Characteristics of inflammatory phenotypes in patients with chronic obstructive pulmonary disease: a cross-sectional study

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ABSTRACT

Background The relationship between airway inflammation in chronic obstructive pulmonary disease (COPD) and clinical characteristics remains unclear. This study aimed to investigate the airway inflammatory phenotypes in COPD and their association with clinical characteristics.

Methods 895 patients with COPD were recruited from Guangdong Province, China in this study. Each patient underwent questionnaire interviews, spirometry testing, CT scans and induced sputum examination. Classification of airway inflammatory phenotypes was based on sputum inflammatory cell counts. Covariance analysis was applied to assess associations with airway inflammation phenotypes.

Results In this study, we found that neutrophilic phenotype (NP, 58.0%) was the most common airway inflammation phenotype in patients with COPD, followed by mixed granulocytic phenotype (MGP, 32.6%), eosinophilic phenotype (EP, 5.4%) and paucigranulocytic phenotype (PP, 4.0%). Compared with NP patients, those with MGP exhibited more frequent chronic respiratory symptoms, and a higher proportion of individuals classified under Global Initiative for Chronic Obstructive Lung Disease stages 3 and 4. After adjusting for confounding factors, MGP patients had lower lung function, and more severe emphysema and air trapping. On the contrary, patients with PP had the best pulmonary function and less emphysema and air trapping.

Conclusions NP was the most common airway inflammation phenotype in patients with COPD. Patients with MGP had more respiratory symptoms, greater loss of lung function, and more severe emphysema and gas trapping compared with those with NP. Meanwhile, PP may be a phenotype of mild damage to lung structure in patients with COPD.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a prevalent respiratory disease characterised by persistent airflow limitation and respiratory symptoms, which causes social and economic burden due to its high morbidity and mortality.1-3 Currently, COPD ranks among the top three causes of death worldwide, with 90% of these deaths occurring in low-income and middle-income countries. In the year 2012 alone, COPD was responsible for claiming the lives of over 3 million people, representing 6% of the global mortality rate.1-3 Previous studies had shown that COPD was characterised by airway inflammation with neutrophil infiltration4-5. The activation of neutrophils in the airway of patients with COPD exacerbates lung parenchymal damage and induces airway mucus secretion by releasing active substances, such as proteases and cytokines.6 Recent studies have revealed the involvement of eosinophils in the inflammation phenotype.7 Eosinophilic

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Identification of airway inflammation in patients with chronic obstructive pulmonary disease (COPD) could be used to guide drug therapy. There are limitations to use eosinophils or neutrophils alone to identify airway inflammation.

WHAT THIS STUDY ADDS

⇒ Neutrophilic phenotype is the most common airway inflammation phenotype in community-based patients with COPD; patients with mixed granulocytic phenotype have more respiratory symptoms, greater loss of lung function, and more severe emphysema and gas trapping.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study provides useful information to improve our understanding of the airway phenotype in patients with COPD, which can provide more scientific evidence for guiding the use of drugs in patients.
inflammation in patients with COPD serves as a reliable biomarker for assessing responsiveness to inhaled corticosteroids (ICS), providing guidance in the use of ICS, especially in the prevention of some exacerbations.\(^8\)\(^9\) Current research on airway inflammation in COPD relies on neutrophils or eosinophils alone.

This method of identifying airway inflammation may have limitations, as mixed granulocytic phenotype (MGP) and paucigranulocytic phenotype (PP) also exist in some patients with COPD.

