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BRIEF ARTICLE

Pulmonary involvement in inflammatory bowel disease

Aydın Yılmaz, Nilgün Yılmaz Demirci, Derya Hoşgün, Enver Üner, Yurdanur Erdoğan, Atila Gökçek, Atalay Çağlar

Aydın Yılmaz, Nilgün Yılmaz Demirci, Yurdanur Erdoğan, Atatürk Chest Disease and Chest Surgery Training and Research Hospital, Pulmonary Medicine, 06000 Ankara, Turkey
Derya Hoşgün, Department of Pulmonary Medicine, Agrı Public Hospital, 04000 Agrı, Turkey
Enver Üner, Numune Education and Research Hospital, Gastroenterology, 06000 Ankara, Turkey
Atila Gökçek, Atatürk Chest Disease and Chest Surgery Training and Research Hospital, Radiology, 06000 Ankara, Turkey
Atalay Çağlar, Pamukkale University Faculty of Economic and Administrative Sciences, 20000 Denizli, Turkey
Author contributions: Yılmaz A and Yılmaz Demirci N arranged the study and wrote the manuscript; Hoşgün D collected the data; Üner E performed endoscopy; Erdoğan Y checked and helped with writing the discussion; Gökçek A evaluated HRCTs; Çağlar A performed the statistical analysis.
Correspondence to: Nilgün Yılmaz Demirci, MD, Atatürk Chest Disease and Chest Surgery Training and Research Hospital, Pulmonary Medicine, 06000 Ankara, Turkey. nilgundemirci@gmail.com
Telephone: +90-312-3552110 Fax: +90-312-3552135
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Abstract

AIM: To determine the relationship of pulmonary abnormalities and bowel disease activity in inflammatory bowel disease (IBD).

METHODS: Thirty ulcerative colitis (UC) and nine Crohn's disease patients, and 20 control subjects were enrolled in this prospective study. Detailed clinical information was obtained. Extent and activity of the bowel disease were established endoscopically. Each patient underwent pulmonary function tests and high-resolution computed tomography (HRCT). Blood samples for measurement of C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), angiotensin converting enzyme and total IgE were delivered by the patients.

RESULTS: Ten (25.6%) patients had respiratory symptoms. A pulmonary function abnormality was present in 22 of 39 patients. Among all patients, the most prevalent abnormalities in lung functions were a decrease in forced expiratory volume in 1 s (FEV1), FEV1/forced vital capacity (FVC), forced expiratory flow (FEF) 25%-75%, transfer coefficient for carbon monoxide (DLCO), DLCO/alveolar volume. Increased respiratory symptoms score was associated with high endoscopic activity index in UC patients. Endoscopic and clinical activities in UC patients were correlated with FEV1, FEV1/FVC, and FEF 25%-75%. Smoking status, duration of disease and medication were not correlated with pulmonary physiological test results, HRCT abnormalities, clinical/endoscopic disease activity, CRP, ESR or total IgE level or body mass index.

CONCLUSION: It is important that respiratory manifestations are recognized and treated early in IBD. Otherwise, they can lead to destructive and irreversible changes in the airway wall.

Key words: Inflammatory bowel disease; Ulcerative colitis; Crohn's disease; High-resolution computed tomography; Pulmonary function tests; Lung diseases

Peer reviewer: Francis Seow-Choen, MBBS, FRCSEd, FAMS, Professor, Seow-Choen Colorectal Centre, Mt Elizabeth Medical Centre, Singapore, 3 Mt Elizabeth Medical Centre #09-10, 228510, Singapore

