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Clinical and Radiological Profile of Chronic Obstructive Pulmonary Disease in Kinshasa

Fiston Fiondo Dikamba[1], Aliocha Natuhoyila Nkodila[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 Congo
[2]Department of Family Medicine and Primary Care, University of Protestante in Congo, Kinshasa, Democratic Republic of Congo
[3]School of Public Health, University of Goma, Goma, Democratic Republic of Congo
[4]Department of Internal Medicine, University of Goma, Goma, Democratic Republic of Congo
[5]Department of Internal Medicine, University of Kinshasa, Kinshasa, Democratic Republic of Congo

Corresponding Author: Aliocha Natuhoyila Nkodila

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ABSTRACT

Background and objective: The diagnosis and follow-up of chronic obstructive pulmonary disease (COPD) are essentially based on the clinic and plethysmography. However, medical imaging techniques remain one of the essential examinations in the differential diagnosis with other pathologies and in the detection of complications of COPD. The objective of this study was to describe the clinical and radiological characteristics of patients with COPD followed in Kinshasa.
Material and Methods: Documentary and descriptive study of 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 clinical and radiological data were the object of this study.
Results: The study population (mean age of 64.52 ± 16.82 years) was predominantly male (78.3% n=94). The clinic of the patients in this series was dominated by dyspnea (96.7% n=116) and chronic cough (94.2% n=113) followed by far by sputum (47.5% n=57). Cardiometabolic risk (cardiovascular disease and diabetes mellitus), interstitial lung disease were the comorbidities in patients with COPD. The proportions of stage II and III being the most frequent around 80%. Thickening of the bronchial walls (airway damage), centrilobular emphysema (emphysematous damage), dilation of the bronchial lumen (emphysematous damage) and dilatation of the pulmonary artery (vascular change) were more frequent.
Conclusion: The high frequency of COPD risk factors are probably the basis for the observed lesions.

Keywords: Clinical, radiological, COPD, Kinshasa.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is defined by a permanent and progressive obstruction of the airways. The most common cause is tobacco [1]. This obstruction is caused by the association, which varies according to the patient, of a change in the caliber of the bronchioles due to anatomical changes (remodeling) and destruction of the pulmonary alveoli (emphysema) [2]. It is associated with an abnormal pulmonary inflammatory response to inhaled toxins, dominated by tobacco. Other pollutants may be involved [1,2].

The diagnosis and follow-up of chronic obstructive pulmonary disease (COPD) are essentially based on the clinic and plethysmography [1] and the presence and

intensity of symptoms contribute to the clinical severity, which makes it one of the therapeutic objectives (1– 4). However, medical imaging techniques remain one of the essential examinations in the differential diagnosis with other pathologies and in the detection of complications of COPD [1].

In Africa, the diagnosis of COPD is even more difficult and crucial due to an unsuitable technical platform and an increase in tobacco intoxication. The median prevalence there in 2015 was 13.4%, slightly higher than the global prevalence (1.5). In the Democratic Republic of Congo, the diagnosis is still mainly based on the clinic and the notion of tobacco intoxication, knowing that other etiologies such as biomass are more involved in COPD in female subjects [5,6]. Spirometry is essentially limited only to a category of population with a high socioeconomic level and is included in private structures, making the diagnosis less accessible and expensive. The objective of this study was to describe the clinical and radiological characteristics of patients with COPD followed in Kinshasa.

PATIENTS AND METHODS

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 400µg 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.

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 [6]. COPD was confirmed by a persistent FEV1/FVC<0.7 and its severity was divided into four subgroups according to FEV1 by the classification of the Global Initiative for Obstructive Lung Diseases (GOLD) [1].

GOLD currently offers four stadiums. This classification is based on the FEV1/FVC ratio<0.70: Stage I: mild, FEV1≥80% of the expected value; Stage II: moderate, 50%≤ FEV1<80% of the expected value; Stage III: severe, 30%≤ FEV <50% of the expected

value; Stage IV: Very severe, FEV <30% of the expected value or FEV <50% and respiratory or right heart failure.
Comorbidities: refers to all other conditions found in patients in this series. Bubble: 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, 5cm) (Figure 1).