Previous studies have detailed the classification of airway inflammation in patients with asthma,\(^10\)\(^11\) respectively, neutrophilic asthma, eosinophilic asthma, mixed granulocytic asthma and paucigranulocytic asthma. Eosinophilic asthma is the most common inflammatory phenotype in asthma and exhibits a strong response to ICS treatment. Neutrophilic asthma has been found to be significantly associated with sputum microbiome in asthma.\(^10\) A higher proportion of severe asthma is also found in neutrophilic asthma, but not in other phenotypes. Patients with eosinophilic asthma exhibit the highest fractional expired nitric oxide levels and poorer asthma control.\(^12\) As asthma and COPD are common heterogeneous diseases,\(^13\)\(^14\) they may share the similarities in their pathophysiological and immunological mechanisms. We hypothesise that there are differences in the clinical characteristics and changes in lung structure among the four airway inflammation phenotypes in patients with COPD. However, the distribution and characteristics of patients with COPD with different inflammatory phenotypes remain unclear. Therefore, we conducted a cross-sectional study to evaluate the airway inflammatory phenotypes in patients with COPD and their association with chronic respiratory symptoms, lung function, as well as findings of emphysema and gas trapping measured using high-resolution computerized tomography (HRCT).

**MATERIALS AND METHODS**

**Study population**

Patients in this study were mainly recruited from the Early Chronic Obstructive Pulmonary Disease Study (ChiCTR 1900024643) conducted in the Guangzhou, Shao Guan and He Yuan communities of Guangdong Province, China, from July 2019 to December 2020.\(^15\) Each recruited patient completed questionnaire interviews, spirometry testing, routine blood analyses, CT scans and induced sputum examination.

Patient inclusion criteria were as follows: (1) aged 40–80 years; (2) completed the standard respiratory epidemiological questionnaire in this study; (3) diagnosis of COPD in accordance with Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria.\(^2\) The exclusion criteria were as follows: (1) diagnosis with other respiratory-related diseases, such as asthma, active tuberculosis, bronchiectasis, lung cancer and pulmonary fibrosis; (2) respiratory infection or exacerbation in the past 4 weeks.

**Patient and public involvement**

This was a cross-sectional study, and no patients were directly involved in our study design, setting the research questions or the outcome measures. No patients were asked to advise on interpretation or writing up of the results.

**Epidemiological questionnaire**

Epidemiological questionnaire adopted in our study was modified from an epidemiological study of COPD in China.\(^16\) The main contents included demographic variables, respiratory symptoms, smoking status, history of occupational exposure to dust/gases/fumes, and family history of respiratory diseases, biomass exposure, passive smoking, comorbidities, modified Medical Research Council (mMRC) score, COPD Assessment Test (CAT) score, Clinical COPD Questionnaire (CCQ) score and medical history.\(^17\)\(^18\) Smoking status was classified as ‘former smoking, current smoking and never smoked’. Former smoking was defined as having previously smoked more than 100 cigarettes but not having smoked for at least 6 months prior to baseline. Current smoking was defined as having smoked for at least 6 months or having smoked at least 100 cigarettes in the patient’s lifetime. Never smoked was defined as having smoked a total of fewer than 100 cigarettes in the past.\(^19\) Smoking index was calculated by multiplying regular smoking years by daily smoking packs. We defined family history of respiratory disease as any parent or sibling diagnosed with chronic bronchitis, emphysema, COPD, asthma, bronchiectasis or lung cancer; bronchiectasis, interstitial lung disease, cor pulmonale or obstructive sleep apnoea–hypopnoea syndrome. We defined history of occupational exposure to dust/gases/fumes as having an exposure to dust/gases/fumes lasting more than 1 year. Passive smoking was defined as exposure to cigarette smoke at home or at work for more than 1 year. Biomass exposure was defined as using firewood or coal for cooking purposes for more than 1 year.\(^20\) Acute exacerbation during preceding year was defined as worsening of at least two major symptoms (cough, sputum purulence, sputum volume, dyspnoea or wheezing) that persisted for at least 48 hours, after excluding other diseases (ventricular dysfunction, pulmonary embolism, pneumothorax, pleural effusion and arrhythmia).\(^21\)\(^22\) A mild event was one that resulted in domiciliary management with COPD medications alone. A moderate event was one that resulted in an outpatient or emergency department visit and the modification of regimen, including antibiotic agents, oral glucocorticoids or both. A severe event was one that resulted in hospitalisation.

