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Clinical and Radiological Particularities of COPD during Aging: Cross-Sectional Study Conducted in 3 Hospitals in Kinshasa

Fiston Fiondo Dikamba[1], Aliocha Nkodila Natuhoyila[2,3*], Stanis Okitotsho Wembonyama[3], Zacharie Kibendelwa Tsongo[4], Jean Tshibola Mukaya[1], Benjamin Longo Mbenza[5]

[1]Department of Radiology, University of Kinshasa, Kinshasa, Democratic Republic of the Congo
[2]Department of Family Medicine and Primary Care, University of Protestante in Congo, Kinshasa, Democratic Republic of the Congo
[3]School of Public Health, University of Goma, Goma, Democratic Republic of the Congo
[4]Department of Internal Medicine, University of Goma, Goma, Democratic Republic of the Congo
[5]Department of Internal Medicine, University of Kinshasa, Kinshasa, Democratic Republic of the Congo
Email: *nkodilaaliocha@gmail.com

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Abstract

Background and Objective: Chronic obstructive pulmonary disease (COPD) is announced as the third leading cause of death worldwide by 2030. Chest imaging plays an important guiding role. The objective of our study is to specify the clinical and functional respiratory characteristics of very old COPD patients followed in 3 hospitals in Kinshasa. **Material and Methods:** Documentary and analytical study were conducted using clinical data and chest imaging (radiography and computed tomography), collected from the files of 120 COPD subjects followed in three medical trainings in Kinshasa between January 2014 and June 2017. The Fisher test made it possible to compare the results obtained. We used Pearson's chi-square test to explore the associations between imaging data and clinical phenotype. The significance level was $p < 0.05$. **Results**: The study population (mean age of 64.52 ± 16.82 years) was predominantly male (78.3% n = 94). The proportion of thoracic distension ($p = 0.022$), pulmonary vascular change ($p = 0.001$), rail image ($p = 0.009$) and sheath trachea ($p = 0.017$) were significantly higher in the elderly compared to young adults. The proportions of bronchial parietal thickening ($p = 0.011$), and bronchial dilation ($p = 0.015$) were significantly higher in aging compared to young adults. **Conclusion**: The radiological profile of young adults differs from that of aging. It was demonstrated through the analysis of this study that the alteration of the radiological parameters and the scanner were more important in aging than in young adults.

Subject Areas

Radiology & Medical Imaging

Keywords

Peculiarity, Radiology, COPD, Aging

1. Introduction

COPD in the elderly presents particularities [1]. These specificities are underpinned by the modification of the cardiorespiratory physiology and increased susceptibility to COPD. Expenditure on care is higher: longer length of stay in critical care unit (SC), and increased use of care after discharge from SC [2]. Age is an important predictor of the prognosis of COPD, but it is often confused with other parameters to determine a state of fragility [3]. The stakes are high in a society with aging demographics. A specialized multidisciplinary assessment is justified beyond chronological age alone to guide the management of COPD in elderly patients [4] [5] [6] [7].

Physiological aging profoundly modifies the respiratory system, its architecture and its local immunity, thereby reducing its ability to overcome pulmonary or general aggression [5] [7]. Changes in respiratory physiology are characterized by loss of elastic tissue surrounding the alveoli and alveolar ducts, increased anteroposterior diameter of the thorax and decreased muscle strength [6] [7].

Morphological changes include an increase in the size of the trachea, proximal bronchi, and alveolar ducts. The alveolar sacs thicken and the alveoli expand, thus the total alveolar surface area decreases [7]. The distal airways tend to atrophy and become more deformable. Contrary to what is observed in emphysema, there is no septal destruction, but a disappearance of the elastic tissue and an increase in the collagen secreted by the fibroblasts [1] [7]. Work suggests that the mechanism underlying the loss of elastic tissue is inflammation coupled with increased oxidative stress; there is thus an increase in the number of neutrophils in the bronchoalveolar lavage fluid and in the elastase of neutrophils [1] [2] [7].

