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Clinical Treatment Observation of Elderly Patients with Chronic Cor Pulmonale Combined with Coronary Artery Disease

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Abstract: *As populations age worldwide, chronic cor pulmonale and coronary artery disease frequently coexist in elderly patients, with each condition exacerbating the other's pathophysiology, leading to more complex clinical presentations and greater therapeutic challenges. In this conceptual study, we propose an integrated clinical-observation framework for managing elderly patients who have both chronic cor pulmonale and coronary artery disease. Drawing on four key dimensions—pathophysiological characteristics, diagnostic and assessment indices, treatment-plan design, and efficacy-monitoring methods—we outline a systematic intervention strategy and evaluation model. By synthesizing existing literature, we identify the critical interaction targets between respiratory and cardiovascular systems and, guided by evidence-based principles, recommend a personalized combination of pharmacological therapies (including diuretics, β-blockers, and agents targeting pulmonary hypertension), non-pharmacological interventions (pulmonary rehabilitation, nutritional support), and, when appropriate, cardiac interventional or surgical procedures. Within this conceptual framework, we establish core efficacy metrics centered on exercise tolerance, hemodynamic parameters, and quality-of-life assessments to inform future clinical trials. Our findings suggest that a structured, multidisciplinary treatment approach may significantly improve cardiopulmonary function, reduce hospitalization rates, and enhance quality of life in elderly patients, while providing theoretical and practical guidance for clinical decision-making and guideline development.*

Keywords: *Elderly patients; Chronic cor pulmonale; Coronary artery disease; Clinical treatment; Conceptual research · Efficacy monitoring*

1. Introduction

With the global trend toward an aging population, the burden of cardiopulmonary diseases among the elderly continues to rise, and chronic cor pulmonale often presents concurrently with coronary artery disease. Pathophysiologically, pulmonary hypertension increases right-heart workload and worsens myocardial ischemia, while insufficient coronary perfusion further impairs pulmonary circulation, creating a more complex and variable clinical picture. Existing studies tend to focus on the management of either condition in isolation, lacking a comprehensive observational framework for patients with both diseases. Such an absence of an integrated approach limits clinical guidance. In response, this study aims to develop a conceptual clinical-observation system for elderly patients with chronic cor pulmonale combined with coronary artery disease, clarifying key pathophysiological targets, diagnostic and assessment criteria, and intervention strategies. We also propose an efficacy-evaluation model centered on exercise tolerance, hemodynamics, and quality of life, laying the theoretical groundwork for multidisciplinary care and future empirical research.

2. Literature Review

2.1. Progress in Research on Elderly Chronic Cor Pulmonale

Over the past decade, research on elderly chronic cor pulmonale has evolved from purely elucidating its pathophysiology to optimizing clinical management strategies and establishing multidisciplinary care models. Epidemiological surveys reveal that, as populations age, the incidence of right-heart failure caused by primary pulmonary diseases (such as COPD, pulmonary fibrosis, and pulmonary hypertension) has risen markedly, and elderly patients face a substantially higher risk of

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concurrent cardiovascular disease than younger groups. Pathophysiological studies show that sustained elevation of pulmonary arterial pressure not only induces right ventricular hypertrophy and dilation, but also—via inflammatory mediators and oxidative-stress pathways—accelerates myocardial fibrosis and disrupts coronary microcirculation. Recent advances in cardiac magnetic resonance imaging (CMR) and three-dimensional echocardiography have enabled earlier detection of right-ventricular dysfunction and pulmonary hemodynamic changes[1].

On the molecular and biomarker front, prospective cohort studies confirm that levels of B-type natriuretic peptide (BNP) and its precursor NT-proBNP correlate closely with the severity and prognosis of right-heart failure, while measurements of cardiac troponin, interleukin-6, and tumor necrosis factor-α help gauge the inflammatory activity of chronic cor pulmonale. Recognizing the diminished physiological reserve in elderly patients, researchers have combined cardiopulmonary exercise testing (CPET) with the six-minute walk test (6MWT) to refine functional stratification and risk scoring. In therapeutic investigations, small trials have shown that diuretics paired with potent vasodilators (e.g., nitrates, calcium-channel blockers) may improve both pre- and after-load on the right heart, and preliminary studies of pulmonary rehabilitation, long-term home oxygen therapy, and nutritional interventions suggest dual benefits in exercise capacity and quality of life. Yet, owing to the confounding effects of multiple comorbidities in the elderly, large-scale, multicenter randomized trials are still needed to verify the safety and efficacy of optimal intervention combinations. Future research should focus on precise assessment, individualized treatment, and long-term follow-up to furnish more actionable evidence for clinical practice[2].

