

**COMPARATIVE STUDY ON MRI versus  
X-RAY IN DETECTING BONE METASTASIS  
IN PATIENTS WITH LOCALLY ADVANCED  
BREAST CARCINOMA**

**M.S DEGREE EXAMINATION  
BRANCH I - GENERAL SURGERY**

**Department of General Surgery  
MADURAI MEDICAL COLLEGE AND GOVT RAJAJI HOSPITAL  
Madurai – 20  
APRIL 2019**



**THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY  
CHENNAI, TAMILNADU, INDIA.**

## **BONAFIDE CERTIFICATE**

This is to certify that the dissertation entitled “**Prospective study comparing the effectiveness of CT and MRI spine in detecting occult spine metastasis in patients with locally advanced breast carcinoma**” submitted by **Dr.D.Govindaraj** to the Tamilnadu Dr.M.G.R medical university, Chennai in partial fulfillment of the requirement for the award of M.S Degree Branch 1 (General Surgery), is a bonafide research work carried out by him under my supervision & guidance.

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## **CERTIFICATE BY THE DEAN**

This is to certify that the dissertation entitled “**Prospective study comparing the effectiveness of CT and MRI spine in detecting occult spine metastasis in patients with locally advanced breast carcinoma**” is a bonafide research work done by **Dr.D.Govindaraj.**, Post graduate student, department of general surgery, Madurai Medical College, Madurai, under guidance and supervision of **Prof.Dr.D.Marudhupandian MS.,FICS.,FAIS.**, unit chief, department of general surgery, Madurai Medical College, Madurai.

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## **DECLARATION**

I, **Dr.D.GOVINDARAJ** declare that, I carried out this work on **“Prospective study comparing the effectiveness of CT and MRI spine in detecting occult spine metastasis in patients with locally advanced breast carcinoma”** at the department of general surgery, Govt.Rajaji hospital Madurai, during the period of Jan2018 to April2019. I also declare that this bonafide work or a part of this work was not submitted by me or any others for any award, degree and diploma to any other university, Board either in India or abroad.

This is submitted to The Tamil Nadu Dr.M.G.R Medical University, Chennai Chennai in partial fulfillment of the rules and regulations for the M.S Degree examination in general surgery.

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## **ACKNOWLEDGEMENT**

I wish to thank our DEAN **Dr.D.Marudhupandian MS., FICS.,FAIS.,** for permitting to use the facilities of Madurai medical College and government Rajaji Hospital to conduct the study.

I thank sincerely, **Prof.Dr.D.Marudhupandian MS., FICS., FAIS.,** my unit chief and dean for his valuable advice and co-operation in completing the study. He has always guided me by example and valuable words of advice and has given me his moral support. I will be grateful to him forever.

I offer my heartfelt thanks to my unit assistant professors **Dr.D.LATHA MS.,DA., Dr.C.SARAVANAN MS., D.Ortho., Dr.S.THIRUMALAIKANNAN MS., DCh., Dr.S.MUTHU KUMAR MCh, Dr.C.RAJ KUMAR MCh.,** for their constant encouragement timely help critical suggestions throughout the study and also for making My stay in the unit both informative and pleasurable

My patients, who form the most integral part of the work, were always kind and cooperative. I pray God to give them courage and strength to endure the release hope all of them go into complete remission.

**Dr.D.GOVINDARAJ**

## **LIST OF ABBREVIATIONS**

LABC	locally advanced breast carcinoma
MRI	magnetic resonance imaging
CT	computed tomography
PET	positron emission tomography
SPECT	single photon emission computed tomography
STIR	Short tau inversion recovery
FLAIR	Fluid-attenuated inversion recovery
DM	diabetes mellitus
SS	skeletal scintigraphy

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## **INTRODUCTION**

Carcinoma breast is the second most common mortality causing cancer next to pulmonary carcinoma worldwide. In India, more than one million women are detected with breast cancer every year. Due to robust healthcare detection of breast cancer, there is a shift in focus from detection of breast cancer, towards appropriate management of breast cancer of all stages. Hence, we studied the need for early detection of spine metastasis which is the most common bone spread of breast cancer, by comparing the accuracies of CT Scan and MRI of spine.

By this, a patient with LABC is detected with spine metastasis, the patient is considered as stage 4 which changes the management protocol.

