中文摘要

肌少症对 COPD、哮喘及 ACO 患者肺功能及血气分析指标的影响

目的：

研究肌少症对慢性阻塞性肺疾病（chronic obstructive pulmonary disease, COPD)、哮喘及哮喘-COPD 重叠综合征（asthma–COPD overlap syndrome, ACO）患者肺功能及血气分析指标的影响，探索 COPD、哮喘及 ACO 合并肌少症的相关危险因素。

方法：

回顾性选取 2021 年 1 月至 2022 年 12 月收住于吉林大学第一医院呼吸与危重症学科患者 148 例，其中确诊为 COPD 患者 52 例，哮喘患者 42 例，ACO 患者 54 例，按病种将其分为 COPD 组、哮喘组、ACO 组，另选取 51 例健康自愿者做对照组。收集患者及健康自愿者的一般资料、人体成分指标、肺功能检测指标、血气分析指标及血清学指标。再根据患者是否合并肌少症，将研究对象分为 COPD 伴肌少症组及非肌少症组，哮喘伴肌少症组及非肌少症组，ACO 伴肌少症组及非肌少症组，分别在两组间进行比较，分析不同类型阻塞性呼吸道疾病合并肌少症的发生情况及其影响因素。

结果：

1. 相比于健康对照组，COPD 组及 ACO 组患者年龄更高，体重指数（BMI）更低，差异有统计学意义（$P<0.05$）。COPD 组和 ACO 组患者吸烟比例更高（$P<0.05$）；COPD 组和 ACO 组患者日常生活活动能力评分（ADL）较对照组低，差异有统计学意义（$P<0.05$）。

2. 在肺功能方面：（1）与对照组相比，COPD 组患者用力肺活量（FVC）、用力肺活量占预计值百分比（FVC%pred）、第一秒用力呼气容积与用力肺活量的比值（FEV_1/FVC）、使用舒张剂前后第一秒用力呼气容积占预计值百分比（FEV_1%pred）、呼气峰流量（PEF）、呼气峰流量占预计值百分比（PEF%pred）、吸气峰流量（PIF）、最大自主通气量占预计值百分比

（MVV%pred）、肺储备率、一氧化碳弥散量占预计值百分比（D_LCO%pred）均显著降低，差异有统计学意义(P<0.01)。COPD 组患者用力呼出 75%肺活量时的瞬间呼气流量（$FEF_{75\%}$）、$FEF_{50\%}$、$FEF_{25\%}$、最大呼气中期流量（$FEF_{25\%-75\%}$）低于对照组，差异有统计学意义(P<0.01)。（2）与对照组相比，哮喘组患者$FEF_{25\%}$减低，差异有统计学意义(P<0.05)。（3）与对照组相比，ACO 组患者 FVC、FVC%pred、用药前后 FEV_1%pred、FEV_1/FVC、PEF、PEF%pred、PIF、MVV%pred、肺储备率均显著降低，差异有统计学意义(P<0.01)；ACO 组患者$FEF_{75\%}$、$FEF_{50\%}$、$FEF_{25\%}$和 $FEF_{25\%-75\%}$低于对照组，差异有统计学意义(P<0.01)；另外，ACO 组患者残气量占预计值百分比（RV% pred）、残气量与肺总量比值占预计值百分比（RV/TLC%pred）及功能残气量占预计值百分比（FRC%pred）均高于对照组，差异有统计学意义(P<0.05)，符合疾病的特征。

3.人体成分分析方面，与对照组相比，COPD 患者脂肪重量（FM）及去脂肪重量指数（FFMI）均减低，差异具有统计学意义（P<0.05）；此外，COPD 组患者骨骼肌肉质量（SMM）、左腿肌量、右腿肌量及骨骼肌质量指数（SMI）减低，差异具有统计学意义（P<0.05）。最后，COPD 患者相角（PhA）、体液总量（TBW）低于对照组，差异具有统计学意义（P<0.05）。哮喘组患者人体成分和对照组相比差异无统计学意义。ACO 组患者 PhA 比对照组低，差异具有统计学意义（P<0.05）。

