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St. Paul's Hospital Millennium Medical College

**EVALUATION OF PATTERNS AND ASSOCIATED
CONDITIONS OF PULMONARY METASTASES FROM
KNOWN PRIMARY CANCER AT SAINT PAUL'S HOSPITAL
MILLENNIUM MEDICAL COLLEGE, ADDIS ABABA,
ETHIOPIA**

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**A RESEARCH PAPER SUBMITTED TO THE DEPARTMENT
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SAINT PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE, ADDIS
ABABA, ETHIOPIA**

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List of Abbreviations

- CT-computed tomography
- FNAC-Fine needle aspiration cytology
- SPHMMC-Saint Paulo's Hospital Millennium Medical College
- HU- Hounsfield unit
- Mets- metastases

Abstract

Background; metastatic disease of the lung is very common. They are detectable in 20- 54 % of patients who died from primary cancer (5). A definitive morphologic pattern is important to

differentiate metastases from benign nodules/lesions/ as well as from primary lung cancers. Each of different types of extra-thoracic malignancies has some typical and atypical morphologic patterns when they metastasize to the lung. Chest CT has emerged as the most useful imaging modality for evaluation of these lesions as it has superior resolution, helps to characterize lesions, detects chest x ray missed nodules and guides for fine needle aspiration of indeterminate nodules.

Objective; to assess the CT patterns of pulmonary metastases among patients with extra-thoracic primaries.

Methods; The study design will be facility based retrospective study describing morphologic patterns of pulmonary metastases in patients with known primary cancer at SPHMMC from April 2019 to July 2019. Data will be collected using structured data collection template, developed based on study variables and available literatures and analyzed using SPSS software.

Plan; Data collection will be from April to June final report will be submitted on August.

Budget; the required cost for the study will be estimated to be 27,431 birrs.

Key Words; primary cancer, LAC pattern, solitary nodule, multiple nodules, cavitating nodule military nodes.

I. Introduction

A. Background

Metastases are dissemination of the cancer cells to discontinuous nearby or distant anatomic sites where they proliferate to form an extravascular mass of cancer cells. (10)

And Pulmonary metastases is cancer that started in another part of the body and spread to the lung which is not the same as cancer that starts in the lung, called primary lung cancer. (11)

Lung is the second most common organ to be affected by metastases next to liver and for this reason metastatic disease of the lung is very common. They are detectable in 20- 54 % of patients who died from primary cancer (5).

Metastases can reach the lung through different ways via blood vessels, lymphatic, direct extension or through the air way. (5)

Cancer is the second leading cause of death globally, and is responsible for an estimated 9.6million deaths in 2018.Globally about 1 in 6 deaths are due to cancer. (12)

The economic impact of cancer is significant and is increasing. The total annual economic of cancer in 2010 was estimated at approximately US\$ 1.16 trillion. (13) Only 1 in 5 countries in sub-Saharan Africa have the necessary data to drive cancer policy. (14)

The prevalence of non-communicable disease in Ethiopia is increasing, owing to life style changes. (15) Cardiovascular disease, diabetes mellitus and cancer are leading chronic disease, with significant contribution to the overall mortality in Ethiopia. (16) Chronic illness including cancer and injuries were responsible for 30% of all deaths in 2005 GC in Ethiopia. (17)

And there is no published study on pattern and health impact of pulmonary metastases in Ethiopia.

B. Statement of the problem

Lung is subjected to infectious, metabolic, tumors, developmental, hereditary and inflammatory pathologies as any organ does. Tumors are either primary cancer that originates from the lung tissue or secondarily from the other sites, called pulmonary metastases.

And most of the disease has specific morphologic patterns on CT scan. It is possible to standardize morphologic criteria to separate disease so that timely diagnosis will be facilitated. The care of oncologic patients is unsatisfactory in our hospital due to delayed diagnosis and poor set up for treatment even after diagnosis. Such inconveniences can decrease with accurate and timely diagnosis.