## **REVIEW OF LITERATURE**

### **PROSPECTIVE STUDY COMPARING THE ROLE OF CT SPINE AND MRI SPINE IN DETECTING OCCULT SPINE METASTASIS IN PATIENTS WITH LOCALLY ADVANCED BREAST CARCINOMA**

#### **ANATOMY OF THE BREAST**

The breast develops at 5-6 weeks of intrauterine life from two ventral bands of thickened ectoderm called the mammary ridges. The breast is rudimentary in males. In females the breast starts developing just before puberty.

The mammary gland or the breast lies over the Anterior chest wall otherwise called the pectoral region. Though the breasts are rudimentary in males it forms an important reproductive organ in the females.

The breast lies in the superficial fascia of the pectoral region. It is divided into four quadrants called upper medial, upper lateral, lower medial, lower lateral. There is a small extension of the breast called the axillary tail of Spence.

The breast is located between 2 to 6 ribs vertically and from the lateral border of the sternum to the mid axillary line. The Breast is separated from the pectoral fascia by the retromammary space.

The nipple is present at the level of the fourth intercostal space. Many circular and longitudinal muscle fibers make up the nipple. The nipple contains many sweat and sebaceous glands. The circular area around the nipple is called the areola. The areola also contain sebaceous glands.



**Fig: Anatomical location of breast**

The breast is a compound tubulo alveolar gland which secretes milk. There are 15 to 20 lobules. Each lobules contain alveoli in clusters. The lactiferous ducts converge near the nipple into a dilatation called the lactiferous sinus.

### **Blood supply.**

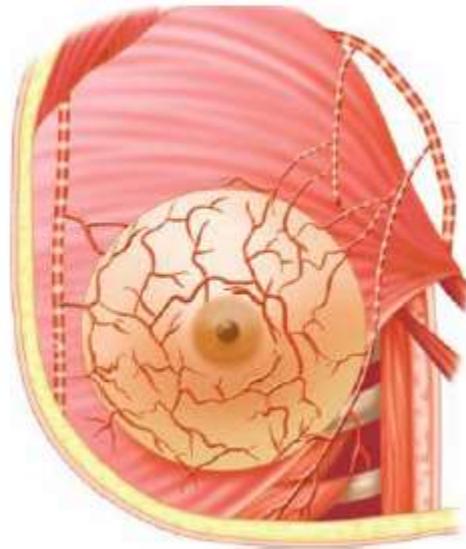
Internal thoracic artery

Axillary artery through the lateral thoracic, superior thoracic and acromiothoracic arteries.

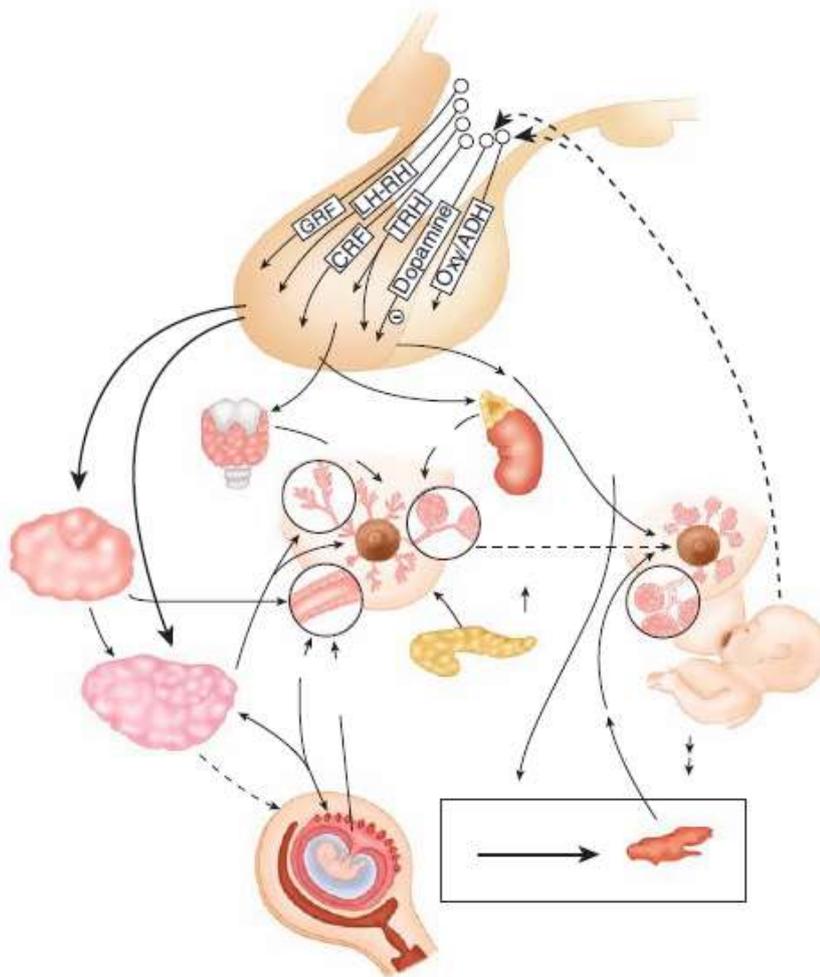
Posterior intercostal artery. The Veins Follow the arteries.

