Postprint of a General Practice Case Analysis on Community Management of COPD-Sarcopenia-Osteoporosis Patients Based on a New General-Specialist Integration Model

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Abstract

Chronic obstructive pulmonary disease (COPD) is a highly fatal and disabling respiratory disease characterized by irreversible airflow limitation. Sarcopenia, as a common comorbidity of COPD, is associated with the Global Initiative for Chronic Obstructive Lung Disease (GOLD) staging and tends to trigger acute exacerbations. It has pathophysiological associations with osteoporosis and exhibits mutually deteriorating effects, jointly influencing patient prognosis. Although domestic guidelines have proposed community-based prevention and treatment recommendations for COPD and sarcopenia-osteoporosis, there is a lack of a COPD comorbidity management system, with problems such as insufficient capability of general practitioners to comprehensively manage COPD comorbidities, discontinuity in referral information, and poor continuity of care. This article reports a diagnostic and therapeutic case of a community COPD patient complicated with sarcopenia, severe osteoporosis, and lumbar fracture. Through integrating community specialty department resources to implement standardized management, it analyzes and explores the synergistic value of the "generalist-specialist collaboration" model in the management of COPD patients with comorbidities, aiming to explore a new model of "generalist-specialist collaboration" diagnosis, treatment, and management for multimorbidity in community settings.

Full Text

Preamble

General Practice Consultation: A General Practice Case Analysis on Community Management of Patients with Chronic Obstructive Pul-

monary Disease and Sarcopenia-Osteoporosis Based on a New Model of "General Practice and Specialty Integration"

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Abstract

Chronic obstructive pulmonary disease (COPD) is a highly fatal and disabling respiratory disease characterized by incompletely reversible airflow limitation. As a common comorbidity of COPD, sarcopenia is associated with Global Initiative for Chronic Obstructive Lung Disease (GOLD) staging and predisposes patients to acute exacerbations. Sarcopenia shares pathological mechanisms with osteoporosis, and their mutual aggravating effects jointly impact patient prognosis. Although domestic guidelines propose community-based prevention and treatment recommendations for COPD and sarcopenia-osteoporosis, a multimorbidity co-management system for COPD is lacking. Problems such as insufficient capacity of general practitioners to comprehensively manage COPD comorbidities, discontinuity in referral information, and poor diagnostic and therapeutic continuity persist. This paper reports the case of a community-dwelling COPD patient with sarcopenia, severe osteoporosis, and lumbar vertebral fracture who received standardized management through integrated community specialty unit resources. We analyze and discuss the collaborative value of the "General Practice and Specialty Integration" model in managing COPD patients with comorbidities, aiming to explore a new model for diagnosis, treatment, and management of patients with multiple chronic conditions in community settings.

Keywords Chronic obstructive pulmonary disease; Sarcopenia-osteoporosis; Multiple chronic conditions; Specialized specialty units; General practice and specialty integration

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1. Case Presentation

1.1 History Collection

The patient was an 85-year-old male, retired engineer, who presented with a one-week history of low back pain and was wheeled into the consultation room.

(1) Present Illness: One week prior, the patient developed low back pain without apparent cause. The pain was migratory, worse at night, and limited his mobility, accompanied by fatigue. He denied numbness or tingling in hands or feet, tetany, gross hematuria, or urinary stones. He also denied dry mouth or

eyes, small joint pain, chronic diarrhea, chronic hepatitis or nephritis, thyroid disease, or urinary stone history. He denied prior fragility fractures or bone pain, and denied glucocorticoid use. He had lost 5 cm in height over the past two years. He rarely engaged in outdoor activities and had irregular milk intake. Since onset, his mental status had been poor, with poor sleep and appetite, though bowel and bladder functions were normal.

(2) Past Medical History: He denied diabetes, cardiovascular disease, cerebrovascular disease, or kidney disease. He had a 10-year history of COPD with irregular use of budesonide/formoterol inhalation powder and salbutamol sulfate aerosol. He experienced chest tightness and shortness of breath after activity, with markedly decreased physical stamina, requiring rest after walking only a few minutes on level ground. He had one hospitalization for COPD acute exacerbation in the past year, with progressive weight loss.

(3) Personal History: He did not exercise regularly, consumed a light diet with approximately 5 g/d of salt, and had a 30-year smoking history of 20 cigarettes per day, but had quit 20 years ago.

(4) Family History: Both parents were healthy. He denied family history of chronic diseases but had one older sister and one younger sister, both diagnosed with severe osteoporosis after sustaining fragility fractures.