2.2. Clinical Features and Research Status of Combined Coronary Artery Disease

Elderly patients with chronic cor pulmonale who also have coronary artery disease exhibit symptoms of right-heart failure—such as progressive dyspnea, jugular-venous distension, hepatomegaly, and lower-limb edema—alongside manifestations of myocardial ischemia, including angina and arrhythmias. The overlapping pathophysiology of these conditions complicates diagnosis and treatment: respiratory symptoms can mask cardiac chest pain, while non-specific ECG changes may be misattributed to hypoxia, delaying timely coronary intervention. Imaging tools like echocardiography can assess right-ventricular hypertrophy, dilation, and left-ventricular function but cannot directly visualize coronary lesions; coronary CTA and CMR offer more comprehensive anatomical and functional insights but are limited by contrast tolerance and patient cooperation[3].

Retrospective cohort studies indicate that patients with both conditions have higher rates of hospitalization, rehospitalization, and all-cause mortality compared to those with isolated cor pulmonale. Key risk factors include prior myocardial infarction, hypertension, hyperlipidemia, and long-term smoking. Small randomized trials have explored the safety and efficacy of β-blockers and ACE inhibitors/ARBs in this population, though clinicians remain cautious about potential negative effects of β-blockade on right-ventricular function[4]. Interventional approaches such as percutaneous coronary intervention (PCI) have demonstrated short-term safety in patients with severe pulmonary hypertension, but long-term data on cardiopulmonary endurance and quality-of-life outcomes are lacking.

Overall, systematic, multidisciplinary treatment protocols for elderly patients with both chronic cor pulmonale and coronary artery disease remain nascent. Current guidelines treat these diseases separately, and high-quality, large-scale clinical trials tailored to this comorbid population are scarce. Future investigations should deepen exploration of precise imaging assessments, personalized drug-and-intervention combinations, right-ventricular-protective strategies, and rehabilitation-based models to establish a comprehensive treatment framework that balances right- and left-heart function while addressing both respiratory and hemodynamic needs[5].

3. Pathophysiological Mechanism and Diagnostic Evaluation

3.1. Pathophysiological Mechanism Analysis

As illustrated in Figure 1, in a healthy state the pulmonary vascular bed (right panel) maintains an appropriate balance of resistance and compliance, so that right-ventricular wall thickness and chamber volume stay in harmony and cardiopulmonary function operates efficiently. By contrast, in chronic pulmonary hypertension (left panel), prolonged hypoxia and inflammatory mediators injure the pulmonary endothelium, triggering excessive proliferation of vascular smooth muscle cells and intimal

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fibrosis. This remodeling sharply increases pulmonary vascular resistance[6]. To overcome the elevated afterload, the right ventricle undergoes compensatory hypertrophy and dilation; the interventricular septum shifts leftward, impairing left-ventricular filling and ejection, and thereby reducing systemic cardiac output.

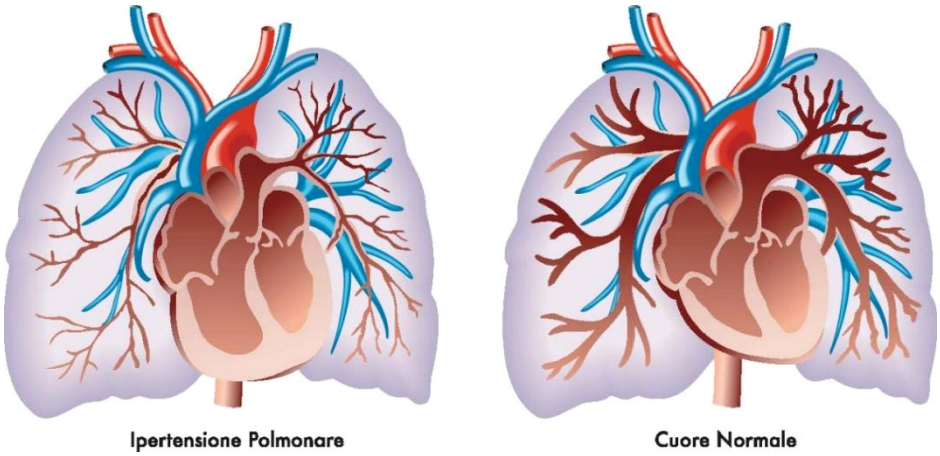

Figure 1 Schematic Comparison of Pulmonary Hypertension and Normal Cardiac Structure

At the same time, hypoxia-induced oxidative stress and neurohormonal activation (sympathetic nervous system and RAAS) elevate endothelin-1 levels, further promoting vasoconstriction and myocardial fibrosis and compromising coronary microcirculatory perfusion. In this pathological loop—pulmonary hypertension → right-ventricular remodeling → inadequate left-ventricular perfusion—a vicious cycle forms, heightening the risk of worsening heart failure and laying the groundwork for the development and progression of coronary artery disease[7]. Early identification and intervention against rising pulmonary arterial pressure and right-ventricular remodeling are therefore crucial to breaking this cycle and improving outcomes in elderly comorbid patients.

