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The chest radiographic appearance and frequency distribution of cavities in pulmonary tuberculosis among adults in Northeastern, Nigeria

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Summary

The aim of the study was to assess the radiographic appearance and frequency of distribution of cavitations in the lungs using chest radiographs in Northeastern, Nigeria. A multi-center retrospective study of chest radiographs of 116 adult patients diagnosed bacteriologically as pulmonary tuberculosis was conducted. The age, sex, presence of cavitations, single or multiple, thin walled or thick walled, presence of fluid level or fungal ball in the cavity and the lobar distribution of cavitations in the lungs were assessed. There were 83 (71.6%) males and 33 (28.4%) females with mean age of 37.99 ± 14.11 . A total of 58 patients (50%) presented with cavitations and no sex preponderance observed. There were more cases with multiple (38 patients = 32.8%) than single (20 patients = 17.2%) cavitations ($P < 0.05$). Cavitations were more common in the right (28.23%) and left upper lobes and less common in the left lower and lingula (9.68%) lobes (Table 3). There were more cavitations involving the right lung (57.16%). Thirty four patients (58.62%) presented with only thick walled cavitations compared with 18 cases (31.03%) with only thin walled cavitations ($P < 0.05$). Six patients (10.35%) had both thick and thin wall cavitations. Out of the 58 patients with cavitations only 2.32% (4 cases) presented with fluid levels and 1.74% (3 cases) with fungal ball. In conclusion, cavitations are a common finding in pulmonary tuberculosis with no sex preponderance and occur predominantly in the upper lobes. Multiple, thick wall cavitations were the common presentation. Fungal balls and fluid levels were rare.

Keywords: Cavitation, distribution, chest radiograph, Maiduguri

Résumé

Le but de cet étude était d'évaluer l'apparence radiographique et la fréquence de distribution des cavitations dans les poumons, en utilisant des radiographies de la poitrine du Nord-est, du Nigeria. Une étude retrospective à multi-centre de radiographies de la poitrine de 116 malades adultes diagnostiqués bactériologiquement comme la tuberculose pulmonaire avait été conduite. L'âge, le sexe, la

présence de cavitation unique ou multiple, à paroi mince ou à paroi charnue, la présence d'un niveau de fluide ou de bulle fongueuse dans la cavité et la distribution lobaire de cavitation unique ou multiple, à paroi mince ou à paroi charnue, la présence de niveau de fluide ou de bulle fongueuse dans la cavité et la distribution lobaire de cavitations dans les poumons ont été évaluées. Il y avait 83 (71,6%) d'homme et 33 (28,4%) de femmes avec la moyenne d'âge de $37,99 \pm 14,11$. Un total de 58 malades (50%) présentés avec des cavitations et sans aucune observation de prépondérance de sexe. Il y avait plus de cas avec de multiples (38 malades = 32,8%) que d'unique (20 malades = 17,2%) cavitations ($P < 0,05$). Les cavitations étaient plus communes dans les lobes droites (28,23%) et les lobes supérieures gauche et moins communes dans les lobes inférieures gauche, la languette 9,68% (Tabl. 3). Il y avait plus de cavitations impliquant le poumon droit (57,16%). 34 malades (58,62%) ont présenté seulement des cavitations à paroi mince charnue comparativement à 18 cas (31,03%) ayant des cavitations à paroi mince ($P < 0,05$). 6 malades (10,35%) avaient les cavitations des deux parois minces et charnues. De ces 58 malades présentant des cavitations, seulement 2,32% (4) ont présenté des niveaux de fluide et 1,74% (3) ayant des bulles fongueuses. En conclusion, les cavitations sont des manifestations communes de tuberculose pulmonaire sans aucune prépondérance de sexe et se produisent le plus souvent dans les lobes supérieures. Les parois multiples, charnues des cavitations étaient la manifestation commune. Les bulles fongueuses et les niveaux de fluide étaient rares.

Introduction

Tuberculosis is the leading cause of death from infectious diseases causing 2-3 million deaths/year and more than 90% of the new cases are in the developing countries [1]. The situation of tuberculosis in Africa has not improved over the years. The infection rate had remained at 3-5%, prior to AIDS epidemic and has been greatly affected by the impact of AIDS [2]. The incidence of the disease in sub-Saharan Africa (191/100,000) where Nigeria has the largest population is second to only south east Asia (247/100,000) [1]. In view of the above, understanding the radiographic manifestation of the disease in this region will aid in prompt diagnosis and early treatment, thereby reducing mortality.

