Incidental finding of bronchial diverticula in a non-smoker population: evaluation on thin-section CT

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Abstract

Bronchial diverticula have been described as a common radiological finding in smoker patients with COPD, but the specificity of this sign should be further investigated. Thus, the aim of our study was to evaluate the prevalence of diverticula in a cohort of non-smoker subjects.

Between February and July 2012, 2438 patients were admitted to our Radiology Unit to undergo a chest CT. Among them, we enrolled 121 non-smoking patients (78/121-64.5% females, 43/121-35.5% males), of different age (57.0±20.7 years-range: 12-88), without any respiratory symptoms, submitted to chest CT for several reasons (oncologic evaluation: 59/121-48.8%; follow up of lung nodules: 27/121-22.3%; screening in connectivitis: 12/121-9.9%; others: 23/121-19.0%). We considered thin-section CT scan on axial, coronal and sagittal plans to evaluate prevalence, numbers and level of bronchial diverticula.

Diverticula were found in 41/121-33.9% patients, with a slight major prevalence in males (p=0.048), but no significant difference on age. In 31/41-75.6% the number was <3, whereof 17/31-54.8% with just one diverticulum assessed. Regarding the level, in 30/41-73.2% they were subcarinal, but they were also detected in mainstem (2/41-4.9%) and lobar bronchi (with the right upper lobe bronchus most frequently involved - 12/41-29.3%).

Bronchial diverticula can be observed in non-smokers, as well as in smoker patients with COPD. However, their prevalence seems to be lower than in smokers and they tend to be isolated and subcarinal. The age of patients does not influence their finding. More studies should be proposed to better define a cut-off between smokers and healthy subjects.

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Riassunto

Sebbene i diverticoli bronchiali rappresentino un reperto comune nei pazienti con BPCO, la specificità di questo segno dovrebbe essere ulteriormente indagata. Pertanto, l'oggetto del nostro studio è stata la valutazione della prevalenza dei diverticoli bronchiali in una popolazione di non fumatori.

2438 pazienti sono stati sottoposti a TC torace presso il nostro Istituto tra Febbraio e Luglio 2012; tra questi, abbiamo selezionato 121 non fumatori (78/121-64.5% donne, 43/121-35.5% uomini), di diverse età (57.0±20.7 anni-range: 12-88), senza alcun sintomo respiratorio e con diverse indicazioni cliniche all'esecuzione dell'indagine (valutazione oncologica: 59/121-48.8%; follow-up di noduli polmonari: 27/121-22.3%; screening per connettivite: 12/121-9.9%; altro: 23/121:19.0%). La presenza, il numero e la sede dei diverticoli sono state valutate su immagini assiali TC a strato sottile.

La presenza di diverticoli è stata registrata in 41/121-33.9% dei pazienti, con maggior prevalenza nei soggetti di sesso maschile (p=0.048), ma senza differenze in base all'età. In 31/41-75.6% casi il numero era <3, di cui singolo in 17/31-54.8%. Relativamente alla sede, la maggior parte (30/41-73.2%) dei diverticoli era sottocarenale, più rari a livello dei bronchi principali (2/41-4.9%) e lobari (con il bronco per il lobo superiore destro più frequentemente coinvolto - 12/41-29.3%).

I diverticoli bronchiali non sono un reperto esclusivo dei pazienti con BPCO, ma possono essere riscontrati anche nei non fumatori, indipendentemente dall'età del soggetto, sebbene con una minor incidenza e tendenzialmente isolati e sottocarenali. Ulteriori studi sarebbero necessari per definire un cut-off tra persone sane e fumatori.