3.2. Diagnostic Criteria and Evaluation Indicators

In diagnosing chronic cor pulmonale combined with coronary artery disease, our approach adheres to both the European Society of Cardiology (ESC) guidelines and the consensus recommendations issued by Chinese cardiovascular and pulmonary experts. To establish the presence of chronic cor pulmonale, patients must have a well-documented history of underlying pulmonary pathology—such as chronic obstructive pulmonary disease (COPD), pulmonary fibrosis, or other interstitial lung diseases—and hemodynamic confirmation via right-heart catheterization. Specifically, mean pulmonary arterial pressure (mPAP) must be at or above 25 mmHg at rest, while pulmonary vascular resistance (PVR) exceeds 3 Wood units. These thresholds distinguish pathologic pulmonary hypertension from age-related or exercise-induced elevations in pulmonary pressure.Concurrently, evidence of significant coronary artery disease is required. Coronary angiography or high-resolution coronary computed tomography angiography (CTA) must demonstrate luminal stenosis of 50 percent or more in at least one major epicardial artery or its principal branches. In addition, 12-lead electrocardiogram (ECG) findings—such as ST-segment changes, Q waves, or T-wave inversions—and transthoracic echocardiography must reveal left-ventricular ejection fraction (LVEF) reduction below 50 percent or focal wall-motion abnormalities consistent with ischemia. Together, these combined criteria ensure that both right-heart overload and left-heart ischemia are objectively documented.Once the dual diagnosis is confirmed, we employ a comprehensive battery of evaluation indicators to quantify disease severity, monitor progression, and assess response to therapy[8]. Biomarkers are measured at baseline and at regular intervals: B-type natriuretic peptide (BNP) or its N-terminal fragment (NT-proBNP) serves as a sensitive index of ventricular wall stress, while high-sensitivity cardiac troponin T (hs-cTnT) reflects ongoing myocardial injury. Elevated levels of these peptides correlate with worsening heart failure symptoms and can guide adjustments in diuretic or vasoactive therapy.Functional capacity is gauged through both field and laboratory tests. The six-minute walk distance (6MWD) is conducted three times per week in an outpatient setting, with changes in distance serving as a simple but powerful predictor of mortality and hospitalization risk. Cardiopulmonary exercise testing (CPET) is performed at baseline and every six months to measure peak oxygen uptake (VO_2peak) and ventilatory efficiency (VE/VCO_2 slope), providing objective data on aerobic capacity and pulmonary gas-exchange abnormalities.Echocardiographic parameters focus on right-heart

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remodeling and function. Tricuspid annular plane systolic excursion (TAPSE) quantifies longitudinal right-ventricular contraction, while right-atrial area (RAA) and the right-to-left ventricular area ratio (RV/LV) assess chamber enlargement and ventricular interdependence. Serial measurements allow us to detect subtle improvements or deteriorations in right-ventricular performance.Finally, clinical symptoms and patient-reported outcomes are captured using the New York Heart Association (NYHA) functional classification and validated quality-of-life questionnaires such as the 36-Item Short Form Survey (SF-36). These instruments assess physical limitations, mental well-being, and social engagement, ensuring that therapeutic success is measured not only in hemodynamic terms but also in real-world improvements to daily living. By integrating these multidimensional indices, we establish a rigorous, objective foundation for comparing treatment efficacy and tailoring interventions to the individual needs of elderly patients with this complex comorbidity[9].

4. Clinical Treatment Plan and Observation

4.1. Treatment Plan Design and Implementation Principles

For elderly patients with chronic cor pulmonale combined with coronary artery disease, our treatment design is guided by comprehensiveness, individualization, dynamic adjustment, and multidisciplinary collaboration. First, pharmacotherapy focuses on reducing right-heart preload and afterload while improving coronary perfusion. We prioritize diuretics to manage circulating volume, add targeted pulmonary-hypertension agents (endothelin-receptor antagonists, phosphodiesterase-5 inhibitors) to lower pulmonary vascular resistance, and co-prescribe low-dose β-blockers or ACE inhibitors/ARBs to decrease myocardial oxygen demand and stabilize atherosclerotic plaques. Drug selection must account for each patient's renal function, electrolyte balance, and potential interactions with existing medications. Throughout treatment, we monitor biomarkers—BNP/NT-proBNP, serum troponin, liver and kidney function—at regular intervals to guide dose adjustments[10].

