional support for 7 to 14 days before surgery with postponed surgery as recommended
- **Determine nutritional support:** ONS or EN is preferred, PN is selected only when EN cannot be implemented or when EN does not provide sufficient energy and proteins
- **Selection of energy supply and formulation:** Intacted Protein preparations are recommended for most patients
- **Determine nutritional delivery methods:** The risk of aspiration is routinely assessed. Nasogastric tube is the preferred method for EN. Feeding with retropyloric tube is recommended for patients at high risk of aspiration or who cannot tolerate gastric tube feeding

Preoperative Strategies

3. Preoperative anticoagulation and bridging

Basic situation

Blood routine (platelets, hemoglobin), coagulation index, liver function, kidney function

Past medical history

Hypertension, diabetes, nasal congestion of lower limb artery, valve replacement, atrial fibrillation, etc

Thrombosis risk factors

Deep vein thrombosis, pulmonary embolism, cerebral infarction, myocardial infarction

Bleeding risk factors

Stomach bleeding, subcutaneous ecchymosis, gum bleeding, stool bleeding, gastric ulcer

Preoperative Strategies

3. Preoperative anticoagulation and bridging

High risk factors for thrombosis:

PCI history, myocardial infarction history, preoperative unstable ACS patients, diffuse lesions in the left main trunk and blood vessels, peripheral vascular disease history, severe hyperlipidemia, diabetes history, ischemic stroke history or cerebral artery embolism history, chronic kidney disease history, excessive obesity, platelet hyperplasia, off-pump operation mode selection, etc

High risk factors for bleeding:

Advanced age、anemia, thrombocytopenia, low body mass, frailty, history of major gastrointestinal bleeding

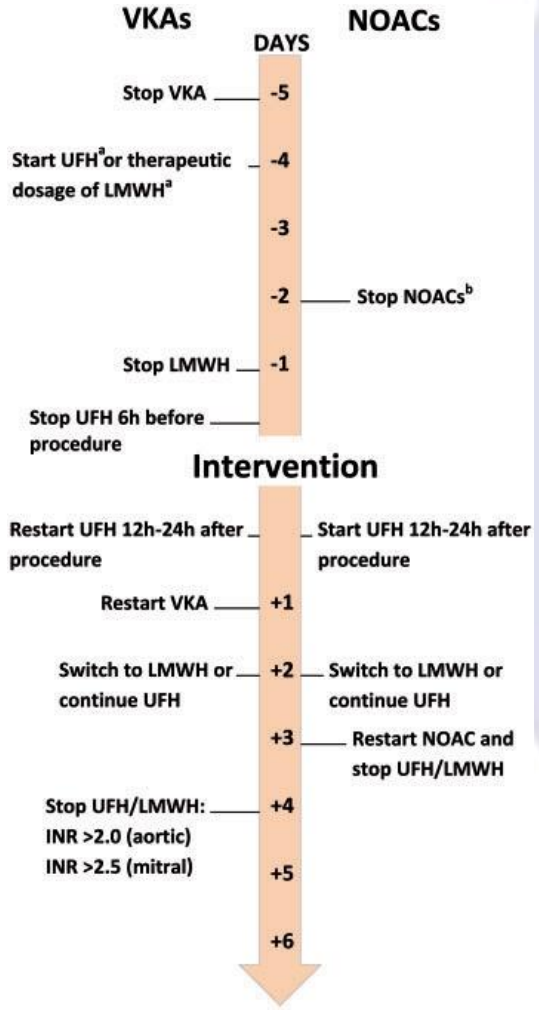
Complex surgery (combined with valve surgery/thoracic aortic surgery)

Poorly controlled hypertension history, hemorrhagic stroke history, renal failure, COPD, liver disease, etc

Perioperative thrombus and bleeding risk should be evaluated individually before operation

Preoperative Strategies

3. Preoperative antithrombotics and bridging



Bridging with oral anticoagulation

- ☑ Mechanical prosthetic heart valve
- ☑ AF with moderate to severe mitral stenosis
- ☑ AF with a CHA2DS2-VASc score >4
- ☑ Acute thrombotic event within the previous 4 weeks

UFH/LMWH

- ✓ It is recommended that VKAs be discontinued 5 days prior to surgery to aim for an INR <1.5 on the day of the elective cardiac surgery
- ✓ For patients on NOACs, preoperative discontinuation of therapy is recommended at least 48–96 hours prior to surgery, depending on renal function and the agent

Preoperative Strategies

3. Preoperative antithrombotics and bridging

	Clopidogrel	Prasugrel	Ticagrelor	Cangrelor
Bioavailability	50%	80%	36%	100%
Half-life (active metabolite)	1-2 hours	2-15 hours	7-9 hours	3-6 minutes
Binding reversibility	Irreversible	Irreversible	Reversible	Reversible
Onset of action	2-6 hours	30 minutes	30 minutes	2 minutes
Frequency of administration	Once daily	Once daily	Twice daily	Intravenous infusion
Duration of effect	3-10 days	7-10 days	3-5 days	1-2 hours
Antidote	No	No	No	No
Discontinuation before non-acute surgery	At least 5 days	At least 7 days	At least 3 days	1 hour

	Aspirin
CABG	continuing ASA throughout the preoperative period should be considered.
non-coronary cardiac surgery; high riskd of re-exploration for bleeding; patients who refuse blood transfusions	Stopping ASA at least 5 days before surgery should be considered

- ✓ In patients on DAPT who need to undergo non-emergent cardiac surgery, postponing surgery for at least 3 days after discontinuation of ticagrelor, 5 days after clopidogrel and 7 days after prasugrel should be considered
- ✓ Bridging P2Y12 inhibitors with GPIIb/IIIa inhibitors or cangrelor may be considered in high ischaemic risk patients. Discontinue GPIIb/IIIa inhibitors at least 4 hours before surgery