Although COPD can develop over a wide age range, few studies have focused on its particularities in older subjects. With the improvement of life expectancy in the Democratic Republic of the Congo, the frequency of the elderly becomes important among COPD patients. The objective of our study is to specify the clinical and functional respiratory characteristics of very old COPD patients followed in 3 hospitals in Kinshasa.

2. Patients and Methods

2.1. Study Type and Population

This was a documentary and descriptive study extending from January 1, 2014 to June 1, 2017 carried out simultaneously at the University Clinics of Kinshasa

(CUK), at the General Reference Hospital of Kinshasa (HGRK), at the BIAMBA Marie MUTOMBO (HBMM); all domiciled in Kinshasa. The choice of these institutions was justified by their respective capacities to manage COPD cases. We included the files of patients over 18 years old, followed on an outpatient basis for COPD with chronic respiratory symptoms (cough, expectoration, dyspnoea) and diagnosed with COPD with spirometry (an FEV1/FVC ratio < 70% before and after administration of 400 µg of inhaled salbutamol). Pregnant women, asthmatics and atopic subjects were excluded from our sample. The recruitment method was exhaustive as long as the inclusion and exclusion criteria were met.

2.2. Collection of Data

Data were extracted from medical records and collected on an anonymized survey form written for the purposes of the study. Sociodemographic, clinical, functional and radiological data were collected. The socio-demographic and clinical data concerned age, sex, chronic cough, dyspnea, expectoration, tobacco risk factors, domestic and occupational pollution, tuberculosis sequelae; comorbidities diabetes, cardiovascular pathology, interstitial lung disease, cardiovascular and pulmonary pathology.

The smoker was defined as a subject who had active tobacco intoxication at the time of diagnosis, the ex-smoker having not stopped active intoxication for at least 1 (one) year. The degree of tobacco intoxication was assessed in packs/year. The others are considered non-smokers or exposed to passive smoking.

Spirometry was performed outside of any acute episode with the Spiro doc from the medical manufacturer International Research (MIR) using a pre-calibrated single-use turbine. The acceptability and reproducibility criteria recommended by the ATS and the European Respiratory Society (ERS) were met. The different ventilatory variables measured included: the forced expiratory volume in the first second (FEV1), the forced vital capacity (FVC), the median expiratory flow rate at 25% - 75% of the vital capacity (FEMM 25 - 75), and the ratio FEV1/FVC [7].

Comorbidities refer to all other conditions found in patients in this series. Bubble is hyperclarity with thin and clear wall measuring 1cm or more. Dilation of the pulmonary artery: a diameter of the common trunk of the pulmonary artery greater than 28.6 mm (predicts the presence of pulmonary arterial hypertension). Dilatation of the bronchi: when the bronchial eye is larger in diameter than the vascular eye. Thoracic distension: it is deduced respectively from the low position of the diaphragm (right hemi-diaphragm below the 7th rib), from the flattening of the diaphragm and from the increase in the retro-sternal clear space on the profile (greater than 2, 5 cm).

Increase in lung height: when the distance from the diaphragmatic dome to the top of the lung reaches 30 cm. Reduction of cardiac diameter: when the cardiac silhouette is verticalized, while its transverse diameter measures less than 11.5 cm on the frontal chest X-ray. Thickening of the bronchial walls: the walls of the bronchioles are not visible under physiological conditions. But in case of

thickening they can now be seen in the form of clear rings contiguous to their satellite arteries. Centrilobular emphysema: this refers to the presence of hypodense, well-defined lesions measuring less than 1 cm and often located at the apex. Panlobular emphysema: corresponds to a localized destruction of the respiratory bronchioles, of basal topography.

Expiratory trapping: corresponds to the reduction of the diaphragmatic stroke on the chest X-ray taken during expiration. Normally the amplitude of the diaphragm under physiological conditions is 1.5 cm.

Pulmonary vascular changes: these relate to the scarcity of vessels in the periphery, while there is a dilation of the proximal arteries. The distortion can sometimes be so pronounced that the lung appears peripherally avascular.

Pulmonary arterial hypertension: said of a right interlobar artery measuring more than 16 cm in diameter or a left pulmonary artery exceeding 18 mm in diameter.

