Findings in Chest High-Resolution Computed Tomography in Severe Asthma

Extremera Ortega AM[1], Moreno Lozano L[1], González Jiménez OM[1], Borja Segade J[1], Joyanes Romo JB[1], Muñoz Rodríguez JR[2], Feo-Brito F[1], Galindo Bonilla PA[1]

[1]Allergy Section, General University Hospital of Ciudad Real, Ciudad Real, Spain

[2]Translational Research Unit, General University Hospital of Ciudad Real, Ciudad Real, Spain

J Investig Allergol Clin Immunol 2022; Vol. 32(2): 146-147
doi: 10.18176/jiaci.0725

Key words: Computed tomography. Bronchiectasis. Severe asthma. Comorbidities.

Palabras clave: Tomografía computarizada. Bronquiectasias. Asma grave. Comorbilidades.

About 3%-10% of asthmatic patients have severe asthma (SA), ie, step 5-6 of GEMA [1] and 4-5 of GINA [2].

Chest high-resolution computed tomography (CHRCT) involves the use of thin slices (≤1.5-mm acquired at 10- to 20-mm intervals through the lungs) and a high spatial frequency reconstruction algorithm to detect and characterize diseases that affect the pulmonary parenchyma and small airways. This technique was followed by the development and widespread availability of multidetector CT scanners capable of acquiring near-isotropic data throughout the entire thorax in a single breath-hold, thus enabling acquisition of volumetric single breath-hold data sets and enabling spaced, contiguous, and/or overlapping CHRCT images to be reconstructed [3].

Imaging tests play a crucial role in the study of asthma, especially in SA. Their main indication is to identify possible complications and comorbidities such as bronchiectasis, which should be appropriately assessed in patients with SA [4].

The aim of our study was to describe CHRCT findings in an SA population and assess the relationship between bronchiectasis and patient characteristics.

A descriptive and retrospective study was carried out under conditions of routine clinical practice. We evaluated the lesions found in CHRCT performed on patients studied in the SA unit of the Allergology Department at the General University Hospital of Ciudad Real, Ciudad Real, Spain.

CHRCTs were requested in asthmatic patients with an atypical course to rule out complications and comorbidities. CHRCT images were obtained by the radiologist, who randomly corresponded with the requesting physicians (radiologists did not know the aim of our study).

The demographic and clinical characteristics of patients with bronchiectasis included age, sex, asthma duration (years), atopy (defined as at least 1 positive prick test result), body mass index, smoking status (yes or no), Asthma Control Test score, FeNO, FEV_1, FEV_1/FVC, $FEF_{25\%-75\%}$, eosinophil cationic protein, peripheral blood eosinophil count (PBEC), gastroesophageal reflux, and asthma exacerbations in the previous year (AEPY).

CHRCT was performed in 121 patients (details available online: Table 1).

The CHRCT image was normal in 58 patients (47.9%) and pathological in 63 (52.1%). The findings were bronchiectasis (19%), atelectasis and/or lamellar fibrosis (18.2%), areas of emphysema (8.3%), ground-glass images (7.4%), centrilobular nodules (5%), bronchial wall thickening (BWT) (5%), hiatal hernia (5%), mucosal impaction and/or tree-in-bud image (4.1%), air trapping (3.3%), increased interstitial tissue (2.5%), pulmonary infiltrate (2.5%), mosaic attenuation pattern (1.65%), pulmonary nodules (1.65%), and pericardial effusion (1.65%). Other findings included (1 patient each) (0.8%) extrapulmonary nodules, pleural thickening, lung abscess, tracheocele, arterial calcification (possible pulmonary thromboembolism), azygos lobe, and endothoracic goiter. Patients with a normal CHRCT scan had FEV_1 above 80%, although the difference was not significant.

Five of the 23 patients (21.7%) who had bronchiectasis met the clinical criteria for allergic bronchopulmonary aspergillosis (ABPA) [5].

Patients with bronchiectasis were older and had higher AEPY, FeNO, and PBEC values. In contrast, bronchiectasis was associated with lower FEV_1 values.

The most common findings in asthma are BWT, air trapping, and bronchiectasis [6]. Machado et al [7] found that the most frequent radiological lesion was BWT (69.7%), followed by bronchiectasis (45.9%). Sánchez-Cuéllar et al [8] found BWT in 71% and bronchiectasis in 73.8% of cases.

The most frequent finding in the present series was bronchiectasis (19% of patients with SA and 36.6% of those with pathological CHRCT) followed by atelectasis and/or lamellar fibrosis (22 patients [18.2%]). The few cases of BWT found (5%) and the lower frequency of bronchiectasis (19%) are striking, probably because our study was retrospective and performed under conditions of routine clinical practice, whereas other authors conducted their studies prospectively or insisting on the need to report specific patterns. In our series, radiologists were not informed of the need to accurately report each imaging pattern.

The presence of BWT could reflect bronchial and peribronchial inflammation. This pattern does not only appear in symptomatic patients or those with SA. Gupta et al [9] found a prevalence of 62%, which was related to the severity of asthma, as did Machado et al [7], who found BWT in 88.9% of patients with SA, in 78.6% of those with moderate disease, and in 40% of patients with mild disease.