Preoperative Strategies

4. Preoperative education

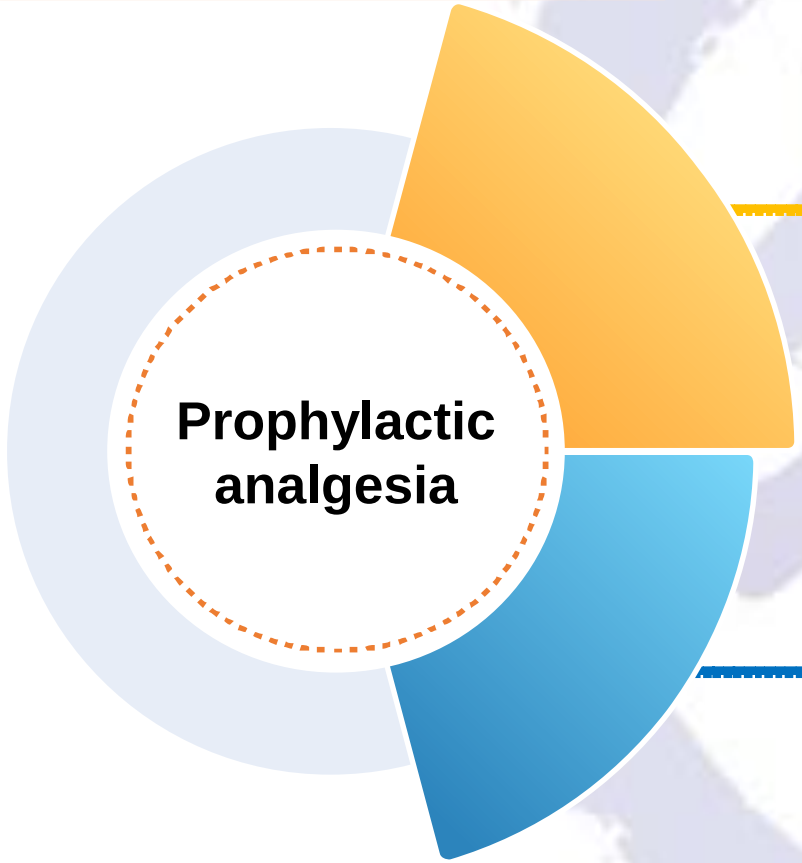
Adequate preoperative education can assist patients in understanding surgical information, alleviating their anxiety and fear, and facilitating postoperative recovery.

Preoperative Strategies

4. Preoperative education

Preoperative Strategies:Prophylactic analgesia

4. Preoperative education



Gabapentin and Pregabalin

Gabapentin and Pregabalin also decrease opioid consumption and are used in postoperative multimodal analgesia.

Selective COX-2

COX-2 inhibitors are not recommended in cardiac surgical patients.

It may be considered to start gabapentin or pregabalin before surgery as postoperative analgesic adjuvants.

1.Chou R, Gordon DB,et al.J Pain. 2016 Feb;17(2):131-57.

Preoperative Strategies

5. Preoperative discontinuation of Renin–angiotensin–aldosterone system inhibitors

RAAS inhibitors, including the ARBs and ACEIs, can also increase the risk for perioperative hypotension and vasodilatory shock ,causing decreased systemic vascular resistance. Therefore, the use of inotropes and vasopressors is increased, and the time patients spend on ventilators and in the intensive care unit (ICU) is extended.

Preoperative Strategies

5. Preoperative discontinuation of Renin–angiotensin–aldosterone system inhibitors

	Captopril	Enalapril	Lisinopril	Ramipril	Losartan	Valsartan
Mechanism of action	**ACEI**	**ACEI**	**ACEI**	**ACEI**	**ARB**	**ARB**
Half-life[a]	2 hours	35-38 hours	12 hours	13-17 hours	6-9 hours	6-9 hours
Frequency of administration	Twice or thrice daily	Once or twice daily	Once daily	Once or twice daily	Once or twice daily	Once or twice daily
Maximum dose	450 mg/day	40 mg/day	40 mg/day	20 mg/day	100 mg/day	320 mg/day
Renal excretion	95%	61%	100%	60%	4%	13%
Discontinuation before non-acute surgery	12 hours	24 hours	24 hours	24 hours	24 hours	24 hours

[a]Including the half-life of its pharmacologically active metabolite.
ACEI: angiotensin-converting enzyme inhibitor; ARB: angiotensin II receptor blocker.

- ✓ Discontinue ACEIs and ARBs preoperatively in patients undergoing cardiac surgery.
- ✓ In patients with preoperative uncontrolled arterial hypertension, switching long-acting ACEI or ARB treatment to short-acting ACEIs should be considered.

Preoperative Strategies

6. Preoperative atrial fibrillation prophylaxis

Beta-blocker therapy

Low-dose oral beta-blocker therapy, 2–3 days before cardiac surgery diffuse, and careful up-titration,according to blood pressure and heart rate, starting several daysbefore surgery

Amiodarone

Starting 5–6 days before cardiac surgery,

- ✓ The most common arrhythmia in the period after cardiac surgery is AF. It is associated with a longer hospital stay and with higher rates of strokes and mortality.
- ✓ It is also a predictor of the occurrence of AF years after surgery