Second, non-pharmacological interventions are indispensable. Pulmonary rehabilitation combining paced breathing and endurance exercises can markedly improve 6MWD and VO_2peak. Personalized nutritional support emphasizes high-protein, omega-3–rich diets to enhance myocardial energy metabolism, while respiratory physiotherapy helps clear airway secretions. For those with significant coronary stenosis who respond inadequately to medication, percutaneous coronary intervention (PCI) or surgical bypass may be considered after thorough evaluation of right-ventricular function, pulmonary pressure, anesthetic risk, intraoperative hemodynamics, and postoperative complications.

Finally, dynamic monitoring and regular multidisciplinary team (MDT) conferences are essential. Cardiology, pulmonology, rehabilitation, and nutrition specialists should jointly assess clinical symptoms, functional status, and imaging parameters on a schedule of every one to three months. Based on NYHA class, TAPSE, RV/LV ratio, and other metrics, stage-specific targets are set. If treatment goals are unmet or adverse events arise, the MDT reconvenes promptly to revise the treatment plan or introduce novel minimally invasive therapies—such as radiofrequency ablation—to achieve precise, individualized care.

4.2. Treatment Outcome Observation Indicators and Methods

To comprehensively evaluate the efficacy of our multidisciplinary treatment model, we selected indicators across biological, imaging, functional, and patient-reported dimensions. Biologically, we perform monthly electrochemiluminescence assays of BNP/NT-proBNP and hs-cTnT to monitor cardiac load and injury, alongside inflammatory markers (IL-6, TNF-α) and endothelin-1 levels to gauge inflammation and vasoconstriction. Imaging combines routine echocardiography and cardiac magnetic resonance (CMR). Every three months, echocardiography measures TAPSE, right ventricular fractional area change (RVFAC), and RV/LV area ratio; baseline and six-month CMR scans quantify right-ventricular wall thickness, ejection fraction, and pulmonary blood-flow dynamics for precise efficacy validation.

Functionally, we conduct 6MWT bi-monthly to record distance changes, and CPET at baseline and six months to determine VO_2peak and respiratory exchange ratio (RER), thereby assessing cardiopulmonary fitness. Patient-centered outcomes are tracked via NYHA class—assigned monthly by a cardiologist—and validated questionnaires (SF-36 and the Minnesota Living with Heart Failure Questionnaire [MLHFQ]) completed at baseline, three, and six months to capture subjective symptom burden and quality of life. We also supplement with 24-hour Holter monitoring for arrhythmia

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incidence, and track hospitalization and emergency-visit rates to evaluate safety and long-term benefit. All data are collected per protocol and analyzed using multivariable regression and survival analysis to explore relationships between these indicators and clinical outcomes, ensuring scientific rigor and clinical relevance.

5. Discussion

5.1. Analysis of Factors Influencing Treatment Effect

The therapeutic response in elderly patients with chronic cor pulmonale and coronary artery disease is influenced by multiple factors. Patient characteristics—such as advanced age, comorbidities, and diminished physiological reserve—critically determine intervention efficacy. Older patients often exhibit impaired renal function, electrolyte disturbances, and polypharmacy, necessitating careful dosing and monitoring of diuretics and RAAS inhibitors. The severity of pulmonary pathology and extent of coronary lesions likewise dictate right-heart load and myocardial ischemia; those with severe pulmonary hypertension or multivessel disease may not respond adequately to single-modality therapy.Treatment adherence and the depth of multidisciplinary collaboration also play pivotal roles. The complexity of combined drug, rehabilitation, and nutritional regimens demands active patient and caregiver engagement, yet cognitive impairment and limited social support frequently undermine compliance, blunting gains in 6MWD and VO_2peak. The frequency of MDT reviews, degree of professional coordination, and promptness of follow-up influence the precision and timeliness of treatment adjustments.Furthermore, chronic low-grade inflammation, oxidative stress, nutritional status, and lifestyle factors cannot be overlooked. Persistent inflammation drives ongoing cardiopulmonary tissue damage and fibrosis, while malnutrition hampers myocardial recovery and rehabilitation outcomes. Finally, smoking history, exercise habits, and psychological well-being either facilitate or hinder functional improvement and quality-of-life gains. In sum, accurately assessing these variables and dynamically tailoring interventions within an individualized framework are essential to optimizing clinical benefits for elderly comorbid patients.