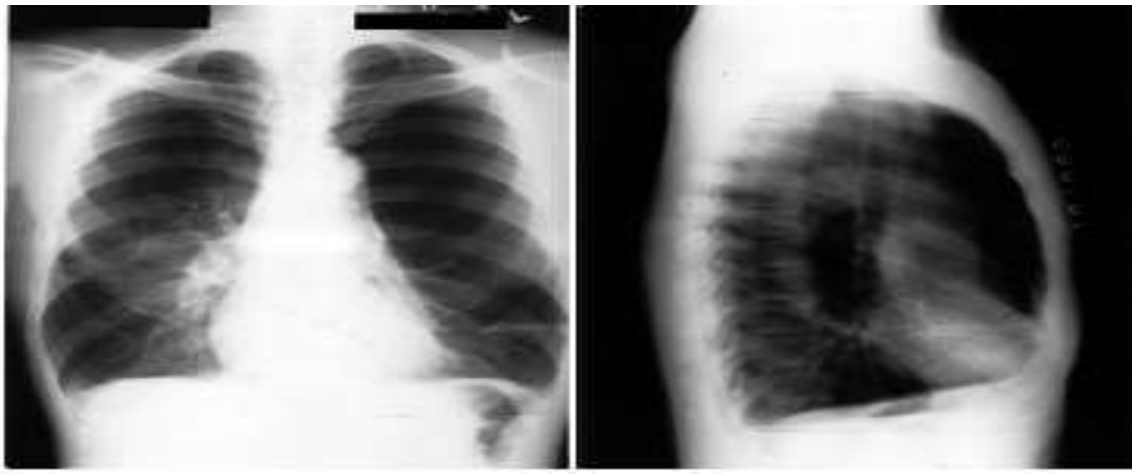

Figure 1. Frontal (A) and lateral (B) chest radiographs of a case of bullous emphysema. There is pulmonary vascular scarcity, dilation of the right interlobar artery on the face

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 (figure 2).

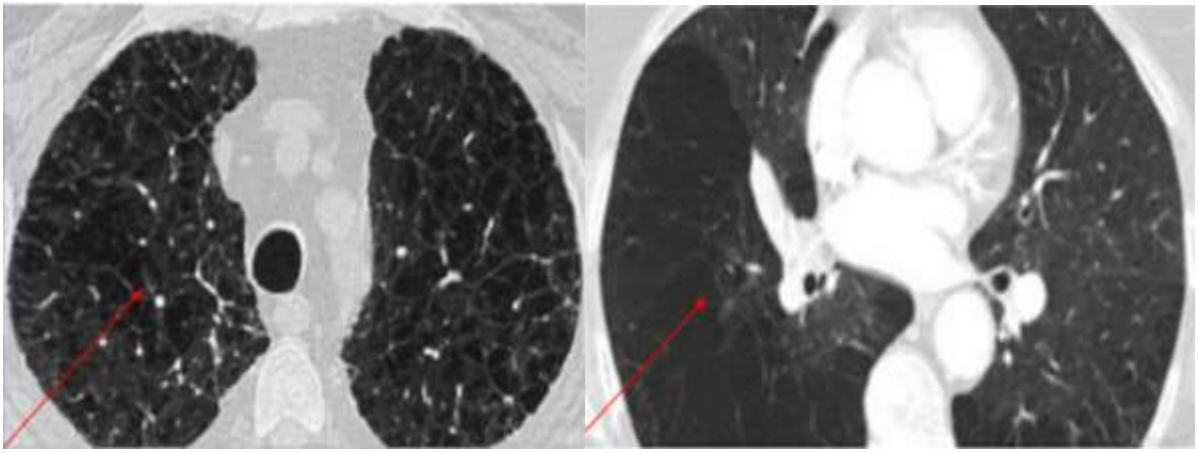

Figure 2. High-resolution CT scans of a case of centrilobular emphysema showing scattered micronodules, appearing on the background of a multivesicular lung (Left) and The right pulmonary area appears completely avascular (right).

