Original Article

Chest and upper abdominal computed tomography scan findings in patients with established breast cancer

Ifeanyi Emmanuel Obike, Olubukola Abeni Titilayo Omidiji[1], Nicholas Kayode Irurhe[1], Omodele Abosede Olowoyeye[1], Adekunle Olakunle Adeyomoye[1], Ogechi Augustina Ihekuna[2], Olukemi Ololade Odukoya[3]

Departments of Radiography, [1]Radiation Biology, Radiotherapy and Radiodiagnosis and [3]Community Health and Primary Care, Faculty of Clinical Sciences, College of Medicine, University of Lagos, [2]Department of Biochemistry, Faculty of Basic Medical Sciences, College of Medicine, University of Lagos, Lagos, Nigeria

Abstract

Background: Computed tomography (CT) of the chest and/or abdomen is usually done in patients with breast cancer for staging regardless of their grade, size, lymph node, or clinical signs/symptoms in Nigeria. This study aimed to determine the diagnostic yield of chest and upper abdominal CT for metastasis, metastatic pattern, and incidental findings in patients with breast cancer in our environment.

Methodology: A retrospective study of all 300 confirmed breast cancer patients who reported for chest/abdominal computed tomographic scans in a tertiary diagnostic center in Lagos between October 2021 and December 2021. Data were extracted from their CT images/radiological reports and analyzed using SPSS version 23 for Windows, $P < 0.05$.

Results: Three hundred patients with established breast cancer were examined, within the age range of 24–83 years, median of 51 years, and mean of 50.91 ± 11.9 years. The majority were female 298 (99.3%) and within the 50–59-year (101, 33.7%) age group. Most had unilateral breast cancer 286 (95%) with left-sided predominance (146, 49%). Metastasis was seen in 183 (61%) patients with nodes being the most common site 158 (52.7%). Solitary metastasis was seen in 91 (30.3%) of the participants, predominating in the lymph nodes 69 (23%), followed by lungs 17 (5.7%), $P < 0.01$. Two-organ involvement was in 59 (19.7%), and the most common combination was lung and node 32 (10.7%), followed by liver and node 8 (2.7%). Metastasis was most common in the 50–59-year age group, 64 (21.3%).

Conclusion: Chest and abdominal CT yielded a definitive diagnosis of metastasis in more than 50% of the patients. The most common structure affected was the lymph nodes. Chest CT is therefore imperative in patients with late presentation of breast cancer.

Keywords: Breast cancer, computed tomography, diagnosis, imaging, metastases, Nigeria, oncology, staging

Address for correspondence: Dr. Olubukola Abeni Titilayo Omidiji, Department of Radiation Biology, Radiotherapy and Radiodiagnosis, Faculty of Clinical Sciences, College of Medicine, University of Lagos, Lagos, Nigeria.
E-mail: tomidiji@unilag.edu.ng

Submitted: 19-Jun-2023 **Revised:** 06-Apr-2024 **Accepted:** 24-Apr-2024 **Published:** 22-May-2024

INTRODUCTION

Breast cancer is the second-leading cause of death in women and is the most common cancer among Nigerian women.[1] Late presentation is the hallmark of breast cancer in Nigeria and Africa, in spite of the increased awareness

Access this article online	
Quick Response Code:	Website: https://journals.lww.com/wajr
	DOI: 10.4103/wajr.wajr_16_23

How to cite this article: Obike IE, Omidiji OA, Irurhe NK, Olowoyeye OA, Adeyomoye AO, Ihekuna OA, *et al*. Chest and upper abdominal computed tomography scan findings in patients with established breast cancer. West Afr J Radiol 2023;30:14-9.

of the disease, most of the women presenting with Stage IV or advanced disease.[1]

Several imaging modalities are utilized in the diagnosis and management of breast cancer.[2] Traditionally, chest X-ray was used as a screening tool for the detection of metastasis in breast cancer patients, as it was widely available and cheap.[3] It, however, has very low sensitivity.[4] Computed tomography (CT) scans of the chest and abdomen are currently utilized for this purpose.[2,5] CT chest has been shown to be more sensitive and can reliably evaluate the structures in the chest and upper abdomen including but not limited to the lung parenchyma, mediastinum, axial skeleton, lymph nodes, and liver. False-positive rates of up to 14% have, however, been noted.[6] This low specificity poses a significant challenge in its routine use. False-positive results can result in unnecessary further investigations, delay in treatment, and patient anxiety.[7]