4. 比较合并肌少症的 COPD、哮喘及 ACO 患者的基本资料及血清学检验，合并肌少症的 COPD 患者年龄高于非肌少症的 COPD 患者，差异具有统计学意义（P<0.01）。合并肌少症的哮喘患者胆碱酯酶（CHE）比非肌少症的哮喘患者低，差异具有统计学意义（P<0.05）。合并肌少症的 ACO 患者前白蛋白（PAB）、甘油三酯（TG）及血红蛋白（Hb）低于非肌少症的 ACO 患者，差异具有统计学意义（P<0.05）。

5. 肺功能方面，合并肌少症的 COPD 患者 FEV_1/FVC、D_LCO%pred 及 D_LCO/V_A%pred 均低于非肌少症的 COPD 患者，差异有统计学意义（P<0.05）。合并肌少症的哮喘患者 D_LCO/V_A%pred 比非肌少症的哮喘患者低，差异具有统计学意义（P<0.05）。合并肌少症的 ACO 患者 FEV_1/FVC 低于非肌少症的 ACO 患者，差异具有统计学意义（P<0.05）。

6. 动脉血气分析结果提示合并肌少症的 COPD 患者乳酸（LAC）低于非肌少症的 COPD 患者，差异有统计学意义（P<0.01）。

7. 合并肌少症的 COPD 患者 FM、脂肪占体重百分比（FM%）、脂肪重量指数（FMI）、去脂肪重量（FFM）及 FFMI 均低于非肌少症的 COPD 患者，差异具有统计学意义（P<0.01）。同时，合并肌少症的 COPD 患者 SMM、SMI、躯干及四肢肌肉含量均较非肌少症的 COPD 患者低，差异具有统计学意义（P<0.01）。合并肌少症的 COPD 患者 PhA 及 TBW 均低于非肌少症的 COPD 患者，差异具有统计学意义（P<0.05）。合并肌少症的哮喘患者 FM 及 FFMI 均较非肌少症的哮喘患者低，差异具有统计学意义（P<0.01）。同时，合并肌少症的哮喘患者 SMM、躯干、左臂、左腿、右腿肌肉质量及 SMI 均低于非肌少症的哮喘患者，差异具有统计学意义（P<0.01）。合并肌少症的哮喘患者 PhA、TBW 及 ECW 均低于非肌少症的哮喘患者，差异具有统计学意义（P<0.01）。合并肌少症的 ACO 患者 FFM、及 FFMI 均低于非肌少症的 ACO 患者，差异具有统计学意义（P<0.01）。同时，合并肌少症的 ACO 患者 SMM、躯干、左臂、右臂、左腿、右腿肌肉质量及 SMI 均低于非肌少症的 ACO 患者，差异具有统计学意义（P<0.01）。合并肌少症的 ACO 患者 PhA、TBW 及 ECW 均低于非肌少症的 ACO 患者，差异具有统计学意义（P<0.01）。

8. COPD 中骨骼肌肉重量、骨骼肌肉重量指数、左腿肌肉质量、右腿肌肉质量、FM、FMI 及 PhA 和 D_LCO%pred 呈正相关（P<0.05）。FM、FFMI、PhA 与 FEV_1/FVC 呈正相关，差异有统计学意义。哮喘中 FM 及 FFMI 与 D_LCO/V_A%pred 呈正相关，差异有统计学意义（P<0.05）。ACO 中 FFM、FFMI、PhA、TBW 及 ECW/TBW 与 D_LCO/V_A%pred 呈正相关，差异有统计学意义（P<0.05）。