**Spirometry**

Spirometry was performed by using portable spirometers (CareFusion, Yorba Linda, CA, USA) in our study,
according to spirometry guidelines set by the American Thoracic Society and European Respiratory Society. Short-acting inhaled drugs (eg, salbutamol/terbutaline or anticholinergic drug ipratropium bromide) are avoided within 6 hours before the trial. Long-acting β-agonist bronchodilators (eg, salmeterol or formoterol) and oral therapy with aminophylline or slow-release β-agonist should not be used within 12 hours prior to the test. After spirometry testing, patients were instructed to inhale 400 µg of salbutamol from 500 mL spacer. After 20 min, the spirometry was repeated using the same criteria. Patients with COPD were defined as those having a forced expiratory volume in 1s (FEV1)/forced vital capacity (FVC) ratio less than 0.70 after bronchodilator use, and the severity of COPD was calculated by the percentage of predicted FEV1 (FEV1, %Pred). Imaging examination

The detailed protocol of HRCT we performed in this study has been published. Volumetric CT scanning was conducted when in full expiration and inspiration. CT image analysis was performed by using a software program (3D Slicer; http://www.slicer.org). Emphysema was defined as the percentage of low-attenuation area of the lung below −950 Hounsfield units (HU) in full-inspiration CT (LAA−950). Gas trapping was defined as the percentage of low-attenuation area of the lung below −856 HU in full-expiration CT (LAA−856).

Induced sputum

The protocols of sputum collection and processing have been described previously, following established standards. Eosinophilic inflammation in induced sputum was defined as ≥3% eosinophils, and neutrophilic inflammation in induced sputum was defined as ≥61% neutrophils. Therefore, airway inflammation phenotype in patients with COPD could be classified into four types: neutrophilic phenotype (NP, ≥61% neutrophils and <3% eosinophils), eosinophilic phenotype (EP, <61% neutrophils and ≥3% eosinophils), MGP (≥61% neutrophils and ≥3% eosinophils) and PP (<61% neutrophils and <3% eosinophils).

Statistical analysis

Continuous variables were expressed as the mean ± standard deviation (SD) when in a normal distribution or as medians (interquartile ranges) when in a...
skewed distribution. The one-way analysis of variance and non-parametric test were applied to investigate significant differences between different airway inflammation phenotypes. Categorical variables were expressed as numbers (percentages). The Fisher’s exact test or \( \chi^2 \) test was applied to assess the intergroup difference. Indices of emphysema and air trapping were converted into natural logarithm (Ln) because those CT variables were not normally distributed. Covariance analysis was used to investigate the relationship of different airway inflammation phenotypes with spirometry measures, emphysema and air trapping parameter after adjustment for age, sex, body mass index (BMI), smoking status, smoking index, family history of respiratory disease, occupational exposure to dust, passive smoke and biofuel exposure. Multiple comparison was adjusted by Bonferroni method.

All tests were two sided, and \( p \) values less than 0.05 were considered statistically significant. All data were analysed using SPSS V.26 (IBM SPSS).

**RESULTS**

**Demographics**

Eight hundred ninety-five patients with COPD participated in this cross-sectional study (figure 1), with men representing 94.4% of the cohort. The average age was 65.0±7.2 years, BMI was 22.1±3.2 kg/m\(^2\) and 61.3% were current smokers. Among all patients with COPD, 519 (58.0%) patients were categorised as NP, 292 (32.6%) as MGP, 48 (5.4%) as EP and 36 (4.0%) as PP (figure 2A), based on published criteria. There was no significant difference published in the distribution of inflammatory phenotypes between male and female patients (figure 2B). Airway inflammation phenotypes were equally distributed among patients with different BMIs (figure 2C). MGP was more common in former smokers (43.0%) compared with non-smokers (27.0%) and current smokers (29.0%) (figure 2D). GOLD stage 3 and 4 patients had a higher proportion of MGP and a lower proportion of NP compared with patients in GOLD stage 1 and 2 (figure 2E). There were no significant differences in gender, smoking index and comorbidities among the four inflammatory phenotype groups (table 1). Notably, patients with MGP were older than those with EP (65.9±7.2 vs 62.5±7.1 years, \( p < 0.05 \)).