In addition there was no previous data on pattern of pulmonary metastases in Saint Paul millennium medical college. And this study will also function as base line data for coming researchers.

The objective of this retrospective study is to analyze the patterns of pulmonary metastases and associated conditions by use of chest CT and to improve daily clinical practice in detection treatment and care of oncologic patient.

II. Literature Review

In a study done by Nasar Bekir Elhassani and et all at Iraq, 59.5% showed nodule enhancement ranging from 30-50 HU. Cavitations and calcified pulmonary nodules were seen in 9.5% and 2.4% of all patients respectively. extraparenchymal chest lesions were found collectively in 33.3% of patients, the most common finding of which is pleural effusion and intrathoracic lymphadenopathy (14.2% and 9.5% respectively), while associated bone metastases were found in 7.1% of patients. (1)

The study done by G Schueller and C JHarolduniversity of Veina , Austria showed Diffuse miliary seeding was seen in medullar carcinoma of the thyroid; large singular metastases pattern was seen in choriocarcinoma, melanoma, and hypernephroma; calcification of metastases was seen in osteosarcoma, adenocarcinoma, and secondary to chemo- and radiation therapy; and cavitation of pulmonary metastases pattern was seen in squamous cell carcinoma of the head and neck and from the genitourinary tract in women.

The study published by radiographic vol.21 no,2 showed majority of patients has the usual patterns of different sized nodules or LAC patterns.in addition the study showed cavitation of the metastatic nodules in 13 (9.5%) of 137 patients with adenocarcinomas, whereas cavitation were detected in five (10%) of 49 patients with squamous cell carcinomas. Metastatic nodules from a synovial sarcoma; giant cell tumor of the bone; and carcinomas of the colon, ovary, breast and thyroid are seen calcified.(2)

The study done on 56 unselected autopsies of patients who died with malignant disease showed 30 (54%)were found to have pulmonary metastases. Single nodule pattern seen in 4 (13%) patients and multiple nodular patterns in four (13%) patients. In two (6.5%) patients there was extensive nodular lesion producing snow storm effect. There was a definite predominance of metastases lying subpleurally and in the outer one-third of the lung fields. The size of the

metastases varied from the just visible parenchymal nodule of 1-2mm and pleural studs of 2-5mm to large masses, one of which was 16cm in diameter(7).

A study done by PatriziaSeminara*, Gaia Manna, Alessandra Emiliani, Alessandro Iannace and Tania Losanno in 78 years old Caucasian who has history of surgery for colorectal cancer showed atypical multiple cavitary nodular lesion pattern which was confusing with infection disease.(4)

A study done by Gaeta M¹, Volta S, Scribano E, Loria G, Vallone A, Pandolfo I.in Italy in 65 patients with gastrointestinal adenocarcinomas showed Six of 65(9.2%) air-space metastases pattern among this three (3.1%) were from pancreatic carcinoma, two(3%) were from colonic carcinoma, and one(1.5%) were from jejunal carcinoma.

In one case(1.5%), metastasis appeared as extensive parenchymal consolidation pattern associated with ground-glass opacities; in one patient (1.5%), the lung metastases appear as an area of ground-glass opacity pattern; in one (1.5%), as an extensive parenchymal consolidation with air bronchogram pattern; in one(1.5%), as parenchymal consolidations with angiogram sign pattern and multiple nodules pattern; in one (1.5%), as air-space nodules and patchy air-space consolidations pattern; and in one (1.5%), as a solitary nodule with halo sign pattern (5)

III. Significance of the study

The detection of pulmonary nodule in chest CT is not enough. The possibility of a nodule to be either benign, primary lung cancer or metastatic has to be settled out. To do so sorting all such cases for diagnostic intervention like image guided biopsy or FNAC is not necessary. Knowing the pattern of pulmonary metastases will decrease or avoid such ambiguities and will improve the overall hospital goal.

The goal of this diagnostic work up now is to lay ground on our knowledge on patterns of pulmonary metastases so that timely detection, triage and management of oncologic patient is facilitated.