Introduction

Bronchial diverticula start as submicroscopic depressions and dilatations of the bronchial gland ducts on the mucosa surface, which coalesce and herniate through smooth-muscle cellular bundles [1]. They were first described in bronchoscopic and bronchographic studies [2] and afterwards detected on high resolution computed tomography, as isolated or multiple (*accordion-like* appearance) [3]. Their radiological finding has been demonstrated to be associated to chronic obstructive pulmonary disease (COPD), especially to a longstanding disease, with

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prevalence up to 45% of patients [4]. However, some authors suggested that they could be detected in healthy subjects as well, commonly in the subcarinal region, though few papers have been published on this topic [5]. Thus, the purpose of the present study was to evaluate the prevalence of bronchial diverticula in a non-smoker population, without respiratory symptoms and with no pathological findings detected on chest CT scans.

Materials and methods

Study population

Between February and July 2012, 2438 patients came to our Radiology Unit to undergo chest CT. Among them, we selected 121 patients who did not present current or past smoke history, without any respiratory symptoms and not showing the following radiological findings in the performed CT scan: parenchymal consolidations, ground-glass opacities, pleural effusion, fibro/pneumothorax, tree-in bud, bronchiectasis, emphysema, pulmonary fibrosis, outcomes of thoracic surgery.

Patients not respecting all of these criteria were excluded from the study.

The indications for conducting the examinations were several, including oncologic evaluation (59/121-48.8%), follow-up of lung nodules (27/121-22.3%), screening in connective tissue diseases (12/121-9.9%), pulmonary hypertension (7/121-5.8%), professional exposure to asbestos (3/121-2.5%), pre-transplantation evaluation (2/121-1.7%), others (11/121-9.1%).

The study group was composed of 78/121-64.5% females and 43/121-35.5% males with a mean age of 57.0±20.7 (range: 12-88 years).

Imaging technique

All CT were performed using a 16-detector-row CT system (Somatom Sensation 16, Siemens Medical Solutions, Forchheim, Germany), during one deep inspiratory breath-hold with or without the use of contrast medium.

Standard parameters were as follows: 120 kV, 120 mAs, 0.75 collimation. The reconstructed data for the detection of pulmonary nodules (2 mm thick sections with a reconstruction increment of 1 mm and a sharp kermel- Siemens B80 kermel) were considered for our study.

We evaluated axial, coronal and sagittal reformations.

Image interpretation

The images were analyzed by two observers; disagreements were solved by a consensus.

The observers were asked to report the presence and the site of diverticula (subcarinal region, major, lobar and segmental bronchi). In order to standardize the interpretation of the extension of bronchial diverticula, we referred to the score proposed by some of us which defined a three-point scale: grade 0, none; grade 1 (mild), one to three diverticula; grade 2 (severe), more than three diverticula [4]. Only diverticula detected on at least two reformation plans were included in the final score.

Finally, presence of tracheal diverticula was evaluated.

Statistical analysis

All data were entered into a database specifically designed for this purpose which was powered by Microsoft® Excel.

The chi-square and t-test were chosen to investigate possible correlations. P value was considered statistically significant when minor than 0.05.

Statistical analysis was performed by using software (STATA/SE version 11.2, StataCorpLP®).

Results

Bronchial diverticula were found in 41/121-33.9% subjects. Grade 1 was detected in 31/41-75.6%, whereas grade 2 in 10/41-24.4%. The mean diameter was of 1.2 mm (range 0.3-2 mm).

Bronchial diverticula were more frequently identified in males (20/43-46.5% versus 21/78-26.9% of females - p=0.048), whereas there was no statistically difference both in terms of prevalence and of grade, depending on the age of subjects (Table 1).

In 20/41-48.8% subjects, isolated subcarinal diverticula (in all cases belonging to grade 1) were assessed; in 10/41-24.4% subcarinal diverticula associated to diverticula in mainstem or lobar bronchi; in 11/41-26.8% only diverticula in mainstem and lobar bronchi (Figure 1).

Thus, 30/121-24.8% subjects showed subcarinal diverticula and 21/121-17.4% diverticula in other levels (with the right upper lobe and the left lower lobe bronchus more frequently involved).

Tracheal diverticula were observed exclusively in 4/121-3.3% of individuals (Table 2).