### **NERVE SUPPLY**

The 4-6 intercostal nerves supply the breast. These nerve fibres supply only the sensory and autonomic sensations. The milk secretion is governed by the pituitary and the hypothalamus.



**Fig: blood supply of the breast**



**Fig: Neuroendocrine control of the breast**

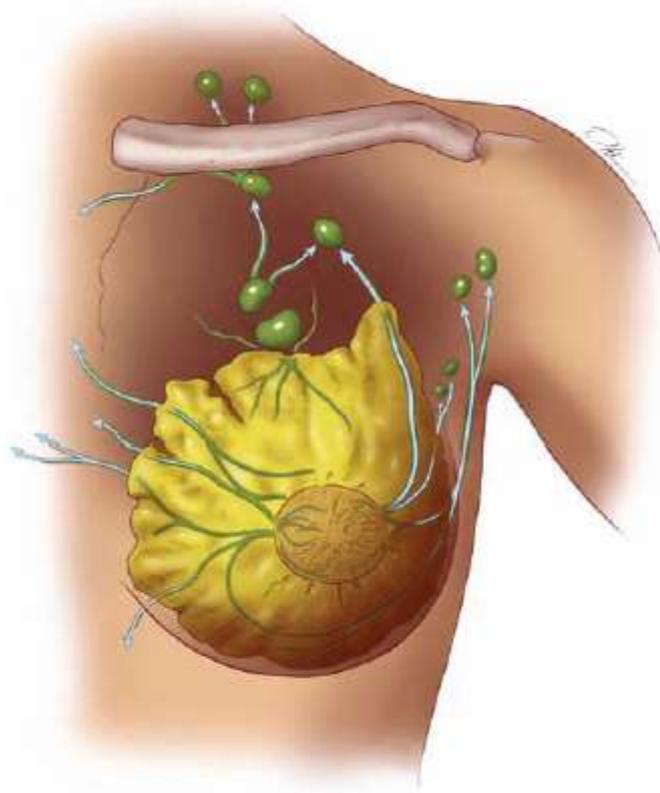
## **LYMPHATIC DRAINAGE:**

1. Axillary lymphnodes, grouped into central, posterior, lateral, apical.
2. The internal mammary nodes
3. Supraclavicular nodes
4. Cephalic (deltopectoral nodes)
5. Posterior intercostal nodes.

The lymphatic drainage is very important as it forms the platform for spread of carcinoma cells from the breast to all over the body.

The lymph channels have no valves. Most lymph is drained by the axillary nodes.

The left breast drain into the thoracic duct and the right breast drain into the right subclavian vein. Rotters nodes are interpectoral nodes.



**Fig:** lymphatic drainage of breast

The *axillary vein group*, called the *lateral group*, consists of four to six lymph nodes that lie lateral and posterior to the axillary vein. This group is well identified at the anatomic confluence of the lateral vein with the latissimus dorsi. These nodes receive the majority of lymphatic contents from the upper extremity and ipsilateral back with the exception of lymph that

drains into the deltopectoral lymph nodes, a group also referred to as the *infraclavicular nodes*.