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INTRODUCTION

Inflammatory bowel disease (IBD) is a chronic inflammatory disease that commonly involves the gastrointes-

tinal tract, and it is of unknown etiology. Crohn's disease (CD) and ulcerative colitis (UC) are the two main forms of chronic IBD. Extraintestinal manifestations are very common: dermatological manifestations, erythema nodosum and pyoderma gangrenosum; ocular manifestations, uveitis and episcleritis; hepatobiliary manifestations, primary sclerosing cholangitis and autoimmune hepatitis; musculoskeletal manifestations, peripheral arthritis and axial arthropathy[1]. In contrast, pulmonary involvement is rare. A relationship between pulmonary disease and IBD was suggested 40 years ago. Respiratory involvement in IBD is disclosed with some pathophysiological mechanisms: both the colonic and respiratory epithelia share embryonic origin from the primitive foregut, and both types of epithelial cells include goblet cells and submucosal glands; and the lungs and gastrointestinal tract contain submucosal lymphoid tissue and play crucial roles in host mucosal defense. The similarity in the mucosal immune system causes the same pathogenetic changes. The aberrations in both innate and acquired immunity that are involved in the pathogenesis of IBD are complex and still incompletely understood[2]. The patterns of involvement in IBD are[2,3]: (1) upper airway: glottic/subglottic stenosis, tracheal inflammation and stenosis; (2) bronchi: chronic bronchitis, bronchiectasis, and chronic bronchial suppuration; (3) small airways: bronchiolitis obliterans, bronchiolitis, and diffuse pan-bronchiolitis; (4) lung parenchyma: bronchiolitis obliterans-organizing pneumonia, nonspecific interstitial pneumonia, granulomatous interstitial lung disease, desquamative interstitial pneumonitis, pulmonary infiltrates and eosinophilia, and sterile necrobiotic nodules; (5) sarcoidosis, α1 antitrypsin deficiency; (6) pulmonary vascular disease; Wegener's granulomatosis, Churg-Strauss syndrome, microscopic polyangiitis, and pulmonary vasculitis; (7) venous thromboembolism; and (8) serositis: pleural and pericardial manifestations.

The aim of present study was to evaluate pulmonary involvement in IBD. For this, we examined frequency of respiratory symptoms, pulmonary function tests, bronchial hyperreactivity, high-resolution computed tomography (HRCT), serum angiotensin-converting enzyme (ACE), C-reactive protein (CRP) level and erythrocyte sedimentation rate (ESR).

MATERIALS AND METHODS

During a 2-year period from January 2007 to December 2009, 39 consecutive patients with the diagnosis of IBD, who were seen in a gastroenterology clinic, were referred to our outpatient clinic. Subjects with the following characteristics were included: age $\geqslant$ 18 years old, CD and UC with endoscopic examination performed in a week.

Subjects with the following characteristics were excluded: lack of compliance in performing lung function tests, age < 18 years old, history of previous lung disease, history of atopy or familial atopy, peripheral eosinophilia, and obesity [body mass index (BMI) > 30 kg/m^2].

Thirty UC and nine CD patients were enrolled in this prospective study. Age- and sex-matched normal controls (20 subjects) were recruited from healthy volunteers. The detailed anamnesis of the subjects (age, sex, cigarette pack/years, family history, occupational history) was gathered. Duration of disease from the date of first endoscopic diagnosis and maximal extent of endoscopic diagnosis were recorded. The extent of the bowel disease was defined as pancolitis when the entire colon was involved; left-side colitis when the bowel from the hepatic flexure to the rectum was involved; and distal colitis when the sigmoid colon and rectum were involved. Patients with CD were classified with colon involvement, small bowel involvement, or ileocecal involvement. In patients with UC, the clinical activity of the disease was assessed using the Truelove score[4]: mild was considered to be in remission, and patients with moderate and severe indices had active disease. Endoscopic activity was assessed by videocolonoscopy (Fujinon EC 450/WL, Tokyo, Japan). All colonoscopic examinations were performed by an experienced investigator. The Rachmilewitz endoscopic activity index for UC was used to assess disease activity[5]. CD activity was assessed on the basis of clinical and endoscopic features[6]. Smoking habit was also recorded, however, most of our patients were nonsmokers or former smokers. Symptoms of cough, sputum, wheezing and breathlessness were scored out of a maximum of 2: 0 = no symptoms; 1 = intermittent symptoms; and 2 = regular symptoms. The total symptom score (maximum of 8) for each patient was derived from the sum of the individual symptom scores. A total symptom score of $\geqslant$ 3 points was assessed as "respiratory symptom is present" or "symptomatic"[7]. Blood samples for measurement of CRP, ESR, ACE and total IgE were delivered by the patients prior to endoscopy.