The smoking status of patients in the four groups was also different. Compared with patients with NP and PP, patients in the MGP group had more former smoking status (36.3%). Patients (27.1%) with EP had higher proportions of family history of respiratory diseases than NP (14.3%) and PP (11.1%). Patients with PP (5.6%) had lower proportions of history of occupational exposure to dust/gases/fumes than patients with other inflammatory phenotypes. No significant differences were observed in passive smoking and biomass exposure. Regarding medications and medical history, patients with MGP and EP had a higher proportion of ICS treatment compared with patients with NP and PP. More detailed demographic characteristics of the study patients stratified by inflammatory phenotypes were shown in table 1.

Figure 2 Distribution of inflammatory phenotypes in patients with chronic obstructive pulmonary disease: (A) all subjects; (B) sex; (C) body mass index (BMI) group; (D) smoking status; (E) GOLD stage. GOLD, Global Initiative for Chronic Obstructive Lung Disease.
In our study, we observed that PP group showed lower chronic cough prevalence (27.8%) than other groups. Conversely, MGP and EP groups had higher rates of respiratory symptoms (chronic expectoration, wheezing and dyspnoea) compared with NP and PP groups. Table 2 displays CAT, mMRC and CCQ scores for distinct airway inflammation groups. PP group reported better quality of life compared with others. Total acute exacerbation frequencies in the preceding year were similar across COPD phenotypes (table 2). However, upon stratification, MGP group had a higher proportion of severe exacerbation compared with NP group.

After adjusting for confounding factors, compared with patients in the NP group (figure 3), those in the MGP group experienced more frequent respiratory symptoms such as chronic cough, expectoration and wheezing. The PP group exhibited a lower proportion of wheezing, but no significant differences were observed in other aspects. Compared with patients in the NP group, those in the MGP group experienced more frequent respiratory symptoms such as chronic cough, expectoration and wheezing. The PP group exhibited a lower proportion of wheezing, but no significant differences were observed in other aspects. When referring to MGP group patients, specific details can be found in figure 4. The total frequencies of respiratory acute exacerbation and the occurrences of moderate-to-severe exacerbation in the past year did not show significant differences among the groups.

### Spirometry

The distribution among GOLD grades showed significant differences between four airway inflammatory phenotypes (table 3). The proportions of GOLD stage 3 or 4 patients with four types of airway inflammation were, respectively, 11.9% (NP), 16.7% (EP), 19.5% (MGP) and 2.8% (PP). After adjusting for potential confounding factors (age, sex, BMI group, smoking status, pack-years of smoking, family history of respiratory diseases, biomass exposure, occupational exposure, passive smoke), MGP group was more likely to have lower FEV₁/FVC ratios and higher FEV₁% predicted values compared with NP group (figure 5). The proportion of patients with MEEM values of 2 or less was significantly higher in MGP group compared with NP group (table 3). The presence of airflow obstruction was associated with increased CAT, mMRC and CCQ scores, as well as greater risk of exacerbation (table 3).
Table 2  Respiratory symptoms and comparison of exacerbation (≥1 in the previous year) for patients with COPD stratified by inflammatory phenotype