Pulmonary tuberculosis has a diversity of radiographic appearances that it is wise to include it in all the differential diagnosis of pulmonary lesions. Adult pulmonary tuberculosis commonly presents with radiographic findings of upper lobe cavitations. However, other radiographic presentations in adults include pulmonary consolidation, pneumatocele, collapse, pleural effusion, hilar or mediastinal lymphadenopathy, millary disease, pleural thickening, fibrosis, nodulation and tuberculoma. In pulmonary tuberculosis, granulomatous reaction and caseous

necrosis occur early and are intense. Caseation leads to the formation of cavities

Cavitations have diagnostic significance in the management of tuberculosis and they appear in 37-75% of all cases of active tuberculosis [3]. Cavities may be single or multiple, thin walled or thick walled and may occur anywhere in the lungs but more common in the upper lobes [3,4]. They may be empty, show fluid levels or contain fungal balls.

The aim of the study was to assess the prevalence, radiographic appearance and distribution of cavitations in the lungs using chest radiographs in an attempt to understand pulmonary tuberculosis.

Materials and methods

A multi-center retrospective review of chest radiographs of 116 adult patients diagnosed bacteriologically as pulmonary tuberculosis was conducted in the University of Maiduguri Teaching Hospital, Maiduguri, Borno State and Federal Medical Centre Nguru, Yobe State for one year from April 2003. Postero-anterior and lateral radiographs were taken with film-screen at 90-140 Kvp and 1.8m film-target distance.

The age and sex were obtained from the X-Ray request forms and the following parameters were assessed in all the radiographs: presence of cavitations, single or multiple, thin walled or thick walled, presence of fluid level or fungal ball in the cavity and the lobar distribution of cavitations in the lungs. In all patients where opacity was seen in a cavity a repeat radiograph was done after 2 weeks to exclude blood clot.

The data was analyzed using SPSS 11 for windows. $P < 0.05$ was considered significant.

Results

A total of 116 radiographs of patients were analyzed comprising 83 (71.6%) males and 33 (28.4%) females with mean age of 37.99 ± 14.11 . The age range of the patients was between 13 - 75 years. The age frequency distribution is shown in Fig. 1

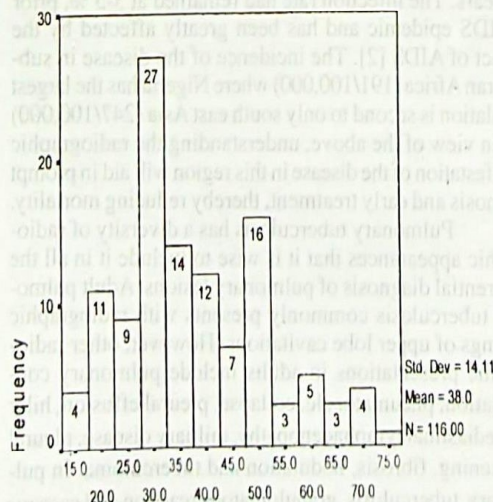


Fig. 1 Age frequency distribution of 116 patients studied

Table 1 show that 58 patients (50%) presented with cavitations. No statistical significance at 95% confidence limit between males and females ($X^2 = 0.04$, $P = 0.837$, Relative Risk = 1.02).

Table 1: Frequency distribution of cavitations among the 116 patients studied.

	Frequency	Percent	Males	Females
No cavitations	58	50.0	42	16
With cavitations	58	50.0	41	17
Total	116	100.0	83	33

Table 2 shows frequency distribution of single or multiple cavitations among the patients studied. There were more cases with multiple (38 patients = 32.8%) than single (20 patients = 17.2%) cavitations ($p < 0.05$). There were more multiple (12 cases) than single (6 cases) cavitations among females. Twenty six cases of multiple cavitations and 14 cases of single cavitations were recorded among males.

Table 2. Frequency distribution of single and multiple cavitations in males and females

	Frequency	Percent	Males	Females
Single cavitation	20	34.48	14	6
Multiple cavitation	38	65.52	26	12
Total	58	100.00	40	18

Cavitations were more common in the right (28.23%) and left upper lobes and less common in the left lower and lingula (9.68%) lobes (Table 3). There were more cavitations involving the right lung (57.16%).

Table 3. Lobar frequency distribution of cavitations in both lungs

Lung lobe involved	Frequency	Percent (%)
Right upper lobe	35.0	28.23
Left upper lobe	26.0	20.97
Right middle lobe	21.0	16.93
Right lower lobe	16.0	12.90
Left lower lobe	14.0	11.29
Lingula lobe	12.0	9.68
Total	124	100.00

Table 4 shows 34 cases (58.62%) with thick walled cavitations compared with 18 cases (31.03%) with thin walled cavitations ($P < 0.05$). Six patients (10.35) had both

thick and thin wall cavitations. Thick walled cavitations (fig.2) were also more common in males (25 cases) than in females (12 cases).

Table 4. Frequency distribution of thin and thick walled cavitations in males and females.