Several studies have debated the use of chest CT, especially in newly diagnosed early breast cancer as metastasis is seen in <3% of cases.[8,9] In some countries, CT staging is done based on certain criteria which include tumor size, clinical signs, symptoms, or laboratory values suggesting the presence of metastasis, clinically positive axillary nodes, large tumors, or aggressive biology; however, currently in Nigeria, all patients able to afford the study, regardless of the above are staged. Other studies have also tested the use of CT in other areas, such as assessing the breast tumor size in comparison with pathologic sizes.[10] Incidental findings of breast lesions have also been noted in CT scan of the chest with indications unrelated to breast cancer.[11] Of pertinent note is the fact that CT has adverse complications due to its high ionizing radiation. Breast cancer risk may increase in patients with multiple chest and cardiac CTs.[12] There is a need to ensure that chest CT is necessary for breast cancer patients in our environment.

This study aimed to evaluate the diagnostic yield, metastatic pattern, and incidental findings in chest CT scan of patients with breast cancer in our environment.

METHODOLOGY

Study design

The study was done in accordance with the "Principles of the Helsinki Declaration."

Ethical approval for the study was obtained from the LUTH Health Research Ethics Committee, approval number ADM/DCST/HREC/APP/3317. Informed consent was also obtained from all participants on the inclusion of their data for research.

This was a cross-sectional study of 300 women, referred to a tertiary diagnostic center for chest CT on account of established breast cancer between October 2021 and December 2021. The cases were diagnosed using histology. Data were extracted manually from the CT images and reports. The ages of the participants were recorded. Other pertinent information such as the site of the breast mass, metastasis to structures, and incidental findings were also recorded.

Inclusion and exclusion criteria

All women who presented at the center with histologically diagnosed breast cancer in all stages were included in the study. Exclusion criteria included those without breast cancer, those without histologic confirmation, metastasis from other sites, and those who did not consent to their data being used for research.

Imaging technique

The CT machine is a 256-slice scanner, Aquilion CXL, manufactured by Toshiba Medical Systems in 2012 at Tochigi, Japan.

At our center, all scans are acquired in volumetric mode, with the scans extending from the thoracic inlet to the mid-abdomen. Patients were imaged in the supine position in suspended deep inspiration with arms extended overhead to reduce beam hardening artifact. An intravenous line is secured in the antecubital fossa for contrast administration. The acquired CT images were reconstructed into soft-tissue mediastinal window (20–30 kernel) and lung window (in sharp algorithm, 60–80 kernel) and in 1.2–1.5 mm section thickness for interpretations.

The CT chest protocol included a nonenhanced phase, followed by intravenous injection of iodinated contrast medium (120 mL) at a flow rate of 5 mL/s. Arterial (delay, 30 s) and portal venous (delay, 60s) scans were obtained for optimal enhancement of the soft tissues.

Image analysis

The images were reviewed by two independent radiologists and also correlated with the reports issued. The lungs, pleura, heart and great vessels, hila, and abdominal organs were all assessed for metastatic lesions, such as masses, bone deposits, lymph node enlargement with width >10 mm, liver masses, renal/adrenal masses, ascites, and pleural effusion. The findings were entered into a pro forma.

Statistical analysis

Data were checked for errors and uniformity and analyzed using Microsoft Excel software and IBM SPSS Statistics for Windows, version 23 (IBM Corp., Armonk, N.Y., USA) for windows. Results were presented as frequencies and tables. The Chi-square and *t*-tests were used to assess associations between the key outcomes and categorical and continuous variables, respectively. The level of significance was set at $P < 0.05$.

RESULTS

A total number of 300 participants with established breast cancer who came to the tertiary diagnostic center for chest CT between the period of October 2021 and December 2021 were included in the study. Their ages ranged from 24 to 83 years; mean age was 50.91 ± 11.9 years. The majority of the participants were between ages 50 and 59 years, making up 33.7% of the population and the least in the 20–29-year age group 5 (1.7%) [Table 1]. The majority of the participants were female 298 (99.3%).

Unilateral breast cancer was seen in the majority of the participants 286 (95%) with left-sided predominance 146 (49%) [Figure 1a and b]. Only 14 (5.0%) of the patients presented with bilateral breast cancer [Figure 2].

The majority, 183 (61%), of the participants had metastasis, giving a high diagnostic yield. The age group most affected by metastasis was the 50–59 years of age 64 (33.7%). Least metastasis was seen in the 20–29-year age Group 2 (2.8%) [Table 2]. Metastasis was found in lymph nodes, lungs, liver, and bone.