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 16cm in diameter or a left pulmonary artery exceeding 18mm 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 (figure 3).

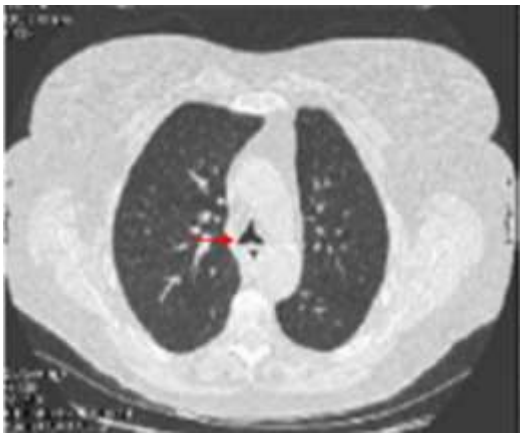

Figure 3. High-resolution CT slice of a case with predominantly airway involvement. We see the lateral flattening (arrow) of the trachea.

STATISTICAL ANALYZES

Data were collected in Excel, and analysis was done with 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, where appropriate they were represented by their median (interquartile range).

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.

RESULTS

Sex and age

The study population was characterized by male predominance (78.3% n=94) compared to female sex (21.7% n=26): sex ratio of 4H:1F.

The mean age of the study population was (64.5±16.8 years (median age equal to 67 years IQ at 59-74) and table 3.2 describes the proportions of the study population according to the groups of ages.

Table 1. Distribution of patients according to age groups

Group age	n	%
Age < 40 years	9	7.5
40 – 59 years	21	17.5
60 - 79 years	71	59.2
Age≥80 years	19	15.8

Among these patients, three-quarters came from an aging population (advancement in age ≥60 years). On the other hand, the female patients were older (69.96 ± 14.3 years IQ = 65-74; P <0, 05) than male patients (63.3±17.3 years IQ=56-74) with great variability according to the whisker diagram (Table 2).

Table 2. Parameters of the age distribution of patients according to sex

Variable of interest	Global	Femme (n=26)	Homme (n=94)
Mean age and SD	64.52 ± 16.82 years	68.96 ± 14.28 years	63.29 ± 17.32 years
Median age et IQ	67 (58,5 - 74) years	70 (65 – 74) years	65 (56– 74) years
Minimum	15 years	15 years	19 years
Maximum	98 years	98 years	95 years

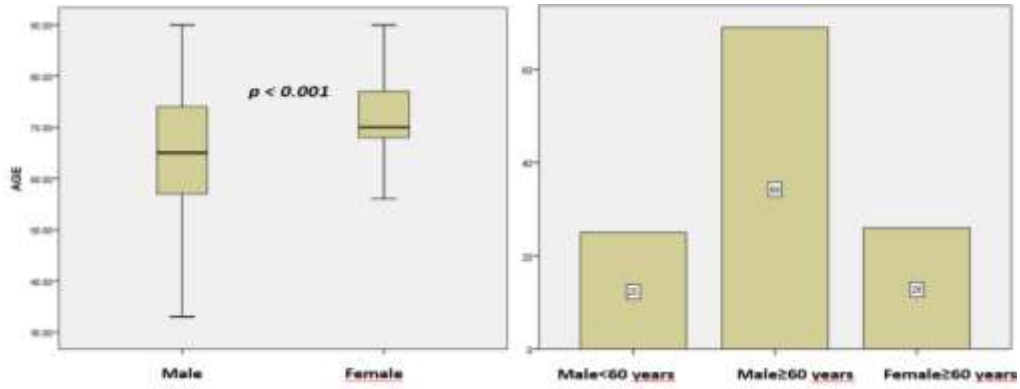

Figure 4. ***Fréquence des patients selon le sexe et le vieillissement.***

Figure 4 shows that all women were characterized by aging while among the 94 men 73.4% (n=69) and 26.6% (n=25) were characterized by young-adult age respectively (Figure 4).

3.3. COPD risk factors

Smoking (32.5% n=39), exposure to domestic pollution (30.8% n=37), exposure to occupational pollution (5.8% n=7), and sequelae of pulmonary tuberculosis (7.5% n=9) were respectively the COPD risk factors observed in the present study as shown in Table 3.