9. 利用 logistic 回归分析 COPD 患者合并肌少症的风险因素，纳入 FEV_1%pred、D_LCO/V_A%pred、$PaCO_2$、吸烟及年龄指标，其中 D_LCO/V_A%pred 及年龄为独立风险因素。

结论：

1.肌少症影响 COPD、哮喘及 ACO 患者的肺功能，合并肌少症的 COPD 患者 FEV_1/FVC 及 D_LCO/V_A%pred 均减低。合并肌少症的哮喘患者 D_LCO/V_A%pred 减低。合并肌少症的 ACO 患者 FEV_1/FVC 减低。

2. 合并肌少症与否对 COPD、哮喘及 ACO 患者的 $PaCO_2$ 及 PaO_2 无明显影响。

3.年龄增长和 D_LCO/V_A%pred 减低是 COPD 合并肌少症的危险因素。

关键词：

慢性阻塞性肺疾病，哮喘，哮喘-慢阻肺重叠综合征，肌肉减少症，肺功能

Abstract

Effects of sarcopenia on pulmonary function, blood gas analysis of COPD, asthma and ACO patients

Objective:

To investigate how sarcopenia influence the pulmonary function and arterial blood gas in chronic obstructive pulmonary disease (COPD), asthma and asthma–COPD overlap syndrome (ACO) patients, and risk factors for developing sarcopenia.

Methods:

A total of 148 patients were enrolled in our study, who were admitted to the Department of Respiratory and critical care medicine, Bethune first hospital, Jilin University from January 2021 to December 2022. They were divided into COPD group (n=52), asthma group (n=42) and ACO group (n=54). Besides, 51 healthy volunteers joined the study as a healthy control group. General information, body composition, pulmonary function, arterial blood gas and serological indicators of all patients were collected. Then, COPD, asthma and ACO patients were divided into two groups respectively according to whether the patients were combined with sarcopenia, to analyze the occurrence of sarcopenia in different obstructive respiratory diseases and risk factors for developing sarcopenia.

Results:

1. Compared with the healthy control group, patients in the COPD and ACO groups were older (P<0.05) and possessed lower BMI (P<0.05). The proportion of patients who smoke in COPD and ACO group was higher than that in healthy control group (P<0.05). The activities of daily living (ADL) scores of patients in the COPD and ACO group were lower than that in the healthy control group (P<0.05).

2. In terms of lung function: (1) FVC, FVC%pred, FEV_1/FVC, FEV_1%pred, PEF, PEF%pred, PIF, MVV%pred, lung reserve rate, and D_LCO%pred were significantly decreased in patients of COPD group compared with those in control group (P<0.01). $FEF_{75\%}$, $FEF_{50\%}$, $FEF_{25\%}$ and $FEF_{25\%-75\%}$ in COPD were significantly lower than that in healthy controls (P<0.01). (2) Compared with the control group, the FEF25% of patients in the asthma group decreased significantly (P<0.05). (3) Compared with the

control group, FVC, FEV_1/FVC, FVC%pred, FEV_1%pred, FEV_1% pred, FEV_1/FVC, PEF, PEF%pred, PIF, MVV%pred and lung reserve rate in the ACO group were significantly decreased (P<0.01). The $FEF_{75\%}$, $FEF_{50\%}$, $FEF_{25\%}$ and $FEF_{25\%-75\%}$ of patients in the ACO group were significantly lower than those in the control group (P<0.01). In addition, RV%pred, RV/TLC%pred, and FRC%pred of ACO group patients were higher than those in control individuals (P<0.05), which was consistent with the characteristics of the disease.

3. For body composition analysis, both FM and FFMI of COPD patients were reduced compared with healthy controls (P<0.05). In addition, the SMM, left and right leg muscle mass, and SMI of COPD patients decreased significantly (P<0.05). Finally, the phase angle (PhA) and TBW of COPD patients were lower than those of control individuals (P<0.05). There was no statistically significant difference in body composition between the patients in asthma group and the control group. The PhA of patients in the ACO group was lower than that in the control group (P<0.05).