	Frequency	Percent	Males	Females
Thin walled	18	31.03	12	6
Thick walled	34	58.62	25	9
Both thin and thick walled	6	10.35	4	2
Total	58	100.00	41	17

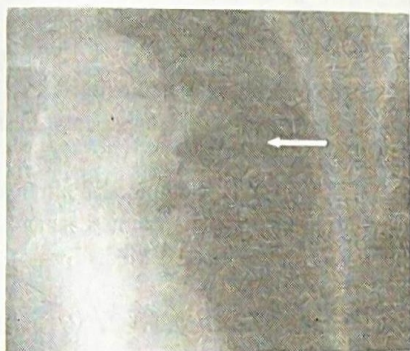


Fig. 2: Showing a thick walled cavity (arrow) in the left upper zone in a patient with pulmonary tuberculosis

Out of the 58 patients with cavitations only 2.32% (4 cases) presented with fluid levels and 1.74% (3 cases) presents with fungal ball (fig.3).



Fig.3: A fungal ball is shown inside a cavity located in the right upper zone.

Discussion

Pulmonary tuberculosis is the most common form of tuberculosis, although the disease may occur in any organ. Tuberculosis in humans is commonly caused by *Mycobacterium tuberculosis*; aerobic bacilli stained by Ziehl-Neelsen and Kinyoun stains. *Mycobacterium bovis* and *mycobacterium africanum* can also cause the disease in humans.

The mean age of our patients was 38 years and the age with the highest frequency was 27 years. Kolawole *et al* in Ibadan, Nigeria reported the peak age of the cases they studied was in the first and third decades [5]. Aktogu, *et al* in his study of 5,480 cases of tuberculosis in Turkey found pulmonary tuberculosis to be more common among persons aged 20-39 years⁶. In India around 80% of TB cases occur in economically productive age group of 15-49 years [7]. The above findings show a similar trend with our study.

There were more males 83 (71.6%) and females 33 (28.4%) in this study. This is in agreement with most previous studies carried out locally⁵ and internationally [6,7]. However, Anjali, *et al* in USA reported that when socio-economic factors were considered, no clear propensity for either sex was observed in their study [8].

Cavitations were seen in the chest radiographs of half (50%) of the patients we studied. There is a great variation in the reported prevalence of cavitations in pulmonary tuberculosis with the lowest being among Indians (7.92%) [7], 41.3% was reported in Uganda [9], 66% in Turkey [6], 28% in Italy [10], 45 % in USA [11] and a wide range of 37%-75% was quoted by Palmer [3]. This shows that there is geographic variation in the distribution of cavitations. Burkitts observed that there is geographic variation not only in the incidence of some diseases but also in their pattern⁵. It may probably be related to the socioeconomic conditions of the patients and other associated diseases affecting the immune system.

There were more cavitory lesions in the right lung 58.06% in our study. A previous study by Vijayasekaran *et al* in Madras [12] has also shown that the right lung was more commonly affected (66%). However, in children below 3 years cavitory lesions were predominantly in the lower lobe, whereas in older children upper lobes were affected [12]. These are due to the fact that primary tuberculosis is the most common presentation in the former age group. According to a previous study in Nigeria, cavitations were more common in the upper lobes more on the right and significant number of cavitations was seen in other lobes especially the lower lobes followed by the lingula, right middle lobe and the right lower in frequency of occurrence [5]. When compared the upper lobes cavitations were similarly more common in our study, however, the distribution in the remaining lobes differs, eg. the right lower lobe was the least in the study and the lingula (9.68%) was the least affected in ours. This may be due to geographic variation of pattern of lesions in some diseases mentioned above.

There were more cases with thick walled cavitations (34) compared with thin wall cavitations (18)

cases) in the present study and 6 patients have both thick and thin walled cavitations. Thick walled cavitations are more common in pulmonary tuberculosis [8] and are due to the fibroblast proliferation and the formation of fibrous wall. There is paucity of literature in the radiographic appearance of the walls of cavitations in pulmonary tuberculosis. This study will serve as a baseline for future studies in this field.

Air-fluid levels are uncommon and usually indicate super-infection; however, they can be seen in other circumstances in 9% of cases [8]. Hemorrhage alone or with subsequent infection may also cause air-fluid level in cavitation. In Toronto, Krysl *et al* found cavitations in 6 out of the 158 patients they studied (3.8%) [13]. This value is slightly higher when compared with our study (2.32%).

Fungal balls were seen in only 3 patients (1.74%) in our study. A solid mass lying in a cavity could be either a fungal ball (mycetoma) or a large blood clot and were distinguished when the mass persisted after two weeks on a repeat radiograph. A blood clot is expected to be reabsorbed within this period. A study of British patients with open healed tuberculous cavities showed one third of them had serological evidence of aspergillus infection [14]. Another study in UK showed 15% had radiographic evidence of aspergilloma within the pulmonary cavities [14]. In both these studies the prevalence were high compared to our study.

In conclusion, cavitations are a common finding in pulmonary tuberculosis with no sex preponderance and occur predominantly in the upper lobes. Multiple, thick wall cavitations were the common presentation. Fungal ball and fluid levels were rare.

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