

## **Invasive Carcinoma of the Breasts - Magnetic Resonance Imaging (MRI) Features**

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## **METHODOLOGY**

- January 2001 till December 2002
- 1.0 T Signa Horizon LX (General Electric Medical System)
- Department of Radiology, Hospital Universiti Sains Malaysia, Kelantan

## **INCLUSION CRITERIA**

- All patients had their breast MRI studies performed in HUSM.
- All patients diagnosed with invasive breast carcinoma confirmed by histopathological examinations.
- All patients had definitive local treatment of mastectomy or lumpectomy.

## **EXCLUSION CRITERIA**

- Patients with contraindications to MRI examination
- Patients who refused surgical intervention
- Patients with a breast lesion not diagnosed as breast cancer

## **IMAGING PROTOCOL**

- Patients were imaged in the prone position
- Standard dedicated bilateral breast coils
- An intravenous cannula with a long line was inserted before imaging
- Pre contrast images obtained
- Rapid bolus Gadolinium 0.1 mmol/kg body weight manual injection over 10 s followed by 10 ml saline flush
- Dynamic scans obtained

## **PRE-CONTRAST VIEW**

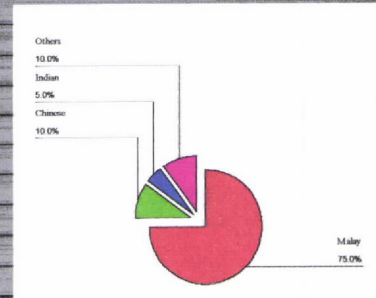
- Axial, coronal and sagittal images of both breasts
- Sagittal T1-weighted fast spin-echo [TR/TE, 500-600/10-11 milliseconds, flip angle 90°]
- Sagittal T2-weighted fast spin-echo [TR/TE, 3500-4300/99-102 milliseconds, flip angle 90°]
- Axial T1-weighted fast spin-echo [TR/TE, 500-600/10-11 milliseconds, flip angle of 90°]
- Axial STIR [TR/TE, 4000-6000/12-13 milliseconds, flip angle 90°]



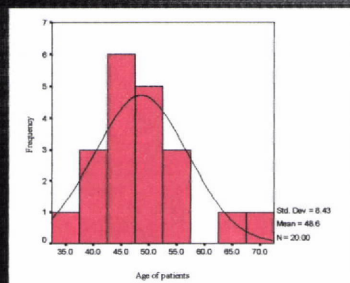
## POST CONTRAST IMAGES

- Dynamic scans
  - 2D T1-weighted, fast, spoiled gradient (SPGR) [TR/TE of 125/3milliseconds and 90° flip angle]
  - Sequential multisession images were obtained at 20-seconds intervals for 6 minutes.
- Delayed images
  - Sagittal
  - Axial
  - fat suppressed T1-weighted fast spin echo [TR/TE, 600/15milliseconds, flip angle 90°]

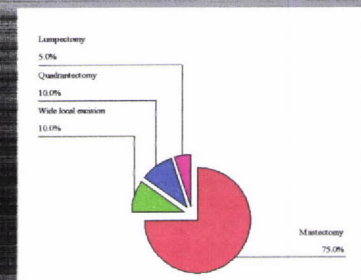
## Patients With Invasive Breast Carcinoma n = 20



## AGE DISTRIBUTION



## n = 20 patients surgical intervention



## Types of Breast Carcinoma

HISTOLOGY FINDINGS	No. of patients
Invasive carcinoma	
Ductal (not otherwise specified NOS)	15
Mucinous	1
Invasive ductal with in situ component	3
Invasive lobular with in situ component	1
<b>TOTAL</b>	<b>20</b>

## HISTOLOGICAL GRADE

Histology findings	No. of patients
Invasive ductal carcinoma	
Grade 1	4
Grade 2	8
Grade 3	9
<b>TOTAL</b>	<b>18</b>



## Morphology

### • Lesion margins

#### – Clarity

- Well defined (>50% circumference visible)
- Ill defined (<50% lesion clearly visible)