The external mammary group, called the *anterior or pectoral group*, consists of four or five lymph nodes positioned along the lower and lateral border of the pectoralis minor muscle contiguous in association with the lateral thoracic vessels. These nodes receive the principal volume of lymph drainage from the breast parenchyma. From these nodes, lymph drains primarily into the central lymph nodes. However, lymph may pass directly from the external mammary nodes to the subclavicular lymph nodes.

The *central group*, centrally positioned, consists of three to four large lymph nodes that are embedded in the fat of the axilla, usually behind the pectoralis minor muscle. These nodes receive lymph from the preceding nodal groups (axillary, external mammary, and scapular nodal sites) and may also receive afferent lymphatic vessels directly from the breast. Lymph from the central group, which may lie directly upon the ventral and anterior aspects of the axillary vein, drains directly to the subclavicular

(apical, level III) nodes. This group is often placed superficially beneath the skin and the fascia of the midaxilla, and it is centrally located between the posterior and anterior axillary folds. This nodal group is the most palpable and numerous of axillary lymphatics, and because of its superficial position may provide accurate clinical assessment of metastatic disease.

The *interpectoral* or *Rotter group* consists of one to four small lymph nodes located *between* the pectoralis major and minor muscles. This group is bordering with pectoral branches of the thoracoacromial vessels. Lymph from these nodes enters the central and subclavicular nodes

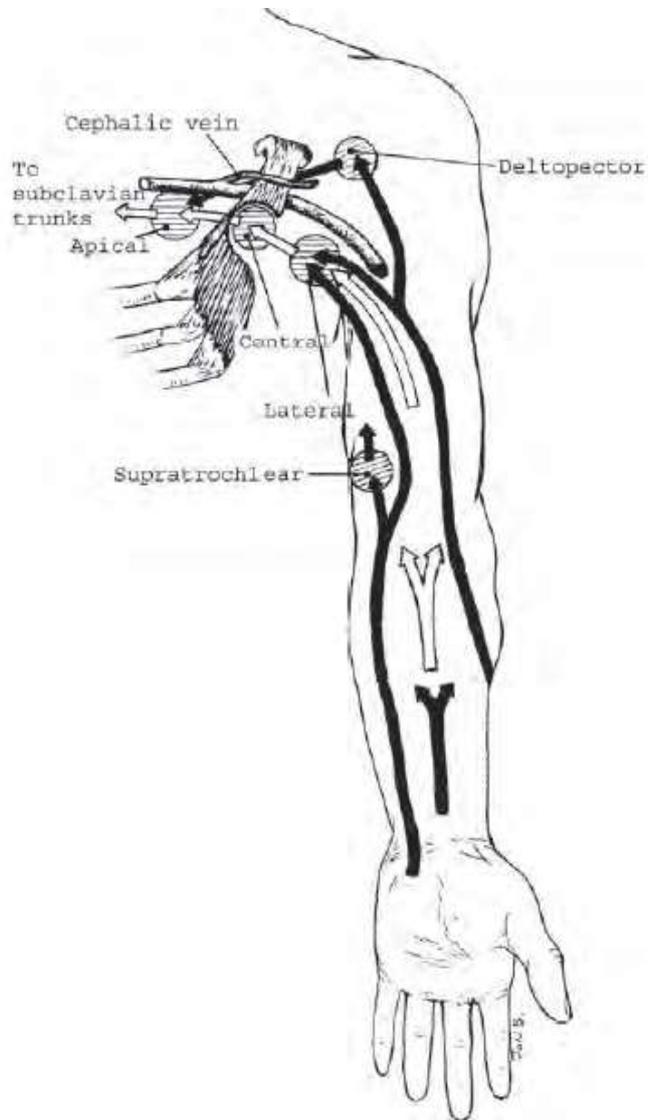
The *subclavicular group*, called the *apical group*, consists of 6 to 12 lymph nodes that are located in part posterior and partially above the upper border of the pectoralis minor muscle. This nodal group extends into the apex of the axilla along the medial aspect of the axillary vein. These nodes receive lymph from all the other axillary lymph node groups. Thereafter, these efferent lymphatic vessels from the subclavicular lymph nodes

unite to form the subclavian trunk. The course of the *subclavian trunk* is highly variable anatomically.