Pulmonary function testing

Each patient underwent standard pulmonary function tests for forced expiratory volume in 1 s (FEV1), vital capacity, forced vital capacity (FVC), and transfer coefficient for carbon monoxide (DLCO) measured by means of the single-breath test. Account was also taken of the hemoglobin value when calculating the DLCO. The results were compared with those of age- and sex-matched controls and expressed as a percentage of predicted values. Pulmonary function test indices were measured with a Sensormedics V max 229 (Sensormedics, Yonda Linda, CA, USA) series flow-sensitive spirometer. The limitation of our study was that lung volumes could not be measured. Bronchial hyperresponsiveness (BHR) (PD_{20}, dose of methacholine that caused a 20% fall in FEV_1) was measured in the morning with the methacholine challenge test using the dosimeter method according to ERS task force in all IBD patients[8]. In patients with high IgE level, the existence of an atopic state was evaluated by skin prick test using common allergen extracts (grass, tree and weed pollens; house dust mites; molds; cat and dog extracts), and reactions at least 3 mm greater then negative control test were regarded as positive (Stallergenes, Antony cedex, France). Histamine was used as a positive control.

HRCT

All CT scans were obtained with a scanner (Siemens Somatom Emotion, Germany). Images were acquired during inspiration. CT scans were evaluated by an independent investigator who was blinded to the results of the pulmonary function tests and clinical data. The individual features evaluated included the following: bronchiectasis, bronchial wall thickening, ground-glass opacification, emphysema and cysts.

Ethical considerations

Informed consent was obtained from all patients and control subjects and the study was approved by the local ethical committee.

RESULTS

Patient description

The characteristics of the control group and the 39 patients with UC and CD are shown in Table 1. Twenty-three male and 16 female (59%, 41%) patients, as well as 20 healthy controls, with mean ages of 44.28 ± 12.85 years and 39.50 ± 12.47 years, respectively, were recruited to the study. The mean duration of disease was 39.07 ± 29.38 mo. Thirty individuals were never smokers, five were ex-smokers and four were smokers. Control patients were nonsmokers. None of our patients had an occupational history or family history of respiratory disease and atopy. Fifteen (50%) UC and four (44.4%) CD patients had clinically active bowel disease at the time of the study. Of the 39 patients, 33 were receiving sulfasalazine, one azathioprine, and five sulfasalazine plus azathioprine. None of the patients had extraintestinal manifestations other than pulmonary involvement.

Twenty-five (64.10%) patients had HRCT abnormalities (Table 2). Ten (25.6%) patients had respiratory symptoms. In 16 (41%) patients, CRP level was elevated, and in 26 (66.7%), ESR was increased. Four (10.3%) patients had high levels of total IgE, and in these patients, skin prick tests were negative, and in one patient, weak BHR was observed.

Pulmonary function tests

Three (7.69%) patients had obstructive dysfunction and small airway obstruction was reported in 17 (43.58%). Two patients (5.12%) had restrictive dysfunction. When comparing all IBD patients with controls, we found statistically significant differences for FEV1, FEV1/FVC, FEF 25%-75%, DLCO and DLCO/alveolar volume (VA) ($P < 0.05$) (Table 3).