Although most common pulmonary metastatic pattern in literature is either LAC or multiple large nodules, atypical pulmonary metastases patterns are not uncommon. Knowing of their pattern increases our confidence of diagnosis and avoids unnecessary image guided FNAC or biopsy which will also decrease the cost of patient care. Knowing pattern of pulmonary

metastases also improves our search of primary tumor as certain tumors has certain morphologic pattern and this too improves quality and timing of our patient care.

In addition to this there are many patients with pulmonary metastases at Saint Paul millennium medical college witnessed in our daily practice, and all this has inspired me to do this research.

IV. Objectives

A. General Objective

To evaluate patterns and associated conditions of pulmonary metastases from known primary cancer at saint Paul's hospital millennium medical college, Addis Ababa, Ethiopia

B. Specific objectives.

1 - To determine patterns of pulmonary metastases from known primary cancer at saint Paul's hospital millennium medical college, Addis Ababa, Ethiopia.

2- To identify associated factors with pulmonary metastases at Saint Paul's hospital millennium medical college, Addis Ababa, Ethiopia.

V. Methods

A. Study Area and Period.

The study will be conducted in Saint Paulo's millennium medical college Addis Ababa, Ethiopia. The hospital is second largest in the country. it was built by Emperor Haile Selassie I with the help of German evangelical church. The hospital is under the St. Paul's Hospital Millennium Medical College which was formed in 2007 It is the training center for undergraduate and a wide spectrum of postgraduate. The radiology department has 14 consultants, 56 residents and 20 radiology technicians. The study will be conducted from April 5- July 30, 2018.

B. Study design.

The study will be institutional based retrospective study

Population

Source Population

All patients with primary cancer.

Study Population

All patients with primary cancer who are referred to SPHMMC for chest CT

Inclusion and exclusion criteria

Inclusion Criteria

Those who has complete record

Exclusion criteria

Those who has non readable, lost images or incomplete data.

C. Sample Size

Sample Size

The sample size was calculated using a formula for estimating a single population proportion assuming a confidence level of 95%.

$$n = \frac{Z^2 (a/2)^2 P (1-P)}{d^2}$$

Were

n= the required sample size

Z (a/2) = the critical value at 95% level of significance (1.96)

P= Proportion of pulmonary metastases among extra-thoracic malignancy with autopsy is 20%

d= Precision of measure (acceptable margin of error)

P= the prevalence of pulmonary metastases in one study is 20%, p=0.2(5)

d= 0.08(SPHMMC is a tertiary hospital and I assume that the study population varies from the source population by about 8%)

$$n = \frac{(1.96)^2 0.2(1-0.2)}{0.08^2}$$

n= 96 adding 10 % non-response rate the final sample size will be 106.

D. Methods of Data Collection

Data collection format will be developed based on study objectives and available literature. Data will be collected by reviewing the record of patients. Five second year

radiology residents will collect data after two day training on how to collect and record data. I, principal investigator, will supervise the data collection for the utmost quality.

E. Study Variables

Dependent Variables

- Number of lung nodules
- Size of nodules
- Irregular margins
- site (Right lobe, left lobe)
- feeding vessel
- calcification,
- cavitation
- lymphadenopathy

Independent Variables

- Age
- Sex
- presenting complaint (cough,hemoptysis,chest pain dyspnea)
- Duration of symptoms
- Type of primary tumor

F. Data Processing and Analysis

Editing and sorting of the questionnaires will be done to determine completeness manually. The responses in the completed questionnaires will be coded and entered into a data entry template. Data entry and analysis will be performed using SPSS version 21. Summary tables and charts will be used for describing data. A relationship among the major variables will be described.

G. Data Quality Control

The structured data collection templates will be designed in English language and pre-tested on 20 patients similar to the study population (5% of the sample size) in the study hospitals which will not be included in the study. The finding of the pre-test will be

incorporated into the final instrument for the study. The data collectors will be given training by the PI on the final questionnaire and data collection techniques.

Operational definitions.

Cavitary nodule; nodules with any amount of gas density inside.

