



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم



MONA MAGHRABY



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم



شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلم



MONA MAGHRABY



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



MONA MAGHRABY



“Dynamic Contrast-Enhanced Breast MRI for Evaluating Residual Tumor Size after Neo- adjuvant Chemotherapy”

Thesis

*Submitted for Partial Fulfillment of the Master Degree
in Radiodiagnosis*

Presented by

Mahmoud Mohamed Anas Abdul Salam
M.B.B.Ch, Ain Shams University

Under Supervision of

Prof. Dr. Sherine Kadry Amin
*Professor of Radiodiagnosis
Faculty of Medicine – Ain Shams University*

Dr. Ahmed Mohamed Samy El Shimy
*Lecturer of Radiodiagnosis
Faculty of Medicine – Ain Shams University*

Faculty of Medicine - Ain Shams University
2020

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قَالَ

سُبْحَانَكَ لَا عِلْمَ لَنَا
إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ
الْعَلِيمُ الْعَظِيمُ

صدقة الله العظيم

سورة البقرة الآية: ٣٢

Acknowledgments

*First and foremost, I feel always indebted to **Allah** the Most Beneficent and Merciful.*

*My deepest gratitude for my supervisor, **Prof. Dr. Sherine Kadry Amin**, Professor of Radiodiagnosis, Faculty of Medicine, Ain Shams University, for her valuable guidance and expert supervision, in addition to her great deal of support.*

*I must express my deepest thanks to **Dr. Ahmed Mohamed Samy**, Lecturer of Radiodiagnosis, Faculty of Medicine, Ain Shams University, for guiding me throughout this work and for granting me much of his time.*

I would like to express my hearty thanks to all my family for their support till this work was completed.

Mahmoud Anas

List of Contents

Title	Page No.
List of Tables.....	5
List of Figures	6
List of Abbreviations.....	8
Abstract	9
Introduction	- 1 -
Aim of the Work	12
Review of Literature	
▪ MRI Anatomy of the Breast	13
▪ Pathology of Breast Cancer.....	23
▪ MRI Appearance of Breast Cancer	35
▪ Role of Neoadjuvant Chemotherapy in Treatment of Breast Cancer	50
Patients and Methods.....	58
Results.....	63
Illustrative Cases.....	75
Discussion	82
Summary and Conclusion	88
References	90
Arabic Summary	

List of Tables

Table No.	Title	Page No.
Table 1:	Histologic types of invasive breast cancer: characteristics and clinical significance	24
Table 2:	5-year relative survival rates for breast cancer	34
Table 3:	Breast lesions signal on T2-fatsat.....	39
Table 4:	Efficacy of neoadjuvant chemotherapy in comparison to adjuvant chemotherapy	56
Table 5:	Age incidence	63
Table 6:	Incidence of operation type.....	66
Table 7:	Tumor enhancement criteria on MRI	67
Table 8:	Tumor morphological criteria on MRI	68
Table 9:	Tumors Sizes at MRI Phases Vs Histopathology	69
Table 10:	Agreement between Residual Tumor Sizes at MRI and Histopathologic Examination	71
Table 11:	Factors affecting residual tumor size discrepancy between early phase and delayed phase MRI	73

List of Figures

Fig. No.	Title	Page No.
Fig. 1:	Schematic of sagittal views of the breast.....	20
Fig. 2:	T2 TSE MRI shows anatomy of breast parenchyma.....	20
Fig. 3:	MIP DMRI. Shows a. Lateral thoracic vessels and their branches [arrow]. b. internal thoracic artery and its perforating branches[arrow].	21
Fig. 4:	Schematic of breast venous drainage.....	21
Fig. 5:	Schematic of breast axillary lymph nodes	22
Fig. 6:	T2 TSE and STIR MRI show normal lymph nodes [arrows].	22
Fig. 7:	Axial CE subtracted MRI shows speculated NME proved to be ILC.	40
Fig. 8:	Axial CE subtracted MRI shows speculated NME proved to be ILC.....	40
Fig. 9:	Type 1 curve with a slow rise and a continued rise.	43
Fig. 10:	Axial DCE MRI shows an enhancing mass in the left breast proved to be an invasive carcinoma	47
Fig. 11:	Axial CE subtracted MRI on the left is an invasive ductal carcinoma presenting as a large, heterogeneously enhancing mass (arrow).....	47
Fig. 12:	Sagittal CE subtracted MRI shows multicentric solid nodules with irregular contours and various sizes proved to be ILC.....	48
Fig. 13:	Fat-saturated T2-W sagittal MRI shows mucinous carcinoma presented as hyperintense lobulated mass (arrow) in inferior quadrant of right breast.....	48
Fig. 14:	CE subtracted axial MRI shows intracystic papillary carcinoma presenting as soft tissue vegetation in a thick-walled cystic lesion.....	49
Fig. 15:	Shows role of NAC in locally advanced cancer	54

List of Figures cont...