Correlation between pulmonary function parameters, clinical characteristics and HRCT features

The correlation of pulmonary function and endoscopic and clinical disease activity is shown in Tables 4 and 5. The most prevalent abnormality was a decrease in FEF 25%-75% in patients with CD and endoscopically and clinically active UC. The impairment in FEV1 and FEV1/FVC was significant and more pronounced in patients with active UC *vs* controls. In 10 (33.3%) patients with UC, the endoscopic activity index was high and correlated significantly with pulmonary symptom scores ($P < 0.05$). There was no significant correlation between smoking status and pulmonary physiological test results, HRCT abnormalities or clinical/endoscopic disease activity. Also, no relationship was found between disease activity and HRCT abnormalities, respiratory symptoms, CRP, total IgE level, ESR or BMI. There was no relationship between duration of disease and pulmonary physiological test results, HRCT abnormalities, CRP, total IgE level or ESR. There was no correlation between BMI and pulmonary function.

Table 1 Characteristics of the control and patient groups with inflammatory bowel disease

	UC	CD	Controls
n	30	9	20
Sex (M/F)	22/8	1/8	10/10
Mean age (yr)	43 ± 3	46 ± 2	39.50 ± 12.47
Smoking (smoker/never/ex-smoker)	4/22/4	-	-
Duration and range of bowel disease (yr) (mean ± SD)	3 ± 0.5 (0-9)	3 ± 0.5 (0.5-4)	
Respiratory symptom (present/absent)	9/21	1/8	0/20
Disease activity (active/remission)	14/16	5/4	

UC: Ulcerative colitis; CD: Crohn's disease.

Table 2 Findings on high-resolution computed tomography in patients with inflammatory bowel disease

Findings on HRCT	*n*
Normal	14
Peribronchial thickness	15
Bronchiectasis	2
Ground-glass opacity	8
Emphysema	9
Air cysts	1
Reticulonodular opacity	1

HRCT: High-resolution computed tomography.

Table 3 Correlations of pulmonary function tests with inflammatory bowel disease and controls

	UC (*n* = 30)	CD (*n* = 9)	Controls (*n* = 20)
FEV1	86.87 ± 15.09[a]	85.89 ± 13.75	95.75 ± 11.56
FVC	88.37 ± 15.80	93.22 ± 8.90	96.40 ± 10.00
FEV1/FVC	79.67 ± 8.98[a]	78.56 ± 11.11	84.15 ± 4.21
FEF 25%-75%	73.93 ± 21.38	64.89 ± 21.23[a]	85.00 ± 11.85
DLCO	96.43 ± 12.84[a]	90.67 ± 19.88[a]	103.5 ± 11.90
DLCO/VA	104.83 ± 16.99	93.00 ± 17.85[a]	112.95 ± 10.22

[a]$P < 0.05$ *vs* control group statistically significant. UC: Ulcerative colitis; CD: Crohn's disease; FEV1: Forced expiratory volume in 1 s; FVC: Forced vital capacity; FEF: Forced expiratory flow; DLCO: Transfer coefficient for carbon monoxide; VA: Alveolar volume.

Table 4 Correlation of pulmonary function tests between endoscopically and clinically active Crohn's disease with controls

	Endoscopically active (n = 5)	inactive(n = 4)	Clinically active (n = 4)	inactive (n = 5)	Control (n = 20)
FEV1	82 ± 12.28	90.75 ± 7.04	81.25 ± 19.50	89.60 ± 7.37	95.75 ± 11.56
FVC	91.20 ± 7.33	95.75 ± 11.15	92.25 ± 7.68	94.00 ± 10.61	96.40 ± 10.00
FEV1/FVC	75.80 ± 14.60	82 ± 4.08	74.25 ± 16.38	82 ± 3.54	84.15 ± 4.21
FEF 25%-75%	61.80 ± 28.84	68.75 ± 7.54	58.50 ± 32.07	70 ± 7.52	85 ± 11.85[a,c]
DLCO	91.20 ± 15.83	90 ± 26.81	103 ± 13.64	80.80 ± 19.42	103.5 ± 11.90[c]
DLCO/VA	95.40 ± 20.38	90 ± 16.55	102.25 ± 16.15	85.60 ± 16.95	112.95 ± 10.22[a,c]

[a]P < 0.05 comparison between active and control groups statistically significant; [c]P < 0.05 comparison between inactive and control groups statistically significant. FEV1: Forced expiratory volume in 1 s; FVC: Forced vital capacity; FEF: Forced expiratory flow; DLCO: Transfer coefficient for carbon monoxide; VA: Alveolar volume.

