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Medication risks and clinical management of metoprolol in elderly patients

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Introduction

Metoprolol, a representative β-blocker, plays a central role in the treatment of various cardiovascular diseases such as coronary heart disease, hypertension, arrhythmia, and chronic heart failure. By selectively blocking β1 receptors in the heart, it slows heart rate, reduces myocardial oxygen consumption, and inhibits excessive sympathetic activation, thereby significantly improving patient prognosis. However, due to natural physiological decline, elderly patients often have decreased liver and kidney function, reduced basal metabolic rate, and multiple chronic comorbidities such as diabetes, Chronic Obstructive Pulmonary Disease (COPD), and peripheral vascular disease. These factors lead to weakened drug metabolism and clearance, significantly increasing the risk of adverse reactions. In addition, elderly patients are more sensitive to drugs, and conventional doses may cause serious problems such as bradycardia, hypotension, bronchospasm, and glucose metabolism disorders. Therefore, this article analyzes the medication risks of metoprolol in elderly patients through two typical cases and proposes individualized clinical management strategies based on evidence-based medicine to provide references for clinical rational drug use.

Case 1: Retinal artery occlusion induced by bradycardia

Case background

A 76-year-old male patient with coronary heart disease was admitted to the hospital due to repeated chest pain. The doctor prescribed metoprolol (25 mg bid) to control heart rate, but the patient's baseline heart rate was only 52 beats/min. After one month of medication, the patient suddenly experienced a significant decrease in vision in the right eye, and fundus examination confirmed central retinal artery occlusion.

Mechanism analysis

Excessive inhibition of heart rate: Metoprolol slows heart rate by blocking β1 receptors. After medication, the patient's heart rate dropped to 46 beats/min, leading to a sharp decrease in ocular artery perfusion pressure.

Thrombotic risk: Low heart rate may activate the renin-angiotensin system, promote platelet aggregation, and combined with the patient's hyperlipidemia, ultimately leading to retinal artery thrombosis.

Neglect of contraindications: The patient did not undergo a complete electrocardiogram examination upon admission, and the doctor did not fully evaluate his baseline heart rate and conduction function, resulting in a medication dose exceeding the safety threshold.

Clinical implications

Pre-medication assessment: Elderly patients need to complete a 24-hour ambulatory electrocardiogram before medication to determine sinus node function and conduction blockage. Individualized dosage: For patients with a baseline heart rate <60 beats/min, the starting dose should be 1/4 of the conventional dose (6.25 mg), gradually increased to the target dose, or other drugs should be considered. Monitoring indicators: During medication, resting heart rate should be monitored daily, with a target range of 55-65 beats/min. If it remains <50 beats/min, medication should be stopped immediately.

Case 2: β-Blocker induced glucose metabolism disorders

Case background

A 70-year-old female patient with unstable angina pectoris received metoprolol (47.5 mg qd) treatment. Her blood glucose level before medication was 6.5 mmol/L. After one year, the patient's fasting blood glucose level was 9.8 mmol/L, and the glycosylated hemoglobin (HbA1c) level was 7.5%.

Mechanism analysis

Inhibition of insulin secretion: β-blockers can block β2 receptors on pancreatic β cells, reducing insulin release. After medication, the peak postprandial insulin secretion in this patient decreased by 38%.

Peripheral insulin resistance: The drug inhibits fat decomposition and reduces the release of free fatty acids, indirectly exacerbating insulin resistance.

Clinical implications

Optimization of drug selection: Patients with diabetes should prioritize β1 receptor-selective blockers with less metabolic effects (such as bisoprolol) or carvedilol, which has both α and β receptor-blocking effects.

Enhanced blood glucose monitoring: Blood glucose levels, including fasting and 2-hour postprandial blood glucose, as well as HbA1c, should be monitored daily during the initial medication period. If blood glucose levels rise or HbA1c increases by >1%, the hypoglycemic regimen should be adjusted or the medication regimen should be considered changed.