Table 3. Distribution of patients according to risk factors

Variable	n	%
Tobacco use	39	32.5
Domestic pollution	37	30.8
Occupational pollution	7	5.8
Sequelae of tuberculosis	9	7.5

3.4. Clinical manifestations

Clinical manifestations were defined by semiology (symptom) and by comorbidity. The clinic of the patients in this series was dominated by dyspnea (96.7% n=116) and chronic cough (94.2% n=113) followed by far by sputum (47.5% n=57). Cardiometabolic risk (cardiovascular disease and diabetes mellitus), interstitial lung disease were the comorbidities in patients with COPD. The competition from interstitial lung diseases and cardiovascular diseases was respectively estimated at 58.6% (n=17), 27.6% (n=8) and 13.8% (n=4) (table 4).

Table 4. Distribution of patients according to symptomatology

Variable	n	%
Symptoms		
Dyspnea	116	96.7
Chronic Cough	113	94.2
Expectoration	57	47.5
Comorbidities		
Cardiovascular pathology	16	55.2
Interstitial lung disease	8	27.6
Cardiovascular and pulmonary pathology	4	13.8
Diabetic sugar	1	3.4

3.5. Respiratory functional explorations

The respiratory function tests characterize the study population according to the staging of the progression of COPD (stage of alteration of FEV1): the proportions of stage II and III being the most frequent around 80% of the series.

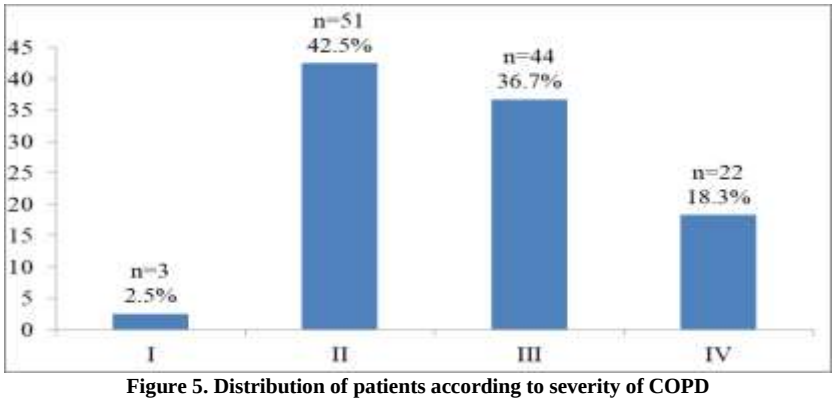

Figure 5. Distribution of patients according to severity of COPD

3.5. Chest x-ray imaging

All patients were evaluated by chest radiography. All AP and lateral chest x-rays were of very good quality. Radiographic manifestations of the thorax were dominated by pulmonary distension (table 5).

Table 5. Distribution of patients according to frontal chest X-ray lesions

Variables of interest	n	%
Lung distention	96	80.0
Pulmonary hypertension	62	51.7
Rail bronchial wall thickening	73	60.8
Emphysema bubbles	56	46.7
Trachea in saber scabbard	48	40.0
Expiratory trapping	8	6.7
Ring-shaped bronchial wall thickening	6	5.0

3.6. COPD phenotype by computed tomography imaging

The constellation comprising tracheobronchial, emphysematous and vascular lesions characterized COPD phenotyping by computed tomography imaging in 32 patients. Thickening of the bronchial walls (airway involvement), centrilobular emphysema (emphysematous involvement), dilation of the bronchial lumen (emphysematous involvement), and dilatation of the pulmonary artery (vascular change) were more common than the nodule centrilobular (airway damage), para septal emphysema (emphysematous damage), bullous emphysema (emphysematous damage) and saber sheath trachea. A concurrent presence was also noted in the form of mixed involvement (emphysematous involvement + airway involvement) in 12.5% (n=8) (Table 6).