#### – Contour

- Regular
- Irregular
- Spiculated
- Lobulated

## MRI margin clarity of invasive ductal carcinoma of the breasts

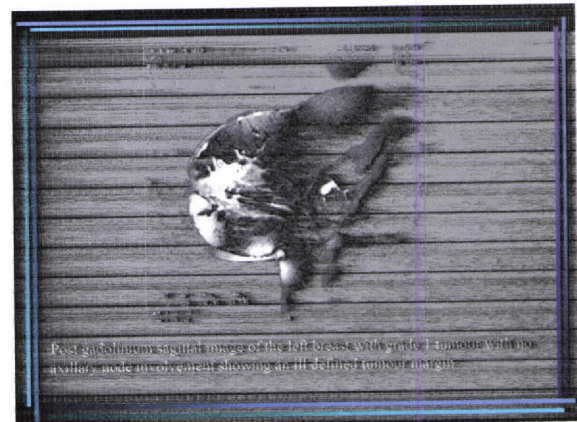
		Well defined	Ill defined	Total	P value
Histology and grading	Grade 1	2	2	4	0.400
	Grade 2	3	2	5	
	Grade 3	3	1	4	0.400
	Grade 3	3	1	4	
TOTAL		10	8	18	

Conclusion: No significant correlation between margin clarity on MRI for the different types of grades

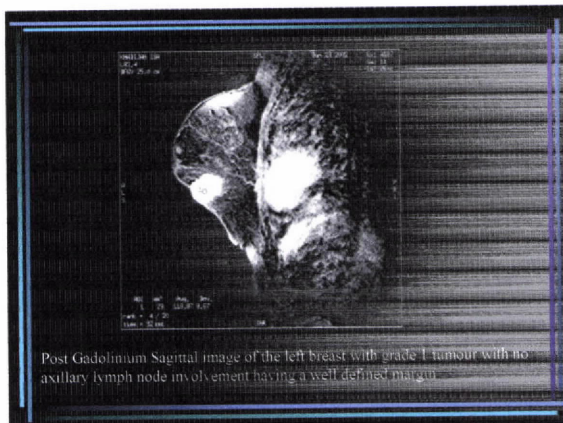
## MARGIN CONTOUR

	Well defined	Ill defined	Total	P value
Histology and grading	Grade 1	2	2	0.400
	Grade 2	3	2	
	Grade 3	3	1	0.400
	Grade 3	3	1	
TOTAL		10	8	

Conclusion: Contour characteristics did not produce significant difference for the various histological grades in invasive ductal carcinoma in 18 patients



Post-gadolinium sagittal image of the left breast with grade 1 tumour with no axillary node involvement showing a well defined tumour margin



Post Gadolinium Sagittal image of the left breast with grade 1 tumour with no axillary lymph node involvement having a well defined margin

## LYMPH NODES SAMPLING

### • Axillary nodes sampling

- n = 18 patients
- 54.5%(n=12) positive for metastases
- 27.3%(n=6) negative

### • No axillary sampling

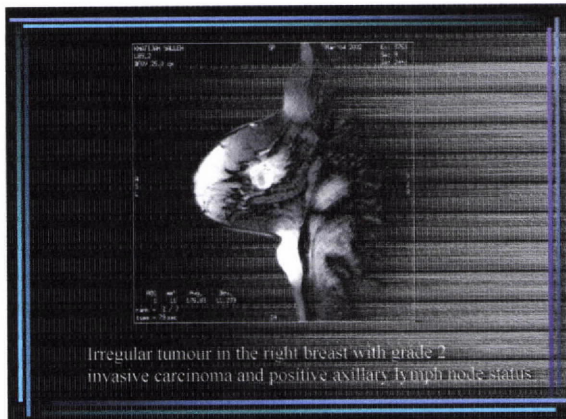
- n = 2 patients



## STATUS OF AXILLARY LYMPH NODE

Lymph node status		Well defined	Ill defined	Total	p value
Positive	Well defined	4 (33.3%)	8 (66.7%)	12	0.016
	Ill defined	4 (33.3%)	1 (17%)		
TOTAL		9	9	18	