Intraoperative Strategies

01

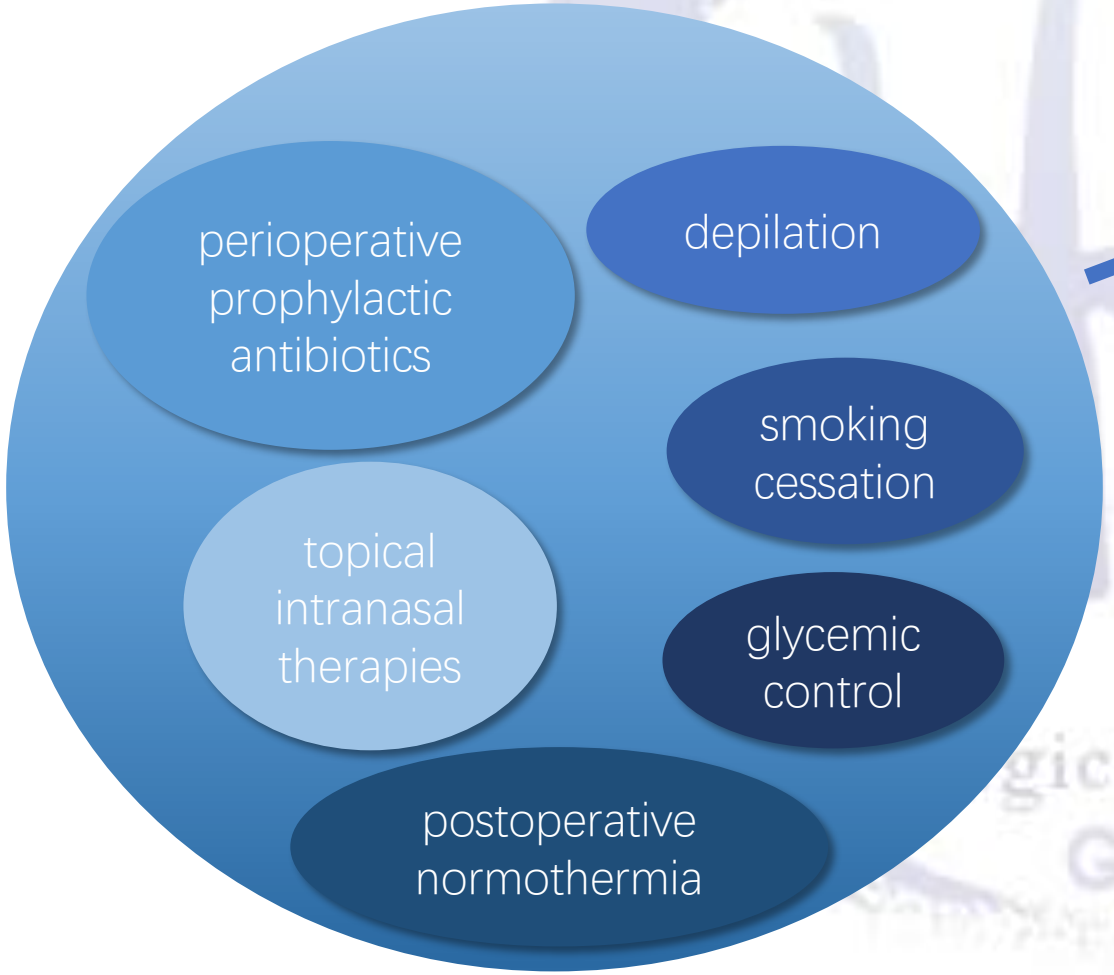
Surgical Site Infection Reduction

02

Tranexamic Acid or Epsilon Aminocaproic Acid

Intraoperative Strategies

1. Surgical Site Infection Reduction



A care bundle is recommended to reduce surgical site infections

LOE by COR	Recommendation
I	
A	Perform topical intranasal decolonization prior to surgery
A	Administer intravenous cephalosporin prophylactic antibiotic 30-60 min prior to surgery
C	Clipping (as opposed to shaving) immediately prior to surgery
IIb	
C	Use a chlorhexidine-alcohol-based solution for skin preparation before surgery
IIa	
C	Remove operative wound dressing after 48 h

Abbreviations: COR, classification of recommendation; LOE, level of evidence.

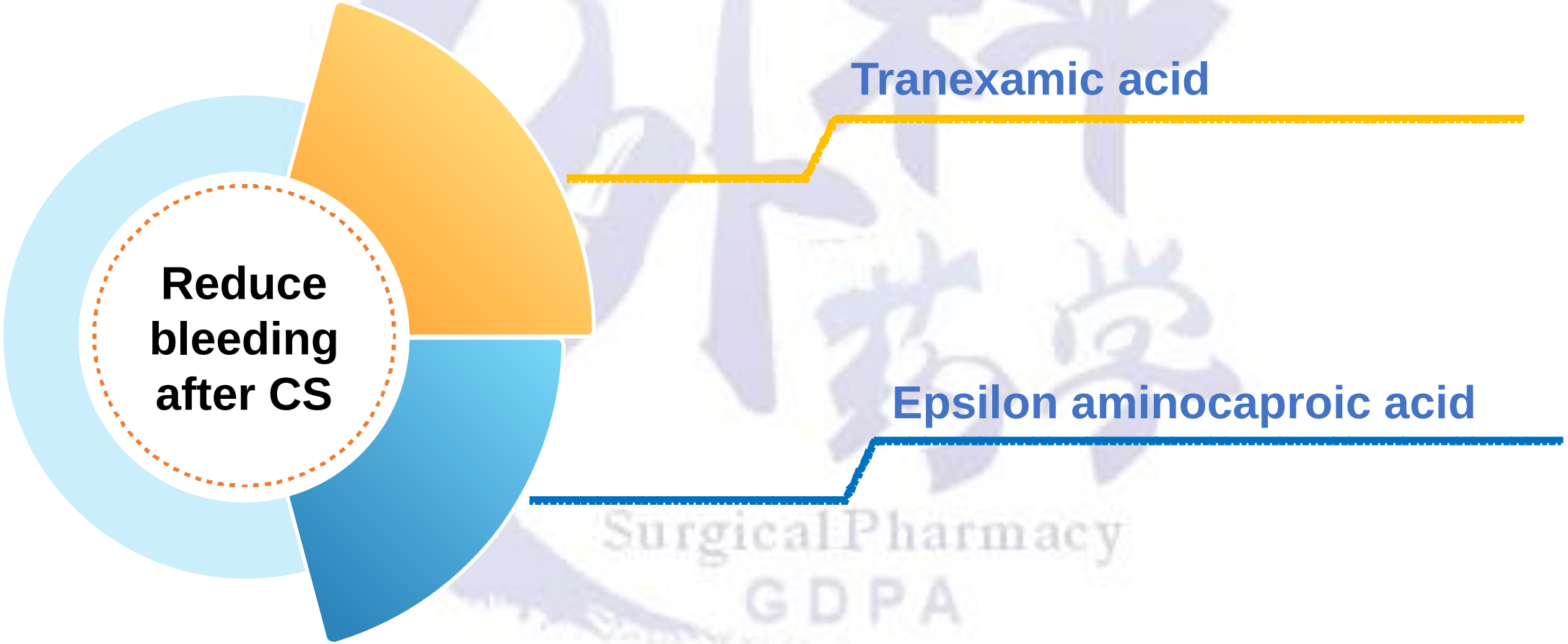
Intraoperative Strategies

1. Surgical Site Infection Reduction

Type of procedure	Recommended agents	Alternative agents in patients with ß-lactam allergy	Strength of evidence
CABG	Cefazolin, cefuroxime	Clindamycin, vancomycin	A
Cardiac device implantation (e.g. pacemaker)	Cefazolin, cefuroxime	Clindamycin, vancomycin	A
Ventricular assist devices	Cefazolin, cefuroxime	Clindamycin, vancomycin	C
Heart, lung, heart-lung transplant	Cefazolin	Clindamycin, vancomycin	A