Discussions and conclusions

Pathogenesis of bronchial diverticula is supposed to be related to a complex spectrum of alterations, which affect the tracheobronchial tree, including loss of bronchial tapering, intraluminal secretions (mucous plugs), enlargement of bronchial glands due to ductal hyperplasia. Conditions determining an increase of intrabronchial pressure (such as cough) may promote the herniation through a weakened portion of bronchial wall [1].

The identification of bronchial diverticula is frequently associated with smoke history and may be relevant because diverticula could act as a reservoir for bronchial secretions and theoretically predispose to repeated respiratory infections [6].

The progress in development in multidetector computed tomography has greatly improved the possibility of studying the tracheo-bronchial tree [7], leading to several reports on this topic [8,9].

Some of us previously demonstrated that patients with multiple diverticula compared to patients with less or even none diverticula were heavier smokers and more frequently reported a history of coughing and showed a more severe airflow obstruction. On the other hand, there was the evidence that when the number of diverticula was very small (<3), there was no significant association with clinical features

Table 1. Prevalence and grading of diverticula according to the age.

a)

Presence of diverticula	Number of patients	Mean age
-	80	57.9 ± 2.00
+	41	55.3 ± 2.7

-: none diverticula detected; +: at least one diverticula detected.

b)

Grade	Number of patients	Mean age
I	31	55.9 ± 2.9
II	10	53.4 ± 6.7

I:1-3 diverticula; II: >3 diverticula.

The age of patients was not linked to significant difference in terms of prevalence (p=0.44-**a**) and of grading of bronchial diverticula (p=0.69-**b**).

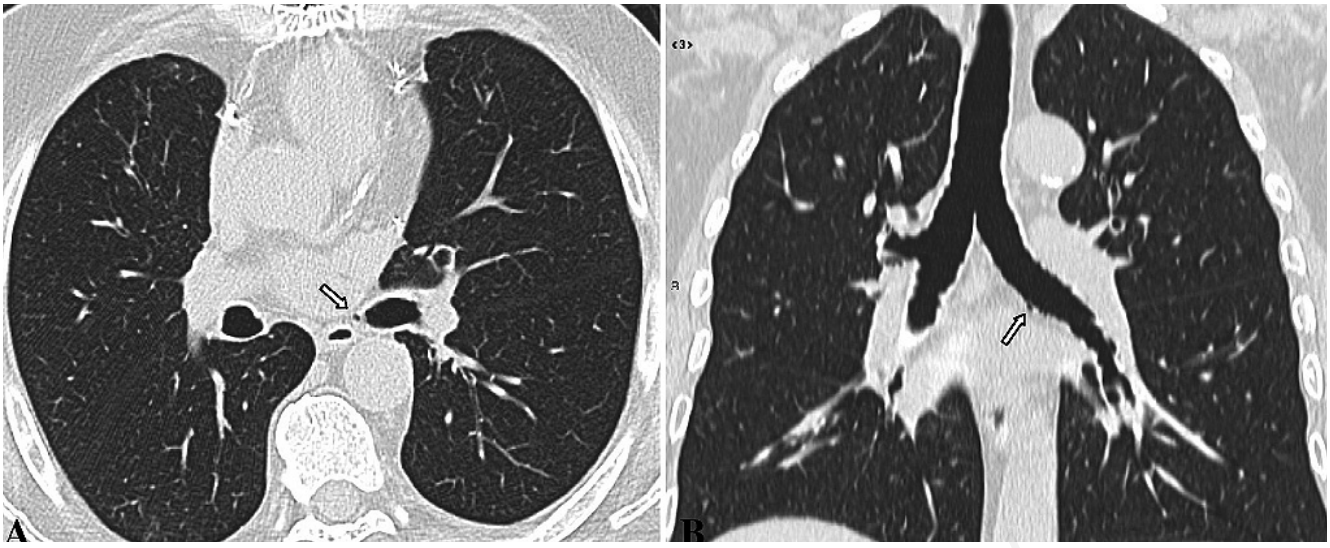

Figure 1. Bronchial diverticula in a 76 years old male detected in the main left bronchus (arrow) both in axial (A) and in coronal plan (B).