Out of the 183 participants that had metastasis, the majority, 91 (30.3%), had spread to just a single site ($P < 0.01$), predominating in the regional lymph nodes 69 (23%). The most common structure affected was the lymph nodes 158 (52.7%) and the least is the liver 32 (10.7%) [Table 3].

Multisite involvement was seen in fewer participants – 59 (19.7%) had metastasis in two sites, 21 participants (7.0%) in three sites, and 12 (4.0%) in 4 sites. The most common double site affectation was nodal/lung and nodal/liver at 32 (10.7%) and 8 (2.7%), respectively, as seen in Figure 3. Single to quadruple site metastasis were all most common in the 50–59-year age group [Table 4].

Ancillary findings included pleural effusion in 31 (10.3%), followed by hepatomegaly 10 (4.3%) and ascites (1%).

Incidental findings were found in the participants and they included cardiomegaly (24%) and liver cysts 22 (7.3%) [Table 5].

Table 1: Age-group frequency distribution of participants

Age group	Frequency (%)
20–29	5 (1.7)
30–39	51 (17.0)
40–49	72 (24.0)
50–59	101 (33.7)
60–69	50 (16.7)
70–79	15 (5.0)
80–89	6 (2.0)
Total	300 (100.0)

Table 2: Frequency distribution of presence of metastasis in each age group

Age group	Frequency (%)	
	No metastasis	Metastasis
20–29	3 (2.6)	2 (0.7)
30–39	25 (21.4)	26 (8.7)
40–49	25 (21.4)	47 (15.7)
50–59	37 (31.6)	64 (21.3)
60–69	21 (17.9)	29 (9.7)
70–79	4 (3.4)	11 (3.7)
80–89	2 (1.7)	4 (1.3)
Total	117 (39.0)	183 (61)

Table 3: Structures affected by metastasis and their frequency distribution

Metastasis	Frequency (183; 100%)
Nodal	158 (86.3)
Pulmonary	81 (44.3)
Liver	32 (17.5)
Bone	49 (26.8)

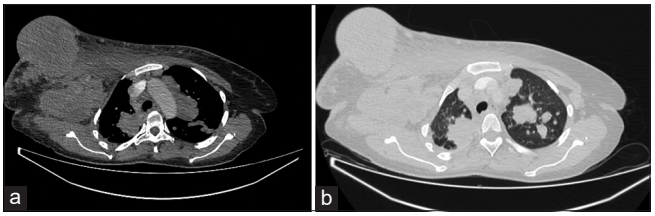

Figure 1: (a and b) Contrast-enhanced computed tomography scan of the upper chest in mediastinal and lung windows shows a right breast mass with an ipsilateral large nodal and lung metastasis

DISCUSSION

Breast cancer is the most common type of cancer in women in Nigeria.[13,14] It has been seen presenting at a younger age in African women than in their Caucasian counterparts.[13] In this study, 300 established breast cancer participants were assessed with ages ranging from 24 to 83 years and a mean age of 50.91 ± 11.9 years. Similar findings were seen in the study of Sharma and Singh with an age range of 23–90 years.[15] Their mean age differed slightly at 44.6 years, likely because they had a larger number of participants. The majority of the participants were between ages 50 and 59 years, making up 34.5% of the population and the least in the 20–29-year age group (1.7%). This is similar to those described in Caucasians with the age range of 55–56 years.

Table 4: The multiplicity of metastatic sites in each age group

Age-group	No metastasis (%)	Solitary site (%)	Double site (%)	Triple site (%)	Quad site (%)	Total (%)
20–29	3 (2.6)	1 (1.1)	1 (1.7)	0	0	5 (1.7)
30–39	25 (21.4)	8 (8.8)	14 (23.7)	3 (14.3)	1 (8.3)	51 (17.0)
40–49	25 (21.4)	23 (25.3)	13 (22.0)	6 (28.6)	5 (41.7)	72 (24.0)
50–59	37 (31.6)	30 (33.0)	22 (37.3)	6 (28.6)	6 (50.0)	101 (33.7)
60–69	21 (17.9)	21 (23.1)	4 (6.8)	4 (19.0)	0	50 (16.7)
70–79	4 (3.4)	5 (5.5)	4 (6.8)	2 (9.5)	0	15 (5.0)
80–89	2 (1.7)	3 (3.3)	1 (1.7)	0	0	6 (2.0)
Total	117 (39.0)	91 (30.3)	59 (19.7)	21 (7.0)	12 (4.0)	300 (100)

