

Evaluation role of imaging studies in the staging of breast cancer

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Abstract

Background: Breast cancer (BC) is ranked as the second most common cancer in the US, while it is the 2nd cause of death from cancer among women. Early screening mammography and enhanced management have been thought to result in a steady decline in the death rates from breast cancer since the late 1980s. **Objectives:** Therefore, in this paper, we will review the proper literature discussing the role of medical imaging professionals in the breast cancer staging. This review will discuss the AJCC TNM staging approach in the context of radiology settings. **Methodology:** We conducted the literature search within the PubMed database using the keywords: “Breast” and “Cancer” and “Radiology” and “Ultrasound” “Computed Tomography” and “Magnetic Resonance Imaging” and “Staging”. **Review:** Screening plays an important part in the identification of early-stage breast cancer. Screening mammography is the preferred way of screening such patients who present asymptotically while a diagnostic one is preferred in symptomatic women. Nodal biopsies taken under the guidance of the US are gradually integrated into breast cancer staging prior to surgical intervention. **Conclusion:** In conclusion, the role of radiologists in breast cancer staging has gained importance over time. Their role in breast cancer management has evolved from simply a diagnostic role to more insightful information providing a role that hugely affects the course of staging and treatment.

Keywords: Breast; Cancer; Magnetic Resonance Imaging; Computed Tomography; Ultrasound; Radiology; Staging.

INTRODUCTION

Health is an important factor in life [1]. Breast cancer (BC) is ranked as the 2nd prevalent cancer in the US, while it is the 2nd cause of death from cancer among women [2]. Cancer is one of the major causes of death worldwide [3-5]. Early screening mammography and enhanced management have been thought to result in a steady decline in the death rates from breast cancer since the late 1980s. American women have a one-in-eight lifetime risk of getting a BC diagnosis [6, 7].

Presently, BC staging plays a pivotal role in prognosis and management. The stage is by far the most important predictor of the management approach. For example, the choice between a conservative or invasive (i.e. mastectomy) approach depends greatly on the BC stage. Similarly, the addition of preoperative and postoperative chemotherapy also depends on the stage [8].

Reports show that increased survival and decreased cancer-related mortality are possible in women with smaller primary cancers at the time of their diagnosis, hence the importance of early detection [9].

The rapid technological advances in radiology have prioritized the role of medical imaging in BC staging. Therefore, in this paper, we will review the proper literature discussing the role of medical imaging professionals in the staging of breast cancer. This review will discuss the American Joint Committee on Cancer (AJCC) tumor-node-metastasis (TNM) staging approach in the context of radiology settings.

METHODOLOGY:

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We conducted the literature search within the PubMed database using the keywords: “Breast” and “Cancer” and “Radiology” and “Ultrasound” “Computed Tomography” and “Magnetic Resonance Imaging” and “Staging” and with dates from 1990 to 2020. We also used the Google Scholar database for additional literature search. After reading the abstracts, we manually selected the relevant papers for this review. The articles were selected based on the inclusion of one of the following topics; breast cancer and radiology. Exclusion criteria were all other articles that did not have one of these topics as their primary endpoint.

REVIEW: Overview

The TNM staging is a systematic approach for cancer evaluation used by clinicians following physical and radiologic examinations. It includes physical (i.e. size) information about the tumor (T), lymphatic involvement (N), and information about the spread of the tumor (M). Table 1 summarizes the preoperative staging performed with the AJCC’s TNM staging system for breast cancer [10]. As radiologists play an integral role in this loop, their knowledge of the TNM is important to deliver a clear and contextually valid report [8].

Generally, screening plays an important part in the identification of early-stage breast cancer. Screening mammography is the preferred way of screening such patients who present asymptotically while a diagnostic one is preferred in symptomatic women [8].

With respect to Ultrasound, it is usually utilized as a tool for diagnosis. However, screening applications of the US are now becoming acceptable. For contrast-MRIs, they remain second-line tools for improving staging. Lastly, CT scans, scintigraphic bone scans, and positron emission tomography (PET) scans are reserved for patients with a high risk of metastasis [8].

TNM Staging: Tumor:

As mentioned earlier, tumor (T) refers to the size of the tumor and its level of local invasion to local structure (e.g. chest wall, nipple, and skin). Table 2 gives an overview of the different classifications for the tumor. The tumor dimensions are measured on three different axes, while the largest measurement is used for staging.

Radiologically, contrast MRI has shown significant superiority in identifying cancerous foci that undetectable by physical exams. A meta-analysis demonstrated that MRI aided in the identification of additional disease in approximately 20% of patients [11, 12]. Despite its superiority, the standardization of MRI remains controversial because of the uncertainty of its impact on survival [7].

Radiologists must pay attention to the examination of the unaffected, contralateral breast as the rate of another lesion in the contralateral breast is increased among women with a primary tumor [13, 14].

Node:

Lymph node draining the breast tissues should be adequately assessed for the purpose of staging and ultimately management. This assessment relay on the presence of physical findings (e.g. size, fixation, position) and radiologic findings (e.g. size).

Nodal biopsies taken under the guidance of the US are gradually integrated into breast cancer staging prior to surgical intervention [15]. Despite its ability to identify lymphatic node involvement that is undetectable clinically, US usage prior to surgical intervention remains debatable. An overview of the different classifications for Nodes (N) is shown in Table 2.