Intraoperative Strategies

4. Tranexamic Acid or Epsilon Aminocaproic Acid

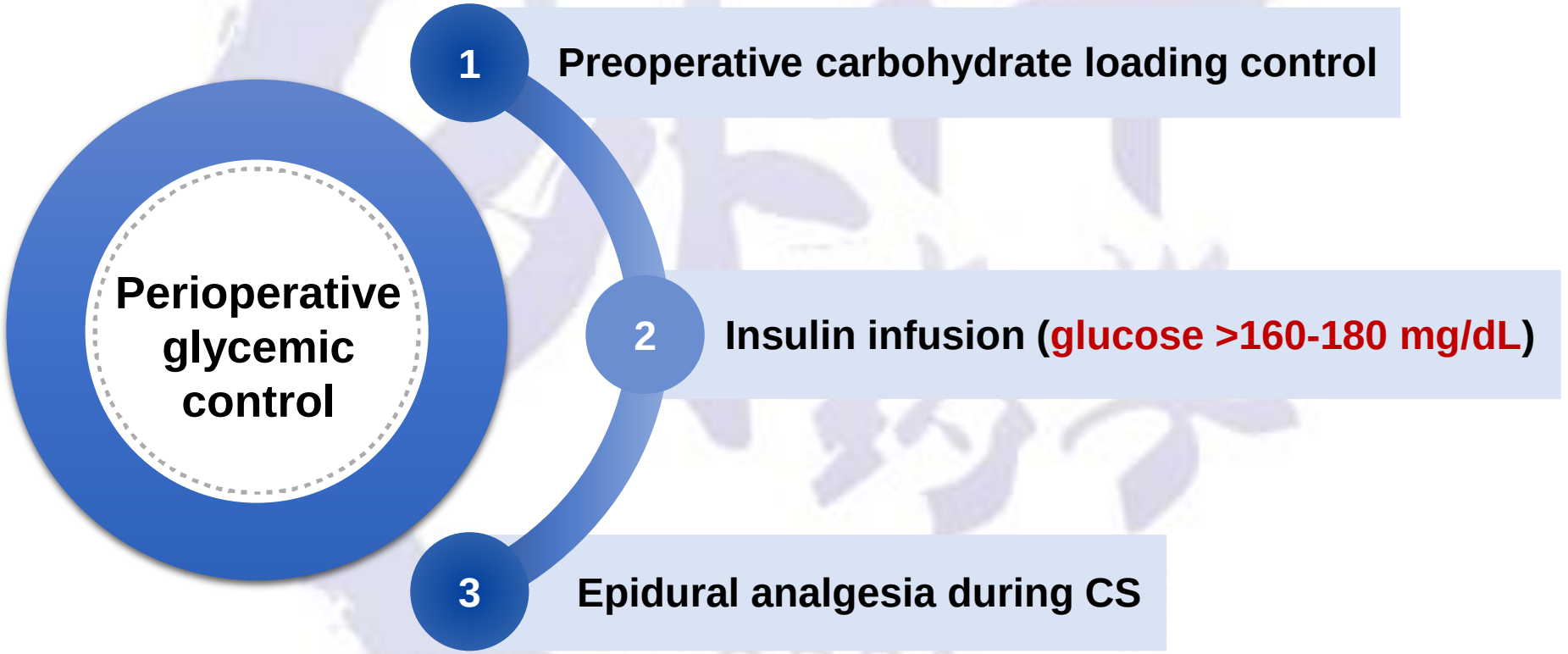


Postoperative Strategies

1. Perioperative Glycemic Control
2. Nutritionation Management
3. Postoperative antithrombotics and bridging
4. Pain Management
5. Postoperative Systematic Delirium Screening
6. Management of postoperative atrial fibrillation

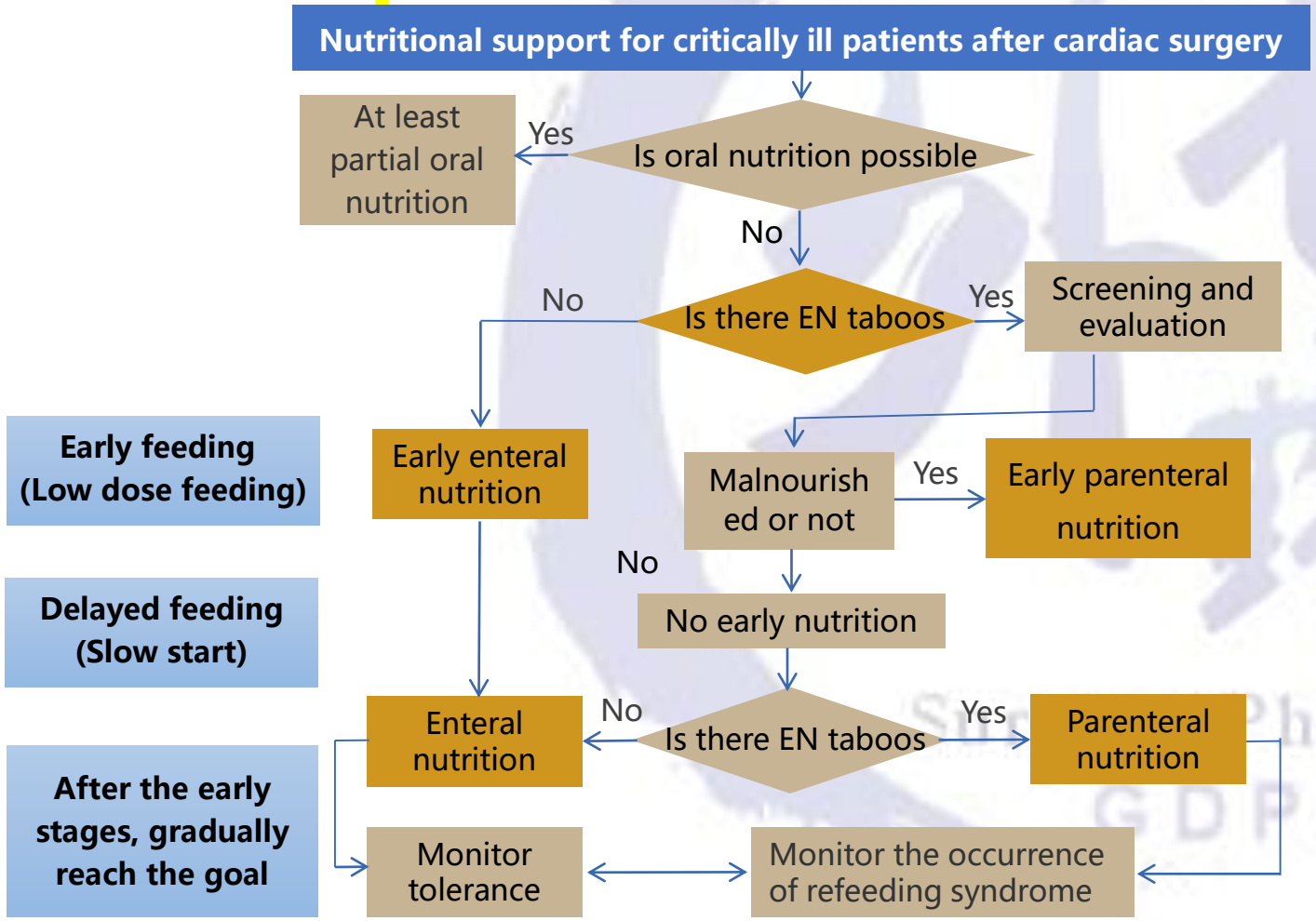
Postoperative Strategies

1. Perioperative Glycemic Control



Postoperative Strategies

2. Nutritionation Management



- Appropriate Population: Identify high-risk groups
- Appropriate Mode: EN, SPN, PN
- Appropriate Timing: Early nutrition, delayed nutrition
- Appropriate Nutritional Support Goals: Staged, individualized assessment.
- Ideal Nutritional Formulas : Individualized
- Pharmacy Monitoring: Tolerance assessment and refeeding risk monitoring