Halo sign; any nodules with surrounding ground glass opacity.

Calcified nodule; any calcific density measuring >70 HU inside the nodule.

Military nodule; millet sized nodules distributed randomly

Feeding vessel sign; any size measuring vessel entering the nodule.

Multiple nodule; greater than two nodules of any size.

Solitary nodules: single pulmonary nodule measuring any size.

Lymphadenopathy; nodes more than 1 cm in their short axis or had micro calcification or cystic areas (irrespective of size) and architectural distortion.

H. Ethical Consideration

The proposal will be approved by the Ethical Review Committee of department of Radiology. Permission will be requested from the hospital to access the client's data included in the study. Concerning the right to anonymity and confidentiality, the study participant's names will not be documented on the questionnaire.

The study participant will not receive any financial or any other type of reward or inducement to be enrolled into the study.

I. Dissemination of the Result

After accomplishing the study, the results will be presented to department of Radiology. Subsequently, attempts will be made to present it on scientific conferences and publish it on scientific journals.

VI. Results

A. Socio-demographic characteristics

A total of 106 cases were analyzed and from this 6 questionnaires were excluded by the principal investigator due to incomplete data. From the 100 questionnaires analyzed 9%(9cases) were under age of 30,11%(11 cases)were above age of 70,51%(51 cases) were between age 30-50,and 29 %(29 cases) were between age 50-70.

No	Age range	Frequency(n=100)	Percent
1	<30	9	9%
2	30-50	51	51%
3	50-70	29	29%
4	>70	11	11%

Table 1: age distribution of pulmonary metastases.

From 100 analyzed cases 30 %(30 cases) were male patients and 70% (70 cases) were female patients. The lowest age was 22, highest age was 80; with the mean age 45.8($\pm$ 13.5) and median age of 46.

Sex	Frequency(n=100)	Percentage
Male	30	30%
Female	70	70%

Table 2: sex distribution of pulmonary metastases

B. Clinical conditions and symptoms

From 100 analyzed cases 42 %(42 cases) has extra thoracic manifestation, 10% (10 cases) present with cough, 5 %(5 cases) present with shortness of breath, 12 %(12 cases) present with chest pain, and 31 %(31 ceases) were asymptomatic.

Symptom	Frequency(n=100)	percentage
Cough	10	10%
Chest pain	12	12%
Shortness of breath	5	5%
Asymptomatic	32	32%
Extra-thoracic symptoms	41	41%

Table 3: symptoms of pulmonary metastases.

From 100 analyzed cases majority 91% presented after long months of illness time.

Duration of symptoms	Frequency(n=100)	Percentage
Acute presentation	9	9%
Chronic presentation	91	91%

Table: 4 presentations of patients with pulmonary metastases

C. Major pulmonary metastases patterns detected

From 100 investigated cases 22 % has a predominant LAC pattern, 2% has miliary pattern, 6% present with solitary nodule, 4% has calcified nodules, 12% has cavitataing nodules and the majority of cases (54%) present with multiple different sized nodular pattern.

No	Type of pattern	Frequency(n=100)	percentage
1	Miliary Nodes pattern	2	2%
2	Multiple different sized nodules	54	54%
3	Cavitataing nodules pattern	12	12%
4	Solitary nodule pattern	6	6%
5	LAC pattern	22	22%
6	Calcified nodules pattern	4	4%
7	Endo-bronchial deposit pattern	0	0%
8	Vascular mets pattern	0	0%
9	Air space pattern	0	0%

Table 5: major pattern of pulmonary metastases.

D. Lymphangitis carcinomatosis (LAC) pattern

Of the 22 cases of LAC pattern 12 has associated lymphadenopathy, 6 associated pleural effusion, 4 associated LAP with pleural effusion and 4 cases has no any association.