(5) Psychosocial Status: Family relationships were harmonious with no financial burden, and he had no symptoms of anxiety or depression.

1.2 Physical Examination

Temperature 36.3°C, pulse 73 beats/min, respiration 17 breaths/min, blood pressure 106/68 mmHg (1 mmHg = 0.133 kPa), height 158.5 cm, weight 36 kg, BMI 14.33 kg/m^2. Mental status and nutritional status were poor. Skin and mucous membranes appeared normal, with no conjunctival edema or cyanosis. Thyroid palpation and auscultation were normal. No carotid bruits were heard. Chest examination revealed a barrel chest with widened intercostal spaces, prolonged expiratory phase, and diminished breath sounds bilaterally. The apical impulse was located 0.76 cm medial to the left midclavicular line at the 5th intercostal space (normal range 0.5–1.0 cm). Cardiac borders were not enlarged, heart rate 73 beats/min with regular rhythm, and no pathological murmurs were heard ($A_2 = P_2$). Abdominal examination was unremarkable. No lower extremity edema was present. Lumbar spine tenderness and percussion pain were positive. No limb deformities were noted, but mobility was limited due to low back pain.

2. General Practitioner' s Diagnostic Approach

2.1 Initial Diagnosis

The patient presented with low back pain, leading to consideration of osteoporosis and lumbar compression fracture based on: (1) Symptoms and signs: nocturnal pain (rest pain may be a nonspecific manifestation of fracture), positive lumbar tenderness and percussion pain, and limited mobility; (2) High-risk factors: advanced age, extremely low BMI, long-standing COPD (systemic inflammation and steroid exposure risk), lack of sunlight exposure and insufficient calcium intake, family history of fragility fractures, and 5 cm height loss over two years; (3) Secondary effects: weight loss, malnutrition, and sarcopenia (decreased physical strength) further exacerbated osteoporosis risk.

2.2 Differential Diagnosis

Diseases to be excluded included: (1) Multiple myeloma/bone metastasis: no clear tumor history, but serum/urine immunofixation electrophoresis, tumor markers, and whole-body bone scan were needed; (2) Infectious spondylitis: no fever or local signs of redness, swelling, heat, or pain, and C-reactive protein (CRP)/erythrocyte sedimentation rate (ESR) were likely normal, but still required exclusion; (3) Ankylosing spondylitis: no typical rheumatologic symptoms such as morning stiffness or small joint pain, making HLA-B27 testing unnecessary.

2.3 Laboratory and Ancillary Investigations

Utilizing available community diagnostic equipment, the following investigations were completed: (1) Imaging studies: thoracolumbar X-ray (MRI unavailable) to observe vertebral morphology (wedge deformity, biconcave sign); (2) Dual-energy X-ray absorptiometry (DXA) to assess osteoporosis severity (T-score $\leq$ -2.5 for diagnosis); (3) Laboratory tests: bone metabolism markers (serum calcium, phosphorus, alkaline phosphatase, 25-hydroxyvitamin D, parathyroid hormone), inflammatory/tumor screening (complete blood count, CRP, ESR, tumor markers), etc.

2.4 Additional Diagnoses

(1) Given the patient' s COPD history, irregular inhalation therapy, recurrent chest tightness, and decreased physical activity, chest CT was needed to exclude lung tumors, tuberculosis, and bronchiectasis, while echocardiography was required to rule out cardiac insufficiency. Pulmonary function testing was performed to assess COPD severity. (2) Due to his emaciation and poor nutritional status, calf circumference was measured to screen for sarcopenia. Examination results are shown in Figure 1 [Figure 1: see original paper].

2.5 Management Plan

After comprehensive analysis of history, physical examination, and ancillary findings, the general practitioner considered the patient to have multimorbidity including osteoporosis, sarcopenia, and COPD (Figure 1). Questions arose regarding the interrelationships among these three conditions and how to implement standardized treatment and comprehensive management, necessitating collaborative specialty care. After signing a family doctor service agreement, the patient was referred to community specialized units for osteoporosis and COPD for further diagnosis and continuous "General Practice-Specialty Integration" management.