Postoperative Strategies

2. Nutritionation Management

☐ Enteral nutrition

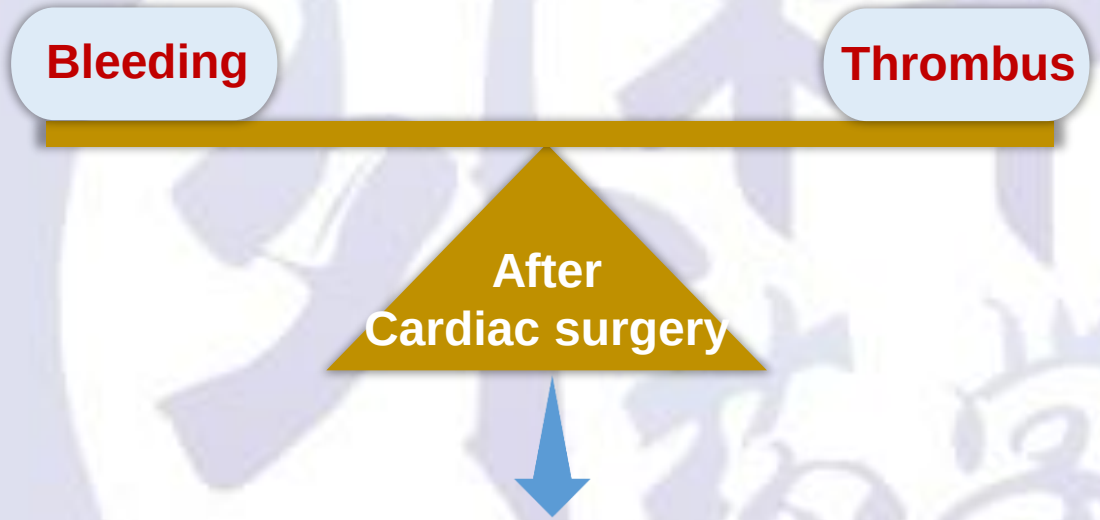
Complication	Treatment
Diarrhea	Speed (from slow to fast), concentration (from low to high), temperature (maintained at 37 ° C), timely correction of hypoproteinemia, use of short peptide preparations
Ventosity	Prevent bacterial imbalance, slow down infusion speed and reduce infusion dose
Gastric retention	Raise the head of the bed 30~40°, reduce the speed of nasal feeding, appropriate use of motility drugs, necessary gastrointestinal decompression, correct nasal feeding position, low fat formula
Constipation	Increase dietary fiber, drink plenty of water, laxatives
Metabolic disorder	Routine monitoring of blood glucose, electrolyte and selection of suitable EN preparations

☐ Parenteral nutrition

Complication	Treatment
Mechanical complications	Pneumothorax: Radiographic examination of catheter positionCatheter occlusion: Add heparinVenous thrombosis: Reduce glucose concentration and add a small amount of cortisol or heparin
Metabolic complications	Hyperglycemia/hypoglycemia: Appropriate glucose concentration, adjust insulin dosage Electrolyte imbalance: Adjust electrolyte intake Hyperlipidemia: Reduce or stop fatty milk
Infection complications	Catheter-associated infections: strictly follow aseptic procedures, reduce multiple use of catheters, and strengthen catheter care

Postoperative Strategies

3. Postoperative antithrombotics and bridging



Pharmacological prophylaxisfor for vascular thrombotic events should be used as soon as satisfactory hemostasis has been achieved (most commonly on postoperative day 1 through discharge)

Overall approach to perioperative antithrombotic drug management in cardiac surgery

Thrombosis and bleeding were monitored throughout perioperative period

1. Assess patients' underlying diseases and past medical history
2. Assess the risk of bleeding and ischemia based on the patient's basic condition
3. Assess the patients' medication history and whether they have used anticoagulant and antiplatelet drugs
4. According to the risk of bleeding and ischemia, evaluate whether antiplatelet and anticoagulant drugs should be stopped during perioperative period, when to stop the drugs, and whether bridging therapy is required
5. Evaluate the timing of postoperative restart of antiplatelet agents, the type of P_2Y_{12} receptor inhibitors and the duration of treatment
6. Assess whether patients have other anticoagulation indications and whether combination therapy with anticoagulants is necessary

Postoperative Strategies

4. Pain Management

Adverse effects

- Sedation
- Respiratory depression
- Nausea
- Vomiting and ileus

Parenteral Opioids

Additive or synergistic effects of different types of analgesics

- Acetaminophen
- Tramadol
- Dexmedetomidine
- Pregabalin, etc

Multimodal opioid-sparing approaches

Ensure the lowest effective opioid dose

Postoperative Strategies

4. Pain Management

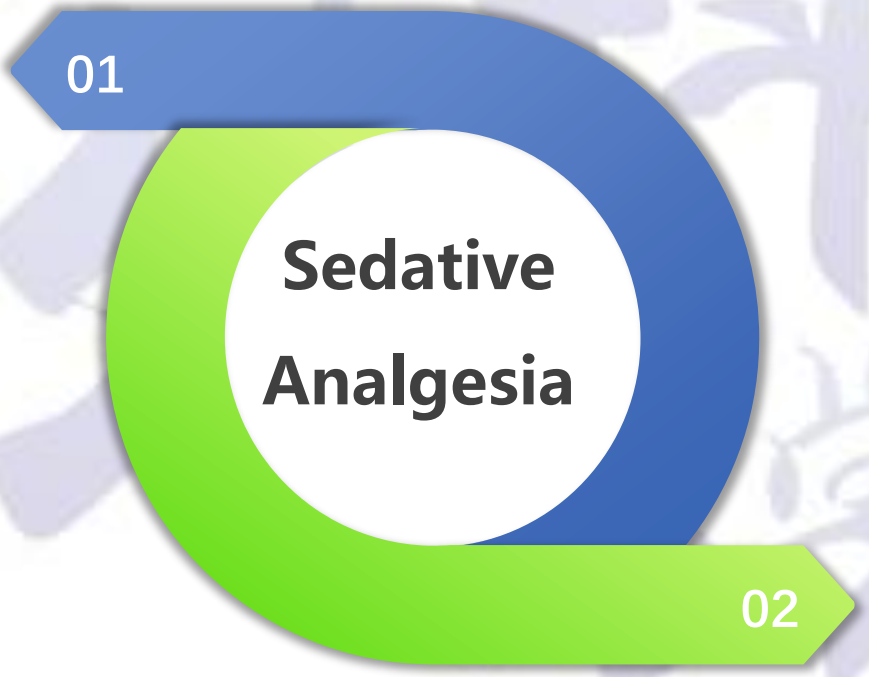
Cardiac Intensive Care Unit

Sedation assessment tools:

RASS、SAS

Sedative Medications：

Diazepam、Midazolam、Propofol、Dexmedetomidine



Pain assessment tools:

BPS、CPOT

Opiate Analgesics:

Morphine、Fentanyl、Hydromorphone、Remifentanil

Surgical Pharmacist:metabolic characteristics 、 hemodynamic、Adverse effects, etc

Postoperative Strategies

4. Pain Management

Medicine	Analgesia	Sedative	Loading dose	Maintenance dose	BP	HR	Comment
Diazepam	–	Not suitable for continuous sedation			↓		Diazepam's extended half-life complicates the attainment of a "mild sedation" approach, rendering it an unsuitable choice for initial sedation therapy.
Midazolam	–	+ + +	1-5mg	1-5mg/h	↓	↑	Has little effect on blood circulation。
Propofol	–	+ + +	1-3mg/kg	0.3-4mg/kg/h	↓↓	↓↑-	Be cautious: hypertriglyceridaemia
Dexmedeto-midine	+	+ +	0.2-1.5μg/kg/h		↓↑	↓	It can prevent and treat delirium with little effect on circulation
Morphine	+ + +	–	2-5mg	1-5mg/h	↓		Morphine augments coronary blood flow, rendering it beneficial in heart failure cases. It also induces a moderate histamine release.
Fentanyl	+ + +	–	50-100μg	20-100μg/h	↓		Patients have a lower risk of hypotension with fentanyl than with morphine.
Remifentanil	+ + +	–			↓		The administration of high-dose remifentanil prior to CABG may enhance myocardial protection.

Postoperative Strategies

4. Pain Management

Medicine	Interacting drugs	Pharmaceutical care(PC)
Morphine **Fentanyl** **Remifentanil** **……**	Cyp3a4 enzyme inhibitor: **Amiodarone**	Respiratory depression was monitored closely, and doses of opioids and amiodarone were reduced as needed.
	P-glycoprotein inhibitors: **Amiodarone、 Diltiazem、** **PPI（Esomeprazole、Omeprazole、Pantoprazole）**	Monitor respiratory depression symptoms, adjust opioid and amiodarone/diltiazem doses to reduce them.
	Neuroinhibitory drugs: **Benzodiazepines、Sedative drugs、Anesthetic drugs, etc**	Administer smallest dosage, opt for shortest duration, monitor for respiratory depression and sedation.
	NMBAs	Observe for respiratory suppression, adjust dosages.
	P_2Y_{12} inhibitors: **Clopidogrel（po）**	Consider non-oral administration.

Postoperative Strategies

5. Postoperative Systematic Delirium Screening

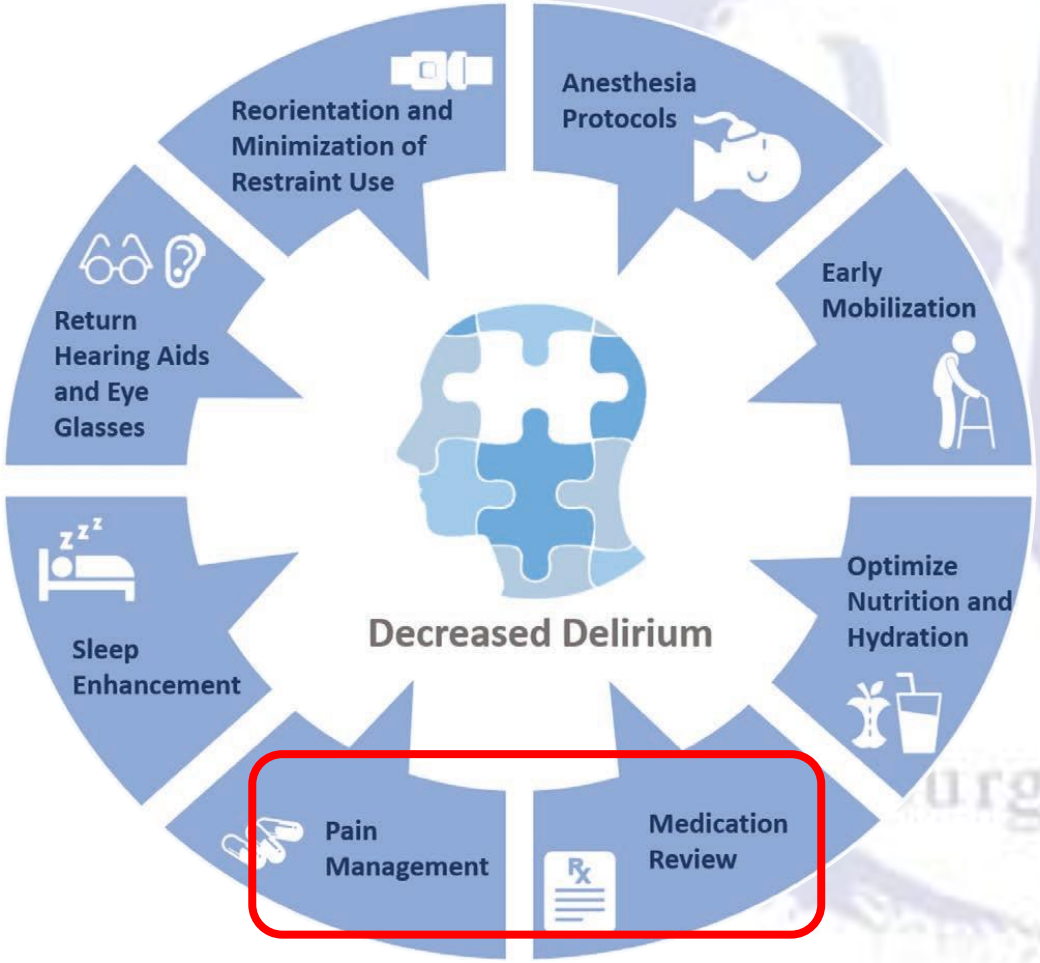
Delirium occurs in approximately 10%-50% of patients after CS and can be as high as 80% in postoperative intensive care units.