Table 5: Ancillary and incidental findings in the study

	Frequency (58; 100%)
Ancillary findings	
Ascites	3 (1.0)
Pleural effusion	31 (10.3)
Hepatomegaly	10 (4.3)
Incidental findings	
Cardiomegaly	24 (8.0)
Renal cysts	7 (2.3)
Liver cysts	22 (7.3)
Uterine myoma	13 (4.3)
Degenerative spine disease	14 (4.7)
Prostatomegaly	1 (0.3)

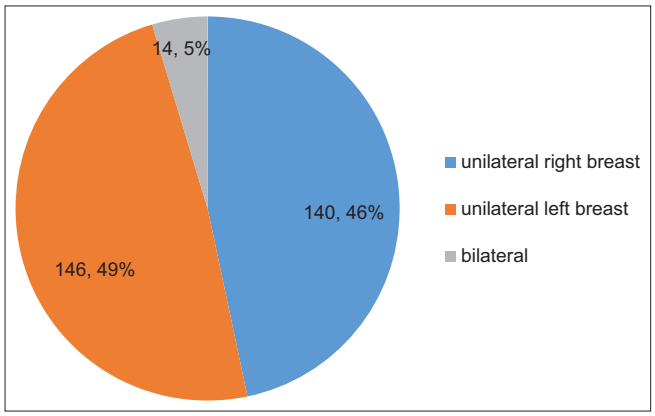

Figure 2: Location of breast mass

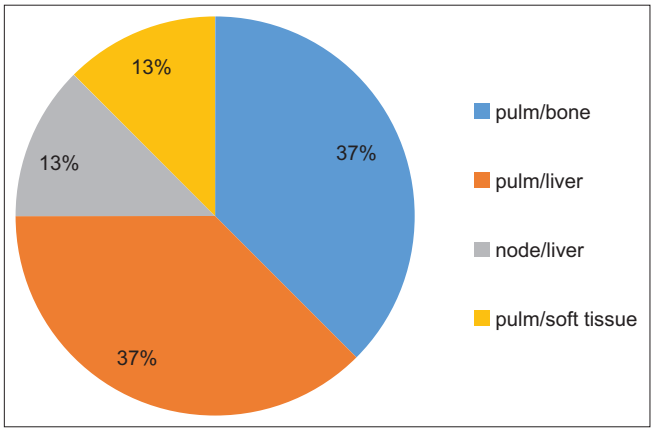

Figure 3: Pie chart showing double metastatic sites

The majority of the participants had unilateral breast cancer (95%). This finding is comparable with those of other studies which document a higher incidence of unilateral breast cancer.[16-19] Unilateral breast cancer was also more common in the left breast similar to findings in other studies.[16-19] Some studies have demonstrated that the unilaterality of breast cancer depends on the country of birth but not age.[20] An Icelandic study also suggested there may be a connection between left-handedness in women and left breast cancer in women <45 years of age.[19]

The age group most affected by metastasis was the 50–59 years of age (36.4%) with few in the 20–29-year age group, similar to findings in Chen *et al*.'s study.[21] A contrary finding was seen in Sharma and Singh who noted that metastasis was more common in patients <40 years.[15] This may be due to the smaller number of patients with metastasis in their study (12 patients) compared with 186 patients in this study. Awareness may also be more in the younger age group in our populace making them present early.

Metastatic lesions were seen in 183 (61%) of the participants, depicting a good diagnostic yield of chest CT in breast cancer (overall yield of 56.9%). This yield is much higher than described in other studies with a significantly higher sample size, in which a diagnostic yield of 1%–4% was documented.[8,22] The high yield may also be due to the late presentation of breast cancer described in our environment.[13] Most of the other studies were also conducted in patients with early breast cancer.

The majority of participants with metastasis had solitary site involvement 91 (30.7%). The sites affected by metastasis were nodes (including both regional and distant), lungs, liver, and bone as seen in other studies. Berman *et al*.[23] and Patanaphan *et al*.[24] also noted solitary site metastasis in the majority of their participants. The pattern of multiplicity of sites was similar to what is described in this study.

