



DIAGNOSTIC VERIFICATION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE USING RADIATION IMAGING

Ravshanov Zafar Khazratkulovich

*Samarkand State Medical University,
Samarkand, Uzbekistan.*

ANNOTATION

Sixty patients presenting with persistent (chronic) cough and breathlessness were assessed by conventional and digital radiography together with computed tomography; in 21 of them the diagnosis of chronic obstructive pulmonary disease was confirmed. The condition was set apart from other entities through a combined clinical and imaging picture pointing to involvement of the small bronchi. On computed tomography, the principal feature confirming the disease was an expiratory “air trap” occurring alongside widening and distortion of bronchi of differing calibre, extending as far as bronchiectasis.

Key words: chronic obstructive pulmonary disease, computed tomography, radiography.

ДИАГНОСТИЧЕСКАЯ ВЕРИФИКАЦИЯ ХРОНИЧЕСКОЙ ОБСТРУКТИВНОЙ БОЛЕЗНИ ЛЁГКИХ С ИСПОЛЬЗОВАНИЕМ ЛУЧЕВЫХ МЕТОДОВ ВИЗУАЛИЗАЦИИ

Равшанов Зафар Хазраткулович

*Самаркандский государственный медицинский университет,
г. Самарканд, Узбекистан*

АННОТАЦИЯ

Обследовано 60 пациентов с жалобами на постоянный (хронический) кашель и одышку с использованием традиционной и цифровой рентгенографии, а также компьютерной томографии. У 21 пациента был подтверждён диагноз хронической обструктивной болезни лёгких (ХОБЛ). Заболевание дифференцировалось с другими патологическими состояниями на основании комплекса клинических и лучевых признаков, свидетельствующих о поражении мелких бронхов. При компьютерной томографии основным диагностическим признаком, подтверждающим заболевание, являлся экспираторный симптом «воздушной ловушки» (air trapping), сопровождавшийся расширением и деформацией бронхов различного калибра, вплоть до формирования бронхоэктазов.

Ключевые слова: хроническая обструктивная болезнь лёгких, компьютерная томография, рентгенография.

O'PKANING SURUNKALI OBSTRUKTIV KASALLIGINI NUR TASVIRLASH USULLARI YORDAMIDA DIAGNOSTIK VERIFIKATSIYA QILISH

Ravshanov Zafar Xazratqulovich

*Samarqand davlat tibbiyot universiteti
Samarqand sh., O'zbekiston*

ANNOTATSIYA

Doimiy (surunkali) yoʻtal va hansirash shikoyatlari bilan murojaat qilgan 60 nafar bemor anʼanaviy va raqamli rentgenografiya hamda kompyuter tomografiyasi yordamida tekshirildi. Ularning 21 nafarida oʻpkaning surunkali obstruktiv kasalligi (OʻSOK) tashxisi tasdiqlandi. Kasallik boshqa patologik holatlardan kichik bronxlarning zararlanishini koʻrsatuvchi klinik va nur diagnostikasi belgilarining majmuasi asosida farqlandi. Kompyuter tomografiyasida kasallikni tasdiqlovchi asosiy belgi ekspirator «havo tutib qolish» (air trapping) boʻlib, u turli kalibrdagi bronxlarning kengayishi va deformatsiyasi, ayrim hollarda esa bronxoektazlarning rivojlanishi bilan birga kuzatildi.

Kalit soʻzlar: oʻpkaning surunkali obstruktiv kasalligi, kompyuter tomografiyasi, rentgenografiya.

Relevance. A troubling pattern is the steady rise in deaths attributable to chronic obstructive pulmonary disease (COPD). Reports of recent years also tie the condition to accompanying psychological and psychiatric difficulties. Estimates suggest that what health and social-security systems now spend to offset the harm COPD inflicts on public health exceeds the cost of preventing that harm by a factor of 30 to 40. Materials of the European Respiratory Society indicate that no more than a quarter of cases are recognised in good time.

In a large share of patients the onset of COPD can be averted, and once established the disease often responds well to therapy. Findings from a physical work-up reflect how advanced the bronchial obstruction and emphysema are; even so, that examination does not capture the full severity of the illness, and a patient without overt symptoms cannot be presumed free of COPD.

Contemporary evidence-based practice draws on a broad set of radiological techniques, each grounded in a different physical principle, to identify COPD. A number of authors regard imaging as having only limited diagnostic worth here, since the structural changes of COPD tend to be non-specific and inconsistent, so that no characteristic radiological pattern emerges. The usual purpose of imaging, therefore, is to exclude other disorders whose presentation resembles COPD or that may coexist with it.

The aim of the study was to evaluate how effectively computed tomography detects the early manifestations of COPD across differing degrees of obstructive patency.

Material and methods. Between 2018 and 2019 we examined 60 individuals (40 men and 20 women) referred with suspected COPD. Their ages spanned 20 to 70 years. For most of those examined the leading complaints were a chronic productive cough and breathlessness on exertion.