Table 6. Distribution of patients according to CT lesions

Variables of interest	n	%
Tracheobronchial abnormality		
Thickening of the bronchial walls	22	68.8
Dilation of the bronchial lumen	18	56.3
Trachea in saber scabbard	2	6.3
Centrilobular nodule	4	12.5
Emphysemas		
Centro lobular	16	50.0
Lobular pan	12	37.5
Para septal	2	6.3
Bullous	2	6.3
Vascular signs		
Pulmonary artery dilation	12	37.5

DISCUSSION

Approximately 40% of COPD patients were exposed to environmental pollution, 84% of which was domestic pollution versus 16% occupational pollution. The socio-political and economic crisis in the DRC without access to electricity exposes the population of the city of Kinshasa to a high risk of COPD [7,8]. In addition, the frequency of 5.8% of occupational pollution in the present study was 5 times lower than that of 31.1% in the USA [29]. The city of Kinshasa is today characterized by the smoke of plastics, firewood, the emanation of gas from factories and second-hand vehicles. Worse still, the dust raised by the wind and also that of the unpaved roads. The extent of exposure to exhaled smoke by relatives, friends, co-workers and other cigarette or cigar smokers was not specified in this study. Indeed, exposure to tobacco and other particles induces COPD and other respiratory pathologies [10].

Despite the lack of genetic data (α 1 trypsin deficiency) and ethnicity (Asian population) according to the literature [2,9]. The present study observed an overrepresentation of the male sex (a non-modifiable factor) in patients with COPD. These results correlate with the publications of Fernandes L et al., in India [11], in the study of Tshiasuma in certain Kinshasa hospitals [11] as well as with the literature [12]. On the other hand, a French study did not show the influence of sex in COPD by Sarah J [13]. Overall the average age of patients with COPD was 65 years with a mode of 60-79 years, this study confirms the influence of aging in the genesis of COPD as demonstrated in the world literature of Gold [14], in India by Fernandes L et al., [22], in Mali by Yaccouba T et al., [15].

The 9H:1F sex ratio in COPD in West Africa reported by a Malian team Yaccouba T et al., [15], was double the 4H:1F sex ratio in COPD observed by the present study. This study highlighted tobacco intoxication in 1/3 of patients with COPD, unlike the rarity of cigarette smoking in several population and clinical studies in the

city of Kinshasa [16]. Indeed, the Gold literature [14], the Malian study by Yaccouba T et al., [15] and other studies around the world exemplify a frequency > 70% of cigarette smokers with ≥10 packs of cigarettes per year.

The clinical picture of COPD described by the present study was similar to that regularly reported by the Gold literature [14]. Indeed, dyspnea and chronic cough were reported in 100% of patients with COPD. These results corroborate the study by Yaccouba T et al., in Mali, which showed that dyspnea had a frequency of 100% and cough at 63% in patients with COPD [15]. On the other hand, sputum from patients with COPD was less frequent than dyspnea and chronic cough in 95% of patients with COPD in the present study. This disparity could be explained by the influence of seasonality and bacterial exacerbation [17, 18].

The present study underlined the coexistence of cardiovascular pathology, diabetes mellitus, interstitial lung disease as reported in the Gold literature [15]. The multimorbidity concept defined by the World Health Organization (WHO) as the concomitant presence of at least 2 chronic medical conditions in the same individual [19], requires a more generalist approach to the patient through personalized (individualized) medicine. [20].

Indeed, personalized medicine promotes early diagnosis and early therapeutic management for a favorable prognosis of COPD in hospitals in Kinshasa. The coexistence of these cardiovascular co-morbidities with COPD (hypoxia) provides the pathophysiological explanations of COPD through the chronic systemic inflammatory reaction [21,22], tobacco intoxication, dysfunction, aging (oxidative stress) and the physical inactivity inflammatory condition [23, 24, 25]. Multimorbidity in COPD in poor, elderly, smoking, underdiagnosed and undertreated patients in hospitals in Kinshasa will be more vulnerable to hospitalization and mortality as reported in the literature [26, 27]