Table 5 Correlation of pulmonary function tests between endoscopically and clinically active ulcerative colitis with controls

	Clinically active (n = 15)	inactive (n = 15)	Endoscopically active (n = 20)	inactive (n = 10)	Control (n = 20)
FEV1	86.53 ± 13.15	87.20 ± 17.28	78.10 ± 19.58	91.25 ± 10.26[c]	95.75 ± 11.56[a]
FVC	91.60 ± 14.07	85.13 ± 17.22	86.70 ± 16.49	89.20 ± 15.81	96.40 ± 10.00
FEV1/FVC	78.07 ± 6.22	81.27 ± 11.08	72.70 ± 10.95	83.15 ± 5.28[c]	84.15 ± 4.21[a]
FEF 25%-75%	67.73 ± 19.00	80.13 ± 22.43[c]	53.80 ± 22.30	84 ± 11.93[c]	85 ± 11.85[a,e]
DLCO	97.93 ± 12.88	94.93 ± 13.07	96 ± 13.42	96.65 ± 12.89	103.5 ± 11.90[e]
DLCO/VA	107.67 ± 14.25	102 ± 19.44	106.50 ± 17.28	104 ± 17.24	112.95 ± 10.22[e]

[a]P < 0.05 comparison between active and control groups statistically significant; [c]P < 0.05 comparison between active and inactive groups statistically significant; [e]P < 0.05 comparison between inactive and control groups statistically significant. FEV1: Forced expiratory volume in 1 s; FVC: Forced vital capacity; FEF: Forced expiratory flow; DLCO: Transfer coefficient for carbon monoxide; VA: Alveolar volume.

DISCUSSION

Extraintestinal manifestations of IBD are increasing in developed countries. In 1976, Kraft *et al*[9] described six patients in whom chronic bronchial suppuration had appeared between 3 and 13 years after the onset of IBD. Since then, all respiratory complaints in IBD patients that cannot be explained by other causes have been defined as pulmonary manifestations of the disease. Furthermore, reports of pulmonary manifestations of the disease are increasingly present in the literature. In our patient group, among all patients, the most prevalent abnormalities in lung functions were a decrease in FEV1, FEV1/FVC, FEF 25%-75%, DLCO, and DLCO/VA. Increased respiratory symptom score was associated with high endoscopic activity index in UC patients. The most prevalent abnormality was a decrease in FEF 25%-75% in patients with CD and endoscopically and clinically active UC. The impairment in FEV1 and FEV1/FVC was significant and more pronounced in patients with active UC compared with the controls.

Godet *et al*[10] have studied patients with UC, and pulmonary function test abnormalities were found in 55%, 15/66 subjects had an obstructive pattern, 19 had abnormal diffusion, one had a restrictive pattern, and five had both an obstructive pattern and abnormal diffusion; these alterations could not be predicted by current or past smoking status, family history of respiratory disease, occupational history or current medication use. In our study, 3/39 (7.69%) patients had obstructive dysfunction, two (5.12%) had restrictive dysfunction, and five (12.8%) had abnormal diffusion. These results were not correlated with smoking status. None of our patients had a family or occupational history of respiratory disease.

The influence of disease activity was studied. In a recent study with UC patients, small airway obstruction (as demonstrated by diminished FEF 25%-75%) was reported in the 15 patients (57.6%), restrictive dysfunction in eight (30.7%) and obstructive dysfunction in three (11.5%), and the impairment in pulmonary function tests was significant and more pronounced in patients with active UC compared with the controls[11]. In our study, the most prevalent abnormality was a decrease in FEF 25%-75%, and FEV1/FVC and FEF 25%-75% were significantly lower in patients with active UC. In 10 (33.3%) patients with UC, the endoscopic activity index was high and correlated significantly with pulmonary symptom scores (P < 0.05). These findings suggest a direct pathogenic link with IBD. Tzanakis *et al*[12] have found small airway dysfunction in patients with CD and UC despite their normal baseline spirometric values, and there was no difference between active and nonactive disease.