Metastasis:

Out of all the TNM staging compartments, metastasis (M) remains the simplest to report. It is designated an (M1) status if any evidence of distant disease is observed. Although the simplest to report, it is the most devastating aspect as the presence of any metastatic lesions renders the overall stage as a terminal IV stage. Only one-fifth of cases with a stage IV diagnosis are expected to survive to 5 years [7].

A battery of radiological screening tests is offered for women with an increased risk of metastatic disease. For instance, chest x-rays, abdominal US, scintigraphic bone scan, CT scans, MRI scans, and PET scans can all be done. Such modalities are indicated in the case of symptomatic patients and asymptomatic patients with stage IIIA or higher disease, according to the National Comprehensive Cancer Network. [16]

Breast imaging-reporting and data system (BI-RADS)

The BI-RADS is a tool that is improvised by the American College of Radiology. BI-RADS acts as a quality assurance tool for risk assessment for imaging of the breast. Its applications include mammography, ultrasound, and MRI. A breast radiological examination is assigned to one of the seven available assessment categories [17, 18]. Different categories that can be assigned are shown in Table 3.

BI-RADS categories 1 and 2 are by far the most commonly assigned category for screening mammograms while a suspicious finding in a screening mammogram should be assigned a BI-RADS 0 to reflect the need for further workup (i.e. diagnosis, evaluation, additional studies). [19]

CONCLUSION:

In conclusion, radiologists’ role in breast cancer staging has gained importance over time. Radiologists’ role in breast

cancer management has evolved from simply a diagnostic role to more insightful information providing role that hugely affects the course of staging and treatments. Radiologists need to be aware of their vital role, which will allow them to report more useful insight to physicians' management, thereby enhancing the quality of care.

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Table 1. Description of breast cancer staging.

Stage	Description
Noninvasive	
0	No evidence of tumor cells or invasion of the basement membrane of the duct or neighboring normal tissue; includes in situ ductal carcinoma.
Invasive	
IA	<ul style="list-style-type: none"> • Tumor < 2 cm AND • No spread outside the breast; no lymph nodes involved
IB	<ul style="list-style-type: none"> • No tumor in the breast, but microscopic metastases (> 0.2 mm but ≤ 2 mm) present in axillary lymph nodes OR • Tumor present in the breast, ≤ 2 cm, with the involvement of lymph nodes
IIA	<ul style="list-style-type: none"> • No tumor in the breast, but macroscopic cancer (> 2 mm) in 1-3 axillary lymph nodes OR • Tumor ≤ 2 cm, with spread to axillary lymph nodes OR • Tumor > 2 cm but ≤ 5 cm, with no spread to axillary lymph nodes
IIB	<ul style="list-style-type: none"> • Tumor > 2 cm but ≤ 5 cm, with spread to 1-3 axillary lymph nodes OR • Tumor > 5 cm, with no spread to axillary lymph nodes
IIIA	<ul style="list-style-type: none"> • No tumor in the breast or presence of a breast tumor of any size associated with metastases in 4-9 axillary lymph nodes or in internal mammary nodes OR • Tumor > 5 cm, with spread to axillary and/or internal mammary nodes
IIIB	<ul style="list-style-type: none"> • Tumor of any size, with spread to the chest wall and/or skin of the breast; may also have spread to axillary or internal mammary nodes
IIIC	<ul style="list-style-type: none"> • Tumor of any size, with spread to 2-10 axillary lymph nodes OR • Spread to lymph nodes above or below the collarbone (supraclavicular nodes) OR • Spread to both axillary lymph nodes and internal mammary nodes
Metastatic	
IV	Spread of cancer to other parts of the body such as liver, lung or bone

Table 2. AJCC TNM Staging System for Breast Cancer (7th Edition).

Stage	Descriptor		
	Tumor	Node	Metastasis
0	Tis	N0	M0
IA	T1*	N0	M0
IB	T0	N1 mi	M0
	T1*	N1 mi	M0
IIA	T0	N1 **	M0
	T1*	N1 **	M0
IIB	T2	N0	M0
	T2	N1	M0
	T3	N0	M0
IIIA	T0	N2	M0
	T1*	N2	M0
	T2	N2	M0
	T3	N1	M0
	T3	N2	M0

	T4	N0	M0
IIIB	T4	N1	M0
	T4	N2	M0
IIIC	Any T	N3	M0
IV	Any T	Any N	M1

Source: American Joint Committee on Cancer. Breast. In: Edge SB, Byrd DR, Compton CC, et al., eds. *AJCC cancer staging manual*. 7th ed. New York, NY: Springer, 2010; 347–376.

*Includes T1mi (microinvasion).

**T0 and T1 tumors with nodal micro-metastases only are excluded from stage IIA and are classified as stage IB disease.

Table 3. BI-RADS mammographic assessment categories.

Assessment category	Recommendation	Possibility of malignancy
0: Incomplete	Need for further evaluations	Not applicable
1: Normal	Normal interval follow-ups	0 %
2: Benign	Normal interval follow-ups	0 %
3: Probably benign A short interval	follow-up is recommended	<2 %
4: Suspicious abnormality	A biopsy should be considered	22 to <95 %
5: Highly suggestive of malignancy	Biopsy or surgery should be performed	≥95 %
6: Biopsy-proven carcinoma	Appropriate action should be taken	--

BI-RADS: Breast Imaging Reporting and Data System. Source: *Breast Imaging Reporting and Data System (BI-RADS) Atlas. 4th Edition*. American College of Radiology, Reston, VA, 2003.