COPD CT phenotype includes respectively:

- predominantly emphysematous involvement (better seen on CT);
- the predominant attack of the airways (made up of micronodules, thickening and irregularity of the bronchial walls;
- mixed damage, combining the two varieties described above.

Saber sheath trachea: corresponds to a narrowing of the frontal diameter of the intrathoracic trachea in favor of a compensatory increase in the sagittal diameter of the viscus measured at the same level.

2.3. Statistical Analyzes

Data were collected in Excel, and analysis was done with Statistical Package for Social Sciences (SPSS) software for Windows version 23.0 (SPSS Inc., Chicago, IL). The qualitative variables were represented in the form of counts and proportions. Continuous variables were summarized on average with standard deviation (SD) when the distribution was normal, and where appropriate they were represented by their median (interquartile range). The chi-square test and the exact probability of filing were used for the comparison of the proportions, and Student's t-test was used for comparison of means. A difference was considered statistically significant if $p < 0.05$.

2.4. Ethical Considerations

Patient data was anonymized with a unique code assigned to each patient and then recoded for analysis. The work was presented and approved by the Medical Ethics Committee of the University of Goma at No. UNIGOM/CEM/11/2022.

3. Results

3.1. Aging and Epidemiology of COPD

The proportions of aging varied unequally and very significantly ($p < 0.001$) between men and women. Aging was observed in all women followed by men with aging and men without aging (**Figure 1**).

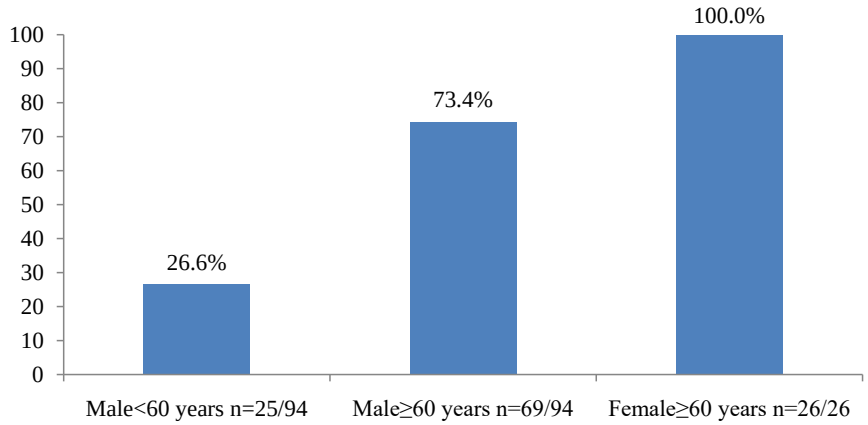

Figure 1. Distribution of the proportions of aging according to gender.

The proportions of men were comparable (p = 0.211) to that of women between the different health structures: 65.3% (n = 62), 20% (n = 19) and 14.7% (n = 14) respectively observed at CUK, HGRK and HBMM. There was no significant association (P = 0.406) of the proportions of exposure to domestic and/or occupational pollution between aging (32.6% n = 31) and young-adult status (24% n = 6) (**Figure 1**).

3.2. Aging and Clinical Picture

The proportions of allergy, comorbidities and types of comorbidities were similar (p < 0.05) between aging and the young-adult state (**Table 1**).

3.3. Aging and Radiography

We note that the proportion of thoracic distension (p = 0.022), the pulmonary vascular modification (p = 0.001), the rail image (p = 0.009) and the trachea in the sheath (p = 0.017) were significantly higher in the elderly compared to young adults (**Table 2**).

3.4. Aging and Phenotyping of COPD by Chest CT Scan

It was noted that the proportions of bronchial parietal thickening (p = 0.011), bronchial dilation (p = 0.015) were significantly higher in aging compared to young adults (**Table 3**).