2.6 "General Practice-Specialty Integration"Collaboration Mechanism

The general practitioner completed differential diagnosis for low back pain, preliminary screening for osteoporosis and sarcopenia, and COPD pulmonary function reassessment. The osteoporosis specialty unit conducted standardized diagnostic evaluation for osteoporosis, sarcopenia, and sarcopenia-osteoporosis, while the COPD specialty unit performed standardized COPD assessment and validated the COPD-sarcopenia-osteoporosis associations. Subsequently, both the general practitioner and specialty units jointly formulated a comorbidity management plan. The general practitioner assumed primary responsibility for follow-up care, assessing fall risk and anxiety/depression symptoms to achieve comprehensive management. During the management process, the general practitioner discussed treatment efficacy and disease progression with specialty units every three months, adjusting the treatment plan as appropriate.

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3. Osteoporosis Specialty Unit' s Diagnostic Approach

Most osteoporosis patients are asymptomatic in early stages. As the disease progresses, manifestations may include low back pain or generalized bone pain, worsening at night or with weight-bearing, accompanied by muscle cramps and activity limitation. Severe cases exhibit height loss, kyphosis, possible nerve compression and visceral dysfunction leading to constipation and abdominal distension, and fragility fractures of vertebrae or hip joints from minimal trauma with significantly increased recurrence risk. These often cause psychological problems such as anxiety and depression, resulting in decreased autonomy and quality of life. This patient presented with low back pain, limited mobility, height loss, and decreased quality of life, prompting lumbar spine X-ray examination that confirmed vertebral fracture and established the diagnosis of osteoporosis.

A diagnosis of primary osteoporosis requires exclusion of other factors affecting bone metabolism to avoid misdiagnosis. A detailed and comprehensive history must be obtained to analyze potential causes, risk factors, and medications.

Causes of secondary osteoporosis mainly include endocrine diseases affecting bone metabolism (thyroid, parathyroid, gonadal, adrenal disorders), gastrointestinal diseases affecting calcium and vitamin D absorption/metabolism, hematologic diseases (multiple myeloma), rheumatic diseases (rheumatoid arthritis), neuromuscular diseases, kidney diseases, malignant tumors, various congenital and acquired bone metabolism disorders, and long-term use of medications affecting bone metabolism (glucocorticoids, proton pump inhibitors, thyroid hormone, thiazolidinedione insulin sensitizers, SGLT2 inhibitors, etc.).

Currently, DXA-measured bone density is the diagnostic standard for osteoporosis. DXA measures central skeleton (lumbar spine 1-4, femoral neck, or total hip) or distal one-third radius bone density, which must be converted to T-scores for diagnosis. T-score = (measured bone density - peak bone density of young normal adults of same race and sex) / standard deviation of peak bone density of young normal adults of same race and sex. A T-score $\leq$ -2.5 at the hip or spine, or fragility fracture of proximal humerus, pelvis, or distal forearm with osteopenia (-2.5 < T-score < -1.0) on DXA, establishes the diagnosis. This patient' s total hip and femoral neck T-scores were both < -2.5, with lumbar compression fracture, confirming primary osteoporosis.

3.2 Sarcopenia Screening and Diagnosis

3.2.1 Recommended Sarcopenia Screening Tools

(1) SARC-F Scale: Assesses Strength, Assistance in walking, Rising from a chair, Climbing stairs, and Falls. Widely used for self-screening, scored 0-10 points with higher scores indicating greater risk; $ $4 points is positive. (2) SARC-F combined with calf circumference (SARC-CalF): Adds calf circumference to SARC-F, scored 0-20 points with $ $11 points as positive. (3) Calf circumference: <34 cm in men and <33 cm in women is the diagnostic threshold for sarcopenia. SARC-F has 98.1% specificity and 29.5% sensitivity; SARC-CalF has 94.7% specificity and 60.7% sensitivity; calf circumference alone has 71.8% specificity and 80.4% sensitivity. SARC-F may miss early suspected sarcopenia cases. Calf circumference measurement alone has higher sensitivity than SARC-F or SARC-CalF, making it recommended for self-screening. However, calf circumference has lower accuracy in obese and elderly populations, and SARC-F/SARC-CalF have poor predictive ability for sarcopenia in elderly COPD patients. Measuring muscle mass in suspected positive cases improves screening accuracy.