Fig. No.	Title	Page No.
Fig. 16:	Chemotherapy regimen	64
Fig. 17:	Histologic type	64
Fig. 18:	Tumor histologic criteria	65
Fig. 19:	Lesion criteria on MRI	68
Fig. 20:	MRI diagnostic accuracy.....	70
Fig. 21:	Factors affecting size discrepancy between early and late phases.....	74
Fig. 22:	Axial T1 subtracted DCE-MRI showed lesion size was 9 mm on early phase (image A) and 15 mm on late phase (image B).	76
Fig. 23:	Axial T1 subtracted DCE-MRI showed 9 mm focus on late phase (image A) that was not evident on early phase (image B).	77
Fig. 24:	Axial T1 subtracted DCE-MRI showed area of NME 10.5 x 4.5 cm on late phase (image B) that was not evident on early phase (image A).....	78
Fig. 25:	Axial T1 subtracted DCE-MRI showed an enhancing area 2x1 cm adjacent to surgical clips on early phase (image A) that was not evident on late phase (image B).....	79
Fig. 26:	Axial T1 subtracted DCE-MRI showed well defined mass lesion 2.2 cm on late phase (image B) and 1.9 cm on early phase (image A).....	80
Fig. 27:	Axial T1 subtracted DCE-MRI showed irregular mass lesion 3 cm on late phase (image B) and 2 cm on early phase (image A).....	81

List of Abbreviations

Abb.	Full term
<i>AJCC</i>	<i>American Joint Committee on Cancer</i>
<i>BCS</i>	<i>Breast Conserving Surgery</i>
<i>BIRADS</i>	<i>Breast Imaging-Reporting And Data System</i>
<i>CAD</i>	<i>Computer Aided Diagnosis</i>
<i>DCE</i>	<i>Dynamic Contrast Enhanced</i>
<i>DCIS</i>	<i>Ductal Carcinoma Insitu</i>
<i>ICC</i>	<i>Interclass Correlation Coefficient</i>
<i>IDS</i>	<i>Invasive Ductal Carcinoma</i>
<i>ILC</i>	<i>Invasive Lobular Carcinoma</i>
<i>MRI</i>	<i>Magnetic Resonance Imaging</i>
<i>MRM</i>	<i>Modified Radical Mastectomy</i>
<i>NAC</i>	<i>Neo-adjuvant Chemotherapy</i>
<i>NCI</i>	<i>National Cancer Institute</i>
<i>NME</i>	<i>Non-mass Enhancement</i>
<i>NPV</i>	<i>Negative Predictive Value</i>
<i>pCR</i>	<i>Pathologic Complete Response</i>
<i>PPV</i>	<i>Positive Predictive Value</i>
<i>SD</i>	<i>Standard Deviation</i>
<i>SEER</i>	<i>Surveillance, Epidemiology, and End Results</i>
<i>TDLU</i>	<i>Terminal Ductal- Lobular Unit</i>
<i>WLE</i>	<i>Wide Local Excision</i>

Abstract

Purpose: to investigate the accuracy of dynamic contrast material-enhanced (DCE) breast MRI for determining residual tumor size after neoadjuvant chemotherapy (NAC) and detect the value of measuring residual size in delayed phase compared to early phase.

Methods: The study included twenty female patients who are newly diagnosed breast cancers after completion of NAC referred from surgical oncologists to radiodiagnosis departments of Ain Shams University and Nasser institute hospitals. Each patient was subjected to full history, reviewing medical sheet and dynamic contrast enhanced MRI using 1.5 T unit (GE). Protocol consisted of a sagittal T2-weighted fat-suppressed fast spin-echo sequence and an axial T1-weighted fat-suppressed fast spoiled gradient-echo sequence with one pre-contrast and five post contrast dynamic series at 90, 180 240, 300, 360 seconds after beginning the intravenous administration of gadobutrol. Residual tumor size at early and late phase MRI was compared to postoperative histopathology.

Results: DCE-MRI after NAC underestimation rate was found to be about 50 % Vs 15 % overestimation rate. 51 % NPV Vs 93 % PPV was reported. Delayed phase better correlated with postsurgical histopathological size than early phase.

Conclusion: DCE-MRI has lower accuracy when performed after NAC. It tends to underestimate residual tumor size. Delayed phase is more accurate than early phase in evaluating residual tumor size.

Keywords: Dynamic Contrast-Enhanced, Breast MRI, Neo-adjuvant Chemotherapy

INTRODUCTION

Breast cancer is the most commonly occurring cancer in women and one of the most important causes of death. 1.67 million new cases of breast cancer were identified worldwide, accounting for 25% of all cancers. The incidence and mortality rates of breast cancer is rising. Patient survival rates depend on both early diagnosis and improved treatment modalities including surgery, radiotherapy and chemotherapy (*Momenimovahed and Salehiniya, 2019*).

Neoadjuvant chemotherapy (NAC) has a well-established role in the management of breast cancer. It increases rates of breast-conserving therapy compared with post-operative chemotherapy and may minimize the need for aggressive nodal surgery with axillary lymph node dissection (*Pilewskie and Morrow, 2017*).

The underestimation of residual tumor sizes after NAC can result in positive resection margins and the necessity of re-excisions or even conversions to mastectomies, with the increased risk of subsequent in-breast tumor recurrences, so the accurate assessment of residual tumor size after NAC is crucial for planning the necessary surgical extent, as well as for monitoring the response to NAC (*Hyton, 2018*).

The immediate goal of MRI after NAC is to provide information on the extent of residual disease in the breast to

enable surgeons to obtain adequate surgical margins at initial surgery and avoid re-excision, yet MRI accuracy when performed after NAC is lower (*Mann et al., 2019*).

At preoperative MRI in patients with breast cancer who do not undergo NAC, tumor size is assessed in the early phase to maximize the contrast of the tumor to the background parenchyma. However, the rate of enhancement of residual cancer after NAC might be delayed because of the antiangiogenic effects of chemotherapy (*Santamaria et al., 2017*).

So, *Kim et al. (2018)* suggested that the lesion size at delayed-phase MRI more accurately reflected the residual tumor size and thus, the current standard practice of assessing size in the early phase may not be adequate following NAC, and the delayed phase should be considered in determining the extent of surgery.

AIM OF THE WORK

To investigate the accuracy of dynamic contrast material–enhanced (DCE) breast MRI for determining residual tumor size after neoadjuvant chemotherapy (NAC) and detect the value of measuring residual size in delayed phase compared to early phase.