Routine delirium screening is recommended at least **once per nursing shift** to identify patients at risk

Facilitating implementation of prevention and treatment protocols

Postoperative Strategies

5. Postoperative Systematic Delirium Screening



Multicomponent interventions to decrease postop erative delirium

- ✓ Postoperative pain control
- ✓ Minimization of medications known to be associated with an increased risk of ostoperative delirium in older high-risk surgical patients

Table 3. Precipitating Factors Associated With Postoperative Delirium

Identified Precipitating Factors		
Intraoperative Aspects	**Postoperative Issues**	**Medication Exposure**
Surgical complexity	Anemia	Benzodiazepines
Surgical duration	Pain	Diphenhydramine
Surgical approach	Sleep disturbances	Scopolamine
Cardiopulmonary bypass	Renal insufficiency	Ketamine
Transfusion	Atrial fibrillation	Meperidine
Blood pressure	Infection	Morphine
Glycemic control	Hypoxemia	Zolpidem
Depth of sedation/ burst suppression	Mechanical ventilation	Histamine-receptor antagonists

Postoperative Strategies

6. Management of postoperative atrial fibrillation

rhythm control

postoperative haemodynamically stable POAF

restore sinus rhythm

postoperative haemodynamically unstable POAF

cardioversion and antiarrhythmic drugs

Anticoagulation

- ✓ **Therapeutic doses of UFH or LMWH**
- ✓ **within 12–48 hours**

In patients at discharge: initiate OAC therapy and continue for at least 4 weeks (or longer), depending on the CHA2DS2-VASc risk score.

MTMs case sharing

Chief complaint

Intermittent chest tightness, edema of both lower limbs for more than 10 years, aggravated for 7 months.

Admission diagnosis

1. Severe mitral regurgitation; 2. Heart function level Ⅲ; 3. Atrial fibrillation

Personal History

No special medical history, family history, personal history, denying food and drug allergy history

Patient underwent mechanical mitral valve replacement surgery on December 29, 2023

After mechanical mitral valve replacement, long-term oral warfarin anticoagulation is required to maintain INR 1.8-2.5 (Chinese population), and reduce the occurrence of mechanical valve thrombosis and systemic thromboembolic events

MTMs case sharing

Cardiac Intensive Care Unit

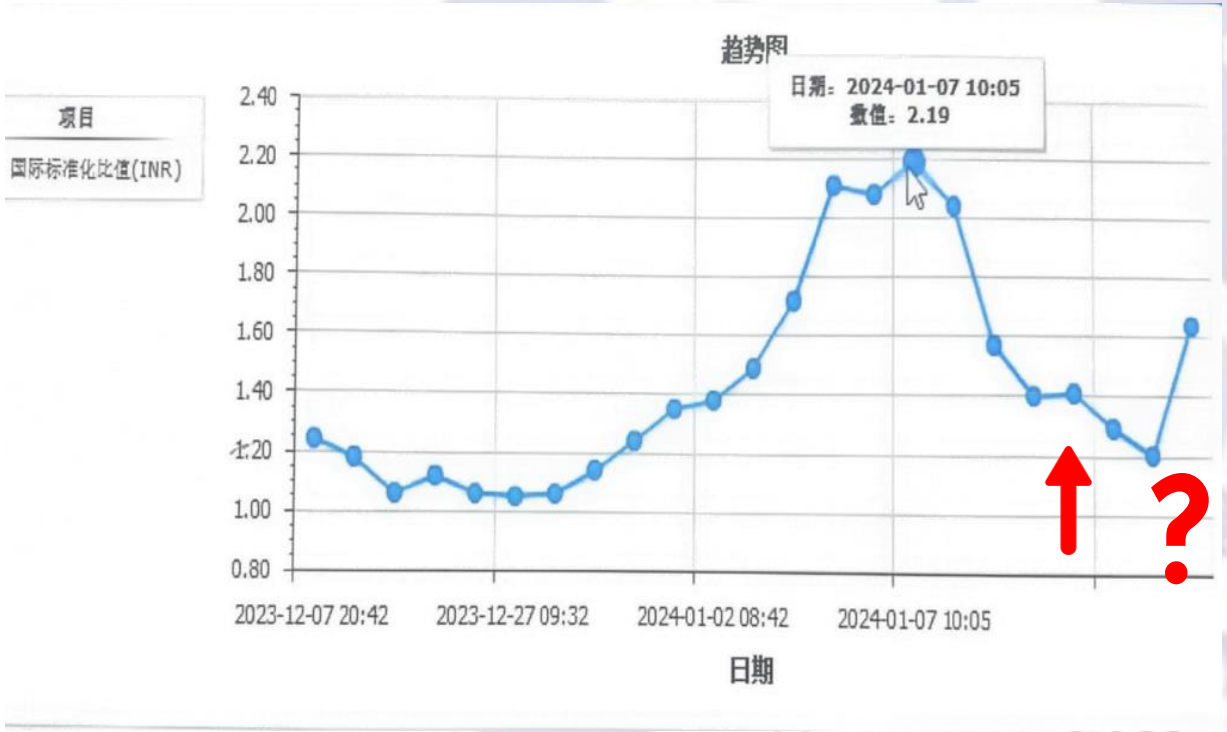
Sedative & Analgesia	Maintenance dose
Dexmedetomidine	0.6μg/kg/h
Remifentanil	2.4μg/kg/h

Pharmaceutical care(PC):

- Heart function level Ⅲ
- Dexmedetomidine may induce a slowing of heart rate

Dexmedetomidine → **Propofol：** Loading dose: 1-3 mg/kg
Maintenance dose: 0.3-4.0 mg/kg/h

MTMs case sharing



The patient's INR briefly reached the target range after surgery but then dropped and failed to rise again for a consecutive week.

Clinical pharmacists' analysis of drug combination:

- ✓ **Bailing capsule**
- ✓ **Jinqiao Reduqing granules**

MTMs case sharing

Enhance

- Medicine: **amiodarone**, **antifungal drugs**, **metronidazole**, sulfonamides, macrolides, tamoxifen, fluvastatin, aspirin, non-steroidal anti-inflammatory drugs, heparin
- Traditional Chinese medicine / Phytomedicine: Notoginseng, Ginkgo biloba, salvia miltiorrhiza, Angelica, safflower, Chuanxiong, etc
- Food: **Grapefruit**, mango, pomegranate, cranberry, fungus, etc