3.2.2 Sarcopenia Diagnosis No unified diagnostic standard exists due to genetic, racial, and environmental factors. The most widely applied criteria are from the 2019 European Working Group on Sarcopenia in Older People (EWGSOP2) and Asian Working Group for Sarcopenia (AWGS). China currently adopts AWGS criteria: (1) Muscle strength: grip strength <28 kg in men, <18 kg in women; (2) Physical function: 6-meter gait speed <1.0

m/s, 5-time sit-to-stand $ $12 seconds, or Short Physical Performance Battery (SPPB) score $ $9 points (meeting any one criterion); (3) Skeletal muscle mass : relative appendicular skeletal muscle mass index (RASM) measured by DXA < 7.0 kg/m^{2}$ in men, <5.4 kg/m^2 in women, or by bioelectrical impedance analysis (BIA) <7.0 kg/m^2 in men, <5.7 kg/m^2 in women. Meeting criterion (1) or (2) indicates probable sarcopenia; meeting (3)+(2) or (3)+(1) indicates sarcopenia; meeting (3)+(2)+(1) indicates severe sarcopenia.

3.2.3 Sarcopenia Assessment

(1) Muscle mass assessment: DXA is the gold standard but is not widely used in communities due to equipment limitations and measurement variability between devices. BIA calculates RASM through bioelectrical impedance, offering portability, simplicity, non-invasiveness, low cost, and rich functional information suitable for community and hospital screening. This patient underwent BIA (Tsinghua Tongfang, Model BCA-2A) for muscle mass measurement. (2) Muscle strength assessment: Hand grip dynamometry is preferred. This study used a JAMAR dynamometer (China, Model Xiangshan BH01), measuring each hand three times and recording the maximum value. (3) Physical function assessment: Methods include gait speed, 6-minute walk test, and SPPB. Gait speed measures time required to walk 4 or 6 meters at normal pace, reflecting physical capacity. This patient used the 6-meter gait speed test. SPPB score was 2 points (Table 1), indicating very poor muscle function.

3.3 Sarcopenia-Osteoporosis Diagnostic Assessment

(1) Multidimensional association between osteoporosis and sarcopenia: First, shared pathological mechanisms include altered mechanical loading (muscle contraction generates mechanical stress on bone; reduced physical activity causes simultaneous muscle atrophy and bone loss), genetic overlap (genome-wide association studies suggest shared genetic susceptibility), and chronic inflammation/metabolic disorders (adipose tissue infiltration, inflammatory cytokine release such as IL-6 and TNF-α, vitamin D deficiency, and endocrine abnormalities accelerate muscle-bone system degeneration through oxidative stress and lipotoxicity). Second, interactive clinical manifestations include muscle-bone functional coupling (muscle atrophy directly reduces bone density and strength, while decreased skeletal mechanical support exacerbates muscle weakness, forming a vicious cycle) and the disability triad (reduced muscle mass causes gait instability and balance disorders, increased bone fragility significantly raises fall-related fracture risk, with fragility fracture incidence reaching 10-15% in those over 80). Third, biological homology and causal interaction: both muscle and bone originate from mesenchymal stem cells, with pathological states involving bidirectional regulation through mechanical signals (Wnt/β-catenin pathway) and bioactive factors (IGF-1,

osteocalcin). Clinical evidence shows significant positive correlation between lumbar spine bone density and grip strength/appendicular muscle mass, confirming their reciprocal causality. Fourth, integrated prevention and treatment strategies: based on these mechanisms, the concept of "sarcopenia-osteoporosis" emphasizes simultaneous assessment of muscle mass (DXA/BIA) and bone density (T-score $\leq$ -2.5) for early identification of high-risk populations. Core interventions include resistance training to improve mechanical loading, vitamin D/protein supplementation for nutritional optimization, and pharmacological intervention for inflammation and metabolic abnormalities to achieve integrated musculoskeletal management and reduce disability risk.

(2) The diagnostic assessment process and content for sarcopenia-osteoporosis are shown in Figure 2 [Figure 2: see original paper].

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4. COPD Assessment and Its Association with Sarcopenia-Osteoporosis

4.1 COPD Assessment

COPD assessment includes airflow limitation severity, current symptoms, acute exacerbation risk, comorbidity evaluation, and comprehensive assessment for treatment selection (Figure 3 [Figure 3: see original paper]).

(1) Airflow limitation assessment: This case' s chest CT excluded pulmonary tuberculosis, bronchiectasis, and lung tumors. Pulmonary function testing showed negative bronchodilator response, with post-bronchodilator FEV_1/FVC of 33.12% and FEV_1 25.1% of predicted value. Using FEV_1 percentage of predicted value for grading according to GOLD criteria, the patient was classified as GOLD Grade 4.