Chest radiography is often normal in patients with respiratory symptoms and IBD. Bronchiectasis is the classic pulmonary manifestation of IBD, and is noted in 66% of cases of IBD that involve the large airways[2]. Mahadeva *et al*[7] have found bronchiectasis in 13 of 17 patients with IBD, in whom sputum production was present in 10. In contrast, bronchiectasis was identified in only two patients in the present study. In our study, the most frequent find-

ing on HRCT was peribronchial thickness. The most common respiratory association of IBD is inflammation of the airways. Biopsy shows either severe nonspecific chronic inflammation or non-caseating tuberculoid granulomas. These appearances have been associated with those in the bowel, and it is possible that the gut and the lung are both affected because they share common antigens[13]. This inflammation is perceived on HRCT as an increase in bronchial wall thickness or an increase in diameter of pulmonary artery branches. In these patients, bronchial dilatation is commonly present and results from traction by fibrous tissue on the bronchial walls and results in bronchiectasis[14]. Consequently, peribronchial thickness might reflect inflammation, which usually responds well to steroids[15]. In this way, bronchiectasis can be prevented. This finding suggests a direct pathogenic link to IBD as well.

The expiratory HRCT seems to be a limitation in our study and air trapping could have been underestimated. In our series, nine patients had upper lobe emphysema, which was probably related to smoking but there was no significant correlation between smoking status and pulmonary physiological test results, HRCT abnormalities or clinical/endoscopic disease activity.

It is important to consider whether therapy with sulfasalazine or mesalazine could have been responsible for the pulmonary changes. The most common abnormality described in association with sulfasalazine therapy is upper lobe peripheral opacity, although lower lobe opacity, eosinophilic pneumonia, interstitial pneumonitis, bronchiolitis obliterans organizing pneumonia and cavitating nodules have also been reported[16,17]. None of our patients had peripheral blood eosinophilia, which is usually present in lung disease caused by sulfasalazine.

Kuzela *et al*[18] have identified a high incidence of pulmonary function abnormalities (suspicious of interstitial lung disorder) in patients with IBD, despite the lack of radiological abnormalities; 56.7% of patients with UC and 57.7% of those with CD had reduced lung transfer factor. Tzanakis *et al*[12] have shown that DLCO is significantly lower among IBD patients with active gastrointestinal disease than those in remission. Marvisi *et al*[19] have studied 32 patients with UC and found a mild reduction in DLCO and FEF 25%-75%, and the incidence was higher in patients with active disease despite the lack of radiological alterations and pulmonary symptoms. Also, significant differences in mean FVC, FEV1, total lung capacity and FEV1\FVC values were found between patients with active and inactive UC. In our study, DLCO and DLCO/VA were significantly lower among IBD patients, but not correlated with disease activity.

Douglas *et al*[20] have studied 44 IBD patients and found that 48% had unspecified respiratory symptoms. Songür *et al*[21] have found that 16 of 36 IBD patients (44%) in a gastroenterology clinic had symptoms of wheezing, cough, sputum production, or breathlessness. In our study, 25.6% of 39 IBD patients had respiratory symptoms.

The true prevalence of airway inflammation and respiratory and atopic symptoms in IBD remains obscure. Ceyhan *et al*[22] have studied 30 consecutive IBD subjects; allergic symptoms were seen in 14 IBD patients, respiratory symptoms were found in 15, asthma and antiasthmatic drug treatment were noted in three, and BHR was determined in four. They have concluded that allergic symptoms, respiratory symptoms, abnormal lung function tests and skin prick test positivity are more common among IBD patients in comparison with controls, and airway dysfunction is accompanied by atopy. Louis *et al*[23] have shown no correlation between BHR and airway inflammation in IBD patients, in contrast to asthma. In our study, we excluded subjects with atopy and a familial history of atopy, subjects with peripheral eosinophilia. Four (10.3%) patients had high levels of total IgE, and in these patients, skin prick tests were negative and in one patient, weak BHR was observed.