During the progression of COPD [18], spirometry and the flow-volume curve defined the severity of the obstructive ventilatory disorder by FEV1/FVC < 0.7 and ≤ 80% in the present study. This study showed that stage II and III of COPD severity according to Gold were predominant with a proportion of 79.2% compared to less than 20% of COPD at stage IV and less than 3% stage I these results corroborate with that of Yaccouba T et al., [15] who noted a predominance of 35% for stage II and 36.4% for stage III. The measurement of FEV1 is almost non-existent in the city of Kinshasa, especially since respiratory function exploration is difficult at the level of the primary and secondary health system, however the old Gold classification [1] is questioned to assess the prognosis. of COPD. This is why the current classification of COPD wants to determine the risk of subsequent exacerbation in order to adapt the optimal therapeutic management according to 3 COPD classification criteria according to Gold revisited [14]:

Severity of bronchial obstruction; Symptoms assessed by different questionnaires validated by a dyspnea assessment scale (MRC and CAT) for quality of life [14, 15]; Assessed the past year, the risk of the number of future exacerbations in the combination of Glod I (FEV ≥ 80%), Gold II (FEV 50-79%), Gold II (FEV 30-49%), Gold IV (≤ 30%), moderate-severe stratification of the history of COPD exacerbations (≥2 or ≥ 1 exacerbation to hospitalization and 0 or 1 exacerbation without hospitalization) to define 4 groups defining the exacerbation of symptoms as follows [14, 28]:

Group A: low risk of future exacerbation, few symptoms; Group B: low risk more symptoms; Group C: high risk, few symptoms; Group D: high risk, more symptoms.

As the Gold classification by exacerbation [14] is not universally accepted, spirometry

remains the most reproductive and objective noninvasive, sensitive and reproductive tool to measure obstructive ventilatory dysfunction despite its low specificity [29].

The present study characterized certain radiographic appearance of the thorax from the front and from the side in patients with COPD. Pulmonary distension was the dominant sign on the AP chest X-ray during this study in 80% of cases. Rail bronchial wall thickening came second in 60.8%, followed by HATP in 52%, emphysema bubble in 46.7% of cases. These results are similar to those of Muller NL et al., in Canada [30] who noted the predominance of pulmonary distension (pulmonary hyperinflation) and pulmonary emphysema in patients with COPD.

The present study shows that bronchial parietal thickening, centrilobular emphysema and predominantly emphysematous involvement constitute the CT expression of COPD in respectively 68.75, 50% and 50% of cases. These results are similar to those of Fernandes L et al., in India [22] who had shown that dominant emphysematous involvement was frequent in patients with COPD. Bruno H et al., in Brazil [31] had also stated that dominant emphysematous disease was the most common in patients with COPD. This study defined a phenotype by constellation of tracheobronchial, emphysematous and vascular lesions by computed tomography imaging of the thorax. On the other hand, other European authors have reported a predominant emphysematous phenotype from sputum examination [32] in addition to the present study, a Japanese study, a Craig J Galban et al. study, in the USA [33], and a study Hochhegger B et al., in Brazil [34] defined the phenotype and characterized a constellation of emphysema of the centri-lobular type para septal, panlobular, bullous, distal and proximal airways in front of the interfaces of interstitial involvement and nodule. COPD by chest CT scan defines the variability of the extent of emphysema and signs of airway damage for the same degree of obstruction. Like Craig J Galban et al., in the USA [33], the present study also defines a Bantu phenotyping of COPD by CT scan with a concurrent presence of mixed involvement (emphysematous involvement and involvement of the small airways which may precede emphysema). Like Bruno H et al., in Brazil [31], the present study reports the coexistence of a severe reduction in the number of terminal bronchioles in the emphysematous area and parietal thickening in the residual bronchiole. The inflammatory reaction coupled with bronchiolar remodeling precedes emphysema.

CONCLUSION

This study on the epidemiological and radiological profile showed that older men and women are more affected by the pathology. The high frequency of COPD risk factors is probably the basis for the observed lesions. Stage III and IV representing a very high frequency are correlated with the radiological lesions encountered.

Author's 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

Declaration by Authors

Ethical Approval: Approved

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Conflict of Interest: The authors declare no conflict of interest.

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