Associated conditions with LAC pattern	Frequency(n=22)	percentage
Lymphadenopathy	12	54.5%
Pleural effusion	6	27.2%
Pleural effusion with LAP	4	18.2%
Only LAC pattern, no association.	4	18.2%

Table 6: associated condition with LAC pattern

From the 22 cases of LAC 10 were from breast ca,4 were from esophageal ca,2 from gastric ca,2 from cervical ca,1 from bladder ca,1 from oral scc,1 from thyroid ca and 1 was from colonic ca.

Type of primary cancer with LAC pattern	Frequency(n=22)	Percentage
Breast ca	10	45.5%
Esophageal ca	4	18.1%
Gastric ca	2	9%
Bladder ca	1	2.2%
Cervical ca	2	4.5%
Oral SCC	1	2.2%
Thyroid ca	1	2.2%
Colonic ca	1	2.2%

Table 6: primary cancers with LAC pattern

E. Military metastatic pattern

There were a total of two cases which present with milliary pattern of lung metastases. Both cases were from thyroid malignancy.

F. Solitary nodular pattern of metastases.

From total 6 cases 2 cases were from ovarian ca, 2 cases were from cervical ca, 1 case were from vulval scc and 1 case were from renal cell ca.

Type of primary ca	Frequency(n=6)	Percentage
Ovarian ca	2	33%

Cervical ca	2	33%
Renal cell ca	1	16%
Vulval scc	1	16%

Table 7: primary cancers with solitary metastatic pattern.

G. Cavitating metastases pattern.

;There were a total of 12 cases with cavitating metastases pattern, among this five were from nasopharyngeal ca ,two were from colonic ca, I were from soft tissue sarcoma,one were from transitional cell ca,there were not specified and one were from cervical ca.

Type of primary with cavitating pulmonary pattern	Frequency(n=12)	Percentage
Nasopharyngeal ca	5	41.6%
Cervical ca	1	8.3%
Soft tissue sarcoma	1	8.3%
Colonic ca	2	16.6%
Transitional cell ca	1	8.3%
Un-specified primary	2	16.6%

Table 8: primary cancers with cavitating pattern of presentation.

Among the 12 case of cavitating pulmonary metastases pattern,1 (8.3%)case was associated with pneumothorax,2(16.6%) cases were associated with lymphadenopathy,1(8.3%) case were associated with pleural effusion while rest are purely parenchymal cavitating nodules only.

In all (100%) case nodules were multiple and range from 5mm to 1cm and in all cases there were none cavitating nodules as non-dominant pattern.

H. Calcified nodular pattern.

There were total of 4 cases with calcified metastatic pattern, and among this 1(25%) were from colonic ca, 1(25%) were from osteosarcoma, 1(25%) were from ovarian ca and 1(25%) were from breast ca.

Type of primary with calcified metastases	Frequency(n=4)	Percentage
Colonic ca	1	25%
Ovarian ca	1	25%
Breast ca	1	25%
Osteosarcoma	1	25%

Table 9: primary cancers with calcified metastases.

All cases were multiple with non-calcifying nodes as non-dominant pattern.

I. Regarding the multiple different sized nodular pattern.

This pattern accounts for 54% of all cases. Majority (in 90.7 %) of the cases were found predominantly at the lower lobe and peripheral lung zone. The majority (in 53.7%) of nodules size is 5mm to 1cm range.

Size of nodules in range	Frequency(n=54)	Percentage
3-5mm	8	14.8%
5mm-1cm	29	53.7%
1cm-3cm	17	31.5%

Table 10: size of pulmonary metastases.

longitudinal distribution of nodules	Frequency(n=54)	Percentage
Predominant upper lobe.	0	0%
Predominant middle lobe	5	9.2%
Predominant lower lobe	49	90.7%

Table 11: longitudinal distribution of pulmonary metastases.

Axial distribution of nodules	Frequency(n=54)	Percentage
Outer third	42	77.7%
Middle third	10	18.5%
Inner third	2	3.7%

Table 12: axial distribution of pulmonary metastases

There was varied number of primary cancer with this metastatic pattern. The most frequently encountered primaries were breast ca 6(11.1%) cases, thyroid ca 4(7.4%) cases, esophageal ca 4(7.4%) case, ovarian ca 5(9.3%) cases, gastric ca 2 (3.7%) cases, colonic ca 3(5.5%) cases and HCC 2 (3.7%) cases. They were from different primary ca with single presentation.