Besides clinical assessment, every patient underwent chest radiography in frontal and lateral projections as well as computed tomography.

Results of the study. COPD was confirmed in 21 (35%) of the 60 people studied. Among the remaining 39, lung pathology fell into the following categories: 22 (56.4%) had chronic bronchitis and 17 (43.6%) pulmonary emphysema. The 21 patients with verified COPD were sorted into four principal groups by disease severity — stage 1 (mild), stage 2 (moderate), stage 3 (severe) and stage 4 (extremely severe) — together with a group at risk of developing the disease (Fig. 1).

The eight people deemed at risk of progression were troubled by a lingering cough and a moderate output of sputum. The five patients forming the mild (first-degree) group reported cough,

moderate sputum and breathlessness only under heavy physical load. In the four patients with moderate (second-degree) disease, exertional dyspnea, cough and the discharge of a considerable volume of sputum were recorded. Among the three patients with third-degree severity, the more advanced cases showed dyspnea at rest, cough and copious sputum. Finally, the single patient in the fourth-degree group ran an extremely severe course marked by resting dyspnea, cyanosis and acrocyanosis, and respiratory together with right-ventricular failure.

Every lung radiograph was obtained at full inspiration with the breath held. The radiological hallmarks of obstruction observed most often were: heightened lucency of the lung parenchyma during expiration owing to surplus air in the respiratory zones (14%); flattened diaphragmatic domes with effacement of the pleural sinuses (19%); a vertically oriented cardiac axis on the frontal survey film, giving a “small” or so-called “drip” heart shadow (19%); and a “sabre” trachea, in which the sagittal (anteroposterior) tracheal dimension on the lateral film exceeds the transverse one seen frontally (12.6%).

Review of the chest films in COPD patients additionally revealed: accentuation and distortion of the pulmonary pattern in the basal and supradiaphragmatic regions (19%); thickened walls of the lobar and segmental bronchi (23%); indistinct outlines of vessels and bronchi together with “smudging” of the hilar architecture (33%); and deformation of the basal pulmonary pattern accompanied by wall thickening of bronchi of various calibre.

Because patients with differing lung pathologies presented with overlapping symptoms, separating COPD from chronic bronchitis and emphysema — and grading its severity — proved difficult. This difficulty prompted us to explore what computed tomography (CT) could add to the diagnostic process and thereby strengthen radiological assessment.

In COPD, CT makes it possible to judge the architecture of the lung tissue and the state of the small bronchi, and to localise the most air-rich regions of the lungs. Where emphysema is present, this indicator climbs toward -900 HU and at times reaches -1000 HU. Comparing the densitometric values of neighbouring lung sections between inspiration and expiration further distinguishes areas that are not only over-inflated but also under-ventilated.

Performing lung CT with functional respiratory manoeuvres — separate inspiratory and expiratory acquisitions — allowed early COPD changes to be detected even at the preclinical (at-risk) phase and even when external respiration tested normal. On the expiratory series, every member of the at-risk group displayed pulmonary air “traps” and a “tree-with-kidneys” appearance, signalling abnormality at the level of the small bronchi.

CT in two first-degree patients showed widened, distorted segmental and subsegmental bronchi, and in one of them bronchial involvement concentrated in the peripheral lung. In two patients (9.5%) the inspiratory images showed unchanged parenchyma, while three (14.3%) showed a “mosaic” pattern on inspiration; all five exhibited an “air trap” on expiration. These data show that in nearly half of the COPD patients examined (43.8%) plain radiography detected no lung abnormality, whereas CT did.

On CT, virtually all second-degree COPD patients showed injury to bronchi of varying calibre. Thickened, deformed segmental and subsegmental bronchial walls were documented in three patients (14.3%), one of whom showed a “tram-rail” sign. Distal bronchial involvement appeared in two patients and proximal involvement in three (15%), while accentuation of the pulmonary pattern in the lower lobes was seen in three (15%). On the inspiratory series a “mosaic” lung was

present in three of the four patients examined, with no parenchymal change in the remaining one; on the expiratory series all four second-stage patients showed CT evidence of an “air trap”.

Three patients carried a stage 3 diagnosis; their radiographs revealed a pulmonary pattern altered by pneumosclerosis and thickened bronchial walls, along with bronchiectasis, the saccular and cylindrical forms of which could be told apart. CT depicted the following bronchial changes: wall thickening, a “tram-rail” sign and alterations at the level of the small bronchioles (the “tree-with-kidneys” sign). Moreover, all three showed a pronounced expiratory “air trap” on the expiratory scan.

In fourth-degree COPD the dominant clinical feature was severe dyspnea at rest that worsened with the slightest effort; drowsiness and mild lethargy were also noted, and examination disclosed cutaneous cyanosis. Radiography showed numerous “sac-shaped” bronchiectases, a thickened and accentuated pulmonary pattern in the lower lung, and an enlarged cardiac shadow. On CT the lungs appeared swollen across both the inspiratory and expiratory phases, remaining in a state of “fixed inspiration”. Here the expiratory scan held the greatest diagnostic value, demonstrating bronchiectasis and the valve-like distension represented by the “air trap”.