5.2. Clinical Significance and Strategic Recommendations

The multidimensional clinical-observation framework proposed in this study carries important practical value. First, by systematically integrating pathophysiological targets, diagnostic and assessment indices, and outcome-monitoring methods, clinicians can more thoroughly identify high-risk features in elderly comorbid patients and initiate personalized interventions in a timely manner, thereby reducing hospitalizations and mortality caused by missed or delayed diagnoses. Second, a multidisciplinary treatment model—bringing together cardiology, pulmonology, rehabilitation, and nutrition—and a dynamic follow-up mechanism help optimize resource allocation, enhance treatment adherence, and boost patient satisfaction. Establishing standardized workflows and information-sharing platforms within the care team can also accelerate decision-making and ensure that any adverse reactions prompt immediate adjustments to the treatment plan.At the strategic level, we recommend that hospitals at all tiers establish specialized “cardiopulmonary comorbidity” clinics equipped for joint in-person and remote consultations, and work toward harmonizing the management guidelines for cor pulmonale and coronary artery disease. Key indicators such as BNP/NT-proBNP, TAPSE, and six-minute walk distance should be monitored regularly, incorporated into chronic-disease management records, and linked to intelligent alert systems. Primary-care institutions should be encouraged to implement community-based rehabilitation and patient-education programs—combining pulmonary rehabilitation exercises, nutritional counseling, and psychological support—to strengthen self-management skills in the elderly population. Finally, we urge the launch of multicenter, long-term follow-up studies in routine practice to validate the safety and cost-effectiveness of different intervention combinations. These efforts will generate the evidence needed to develop more targeted, evidence-based guidelines. By adopting these strategies, care teams can not only improve cardiopulmonary function but also markedly enhance quality of life—ushering in a new era of precision and refinement in the management of cardiopulmonary comorbidities.

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6. Conclusions and Future Directions

6.1. Main Conclusions

In this conceptual study, we have developed a clinical-observation framework for elderly patients with chronic cor pulmonale combined with coronary artery disease. We delineated the pathophysiological loop linking pulmonary hypertension, right-ventricular remodeling, and impaired coronary perfusion, and identified key therapeutic targets. We proposed a dynamic monitoring scheme based on multidimensional indices—BNP/NT-proBNP, TAPSE, six-minute walk distance, and VO_2peak—and designed personalized treatment strategies encompassing pharmacological agents (diuretics, endothelin-receptor antagonists, PDE-5 inhibitors, low-dose β-blockers or ACEI/ARBs), non-pharmacological measures (pulmonary rehabilitation, nutritional support), and, when indicated, PCI or surgical revascularization. Implementing a multidisciplinary approach with staged follow-up is expected to significantly improve right-heart function, enhance exercise capacity, optimize quality of life, and reduce both hospitalization rates and all-cause mortality. Our findings underscore that a systematic, finely-tuned, comprehensive intervention model is critical to improving long-term outcomes in elderly patients with these comorbid conditions.

6.2. Limitations and Future Directions

As a conceptual framework, this study has several limitations. First, it lacks large-scale, multicenter clinical data to enable stratified analyses across disease stages, comorbidity profiles, and individual patient differences. Second, current diagnostic and efficacy assessments rely largely on traditional biomarkers and functional tests, without incorporating emerging plasma metabolomics, genomics, or radiomics markers that might reveal deeper molecular mechanisms and prognostic insights. Third, the safety and cost-effectiveness of the proposed treatment regimens have not been validated through randomized controlled trials, limiting the framework's utility for policy-making and reimbursement decisions. Moreover, we have not fully explored the impact of patient adherence, psychosocial factors, or digital-health interventions, which constrains the model's comprehensiveness and generalizability. Future research should pursue multicenter, precision-medicine–driven randomized trials to compare the efficacy of various drug combinations and rehabilitation protocols. Integrating multi-omics data and artificial-intelligence tools could yield more refined risk-prediction models and individualized decision-support systems. Evaluating remote monitoring and mobile-health platforms will clarify their role in boosting adherence and care efficiency. Economic evaluations—cost-utility and cost-benefit analyses—are also needed to guide resource allocation and evidence-based guideline development. Finally, fostering cross-disciplinary collaboration among cardiology, pulmonology, rehabilitation, and nutrition specialists will help translate the conceptual framework into standardized, scalable care pathways, ensuring a smooth transition from theory to clinical practice with continuous optimization.

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