(2) Symptom assessment: The modified Medical Research Council (mMRC) questionnaire assessed dyspnea severity (Grade 2 or higher indicates more symptoms); this patient scored Grade 3. The COPD Assessment Test (CAT) questionnaire provided comprehensive symptom scoring (10 points or more indicates more symptoms); this patient scored 31 points, indicating very severe impact on daily life.

(3) Acute exacerbation risk assessment: COPD acute exacerbation is defined as a 14-day event featuring increased dyspnea and/or cough and sputum production. Prior exacerbation history is the best predictor; this patient had one hospitalization for acute exacerbation in the past year.

(4) Comorbidity assessment: Common COPD comorbidities include cardiovascular disease, lung cancer, metabolic syndrome, osteoporosis, skeletal muscle dysfunction, malnutrition, depression, and anxiety, which increase

hospitalization rates, adverse outcomes, and mortality risk, requiring early identification, regular assessment, and standardized treatment.

(5) Comprehensive assessment and grouping: Stable COPD patients are comprehensively assessed based on GOLD grade, symptoms, and exacerbation risk, classified into Group A (few symptoms, low exacerbation risk), Group B (more symptoms, low risk), and Group E (high exacerbation risk). Initial treatment selects inhaled medications based on group classification.

4.2 Association Between COPD and Sarcopenia-Osteoporosis

COPD systemic complications are associated with progressive loss of muscle mass and function. Sarcopenia and osteoporosis are common musculoskeletal comorbidities in COPD. Sarcopenia leads to decreased lung function and quality of life and significantly increased osteoporosis risk. Elderly COPD patients with sarcopenia have higher disability risk, greater severity, and more pronounced quality of life decline. Osteoporosis is prevalent in COPD patients and significantly impacts fragility fracture, hospitalization, and mortality risks; COPD patients should be screened for osteoporosis and its risk factors. Sarcopenia-osteoporosis and COPD are interconnected across epidemiological, pathological, and clinical dimensions:

(1) Epidemiological aspects: First, high comorbidity rates—COPD patients have significantly higher prevalence of sarcopenia (15-40%) and osteoporosis (35-65%) than healthy populations, with 30-70% increased mortality and fracture risk when comorbid. Second, shared risk factors include advanced age, smoking, hypoxia, chronic inflammation, corticosteroid therapy, physical inactivity, and malnutrition.

(2) Pathological mechanisms: First, inflammatory and oxidative damage—pro-inflammatory cytokines such as TNF-α and IL-6 activate muscle catabolism (ubiquitin-proteasome system) and bone resorption (osteoclast activation), while oxidative stress inhibits osteoblasts and accelerates muscle protein degradation. Second, hormonal and metabolic abnormalities—COPD patients often have low vitamin D levels due to insufficient sunlight exposure, malnutrition, or absorption disorders, affecting calcium absorption and muscle function; decreased sex hormones (testosterone/estrogen) inhibit bone formation and muscle synthesis, while long-term glucocorticoid use exacerbates bone loss and muscle atrophy. Third, activity limitation and hypoxia—COPD patients' dyspnea leads to reduced exercise, accelerating disuse muscle atrophy and bone loss. Chronic hypoxia further reduces bone density by inhibiting osteoblast activity and decreasing collagen synthase function.

(3) Clinical impacts: First, worsened prognosis—sarcopenia weakens respiratory muscles, while osteoporotic vertebral fractures restrict lung expansion, significantly increasing acute exacerbation, hospitalization, and mortality risks. Second, reduced quality of life—physical function limitation, in-

creased fall risk (3-fold higher in sarcopenia patients), and pain/disability risk escalation. Sarcopenia-osteoporosis and COPD form a vicious cycle through inflammation, metabolic abnormalities, and activity restriction, requiring early intervention to break the pathological chain.

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5. Integrated Management Strategy for COPD and Sarcopenia-Osteoporosis

After family doctor contract signing and information sharing between specialty units, collaborative discussion determined integrated management through "respiratory function-muscle metabolism-bone homeostasis" triad regulation to achieve systematic COPD and comorbidity management, with regular assessment of pulmonary function, muscle mass, and bone density for dynamic adjustment of interventions.