Nutritional status has been shown to have a significant influence on the overall pulmonary function in patients with IBD. Christie and Hill have demonstrated a 35% loss of body protein stores and associated 40% physiological impairment (FEV1, FVC and maximal voluntary ventilation) in patients with acute exacerbations of CD, compared to controls. There was a significant immediate and delayed improvement in these parameters after 2 wk nutritional supplementation, and further improvement on restoration of body proteins during convalescence[24]. Similarly, BMI has been examined as an index of nutritional status in patients with UC and in controls, and a significant positive correlation has been found between BMI and pulmonary function[10]. In our study, 19 patients were overweight (BMI: 25-29.9 kg/m^2), and there was no correlation between BMI and pulmonary function.

In conclusion, both the colonic and respiratory epithelia share embryonic origin from the primitive foregut. The inflammatory lesions seen beneath the bronchial epithelium are similar to those observed beneath the colonic epithelium in IBD. This means that there is inflammation that can be detected early by HRCT and pulmonary function tests. Although most patients have subclinical disease, the pulmonologist must be aware of the multiple potential pulmonary manifestations that can occur in a patient with IBD. Otherwise, they tend to generate persistent and annoying symptoms, and can lead to destructive and irreversible changes in the airway wall, or the "end-stage lung"[3].

COMMENTS

Background

Crohn's disease (CD) and ulcerative colitis (UC) are the two main forms of chronic inflammatory bowel disease (IBD), with unknown etiology. Extraintestinal manifestations such as dermatological, ocular, hepatobiliary and musculoskeletal diseases are very common. In contrast, pulmonary involvement is rare.

Research frontiers

Respiratory involvement in IBD is seen with some pathophysiological mechanisms: both the colonic and respiratory epithelia share embryonic origin from the primitive foregut, both types of epithelial cells include goblet cells and submucosal glands, and both the lungs and gastrointestinal tract contain submucosal lymphoid tissue and play crucial roles in host mucosal defense. The similarity in the mucosal immune system causes similar pathogenic changes. The aberrations in both innate and acquired immunity that are involved in the pathogenesis of IBD are complex and still incompletely understood. In this study, pulmonary involvement in IBD was evaluated.

Innovations and breakthroughs

The most prevalent abnormalities in lung functions are a decrease in forced expiratory volume in 1 s (FEV1), FEV1/forced vital capacity, forced expiratory flow 25%-75%, transfer coefficient for carbon monoxide (DLCO), DLCO/alveolar volume. The most frequent finding on high-resolution computed tomography, unlike previous studies, was peribronchial thickness. The most common respiratory association of IBD is inflammation of the airways. Biopsy shows either severe nonspecific chronic inflammation or non-caseating tuberculoid granulomas. These appearances are associated with those in the bowel, and it is possible that the gut and the lung are both affected because they share common antigens. This inflammation is perceived on high-resolution computed tomography as an increase in bronchial wall thickness or an increase in diameter of pulmonary artery branches. In these patients, bronchial dilatation is commonly present and results from traction by fibrous tissue on the bronchial walls, which results in bronchiectasis. Consequently, peribronchial thickness might reflect inflammation, which usually responds well to steroids. In this way, bronchiectasis can be prevented.

Applications

Various pulmonary manifestations can occur in IBD. It is important that respiratory manifestations are recognized and treated early. Otherwise, they might lead to destructive and irreversible changes in the airway wall, or the "end-stage lung".

Peer review

This is a very interesting study and gives us further insight into a disease that may manifest in various systems. Pulmonary disease in IBD has not been extensively studied because the problem is often treated only by gastroenterologists. This is a timely study and could lead to further studies that will help us understand more about this disease.

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