4. For basic data and serological tests of COPD, asthma, and ACO patients with sarcopenia, it was found that COPD patients with sarcopenia was significantly older than non-sarcopenia COPD patients (P<0.01). Cholinesterase (CHE) in asthma with sarcopenia was lower compared to non-sarcopenia asthma patients (P<0.05). Moreover, prealbumin, triglycerides, and hemoglobin in ACO patients with sarcopenia were significantly lower than those non-sarcopenia ACO patients (P<0.05).

5.Regarding lung function for sarcopenia, FEV_1/FVC, D_LCO%pred, and D_LCO/V_A%pred in COPD patients with sarcopenia were significantly lower than those in non-sarcopenia patients (P<0.05). The D_LCO/V_A%pred of asthma patients with sarcopenia was lower than that of non-sarcopenia asthma patients (P<0.05). The FEV_1/FVC of ACO patients with sarcopenia was lower than that of non-sarcopenia ACO patients (P<0.05).

6. For arterial blood gas of sarcopenia patients, the lactic acid (LAC) of COPD patients with sarcopenia was significantly lower than that of non-sarcopenia COPD patients without sarcopenia (P<0.01).

7. For body composition analysis of sarcopenia patients, the FM, FM%, FMI, FFM and FFMI in COPD patients with sarcopenia were significantly lower than those of non-sarcopenia COPD patients (P<0.01). Meanwhile, COPD patients with sarcopenia had significantly decreased SMM, SMI, trunk and limb muscle content compared to non-sarcopenia COPD patients (P<0.01). In addition, the PhA and TBW

of COPD patients with sarcopenia were lower than those without sarcopenia (P<0.05). The FM, FMI, SMM, trunk, left arm, left leg, right leg muscle mass and SMI of asthma patients with sarcopenia were all significantly devalued compared to those of non-sarcopenia asthma patients (P<0.01). Asthma patients with sarcopenia showed depressed PhA, TBW, and ECW compared to non-sarcopenia asthma patients, with statistically significant differences (P<0.01). ACO patients with sarcopenia demonstrated decreased FFM and FFMI compared to those without sarcopenia (P<0.01). Meanwhile, ACO patients with sarcopenia showed lower SMM, trunk, left and right arm, left and right leg muscle mass and SMI compared to non-sarcopenia (P<0.01). In addition, the PhA, TBW, and ECW in ACO patients with sarcopenia were also significantly lower than those of non-sarcopenia ACO patients (P<0.01).

8. In COPD patients, SMM, SMI, the muscle mass of the left leg and right leg, FM and FMI, and PhA were positively correlated with D_LCO%pred as pulmonary dispersion function (P<0.05). FM, FFMI, and PhA were positively correlated with FEV_1/FVC. In asthma patients, FM and FFMI were positively associated with D_LCO/V_A%pred (P<0.05). In ACO patients, there was a positive correlation between FFM, FFMI, PhA, total body fluid, ECW/TBW, and D_LCO/V_A%pred (P<0.05).

9. Logistic regression was used to analyze the risk factors of COPD patients with sarcopenia. FEV_1%pred, D_LCO/V_A%pred, $PaCO_2$, smoking, and age were included, among which D_LCO/V_A%pred and age were independent risk factors.

Conclusions:

1. Sarcopenia affected pulmonary function in COPD, asthma, and ACO patients.The FEV_1/FVC and D_LCO/V_A% pred of COPD patients with sarcopenia were both reduced. In asthma patients, combined sarcopenia only lower D_LCO/V_A%pred levels. In ACO patients, reduction of FEV_1/FVC was observed in sarcopenia patients.

2. The presence or absence of sarcopenia was no significant effects on $PaCO_2$ and PaO_2 in patients with COPD, asthma, and ACO.