Summary

Accurate Selection of Indications and Contraindications: Severe bradycardia (<50 beats/min), second-degree or higher atrioventricular block, and acute asthma attacks are contraindications. Diabetes with poor metabolic control, Chronic Obstructive Pulmonary Disease (COPD), and peripheral vascular disease require caution.

Dynamic dose adjustment

The starting dose for elderly patients is recommended to be 1/4-1/2 of the conventional dose, such as metoprolol tablet 6.25 mg bid. The adjustment cycle is every 2-4 weeks, with each increment not exceeding 12.5 mg, until the target heart rate or maximum tolerated dose is reached. Withdrawal principle: If severe bradycardia, worsening heart failure, or bronchospasm occur, the dose should be gradually reduced and discontinued within 2 weeks to avoid rebound sympathetic excitement.

Multidimensional monitoring system

Heart rate monitoring: Measure and record the resting heart rate every morning after waking up. Metabolic indicators: Diabetic patients should test HbA1c every 3 months and evaluate liver and kidney function every 6 months. Symptom warning: Educate patients to identify adverse reactions such as dizziness, fatigue, and difficulty breathing. Seek medical attention immediately if new symptoms occur.

Drug interaction management

Avoid concomitant use with verapamil and diltiazem to prevent severe bradycardia and heart failure. Concomitant monitoring: When used concomitantly with insulin and other hypoglycemic agents, blood glucose and HbA1c should be monitored regularly, and the dose should be adjusted appropriately to control both coronary heart disease and diabetes well.

Discussion

The use of metoprolol in elderly patients requires extra caution. Although its pharmacological effects are significant in the treatment of cardiovascular diseases, the physiological characteristics of the elderly population determine that its medication risks are higher. Elderly patients often have decreased liver and kidney function, reduced basal metabolic rate, and multiple comorbidities, which weaken drug metabolism and clearance, easily leading to drug accumulation and increasing the risk of adverse reactions. For example, the patient in Case 1 had a low baseline heart rate and developed severe bradycardia after using a conventional dose, eventually leading to retinal artery occlusion. This suggests that clinicians should fully evaluate the patient's cardiovascular function before medication to avoid contraindications and cautionary situations. In addition, Case 2 demonstrates the potential impact of metoprolol on glucose metabolism. β-blockers can inhibit insulin secretion and exacerbate insulin resistance, which may make it more difficult for diabetic patients to control their blood sugar levels. Therefore, in clinical practice, for elderly patients with diabetes, β1 receptor-selective blockers with less metabolic effects should be prioritized, and blood glucose monitoring should be strengthened to adjust treatment regimens in a timely manner.

From the perspective of clinical management strategies, medication for elderly patients should follow the principles of "individualization, small doses, slow adjustments, and strict monitoring." Individualized medication not only includes adjusting the dose according to the patient's physiological characteristics but also considers their comorbidities and concomitant medications. For example, for patients with COPD, non-selective β-blockers should be avoided to prevent bronchospasm. At the same time, the management of drug interactions is crucial, such as avoiding the concomitant use of calcium channel blockers such as verapamil and diltiazem to prevent severe bradycardia or heart failure. In the future, with the development of precision medicine, individualized medication models based on physiological age, organ function, and genetic polymorphism are expected to further optimize medication regimens for elderly patients. Through dynamic monitoring and patient education, clinicians can better balance efficacy and safety, maximize the therapeutic effect of metoprolol, and reduce the risk of adverse reactions.

Conclusion

The application of metoprolol in elderly patients should follow the principles of "individualization, small doses, slow adjustments, and strict monitoring." Clinicians should fully assess the patient's baseline heart rate, metabolic status, and comorbidities and achieve precise medication through tools such as dynamic electrocardiograms and blood glucose monitoring. At the same time, strengthening patient education and improving their ability to identify adverse drug reactions are key to ensuring medication safety. Establishing an individualized medication model based on physiological age, organ function, etc., can maximize drug efficacy and reduce risks.

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