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>NP (n=519)</th>
<th>EP (n=48)</th>
<th>MGP (n=292)</th>
<th>PP (n=36)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic cough, n (%) 221 (42.6)‡§</td>
<td>23 (47.9)§</td>
<td>149 (51.0)§</td>
<td>10 (27.8)†‡</td>
<td>0.019</td>
<td></td>
</tr>
<tr>
<td>Expectoration of phlegm, n (%) 236 (45.5)†</td>
<td>26 (54.2)</td>
<td>168 (57.5)§</td>
<td>16 (44.4)</td>
<td>0.009</td>
<td></td>
</tr>
<tr>
<td>Dyspnoea, n (%) 173 (33.3)‡‡</td>
<td>23 (47.9)§</td>
<td>126 (43.2)§</td>
<td>11 (30.6)†‡</td>
<td>0.013</td>
<td></td>
</tr>
<tr>
<td>Wheeze, n (%) 104 (49.3)§</td>
<td>17 (35.4)§</td>
<td>86 (29.5)§</td>
<td>4 (11.1)†‡</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>mMRC dyspnoea scale score 0.46±0.72‡‡</td>
<td>0.61±0.71§</td>
<td>0.70±0.79§</td>
<td>0.33±0.63†‡</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>CAT score 5.04±5.28‡</td>
<td>6.29±6.67§</td>
<td>6.83±6.56§</td>
<td>2.72±3.67†‡</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>CCQ score 0.85±0.69‡</td>
<td>0.87±0.87§</td>
<td>0.88±0.80§</td>
<td>0.43±0.59†‡</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Acute respiratory exacerbation during preceding year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total, n (%)</td>
<td>82 (15.8)</td>
<td>4 (8.4)</td>
<td>54 (18.5)</td>
<td>4 (11.1)</td>
<td>0.253</td>
</tr>
<tr>
<td>Mild exacerbation, n (%) 26 (5.0)</td>
<td>2 (4.2)</td>
<td>13 (4.5)</td>
<td>0 (0.0)</td>
<td>0.338</td>
<td></td>
</tr>
<tr>
<td>Moderate exacerbation, n (%) 40 (7.7)‡</td>
<td>1 (2.1)</td>
<td>20 (6.8)</td>
<td>4 (11.1)</td>
<td>0.062</td>
<td></td>
</tr>
<tr>
<td>Severe exacerbation, n (%) 16 (3.1)‡‡</td>
<td>1 (2.1)</td>
<td>21 (7.2)*</td>
<td>0 (0.0)</td>
<td>0.048</td>
<td></td>
</tr>
</tbody>
</table>

Data are mean±SD or n (%).  
P<0.05: *versus NP; †versus EP; ‡versus MGP; §versus PP.  
The bolded text in the table indicates significant statistical differences.  
CAT, COPD Assessment Test; CCQ, Clinical COPD Questionnaire; COPD, chronic obstructive pulmonary disease; EP, eosinophilic inflammatory phenotype; MGP, mixed granulocytic inflammatory phenotype; mMRC, modified Medical Research Council; NP, neutrophilic inflammatory phenotype; PP, paucigranulocytic inflammatory phenotype.

Figure 3  Impact of airway inflammatory phenotypes on respiratory symptoms and exacerbation (≥1 in the previous year), presented as ORs and 95% CIs, with the NP group as the reference. Analyses were adjusted for age, sex, body mass index group, smoking status, pack-years of smoking, family history of respiratory diseases, biomass exposure, occupational exposure and passive smoke. CI, confidence interval; EP, eosinophilic inflammatory phenotype; MGP, mixed granulocytic inflammatory phenotype; NP, neutrophilic inflammatory phenotype; OR, odd ratio; PP, paucigranulocytic inflammatory phenotype.
We found that patients with MGP had lower pre-bronchodilator FEV₁ (1.37±0.05 L), FEV₁/FVC (52.2±0.9%) and FEV₁%Pred (65.2±1.9%) compared with patients with NP (1.53±0.05 L, 56.0±0.8%, 71.0±3%) and PP (1.67±0.10 L, 61.1±1.7%, 75.3±3.7% (table 3). There was no significant difference in pulmonary function between EP and MGP. The post-bronchodilator pulmonary function of patients was similar to that pre-bronchodilator (table 3). There was no difference in airflow reversibility between the four groups (p=0.224).