3. Aging and decreased D_LCO/V_A%pred are risk factors for COPD developing sarcopenia.

Key words:

chronic obstructive pulmonary disease, asthma, asthma–COPD overlap syndrome, sarcopenia, lung function

目 录

英文缩写词表

英文缩写	英文全称	中文全称
OAD	Obstructive airway disease	阻塞性呼吸道疾病
COPD	Chronic obstructive pulmonary disease	慢性阻塞性肺病
ACO	Asthma–COPD overlap syndrome	哮喘慢阻肺重叠综合征
FEV_1	Forced expiratory volume in 1 second	第 1 秒用力呼气容积
FVC	Forced vital capacity	用力肺活量
FEV_1/FVC	Forced expiratory volume in 1 second /Forced vital capacity	第 1 秒用力呼气容积/用力肺活量
FFM	Fat-free mass	无脂肪重量
SMI	Skeletal muscle mass index	骨骼肌质量指数
FM	Fat mass	脂肪重量
PhA	Phase angle	相角
BMI	Body mass index	体重指数
BIA	Bioelectrical impedance analysis	生物电阻抗分析
FEV_1%pred	Forced expiratory volume in 1 second of Predicted value	第 1 秒用力呼气容积占预计值百分比
EWGSOP	European working group on sarcopenia in older people	欧洲老年肌少症工作组
AWGS	Asian working group for sarcopenia	亚洲肌少症工作组
TNF-α	Tumor necrosis factor-α	肿瘤坏死因子-α
IL-1	Interleukin-1	白介素-1
IL-6	Interleukin-6	白介素-6
MSTN	Myostatin	肌肉生长抑素
ASM	Appendicular skeletal muscle mass	四肢骨骼肌含量
DXA	Dualenergy X-ray absorptiometry	双能 X 线吸收测定法
NMES	Neuromuscular electrical stimulation	神经肌肉电刺激
PEF	Peak expiratory flow	呼气峰流量
ASMI	Appendicular skeletal muscle mass index	四肢骨骼肌含量指数

续表　英文缩写词表

英文缩写	英文全称	中文全称
WBC	White blood cell count	白细胞计数
NE	Neutrophilic granulocyte	中性粒细胞
LC	Lymphocyte	淋巴细胞
Hb	Hemoglobin	血红蛋白
PLT	Platelet	血小板
TP	Total protein	总蛋白
ALB	Albumin	白蛋白
PAB	Prealbumin	前白蛋白
CHE	Cholinesterase	胆碱酯酶
TG	Triglyceride	甘油三酯
TC	Cholesterol	胆固醇
CRP	C-reactive protein	C-反应蛋白
PCT	Procalcitonin	降钙素原
PIF	Peak inspiratory flow	吸气峰流量
MVV	Maximum voluntary ventilation	最大自主通气量
D_LCO	Diffusion capacity for carbon monoxide of lung	一氧化碳弥散量
V_A	Alveolar ventilation	肺泡通气量
D_LCO/V_A	Diffusion capacity for carbon monoxide of lung/alveolar ventilation	单位肺泡容积的弥散量
TLC	Total lung capacity	肺总量
RV	Residual volume	肺残气量
RV/TLC	Residual volume/Total lung capacity	残气量/肺总量
FRC	Functional residual capacity	功能残气量
FMI	Fat mass index	脂肪重量指数
FFMI	Fat-free mass index	去脂肪重量指数
SMM	Skeletal muscle mass	骨骼肌肉质量

续表　英文缩写词表

英文缩写	英文全称	中文全称
FEF	Forced expiratory flow	用力呼气流量
TBW	Total body water	体液总量
ECW	Extra cellular water	细胞外液
ADL	Activities of daily living	日常生活能力
$PaCO_2$	Arterial partial pressure of carbon dioxide	动脉血二氧化碳分压
PaO_2	Arterial partial pressure of oxygen	动脉血氧分压
LAC	Lactic acid	乳酸