Type of primary ca	Frequency(n=54)	Percentage
Breast ca.	6	11.1%
Thyroid ca	4	7.4%
Colonic ca	3	5.5%
Gastric ca	2	3.7%
Esophageal ca	4	7.4%
HCC	2	3.7%
Ovarian ca	5	9.3%
Others,	28	51.8%

Table13: primary cancers with multiple different sized nodules.

Among the 54 cases with this pattern 39 cases (72.2%) were associated with positive feeding vessel, 5 (9.2%) cases with pleural effusion, 7(12.9%) cases with lymphadenopathy, 2 (3.7%) cases not associated with any of these additional conditions, and 1(1.8%) case with positive CT halo sign

Associated conditions with multiple and different sized metastatic pattern	Frequency(n=54)	percentage
CT halo sign	1	1.8%

Feeding vessel sign	39	72.2%
Pleural effusion	5	9.2%
Lymphadenopathy	7	12.9%
Pleural effusion with LAP	2	3.7%
Feeding vessel sign with LAP	6	11.1%
Feeding vessel sign with pleural effusion	5	9.2%
Not associated ,only the stated pattern	2	3.7%

Table 14; associated condition with multiple and different sized nodular pattern.

Of 54 patients with multiple different sized pulmonary nodules, majority (51.8%) of cases has moderate amount of nodules.

Number of nodules	Frequency(n=54)	Percentage
Few scattered nodules	12	22.2%
Moderate number of nodules	28	51.8%
Snowstorm type of nodules	14	25.9%

Table 15: number of pulmonary nodules.

All cases has smooth and well defined margin. In half of the all cases with this pattern post contrast study was done and show enhancement by greater than 15 HU in all cases.

VII. Discussion

This is the first institutional survey to evaluate patterns of pulmonary metastases from known primary cancers among patients with primary cancer and chest CT scan in Ethiopia. The study showed that the majority of patients present either with lymphangitis carcinomatosa or multiple and different sized nodular pattern 22 and 54 percent respectively. This study was consistent with radiographic vol.21 no,2.(2)

In this study the calcified nodule and cavitating pattern account for 4 and 12 percent of case respectively. This was higher than the study done by Nasar Bekir Elhassani and et al at Iraq which showed 9.5% and 2.4% for cavitating and calcified nodules respectively. The difference might result from local cancer risk for cancer difference and Saint Paul being a tertiary hospital might increase referral of such cases.(1)

The nasopharyngeal Ca,colonic Ca,cervical Ca,soft tissue sarcoma,and transitional cell Ca were associated with cavitating pulmonary metastatic pattern. And this result was consistent with a study done by G Schueller and C JHarolduniversity of Veina , Austria, radiographics volume.21 no.2 and a study done by PatriziaSeminara*, Gaia Manna, Alessandra Emiliani, Alessandro Iannace and Tania Losanno.(2,18,4).

The colonic ca,ovarian ca,breast ca and osteosarcoma present with calcified metastases pattern. This was consistent with the study done by radiographics vol.21 no.2 and a study G Schueller and C JHarolduniversity of Vienna, Austria. (2, 18).

The breast ca,esophageal ca,gastric ca,bladder ca,cervical ca,oral scc,thyroid ca and colonic cas present in lymphngitis carcinomatosis pattern. There was no included study for comparison of this result. Pleural effusion and lymphadenopathy were seen associated in patients with lymphangitis carcinomatosis pattern.