4. Discussion

The present study characterized the phenotyping of COPD during aging through chest radiographic abnormalities and computed tomography imaging of the chest. In this study, the expiratory entrapment defined on the chest X-ray was mainly related to the female sex while the literature shows that the male sex is more prone to cigarette smoking and entrapment in the developed country [8] [9]. In contrast, the present study reports the role of aging and the extent of centrilobular emphysema, panlobular emphysema, predominantly airway involve-

ment, mixed involvement (including predominantly emphysema involvement and predominantly airway involvement) between men and women examined by chest CT scan. Indeed, this study shows a particular phenotype of COPD paradoxically defined by the coexistence of emphysema, all locations combined, and the predominant airway involvement in young-adult men, versus a phenotyping of COPD characterized by the coexistence of predominantly emphysematous involvement, and predominantly airway involvement [10] and in men with aging as reported by the GOLD literature [11]. The results of the present study went towards the global medical movement between the role of COPD, senescence and senility [10] [12].

Table 1. Comparison of rates of clinical manifestations between aging and the young-adult state.

Variable	Aging % (n)	Young-adult % (n)	p-value
Allergy	8.4 (8)	4.0 (1)	0.455
Comorbidity	27.4 (26)	12.0 (3)	0.110
Type of comorbidities			0.395
• Cardiovascular disease	15.8 (15)	4.0 (1)	
• Diabete millitus	1.1 (1)	0 (0)	
• Association of cardiovascular disease and diabetes mellitus	4.2 (4)	0 (0)	
• Interstitial lung disease	6.3 (6)	8.0 (2)	

Table 2. Comparison of radiological parameters.

Variable	Aging % (n)	Young-adult % (n)	p-value
Chest distension	80.0 (76)	80.0 (20)	**0.022**
Pulmonary vascular modification	52.6 (50)	48.0 (12)	**0.001**
Emphysema bubbles	49.5 (47)	9.0 (36)	0.230
Rail picture	58.9 (56)	68.0 (17)	**0.009**
Ring Image	4.2 (4)	8.0 (2)	0.439
Trachea in sheath	40.0 (38)	40.0 (10)	**0.017**
Expiratory trapping	7.4 (7)	4.0 (1)	0.473

Table 3. Comparison of COPD phenotyping by chest CT scan.

Variable	Aging % (n)	Young-adult %(n)	p-value
Bronchial wall thickening	16.8 (16)	24.0 (6)	**0.011**
Bronchial dilation	14.7 (14)	16.0 (4)	**0.015**
Centrilobular nodule	4.2 (4)	0.0 (0)	-
Dilation of the pulmonary artery	33.8 (8)	50.0 (4)	0.399

The molecular biology of senescence allows a better understanding of physiological aging at the scale of an organ such as an individual's lung to shed light on the pathophysiology of multimorbidity (COPD, cardiovascular disease, weight loss, and demineralization) linked to advancing age [13]. In addition, COPD causes high rates of morbidity, mortality and socioeconomic impact [10] [13]. Lung cell senescence is also implicated in lung remodeling in parenchymal and vascular remodeling through inflammation and oxidative stress [13].

It is currently established that COPD is linked to premature aging by attrition of the telomeres [10] [12], (end of the chromosome with a critical role in the stability of DNA and cellular functions [14] [15].

There is an absence of cell regeneration, a deficit of tissue repair, a release of mediators and tissue changes during the development of COPD [13]. The last mechanism explains the accumulation of cells from either cell renewal towards replicative semen or through somatic cells under oxidative stress (oncogenic factors, cytokine signaling abnormalities through premature semen) [13].

Telomere shortening is reported in the white blood cell and lung cells of COPD patients [14] [15]. It is therefore an accumulation of senescent alveolar epithelial cells, endothelial cells and fibroblasts [15] [16] which may explain the susceptibility to the emergence of COPD with a short telomere in 20% of smokers [17], for against the exaggeration of tissue repair processes and inflammatory reaction associated with COPD could shorten the telomere and induce an exhaustion of the replicative potential of cells [17] [18].

5. Conclusion

This study was objective to specify the clinical and functional respiratory characteristics of very old COPD patients followed in 3 hospitals in Kinshasa. After analyzing the results, it shows that the radiological profile of young adults differs from that of aging. It was demonstrated through the analysis of this study that the alteration of the radiological parameters and the scanner were more important in aging than in young adults.

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Authors' Contributions

FDF, BLM, ANN designed and analyzed the statistical data for the study. ZKT, SOW and JMT supervised the study. All authors have read and approved the final and revised version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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