Conclusion: Margin clarity between lesions which were accompanied by lymph nodes metastasis with those without lymph node metastasis were significantly different ( $p = 0.05$ )



## MORPHOLOGY

- Contrast enhancement
  - None:** no increase in intensity when compared to the non-enhanced T1W image
  - Homogenous:** increase in intensity >90% of the lesion in all slices
  - Heterogenous:** different characteristics of intensity enhancement in all slices
  - Rim like:** increase in intensity at the periphery/margin of the lesion

## ENHANCEMENT PATTERN

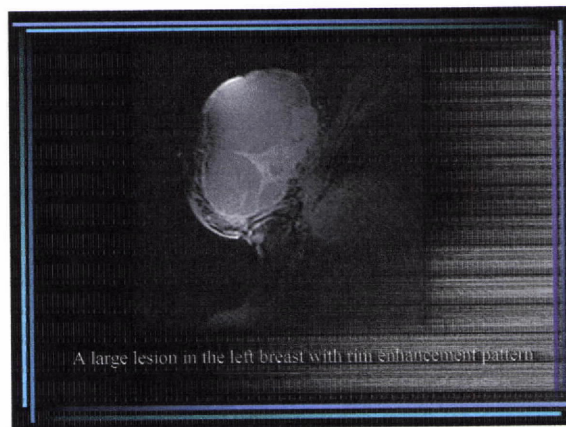
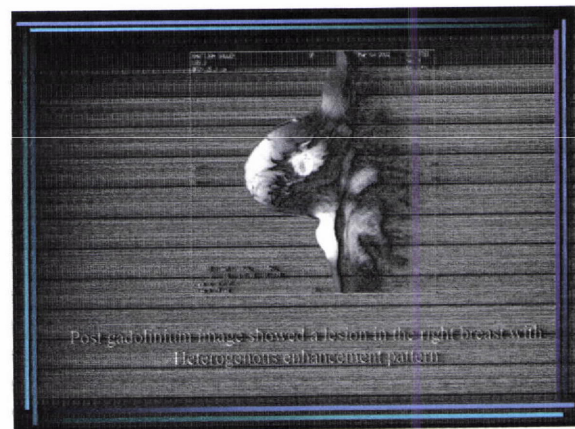
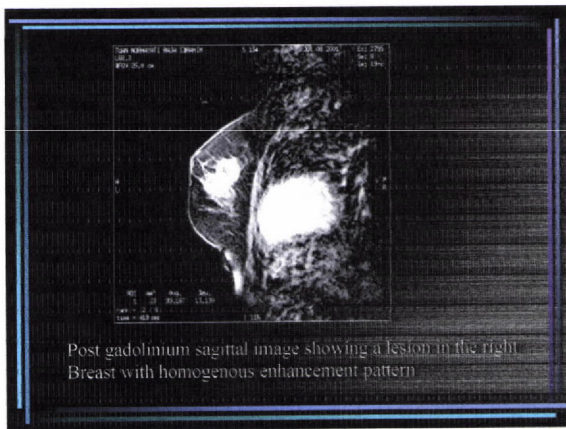
Histological grading		Enhancement pattern			Total
		Homogenous	Heterogenous	Rim-like	
1	Homogenous	5 (75%)	1 (25%)	0	6
	Heterogenous	2 (40%)	3 (60%)	0	
2	Homogenous	4 (11.1%)	7 (77.8%)	1 (11.1%)	12
	Heterogenous	6	1	1	
TOTAL		6	11	1	18

Lymph node status		Enhancement pattern			Total
		Homogenous	Heterogenous	Rim-like	
Positive	Homogenous	1 (10%)	1 (10%)	0	2
	Heterogenous	5 (50%)	4 (40%)	0	
Negative	Homogenous	4 (44.4%)	7 (77.8%)	1 (11.1%)	12
	Heterogenous	6	1	1	
TOTAL		6	11	1	18