5.1 Core Interventions

(1) Smoking cessation and exposure control: Strict smoking cessation (core intervention for COPD, sarcopenia, and osteoporosis), avoidance of dust, smoke, and air pollution exposure to reduce acute infection risk. (2) Pharmacological optimization: Standardized COPD medication—this case, classified as Group E with blood eosinophils $ $300 cells/ L and no contraindications to inhaled corticosteroids, was started on fixed triple therapy with budesonide/glycopyrrolide/formoterol fumarate inhalation aerosol (ICS+LABA+LAMA, 160 g/7.2 g/4.8 g, 2 inhalations twice daily). Pulmonary function was reassessed after 3 months to evaluate treatment efficacy. Long-term systemic glucocorticoid use was limited to reduce osteoporosis and sarcopenia risk. (3) Infection prevention: Influenza and pneumonia vaccination to reduce acute exacerbation events.

5.2 Nutritional and Metabolic Support

(1) Protein-energy supplementation: High-quality protein intake ($ $1.2g \cdot kg^{\{-1\} \cdot d}\{-1\}$) to reverse sarcopenia and underweight status; vitamin D (800-1,000 IU/d) combined with calcium (1,000-1,200 mg/d) to improve bone health. (2) Metabolic modulation: Correction of malnutrition and regulation of systemic inflammatory response (shared pathological mechanism of COPD-osteoporosis).

5.3 Exercise Rehabilitation System

(1) Respiratory function training: Individualized pulmonary rehabilitation program combined with specific inspiratory muscle training to improve ventilation efficiency, including pursed-lip breathing (inhale through nose, exhale slowly through pursed lips at 1:2 or 1:3 ratio, 5-10 min/session, 2-3

times/day) and diaphragmatic breathing (place one hand on abdomen, inhale with abdominal rise, exhale with abdominal contraction at 7-8 breaths/min, 10-20 min/session, twice daily). (2) Musculoskeletal strengthening: Combined resistance and aerobic exercise to improve muscle mass and function (sarcopenia intervention). Resistance training frequency/intensity: 3 times/week at 60-80% 1RM (elderly/frail patients may start at 40% 1RM), targeting lower limbs (quadriceps, gluteal muscles) and core muscles (transverse abdominis, erector spinae). Recommended exercises: seated leg press (weight machine), resistance band squats (with chair back support for fall prevention), modified plank (knees on ground to reduce difficulty). Aerobic training modes: intermittent aerobic exercise (more suitable for COPD patients); high-intensity interval: brisk walking or stationary cycling, 30 seconds maximal effort + 1 minute rest, repeated 6-8 sets; low-intensity continuous: level ground walking at Borg scale 4-6 (somewhat hard but able to converse); frequency/duration: 5 times/week, 20-40 min/session (completed in segments based on tolerance). (3) Weight-bearing/balance training: To enhance bone density and prevent falls (osteoporosis management).

5.4 Osteoporosis Targeted Management

Stepwise intervention: Basic treatment (calcium/vitamin D supplementation + weight-bearing exercise) and pharmacological intensification. This patient had severe low back pain and bone pain significantly affecting quality of life, so elcatonin injection (1 mL: 3.3 g, once weekly) was prioritized for pain relief, combined with calcitriol (0.25 g twice daily), calcium carbonate (1,200 mg once daily), and vitamin D3 (2,000 IU once daily). After one month, the patient reported 80% pain relief; elcatonin was continued for two months then discontinued, switched to denosumab injection (60 mg every 6 months) to reduce bone loss.

5.5 Multidisciplinary Collaborative Management

(1) Comorbidity linkage mechanism: COPD and sarcopenia-osteoporosis share pathological pathways (inflammation, oxidative stress, metabolic disorders) requiring joint assessment and intervention; sarcopenia and osteoporosis are mutual risk factors requiring simultaneous monitoring of muscle mass, bone density, and body composition. (2) Integrated psychological support: Psychological status assessment with cognitive-behavioral interventions for anxiety/depression.

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6. Comprehensive Management by Family Doctor

6.1 Fall Risk Assessment

The Fall Risk Assessment Scale for the Elderly (FRASE) is a commonly used tool for community-dwelling older adults, designed as a rapid, concise, and efficient screening instrument covering environmental and functional risk factors. It includes 35 items across 8 dimensions: exercise, fall history, mental status, self-control ability, sensation, sleep, medication history, and relevant medical history, each scored 0-3 points for a total of 53 points; higher scores indicate greater fall risk. The family doctor used FRASE to assess this case, identifying high fall risk (Table 2). According to the World Guidelines for Falls Prevention and Management for Older Adults (2022), the patient and family were informed of the risk level and provided targeted fall prevention education.