Solitary nodular pattern was seen 4 % of our cases, which is smaller incidence than a study by JULIE CROW, BSC, MB, BS, MRCPATH,* GERARD SLAVIN, FRCP, FRCPATH, AND LOUISKREEL, MD, FRCP, FRCRS which showed an incidence of 13%.This marked variation might result from late coming of our patients and difference in sample size between the or and their study.(7) The ovarian ca,cervical ca,renal cell ca,and vulvar SCC present with solitary nodule, and this is similar to a study done by G Schueller and C JHarolduniversity of Veina , Austria.(18)

Majority (54%) of patients with pulmonary metastases present with multiple different sized nodular pattern, which is consistent with majority of studies.(2,7).The nodules predominately seen at the lower lobe and outer third, which is consistent with a study done by JULIE CROW, BSC, MB, BS, MRCPATH,* GERARD SLAVIN, FRCP, FRCPATH, AND LOUISKREEL, MD, FRCP, FRCRS.(7).

The majority of the nodules range in size from 5mm to 10mm, which is consistent with most studies. The most commonly associated finding was positive feeding vessel sign and lymphadenopathy in 72.2 and 12.9 percent of cases with multiple and different sized nodular pattern.

The breast ca,thyroid ca,colonic ca,gastric ca,esophageal ca HCC and ovarian ca account for the majority of cases with multiple and different sized nodular pattern.

Majority of nodules moderate in number.

VIII. Strength of the study

1. Clear title with clear inclusion and exclusion criteria
2. It was the first such study conducted in Ethiopia.
3. It was a well-designed study that addresses relevant radiologic issues.

IX. Limitation of the study

1. There was no previous study in this area in our hospital and our country, Ethiopia.
2. Our study had not included the histological diagnosis of the primary cancer.
3. We have not fully functioning oncology center, which might affect distribution of cases.

X. Conclusion

Pulmonary metastases are a major radiological and clinical concern with a substantial risk of morbidity and mortality in Saint Paul millennium medical college. The majority of patients present with either LAC or multiple different sized nodular pattern of metastases. And some specific tumors has specific pulmonary metastatic pattern. So such studies facilitate timely diagnosis and care of oncologic patient.

XI. Recommendation

Our study revealed that characterizing pulmonary metastases in to patterns can increase timely diagnosis of and care of oncologic patient, so we recommend.

1. Further studies should be done to further consolidate such knowledge.
1. It is important to encourage hospital in use of such studies for daily radiologic practice.
2. Efforts should be made to aware oncology department for mutual understanding.
- 3 efforts should be made to include biopsy result at primary and at lung secondary site in coming researchers.

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ANNEXES

Questionnaires'

I. Demographics

1. Age-----
2. Sex---M-----F----
3. Duration of symptoms-----acute..... chronic....
4. Presenting complaint.....cough----- chest pain----- dyspnea-----others specify-----

XIII. chest CT features

Type of primary tumor-----

1. LAC pattern-----yes no-----
2. Multiple nodules (non miliary) pattern -----yes.....no.....if yes number of nodules few scattered.....moderate.....diffuse snow storm.....
3. Multiple nodule (miliary size) patterns-----yes.....no.....
4. Solitary nodule—yes-----no----
5. Margins----smooth-----irregular
6. Positive feeding vessel sign yes.....no.....
7. Predominant Site of involvement (Right lobe, middle lobe, left lobe/ outer third, middle third, inner third)
8. Enhancement----yes with HU -----no-----
9. Calcification in nodule----NO---Yes----
10. Lymphadenopathy---No---YES----
11. Cavitating nodule yes no.....
12. CT halo sign.....Yes.....NO.....
13. Air space pattern.....yes.....no.....
14. Pleural effusion.....yes no..... pleural deposit Yes..... No
15. Size..... <2-3mm.....3mm-5mm.....5mm-10mm.....10mm-3cm....>3cm
16. Pneumothorax yes.....no.....
17. endobronchial metsestases yes.... No....
18. Vascular metastases yes... no....

Tables

APPROVED BY BOARD OF EXAMINERS

This thesis by **Wollelaw Eniyew (MD)** is accepted in its present form by board of examiners in satisfying thesis requirement for the Specialty certificate in Radiology.

EXAMINERS

1. _____

2. _____

FULL NAME

RANK

SIGNATURE

DATE