(smoke history, respiratory symptoms, FEV1); thus, isolated bronchial diverticula did not influence relevant clinical changes [4].

This conclusion does not seem in contrast with what reported by other authors who found a high percentage of subcarinal diverticula in general population (in approximately 40% of subjects) [5].

Subcarinal diverticula are in most cases spotty or microtubular; when larger, they tend to present a cystic shape with duct-like communication with tracheo-bronchial tree; the communication with the main bronchi is in most of cases clearly detectable (Figure 2) [10].

However, their pathogenesis could be different from diverticula arising from other parts of bronchial tree, as supposed by their common incidental finding and by the absence of association with FEV1 [11].

In our study we demonstrate that bronchial diverticula could be incidentally found in a non-smoker population, with a higher prevalence in males; they are more common in the subcarinal region, but they could be seen in the main and lobar bronchi as well (Figure 3). However, in the majority of subjects (75.6%), their number was <3.

When isolated, pathogenesis of bronchial diverticula is probably related to different factors than those involved in COPD: intrabronchial pressure could play an important role (the most frequent location of diverticula is tracheal bifurcation). Moreover, we should consider a genetic and congenital component since we did not observe a link between the presence of diverticula and the age of patients. This data could also explain the slightly different prevalence we found in comparison with asiatic authors [5,6,11]. To our knowledge, this is the first study that considers the incidental finding of bronchial diverticula in a non-smoker population, without respiratory symptoms and pathological findings on CT. We can theoretically assume that the data obtained in these subjects could be applied to non-smoker general population.

Nevertheless, the main limit of the present study consists in the absence of a gold-standard technique (bronchoscopy) to confirm CT diagnosis. We did not evaluate inter-observer agreement because already reported to be only moderate for the detection of bronchial diverticula [4].

In conclusion, bronchial diverticula are not a rare finding, significantly more frequent than tracheal diverticula [12]. In contrast to smokers with COPD, where diverticula are multiple and located on the main and lobar bronchi, we mainly found isolated and subcarinal diverticula.

Table 2. Bronchial diverticula distribution on the tracheo-bronchial tree.

Level	Number of patients
Trachea	4
Sub-carinal region	30
Main Right Bronchus	2
Left Right Bronchus	2
Right Upper Lobe	12
Left Upper Lobe	5
Intermedius Bronchus	1
Middle Lobe	2
Lingular Lobe	0
Right Lower Lobe	0
Left Lower Lobe	7

Diverticula were more frequently detected in the sub-carinal region.

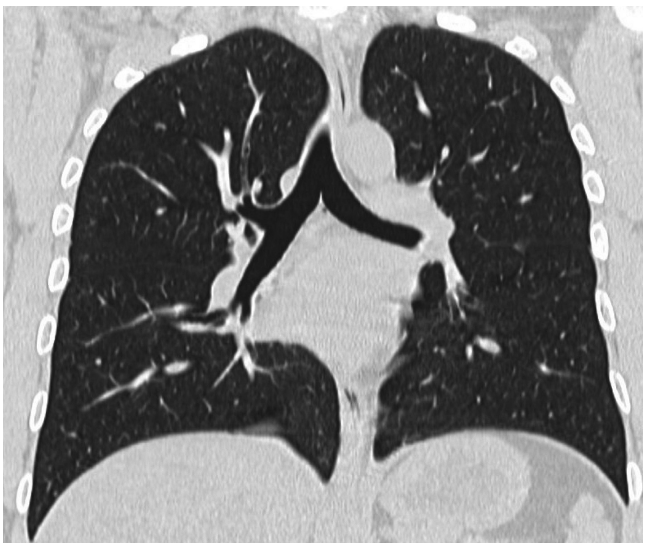

Figure 2. Isolated subcarinal diverticula in a 38 years old male who underwent CT for a suspicious lung nodule detected on chest-XR.