6.2 Psychological Assessment

The Patient Health Questionnaire-9 (PHQ-9) and 7-item Generalized Anxiety Disorder Scale (GAD-7) were used for psychological assessment (Tables 3 and 4), indicating mild depression without anxiety disorder. After communication and obtaining consent, the family informed the patient' s relatives about disease severity and expected outcomes, encouraging treatment compliance and emotional support. At two-week follow-up, improved pain led to better sleep and mood, with PHQ-9 score decreasing to 4 points.

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7. Treatment Effectiveness of "General Practice-Specialty Integration"

After three months of treatment, the patient progressed from wheelchair-bound to walking independently into the consultation room, with near-complete pain resolution. Pulmonary function, DXA, fall risk, and anxiety/depression were reassessed to evaluate treatment efficacy (Table 5). The patient showed improved pulmonary function (effective treatment), significant improvement in sarcopenia-osteoporosis, reduced fall risk, and reversal of depressive status.

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8. Discussion

8.1 Management Approach for COPD and Sarcopenia-Osteoporosis Comorbidity Under the "General Practice-Specialty Integration" Model

(1) Role of General Practitioners: First, initial diagnosis and screening—general practitioners, as the first point of contact, should enhance awareness of

COPD-sarcopenia-osteoporosis comorbidity, screen COPD patients for sarcopenia and osteoporosis, and early identify high-risk populations. According to COPD guidelines, pulmonary function testing should be completed, and combined with mMRC scoring to confirm COPD diagnosis and GOLD grading. Age, GOLD grade, mMRC score, BMI, and FEV_1/FVC are influencing factors for COPD comorbid sarcopenia; community general practitioners should focus on high-risk populations for early sarcopenia screening and prevention. Second, long-term follow-up and management—regular follow-up to monitor disease changes, timely treatment adjustment, and health education to improve self-management capacity. Third, two-way referral and coordination—maintaining close communication with specialty units through specialized clinics, implementing two-way referral based on patient needs, and coordinating specialty treatment plans to ensure continuous, effective care.

(2) Role of Specialty Units/Clinics: First, providing specialized diagnostic and treatment services—including precise diagnosis (comprehensive assessment of history, physical examination, pulmonary function, muscle strength, bone density) and individualized treatment plans (medications, nutritional support, exercise rehabilitation, psychological intervention). Second, conducting clinical research and new technology application—actively researching COPD-sarcopenia-osteoporosis comorbidity, exploring new diagnostic and therapeutic methods, and applying them in clinical practice. Third, training and guiding general practitioners—enhancing general practitioners' knowledge and management capacity for COPD-sarcopenia-osteoporosis comorbidity.

(3) Advantages of "General Practice-Specialty Integration" for COPD and Sarcopenia-Osteoporosis Management: Due to population aging, increased smoking, air pollution, and tuberculosis infection, COPD exhibits high prevalence, mortality, and disease burden, with severe prevention and control challenges. As tiered diagnosis and treatment advances and COPD specialty clinics are established, community general practitioners' management capacity has improved, making primary care critical for COPD control. However, primary COPD management faces challenges including uneven availability of diagnostic equipment, insufficient mastery of COPD knowledge by community general practitioners, and significant demand for theoretical knowledge and practical skills. Pulmonary function testing, the gold standard for COPD diagnosis, is crucial for diagnosis, severity assessment, disease progression monitoring, prognosis evaluation, and treatment response assessment, yet its implementation remains unbalanced with low penetration in primary care institutions. COPD, sarcopenia, and osteoporosis are common comorbidities in older adults that interact and form vicious cycles, severely impacting quality of life and prognosis. Traditional single-disease management models cannot meet the comprehensive management needs of such patients. The "General Practice-Specialty Integration" model offers several advantages: First, integrating medical resources by establishing specialty units in community health service centers with "bound" general practitioner-specialist collaboration, regular specialist guidance in communities, and convenient referral systems achieves deep integration of general

and specialty care, resource sharing, and improved efficiency. Second, optimizing diagnostic and treatment processes by providing one-stop services reduces patient burden of traveling between different hospitals and departments. Third, improving patient compliance through long-term general practitioner follow-up and health education enhances prognosis. The "General Practice-Specialty Integration" model represents the future trend in chronic disease management, providing higher quality, more efficient, and convenient services for COPD-sarcopenia-osteoporosis patients, ultimately improving prognosis and quality of life.