The most and least common solitary sites affected in this study were nodal (52.6%) and liver (10.7%), respectively, as opposed to the studies of Berman *et al*.[23] and Patanaphan *et al*.[24] that noted bones as the most common site of metastasis. They also, however, had liver as the least common site. The discrepancy may be due to the fewer

number of participants in this study. Berman *et al*.[23] also did not include nodal metastasis in their findings. James *et al*. also mentioned the lung as the most frequent site, however, in their study nodal metastasis referred to distant sites only, accounting for the contrast to this study.[22] According to Kutomi *et al*., CT is useful at predicting nodal metastasis using size (>10 mm), shape, and presence of central fat determined using Hounsfield units of the region of interest.[25]

Multiple site affectation has also been described in the middle-aged population in other studies.[15,21] Most common multiple metastatic combination in this study was nodal/lung followed by node/liver. This was seen more commonly in patients older than 40 years, in line with what was described in Chen *et al*.'s population-based analysis on comparison of patterns and prognosis among distant metastatic breast cancer patients.[21] Multiple metastatic sites are often associated with a poorer prognosis, compared with single-site metastasis.

Very few of the participants had ancillary metastatic findings, which included pleural effusion 31 (10.3%). Malignant pleural effusion is a common finding in cancers and affects 15% of all patients with cancer,[26] within the range obtained in this study. The difference in prevalence may be because only one type of cancer is discussed in this study.

Incidental radiologic findings are common in clinical practice and research and are findings not directly related to the specific pathology being assessed.[27] The predominant incidental finding in this study was cardiomegaly 5 (8.6%). Cardiac pathologies have been described in breast cancer patients, both pre- and posttherapy. This is because radiation, and other treatments can cause rigidity of cardiac tissue with resultant cardiac problems such as hypertension and myocardial ischemia.[28] Some of the patients may have had preexisting hypertension. Other incidental findings include hepatic cysts.

The appropriateness of CT staging in Stage 1 and 2 cancers has been discussed in literature, some studies state that there is a clear lack of evidence for the use of CT in asymptomatic individuals.[9] At present in our environment, both asymptomatic and symptomatic patients are screened and followed up annually with posttreatment CTs.

Limitation

This study was limited to a tertiary diagnostic center which may also skew the findings. Limited clinical information such as the clinical stage of breast cancer was also not available.

CONCLUSION

This study showed that chest and abdomen CT scans have a high diagnostic yield in metastasis of breast cancer in our environment. The pattern in which the cancer spread from the primary site to other sites was assessed, having nodes (both regional and distal) as the most common affected site of metastasis. The most frequent metastatic combination was seen in nodal and lung. The predominant incidental finding was cardiomegaly.

Recommendations for future research

A multi-institutional study involving a much larger number of participants on CT in the detection of metastasis in breast cancer patients is recommended.

Studies regarding its use in asymptomatic and early-stage breast cancer in our environment.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Jedy-Agba EE, Dos-Santos-Silva I, Olaomi O, Yilkudi M, Ezeome E, Idris S. Delays in breast cancer presentation and diagnosis in Nigeria. J Clin Oncol 2016;34:15 Suppl: e13092. Available from: https://www.ascopubs.org/doi/abs/10.1200/JCO.2016.34.15_suppl.e13092. [Last accessed on 2020 Apr 24].
2. Barrett T, Bowden DJ, Greenberg DC, Brown CH, Wishart GC, Britton PD. Radiological staging in breast cancer: Which asymptomatic patients to image and how. Br J Cancer 2009;101:1522-8.
3. Ravaioli A, Pasini G, Polselli A, Papi M, Tassinari D, Arcangeli V, *et al*. Staging of breast cancer: New recommended standard procedure. Breast Cancer Res Treat 2002;72:53-60.
4. Ciatto S, Pacini P, Azzini V, Neri A, Jannini A, Gosso P, *et al*. Preoperative staging of primary breast cancer. A multicentric study. Cancer 1988;61:1038-40.
5. Crivello ML, Ruth K, Sigurdson ER, Egleston BL, Evers K, Wong YN, *et al*. Advanced imaging modalities in early stage breast cancer: Preoperative use in the United States Medicare population. Ann Surg Oncol 2013;20:102-10.
6. Kim H, Han W, Moon HG, Min J, Ahn SK, Kim TY, *et al*. The value of preoperative staging chest computed tomography to detect asymptomatic lung and liver metastasis in patients with primary breast carcinoma. Breast Cancer Res Treat 2011;126:637-41.
7. Gerber B, Seitz E, Müller H, Krause A, Reimer T, Kundt G, *et al*. Perioperative screening for metastatic disease is not indicated in patients with primary breast cancer and no clinical signs of tumor spread. Breast Cancer Res Treat 2003;82:29-37.
8. James J, Teo M, Ramachandran V, Law M, Stoney D, Cheng M. A critical review of the chest CT scans performed to detect asymptomatic synchronous metastasis in new and recurrent breast cancers. World J