$p = 0.106$  significant difference

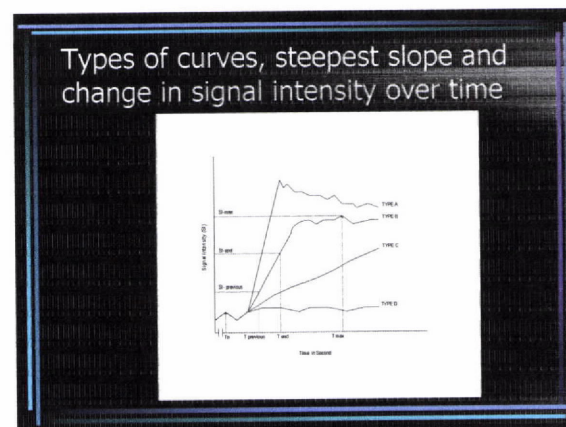
MRI enhancement for lesion with and without lymph nodes. In invasive carcinoma of the breasts in 18 patients. Most breast lesions with axillary lymph node metastasis are heterogenous.





### ENHANCEMENT KINETICS

- Derived from the dynamic scans
- Post processing of the images
  - Time Intensity curve
  - Steepest slope
  - Signal intensity increase
- Functool software of GE Advantage 3.1 Workstation, GE Medical System)
- Circle cursor clicked and dragged to an area of tumour mass which produced the ROI
- Signal intensity values and time intensity graphs produced



### VARIOUS TYPES OF TIME INTENSITY CURVES

- Type A: peak enhancement and washout seen within 120s (early phase) followed by a decrease during the delayed phase
- Type B: enhancement increase in the early phase followed by a plateau in the delayed phase
- Type C: no peak enhancement increased with time throughout the examination
- Type D: no definite increase in enhancement seen throughout the examination

Quinn J, et al. 1995. Radiology 195: 699-703. The time intensity curves of dynamic contrast-enhanced MR images of the breast: time findings and tumor angiogenesis



	Types of curve			Total
	A	B	C	
	Histological grading	1	0	3
	2	0	4	5
	3	3	0	6
TOTAL	3 (17%)	13 (72%)	2 (11%)	18

Types of time intensity curves of enhancement kinetics of various histological grades of invasive ductal carcinoma. Type D was not seen in any case

		Types of curve			Total
		A	B	C	
Lymph node status	Positive	2	8	2	12
	Negative	1	4	1	6
TOTAL		3	12	3	18

Types of intensity curves of enhancement kinetics of lesions with and without axillary lymph nodes in invasive breast carcinoma

## QUANTITATIVE ASSESSMENT

- Steepest slope – sharp inclined line obtained from the time intensity curve
- Steepest slope (in percent per second) =  $[(SI_{end} - SI_{pre}) \times 100] / [SI_{pre} \times (T_{end} - T_{pre})]$
- Signal intensity increase – change in the signal intensity from the precontrast to the lesion maximum enhancement
- $E = [(SI_{max} - SI_{pre}) \times 100] / SI_{pre}$

	Steepest slope			Total
	0 to 2.0	2.1 to 4.0	4.1 to 6.0	
	Histological grading	1	1	0
	2	3	0	5
	3	1	2	6
TOTAL	11	5	2	18

Mean of the steepest slope: 2.20 s.d. 1.14

No significant difference between the different histological grades and steepest slope of enhancement

		Steepest slope			Total
		0 to 2.0 4.0	2.1 to 4.0	4.1 to 6.0	
Lymph node status	Positive	7	3	2	12
	Negative	4	2	0	6
	TOTAL	11	5	2	18

Steepest slope of enhancement kinetics of lesions with and without axillary lymph node in invasive breast carcinoma

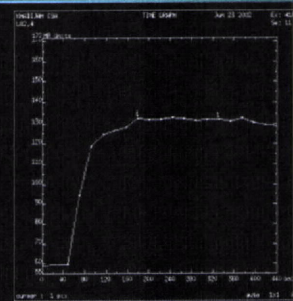
	Signal increase			Total
	1 to 30%	31 to 60%	61 to 90%	
	1	2	1	4
Histological grading	2	0	1	3
	3	1	2	3
	TOTAL	2	1	3