8.2 Value of the "General Practice-Specialty Integration" Model

8.2.1 Promotional Value and Innovation Compared with traditional single-disease management, the "General Practice-Specialty Integration" model achieves breakthroughs through: (1) Integrated management of pathophysiological associations—COPD patients develop sarcopenia and osteoporosis due to chronic hypoxia, systemic inflammation, and steroid use, forming an "hypoxia-inflammation-metabolic imbalance" vicious cycle. This model breaks the cycle through general practitioner-led early screening (pulmonary function, muscle strength, bone density) and specialist precision intervention ("respiratory function-muscle metabolism-bone homeostasis" triad regulation), overcoming limitations of traditional specialty-based care. (2) Resource synergy advantages—Compared with UK's NHS "Integrated Care Systems" and US "Patient-Centered Medical Home" models, this approach emphasizes seamless community general-specialty integration, enabling shared diagnostic data and homogeneous services, reducing redundant examinations and patient time costs by over 30%, increasing disease screening rates, optimizing tiered referral processes, and significantly improving community visit rates.

8.2.2 Current Challenges and Improvement Directions Despite its importance, primary care faces widespread challenges including lack of diagnostic equipment (e.g., spirometers) and lagging specialist knowledge updates among general practitioners. Shanghai's early "General Practice-Specialty Integration" clinics in 2024 revealed challenges including imperfect management systems, lack of information platforms, low awareness of integrated clinics, and insufficient specialist guidance. Recommendations include establishing a "stepped training system": basic training focusing on comorbidity screening skills (pulmonary function, mMRC scoring, SARC-F scale application), advanced training through joint case discussions with specialists, and inclusion in assessment and incentive mechanisms. Using community general practice as the foundation, specialized disease management should be developed through technical deepening (primary care autonomous development) or vertical integration (collaboration with higher-level hospitals), combining generalist integration with specialist precision. Specialists should provide regular teaching (e.g., weekly clinics and ward rounds), utilize new media to promote specialty clinic advantages, and organize community health activities to improve participation. Establishing combined

specialty clinics (e.g., COPD-sarcopenia-osteoporosis joint clinic) with institutionalized two-way referral and data sharing mechanisms is recommended.

8.2.3 Study Limitations and Future Directions This study explored the "General Practice-Specialty Integration" model application in COPD-sarcopenia-osteoporosis comorbidity management through a single-case practice, demonstrating effective integration of primary and specialist resources and improved comprehensive management efficiency. However, single-case design cannot exclude confounding factors and lacks long-term follow-up data to verify prognosis improvement, limiting generalizability. Future work should include: multicenter randomized controlled trials comparing the new model with traditional care on hard endpoints such as annual FEV_1 decline and fracture incidence; biomarker profiling (e.g., dynamic IL-6, myostatin levels) to reveal comorbidity interaction mechanisms for precision intervention targets; and exploring application in complex combinations like "COPD-cardiometabolic comorbidity" to gradually establish a general practice-centered multimorbidity management model.

8.3 International Experience and Implications

International COPD comorbidity management models include: (1) Multidisciplinary integrated care—Netherlands' COLIBRI project reduced COPD exacerbation hospitalizations by 20-30% through multidisciplinary teams (general practitioners, pulmonologists, nurses, rehabilitation therapists) combined with electronic health records and remote monitoring. (2) Personalized intervention —American Thoracic Society guidelines recommend high-protein diet (1.2-1.5 $g \cdot kg^{-1} \cdot d^{-1}$) plus resistance training for COPD with sarcopenia, significantly improving muscle mass and lung function. (3) Systematic screening and stratification—Germany's COPD-COMBO scale assesses comorbidity risks and reduces 5-year mortality by 15% through tiered management. (4) Policy and insurance innovation—Japan' s Long-Term Care Insurance covers home rehabilitation and nutritional support, reducing acute exacerbation-related costs. (5) Sarcopenia comorbidity management—COPD with sarcopenia carries hazard ratios of 1.87 for all-cause mortality and 8.69 for respiratory mortality, requiring comprehensive intervention through nutrition, resistance training, and pulmonary rehabilitation.

While international models emphasize patient-centeredness, they have insufficient referral flexibility. Implications for China include: promoting institutionalized general-specialty collaboration (multidisciplinary teams), developing AI-assisted decision systems (e.g., GOLD-based personalized intervention recommendations) to reduce experience dependency, creating localized comorbidity screening tools, and bundling COPD-sarcopenia-osteoporosis into diagnosis-related group payment systems to incentivize integrated care and leverage insurance policies to support primary care comprehensive management.

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