### Imaging

After adjusting for potential confounding factors, indices of emphysema (LAA−950) and air trapping (LAA−856) differed statistically between patients with different airway inflammations (table 3). Compared with other groups of patients, patients with MGP had significantly more Ln (LAA−950) (0.51±0.14%) and Ln (LAA−856) (3.27±0.08%). Meanwhile, patients with PP had lower emphysema (−0.69±0.26% vs 0.13±0.13%; p<0.05) and air trapping (2.46±0.16% vs 3.08±0.08%; p<0.05) than patients with NP (table 3).

### DISCUSSION

The cross-sectional study investigated in detail the distribution and characteristics of four different inflammatory phenotypes among patients with COPD. The primary finding of this study was that NP was the most common airway inflammatory phenotype in patients with COPD, and patients with MGP had more respiratory symptoms, worse lung function, and more severe emphysema and gas trapping compared with NP patients.

Eosinophilic inflammation in patients with COPD served as a valuable biomarker for responsiveness to ICS. Eosinophil levels provide guidance in the use of ICS, especially in the prevention of some exacerbation. However, the level of eosinophils was also susceptible to various factors, such as gender, age, smoking status, BMI, allergy and previous use of drugs for airway diseases. Moldoveanu et al found that airway inflammation in patients with COPD was mainly neutrophil infiltration, which was driven by chemokines generated by epithelial cells and alveolar macrophages, such as CXCL1, leukotriene B4, CXCL5 and CXCL8. In previous studies of asthma, PP was the most common phenotype, followed by eosinophilic asthma. In our study, we found that the proportion of patients with COPD with NP was 58.0% and EP was 5.4%. This observation further emphasises that the presence of neutrophil infiltration in the airways was a distinct feature between COPD and asthma. Airway inflammation in patients with COPD was susceptible to
multiple factors. In our study, no significant differences in the distribution of airway inflammation were found when stratified by gender. As the proportion of women we included in our cohort was smaller, there may have been a certain population bias, which may explain the inconsistency with other studies. Smoking and age could lead to not only increased neutrophils in sputum, but also affected the number of eosinophils; this partly explained the older and more smoking status of MGP subjects. There may exist another important reason because of the patients with COPD in previous studies were mainly recruited from hospitals, affected by the severity of the disease and medications. However, as our patients were enrolled from community screening, there was less history of drug applications, which could directly show the distribution of airway inflammation in patients with COPD.

Our research indicated that patients with COPD with MGP had more respiratory symptoms, greater loss of lung function, and more severe emphysema and gas trapping. This may be caused by a combination of airway neutrophils and eosinophils. Previous studies found that high sputum neutrophil and eosinophil counts were all associated with a faster decline in FEV$_1$%Pred of between 0.3% and 0.9% per year. In the CanCOLD cohort, it had been confirmed that the absolute value of FEV$_1$ in subjects with blood eosinophil count more than 300 cells/µL decreased to 67.3 mL per year, which was the fastest decline in lung function compared with the low eosinophil group. Zeig-Owens et al confirmed higher levels of blood neutrophils and eosinophils were associated with decreased FEV$_1$ in firefighters, and elevated blood eosinophil levels were related to persistent airflow limitation and dyspnoea in firefighters. Previous study found that the percentage of neutrophils was significantly correlated with the decrease rate of FEV$_1$ (r=−0.4, p<0.01) by analysing the classification and count of induced leucocytes. The neutrophil infiltration was correlated with peripheral airway dysfunction.
and airway obstruction. O’Donnell et al reported for the first time that neutrophil count was significantly associated with peripheral airway dysfunction index. Meanwhile, patients with high level of eosinophil count also had reduction in the total number of visible airways and thickened central airway wall, indicating airway remodeling. Compared with subjects with sputum eosinophil <1.25%, significantly higher emphysema and gas trapping indices were observed in sputum eosinophil ≥1.25%. This also partly explained patients with increased neutrophils accompanied by increased eosinophils were associated with more severe emphysema and gas trapping. On the contrary, low level of airway neutrophil and eosinophil aggregation in patients with NP showed better lung function and less destruction of lung structure.