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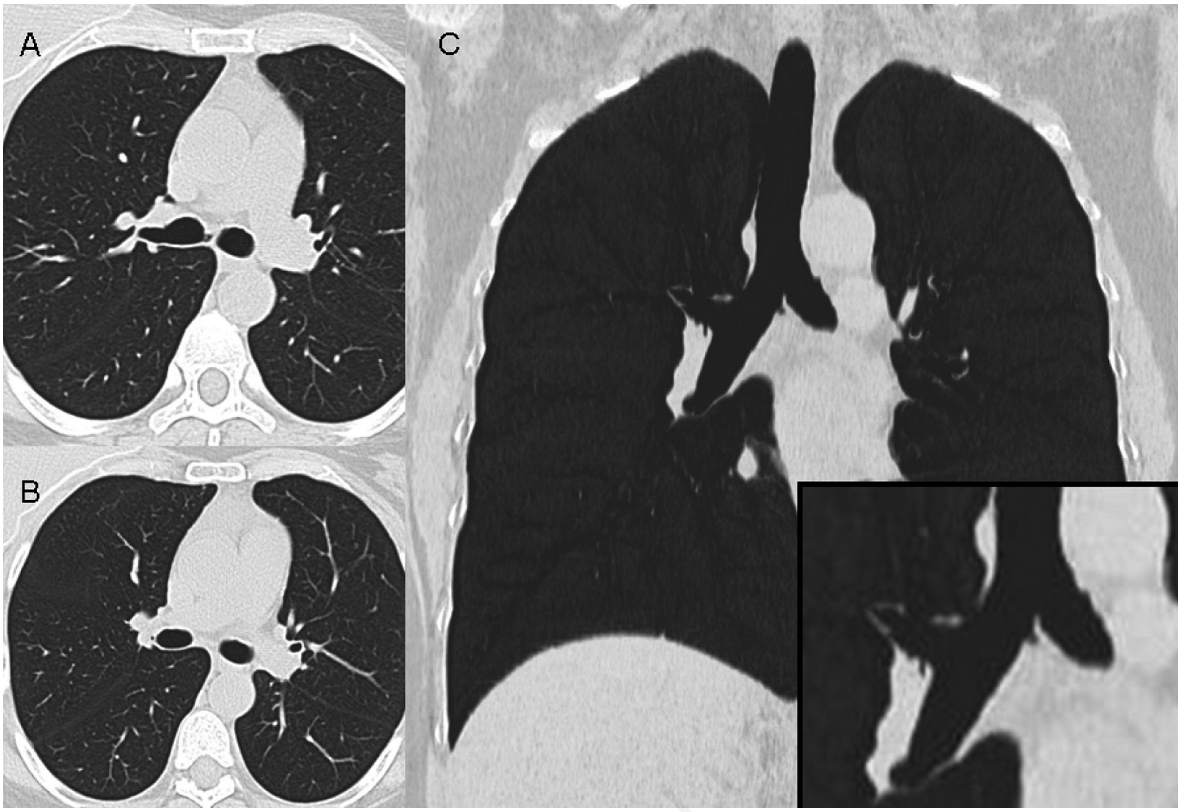

Figure 3. Detection of bronchial diverticula in a 37 years old woman who came to our attention for a follow-up evaluation (breast cancer disease). The axial plan (A, B) demonstrated the presence of bronchial diverticula at subcarinal region (A) and at right upper lobe bronchus (B). These findings were confirmed on coronal plan-MinIP reconstruction that could be advantageous to better visualize the diverticula (C).

We suppose that isolated diverticula, especially subcarinal, could arise independently from smoke or cough history and should not be considered pathological, but mainly as an anatomical variation of a normal finding.

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