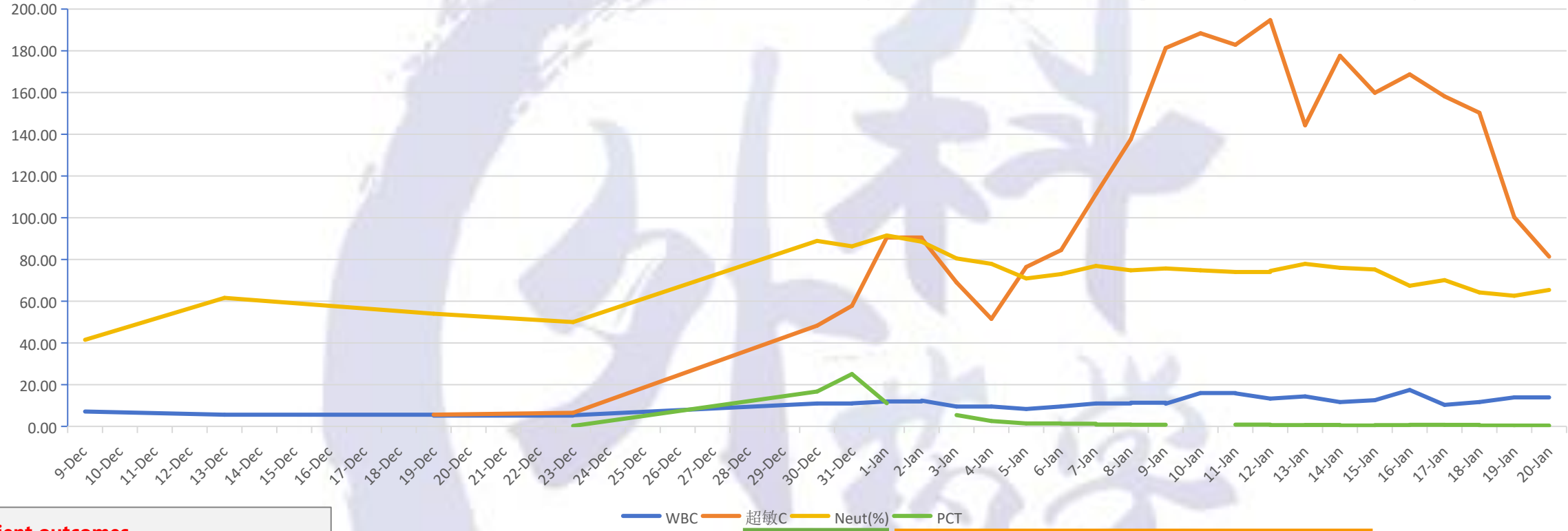
Weaken

- Medicine: **rifampicin**, **carbamazepine**, **vitamins**, barbiturates
- Traditional Chinese medicine / Phytomedicine : **St. John’ s Wort** , ginseng, American ginseng, forsythia
- Food: **Broccoli**, avocados and other green vegetables and fruits; Beans and soy products; Animal viscera

Aim for a balanced diet and maintain a consistent eating pattern and structure

Postoperative anti-infection therapy

The patient had fever, cough and sputum after operation



Patient outcomes

After clinical pharmacists participated in the whole process of antibacterial consultation and adjusted the antimicrobial treatment plan, the patient's PCT dropped to the normal range, clinical symptoms improved and was discharged .

Cefuroxime 1.5g q8h

Piperacillin 4.5g q8h

Tigacycline 50mg q12h

Vancomycin 0.5g q12h

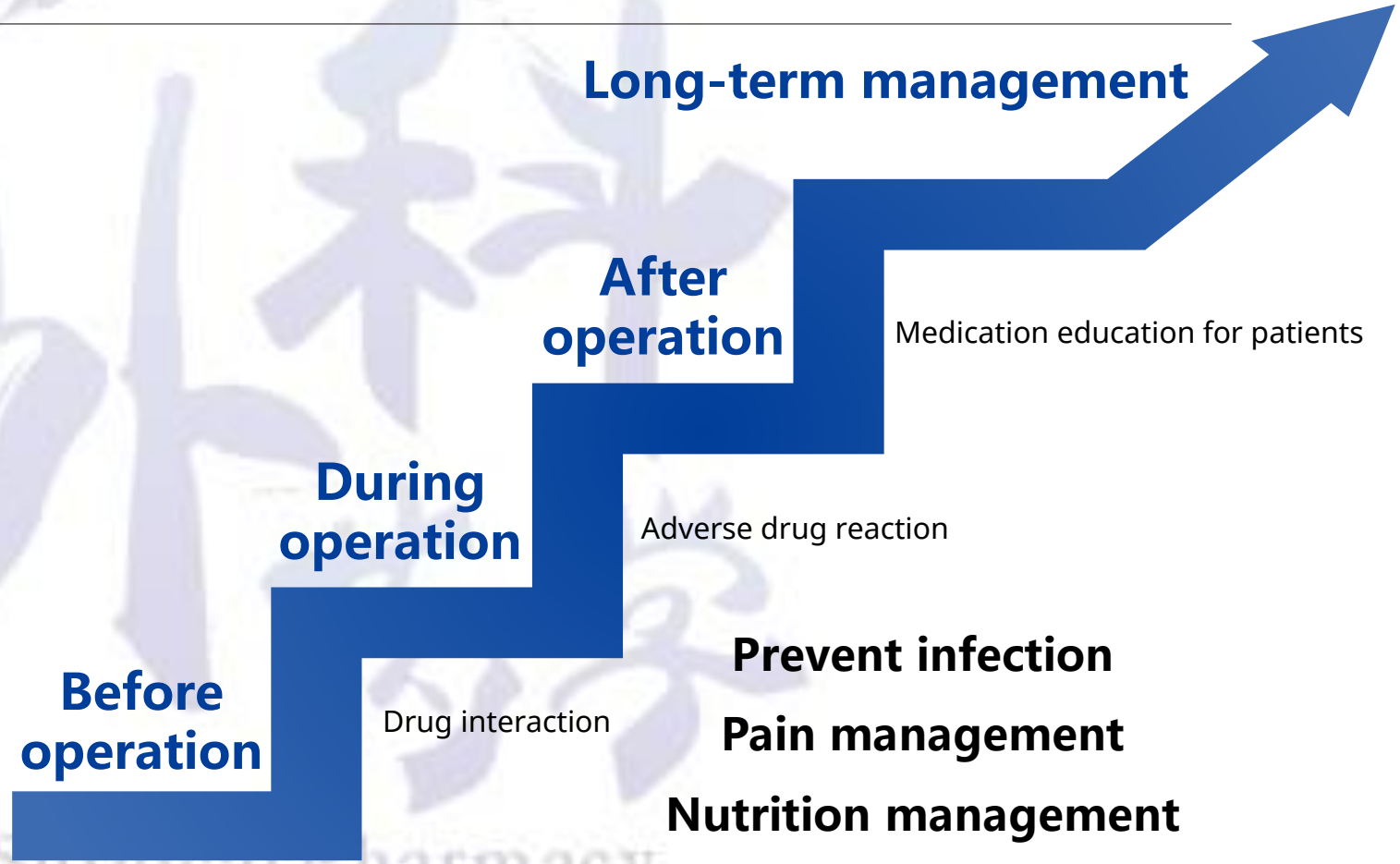
Polymyxin E 150mg bid (Atomization)

Butanicana 0.1g qd

Conclusions

Surgical pharmacist

- Surgical pharmacists ensure the safety of patients' entire perioperative drug therapy by optimizing drug selection and use, providing patients with whole-process drug therapy management services, including medication education, consultation and guidance, and drug restructuring, etc., improving patients' medication compliance and reducing drug-related adverse events.
- Surgical pharmacists can promote perioperative rehabilitation of patients, reduce complications, shorten hospital stay, improve treatment effect, improve medical quality and control medical costs.



THANK YOU