To the best of our knowledge, this was the first study to investigate airway inflammatory phenotype based on induced cell classification in community-derived patients with COPD. The clinical characteristics and chest imaging changes of patients with COPD with different airway inflammation phenotypes were described in detail, which could improve our understanding of the airway phenotype of COPD. Some potential limitations in our study should be mentioned. First, we excluded patients with previously diagnosed asthma. It is worth noting that asthma may be underdiagnosed in China due to limited medical resources. Nevertheless, we are confident that the low prevalence of asthma in the community does not compromise the validity of our primary findings. Second, parasitic infection is closely related to high sputum eosinophil, but we did not collect information about parasite infections. However, the prevalence of parasitic infection is low in China because of improvements in national prevention and control strategies. Third, we diagnosed patients with COPD only from single spirometry in this study, and diagnosis may fluctuate or even reverse in some patients. Additionally, due to the current absence of studies specifically defining the combined sputum eosinophils and neutrophils-based inflammatory phenotype in patients with COPD, the grouping of airway inflammation phenotypes in this study is based on research conducted in patients with asthma. It is important to note that these definitions may not entirely align with the unique pathophysiological characteristics of COPD. Nonetheless, we believe our research findings may provide some valuable reference for future studies on inflammatory phenotypes in the airways of patients with COPD. Finally, previous studies have indicated that the levels of eosinophils and neutrophils can fluctuate over time, which may potentially impact our research findings. Therefore, it is crucial to conduct a more in-depth exploration in this aspect in the future.

CONCLUSION

In summary, NP was the most prevalent airway inflammatory phenotype in community-based patients with COPD. Additionally, compared with patients with NP, those with MGP had more respiratory symptoms, greater loss of lung function, and more severe emphysema and gas trapping.

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Acknowledgements We thank all participants who have consented to include their data for analysis. We thank the medical staff of The First Affiliated Hospital of Guangzhou Medical University (Qingzi Zeng, Xiaoyan Huang, Yu Deng and Huai Chen), Liuping County People’s Hospital (Xiangwen Luo, Jiahui Huang and Shuqing Yu) and Wengyuan County People’s Hospital (Changyi Yang and Shengtang Chen) for their assistance in conducting this study. We thank Peiyu Huang, Bailing Lin, Shaolan Wei, Xiaopeng Ling, Wenjun Lai and Qiayi He (State Key Laboratory of Respiratory Disease, National Clinical Research Center for Respiratory Disease, Guangzhou Institute of Respiratory Health, The First Affiliated Hospital of Guangzhou Medical University) for their efforts in collecting the information and verification.

Contributors XWen, YZhou and PR had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Concept and design—PR, YZhou and XWen. Acquisition, analysis or interpretation of data—all authors. Statistical analysis—XWen and ZD. Drafting of the manuscript—PR, YZhou and XWen. Study guarantor—YZhou. Critical revision of the manuscript—all authors.

Funding This work was supported by the National Key Research and Development Program (2016YFC1304101), the Local Innovative and Research Teams Project of Guangdong Pearl River Talents Program (2017BT01S155), the National Natural Science Foundation of China (81970045, 81970038, and 82270043), the Foundation of Guangzhou National Laboratory (SRPG22-016 and SRPG22-018), and the Clinical and Epidemiological Research Project of State Key Laboratory of Respiratory Disease (SKLRD-L-202402).

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Obtained.

Ethics approval This study involves human participants and was approved by the Ethics Committee of the First Affiliated Hospital of Guangzhou Medical University (no. 2018-53), and written informed consent will be obtained from all patients.

Data availability statement Data are available upon reasonable request. No data are available. Not applicable.

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