Surg Oncol 2019;17:40.
9. Dull B, Linkugel A, Margenthaler JA, Cyr AE. Overuse of chest CT in patients with stage I and II breast cancer: An opportunity to increase guidelines compliance at an NCCN member institution. J Natl Compr Canc Netw 2017;15:783-9.
10. Ahn SJ, Kim YS, Kim EY, Park HK, Cho EK, Kim YK, *et al*. The value of chest CT for prediction of breast tumor size: Comparison with pathology measurement. World J Surg Oncol 2013;11:130.
11. Son JH, Jung HK, Song JW, Baek HJ, Doo KW, Kim W, *et al*. Incidentally detected breast lesions on chest CT with US correlation: A pictorial essay. Diagn Interv Radiol 2016;22:514-8.
12. Smith-Bindman R. Environmental causes of breast cancer and radiation from medical imaging: Findings from the institute of medicine report. Arch Intern Med 2012;172:1023-7.
13. Omidiji OA, Campbell PC, Irurhe NK, Atalabi OM, Toyobo OO. Breast cancer screening in a resource poor country: Ultrasound versus mammography. Ghana Med J 2017;51:6-12.
14. Olubunmi Obajimi M, Adeniji-Sofoluwe AT, Adeoye AO, Obajimi GO, Ajani MA, Adejumo PO, *et al*. Bilateral breast cancer among three Yoruba women in a Nigerian teaching hospital. BJR Case Rep 2015;1:1-6.
15. Sharma D, Singh G. Breast cancer in young women: A retrospective study from tertiary care center of North India. South Asian J Cancer 2017;6:51-3.
16. Perkins CI, Hotes J, Kohler BA, Howe HL. Association between breast cancer laterality and tumor location, United States, 1994-1998. Cancer Causes Control 2004;15:637-45.
17. Weiss HA, Devesa SS, Brinton LA. Laterality of breast cancer in the United States. Cancer Causes Control 1996;7:539-43.
18. Roychoudhuri R, Putcha V, Møller H. Cancer and laterality: A study of the five major paired organs (UK). Cancer Causes Control 2006;17:655-62.
19. Tulinius H, Sigvaldason H, Olafsdóttir G. Left and right sided breast cancer. Pathol Res Pract 1990;186:92-4.
20. Sughrue T, Brody JP. Breast tumor laterality in the United States depends upon the country of birth, but not race. PLoS One 2014;9:e103313.
21. Chen MT, Sun HF, Zhao Y, Fu WY, Yang LP, Gao SP, *et al*. Comparison of patterns and prognosis among distant metastatic breast cancer patients by age groups: A SEER population-based analysis. Sci Rep 2017;7:9254.
22. James J, Teo M, Ramachandran V, Law M, Stoney D, Cheng M. Performance of CT scan of abdomen and pelvis in detecting asymptomatic synchronous metastasis in breast cancer. Int J Surg 2017;46:164-9.
23. Berman AT, Thukral AD, Hwang WT, Solin LJ, Vapiwala N. Incidence and patterns of distant metastases for patients with early-stage breast cancer after breast conservation treatment. Clin Breast Cancer 2013;13:88-94.
24. Patanaphan V, Salazar OM, Risco R. Breast cancer: Metastatic patterns and their prognosis. South Med J 1988;81:1109-12.
25. Kutomi G, Ohmura T, Satomi F, Takamaru T, Shima H, Suzuki Y, *et al*. Lymph node shape in computed tomography imaging as a predictor for axillary lymph node metastasis in patients with breast cancer. Exp Ther Med 2014;8:681-5.
26. Skok K, Hladnik G, Grm A, Crnjac A. Malignant pleural effusion and its current management: A review. Medicina (Kaunas) 2019;55:490.
27. Incidental Findings. American College of Radiology. Available from: https://www.acr.org/clinical-resources/incidental-findings. [Last accessed on 2020 Apr 24].
28. Mehta LS, Watson KE, Barac A, Beckie TM, Bittner V, Cruz-Flores S, *et al*. Cardiovascular disease and breast cancer: Where these entities intersect: A scientific statement from the American Heart Association. Circulation 2018;137:e30-66.