Signal intensity increase of enhancement kinetics of various histological grades of invasive ductal carcinoma of breasts

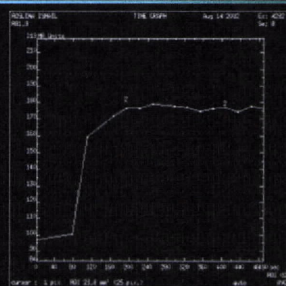


		Signal increase				Total
		1 to 50%	51 to 60%	61 to 90%	> 90%	
Lymph node status	Positive	2	2	2	6	12
	Negative	0	5	1	2	6
TOTAL		2	5	3	8	18

Signal increase of enhancement kinetics of lesions with and without axillary lymph node in invasive breast carcinoma



TIC demonstrated a peak enhancement in 92s followed by a plateau formation. Relative post contrast signal increase was 93% and steepest slope was 3.59. HPE revealed invasive ductal carcinoma (NOS), grade 2 with lymph node metastasis



TIC demonstrated a peak enhancement at 194s followed by a plateau formation. Relative post contrast signal increase was 1.76 and steepest slope was 66%. HPE analysis revealed invasive ductal carcinoma (NOS), grade 1 with no evidence of lymph node metastasis.

## NUMBER AND SIZE OF LESIONS

- Tumour size measured on the post contrast dynamic series
- Multifocal defined as 2 or more clearly separated suspicious enhancing lesions
- Visualization of axillary lymph node
  - Enhancement characteristics
  - Compared with the MRI and pathological examinations

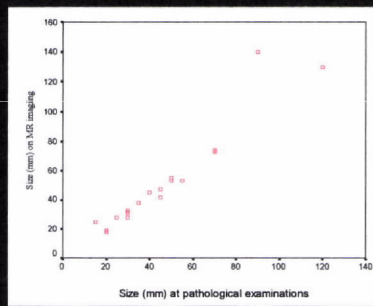
## HISTOPATH. EXAMINATION

- Tumour removed and mastectomy specimens sent for HPE
- Definitive tissue diagnosis and assessment
- Description of the pathological findings
- Lymph node status

Bloom Richardson Grading System

	On MRI	At pathological examinations
Mean	51.90	47.00
Median	46.00	45.00
Mode	53	50
Std. Deviation	32.406	25.516
Minimum	18.00	15.00
Maximum	140.00	120.00





Scatter diagram showed linear correlation between the tumour size measurement on MRI and HPE

### LYMPH NODE STATUS ON MRI AND HPE

		Lymph-node on MRI		Total
		Positive	Negative	
Lymph node status	Positive	7	5	12
	Negative	1	5	6
TOTAL		8	10	18

### DIAGNOSTIC TESTS PARAMETERS

Sensitivity	7/12 x 100	58.3%
Specificity	5/6 x 100	83.3%
Positive Predictive Value	7/8 x 100	87.5%
Negative Predictive Value	5/10 x 100	50.0%
False positive	1/8 x 100	12.5%
False negative	5/10 x 100	50.0%
Accuracy	7+5/18 x 100	66.7%

### LIMITATIONS

- SMALL NUMBER OF PATIENTS LIMITS STATISTICAL INFERENCES
- ACCURACY IS REDUCED AND WOULD BE BETTER WITH A LARGE POPULATION
- 1.0 TESLA MRI

### CONCLUSION

- No significant correlation between the different histological grades and lymph node status on MRI
- There is significant difference in margin clarity and enhancement pattern between patients with and without lymph node involvement
- Good correlation of the size measured in MRI and HPE

### CONCLUSION

- In patients with lymph node positive, the mean size is larger than that of the lymph node negative group
- MRI had low sensitivity in detecting axillary lymph node involvement



THANKS FOR YOUR ATTENTION

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