Bronchiectasis is the consequence of infection, inflammation, and airway epithelium repair, which eventually leads to the destruction of the bronchial wall and irreversible dilation. CHRCT is currently the gold standard technique for diagnosis of bronchiectasis, with specificity and sensitivity greater than 90%. Bronchiectasis is not necessarily a synonym of synonymous with ABPA.

In our series, 21.7% of patients with bronchiectasis fulfilled the clinical criteria for ABPA. If we exclude patients with ABPA, the results were similar in asthmatics with or without bronchiectasis, except for PBEC and FeNO values, which were

higher. Our results were not statistically significant, probably because of the small sample size (5 patients).

The frequency of bronchiectasis in asthma is variable. A high frequency of bronchiectasis has been found in patients with SA and impaired lung function. Machado et al [7] found bronchiectasis in 77.7% of severe asthmatics, 42.9% of moderate asthmatics, and 20% of mild asthmatics. Sanchez-Cuellar et al [8] found bronchiectasis in 73.8% of patients with 3 or more AEPY and impaired lung function. Gupta et al [9] found bronchiectasis in 40% of patients with SA and reported that it was associated with more AEPY and impaired lung function. Harmanci et al [10] found that the presence of bronchiectasis was inversely related to FEV_1 values. Similar results were observed in the cases we report. Oguzulgen et al [11] found that asthmatics with bronchiectasis had poorer lung function, more severe disease, and more AEPY than asthmatics without bronchiectasis.

Bronchiectasis was more frequent in older patients and was associated with lower FEV_1 values, higher FeNO, more AEPY, and greater eosinophilia. Padilla-Galo et al [12] found that almost a third of patients with SA had bronchiectasis and that this was associated with lower FeNO values.

In the present series, the cost-effectiveness of CHRCT requests was high: more than half of the patients had pathological CHRCT images. The most frequently detected alteration was bronchiectasis, followed by atelectasis and/or laminar fibrosis and areas of emphysema. ABPA must be ruled out in cases of bronchiectasis.

Funding

The authors declare that no funding was received for the present study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

1. Global Initiative for Asthma [Internet]. Global Initiative for Asthma - GINA. [Accessed Mar 8, 2021]. Available from: https://ginasthma.org
2. Gemasma [Internet]. [Accessed Mar 8, 2021]. Available from: https://www.gemasma.com/
3. American College of Radiology. ACR-STR practice parameter for the performance of high-resolution computed tomography (HRCT) of the lungs in adults. (Resolution 33). 2020; Available at: https://www.acr.org/-/media/ACR/Files/Practice Parameters/HRCT-Lungs.pdf. [Accessed May 28, 2021].
4. Trigueros JA, Plaza V, Domínguez-Ortega J, Serrano J, Cisneros C, Padilla A, et al. GEMAFORUM Task Force. Asthma, Comorbidities, and Aggravating Circumstances: The GEMA-FORUM II Task Force. J Investig Allergol Clin Immunol. 2020 Apr 24;30(2):140-3.
5. Agarwal R, Chakrabarti A, Shah A, Gupta D, Meis JF, Guleria R, et al. Allergic bronchopulmonary aspergillosis: review of literature and proposal of new diagnostic and classification criteria. Clin Exp Allergy. 2013 Aug;43(8):850-73.
6. Richards JC, Lynch D, Koelsch T, Dyer D. Imaging of Asthma. Immunol Allergy Clin North Am. 2016 Aug;36(3):529-45.
7. Machado D, Pereira C, Teixeira L, Canelas A, Tavares B, Loureiro G, et al. Thoracic high resolution computed tomography (HRCT) in asthma. Eur Ann Allergy Clin Immunol. 2009 Oct;41(5):139-45.
8. Sánchez-Cuéllar S, Girón RM, Cisneros C, Caballero P, Tejerina A, Ancochea J. Valoración de bronquiectasias en pacientes con asma. Rev Patol Respir. 2015 Jun;18(2):57-62.
9. Gupta S, Siddiqui S, Haldar P, Raj JV, Entwisle JJ, Wardlaw AJ, et al. Qualitative analysis of high-resolution CT scans in severe asthma. Chest. 2009 Dec;136(6):1521-8.
10. Harmanci E, Kebapci M, Metintas M, Ozkan R. High-resolution computed tomography findings are correlated with disease severity in asthma. Respiration. 2002;69(5):420-6.
11. Oguzulgen IK, Kervan F, Ozis T, Turktas H. The impact of bronchiectasis in clinical presentation of asthma. South Med J. 2007 May;100(5):468-71.
12. Padilla-Galo A, Olveira C, Fernández de Rota-Garcia L, Marco-Galve I, Plata AJ, Alvarez A, et al. Factors associated with bronchiectasis in patients with uncontrolled asthma; the NOPES score: a study in 398 patients. Respir Res. 2018 Mar 16;19(1):43.

Manuscript received March 11, 2021; accepted for publication June 23, 2021.

Alba María Extremera Ortega
Sección de Alergología
Hospital General Universitario de Ciudad Real
C/ Obispo Rafael Torija, s/n
13005 Ciudad Real
Spain
E-mail: albaextremera@hotmail.com