Table 1 sets out how often the diagnostic CT signs of lung and bronchial involvement in COPD were found at each level of disease severity.

Table 1

The frequency of detection of diagnostic CT signs of damage to the lungs and bronchi in COPD, depending on the severity

CT signs of COPD	Sign detection frequency							
	1 g. (n=5)	%	2 gr. (n=4)	%	3 gr. (n=3)	%	4 gr. (n=1)	%
The presence of single sections of emphysema of various types	2	40	2	20	2	66	1	100
Expiratory air “trap”	5	100	4	100	3	100	1	100
The presence of zones of volume of lung tissue with a low density with a range from -1000 to -950 HU	1	20	1	25	2	66	1	100
“Mosaic” lung tissue	3	60	3	75	3	100	1	100
Expansion and deformation of segmental and subsegmental bronchi	2	40	3	75	3	100	1	100
Thickening of the walls of the bronchi	2	40	3	75	2	66	1	100
Lesion of bronchioles (symptom of a “tree in the kidneys”)	1	20	3	75	3	100	1	100
The presence of bronchiectasis (symptom of “ring”)	-	-	1	25	2	66	1	100

As the table shows, the range of bronchopulmonary disorders sharing similar clinical pictures makes the differential diagnosis of COPD very demanding. This underscores the need for objective diagnostic criteria obtainable through radiological investigation.

Accordingly, imaging of a COPD patient begins with plain radiography of the chest cavity; where clinical grounds exist or the radiographic findings are equivocal, lung CT may follow. Bringing computed tomography — expiratory acquisition included — into routine practice has markedly broadened diagnostic possibilities, revealing a number of typical lung changes that frequently escape detection on ordinary films.

Conclusion. COPD develops as a result of injury to the small bronchi, and it is this that produces the characteristic clinical and imaging symptom complex permitting the disease to be distinguished from emphysema and chronic bronchitis.

Grading the ventilatory impairment in the lungs of COPD patients is best done with CT acquired in both the inspiratory and expiratory phases. The diagnostically decisive CT feature is the expiratory “air trap” together with widening and distortion of bronchi of differing calibre extending to bronchiectasis. CT is an informative technique that detects the emerging pathological changes of COPD in the parenchyma and bronchi — the small ones in particular — at an early point.

As a non-invasive tool, CT can reveal structural lung changes during the early stages of COPD, allowing appropriate treatment to be started promptly and its effect to be monitored. Inspiratory–expiratory CT therefore stands as the most informative radiological method for diagnosing chronic obstructive pulmonary disease.

LITERATURE

1. Abdullaeva M.N., Mardieva G.M., Kudratova M.P. Clinical and functional indicators during the period of reparation for complicated pneumonia in children // *Ilmiy-amaliy journal “Pediatrics”* - T., 2017. - No. 2. - P. 26-29.
2. Aisanov Z.R., Kokosov A.N., Ovcharenko S.I. Chronic obstructive pulmonary disease. Federal Program // *Russian Medical Journal*. - 2001. - T. 9, No. 1 (120). - S. 9–34.
3. Emelyanov A.V. Diagnosis and treatment of exacerbations of chronic obstructive pulmonary disease // *Russian Medical Journal*. - 2005. - T. 13, No. 4. - S. 183–189.
4. Clinical recommendations. Chronic obstructive pulmonary disease / ed. A.G. Chuchalina.- M.: Atmosphere, 2003. -- 168 p.
5. Momot N.V., Pervak M.B., Vysotsky A.B. The role of multislice computed tomography (MSCT) in the diagnosis of pulmonary pulmonary emphysema / *Nevsky Radiological Forum 2011* / Ed. L.A. Tyutin. - St. Petersburg: ELBII - St. Petersburg, 2011. -- S. 137–138.
6. Trishina NN, Vitko NK, Zubanov A.G. Computed tomography in the diagnosis of chronic obstructive pulmonary diseases / *Diagnostic and interventional radiology: materials of the V All-Russian National Congress of Radiologists and Therapists*. - M., 2011. - No. 2. - S. 439–440.
7. Turdumatov Zh.A., Mardieva G.M., Fayzieva D.O., Yanova E.U. Improving the radiation diagnosis of chronic obstructive pulmonary disease / “Trends and prospects for the development of science and education in the context of globalization”: *Sat. scientific labor*. - Pereyaslav-Khmelnitsky, 2019.- No. 44. - C 538-541.

8. Yusupov Sh.A., Mardieva G.M., Bakhritdinov B.R. Features of x-ray semiotics in pneumonia in young children // Scientific-practical journal “Actual nutrition of pediatrics, obstetrics and gynecology” - Ternopol, 2017. - No. 2 (20). - S. 21-24.