It may join and directly enter the internal jugular vein or the subclavian vein, or their junction. On the right side of the subclavian trunk, the right lymphatic duct may enter this structure, whereas on the left side confluence with the *thoracic duct* is common. Efferent vessels from the subclavicular lymph nodes may also pass to the deep cervical lymph nodes.

Axillary lymphatics are divided according to their lateral and medial (surgical) anatomic relationships with the pectoralis minor muscle into three distinct levels and are identified as *levels I through III*. *Level I nodes* are located lateral to or below the inferior border of the pectoralis minor; this level includes the *external mammary*, the *lateral axillary vein*, and the *scapular lymph node groups*. *Level II nodes* are located deep in or behind the pectoralis minor and include the *central lymph node group* and possibly some of the *subclavicular lymph node group*.

*Level III nodes* are located superomedial to the upper margin of the pectoralis minor and include the *subclavicular (apical) lymph node group*.



**Fig: Lymphatic drainage of upper limb and breast**

## ABERRATIONS OF NORMAL DEVELOPMENT & INVOLUTION

	NORMAL	DISORDER	DISEASE
Early reproductive years (age 15–25 y)	Lobular development	Fibroadenoma	Giant fibroadenoma
	Stromal development	Adolescent hypertrophy	Gigantomastia
	Nipple eversion	Nipple inversion	Subareolar abscess Mammary duct fistula
Later reproductive years (age 25–40 y)	Cyclical changes of menstruation	Cyclical mastalgia	Incapacitating mastalgia
		Nodularity	
	Epithelial hyperplasia of pregnancy	Bloody nipple discharge	
Involution (age 35–55 y)	Lobular involution	Macrocysts	—
		Sclerosing lesions	
	Duct involution		
	Dilatation	Duct ectasia	Periductal mastitis
	Sclerosis	Nipple retraction	—
	Epithelial turnover	Epithelial hyperplasia	Epithelial hyperplasia with atypia

**Fig:** Aberrations of normal development and involution (ANDI)  
ANDI classifies benign breast disorders which may be normal processes in reproductive life and to involution, diseases of the breast and pathogenesis and degree of abnormality

**Table: Cance Table: Cancer risk associated with various breast disorders and diseases.**

<b>Abnormality</b>	<b>Relative risk (RR)</b>
Non proliferating lesions	No risk
Sclerosing adenosis	No risk
Intraductal papilloma	No risk
Florid hyperplasia	1.5-2.0
Atypical lobular hyperplasia	4
Atypical ductal hyperplasia	4
Lobular carcinoma in situ	10
Ductal carcinoma in situ	10

## **RISK FACTORS FOR BREAST CANCER**

### **NON MODIFIABLE:**

- Age
- Female sex
- Early menarche
- Late menopause
- Nulliparity

- Family history
- Genetic risk
- Personal history of cancer
- Race & ethnicity
- Radiation exposure

**MODIFIABLE:**

- Age at first child birth
- Parity
- Breast feeding
- Obesity
- Alcohol and tobacco consumption
- Hormone replacement therapy
- Physical activity

**HISTOLOGICAL RISK FACTORS:**

- Proliferative breast disease
- Atypical ductal hyperplasia
- Atypical lobular hyperplasia
- Lobular carcinoma in situ

### **Noninvasive Epithelial Cancers**

Lobular carcinoma in situ

Ductal carcinoma in situ or intraductal carcinoma

- Papillary, cribriform, solid, and comedo types

### **Invasive Epithelial Cancers (Percentage of Total)**

Invasive lobular carcinoma (10%)

Invasive ductal carcinoma

- Invasive ductal carcinoma, not otherwise specified (50%-70%)
- Tubular carcinoma (2%-3%)
- Mucinous or colloid carcinoma (2%-3%)
- Medullary carcinoma (5%)
- Invasive cribriform carcinoma (1%-3%)
- Invasive papillary carcinoma (1%-2%)
- Adenoid cystic carcinoma (1%)
- Metaplastic carcinoma (1%)

### **Mixed Connective and Epithelial Tumors**

Phyllodes tumors, benign and malignant

Carcinosarcoma

Angiosarcoma

Adenocarcinoma

**FIG: classification of primary breast carcinoma**

## **STAGING OF BREAST CANCER**

<b>STAGE</b>	<b>DESCRIPTION</b>
Tis	Carcinoma In Situ
T1	Tumour <2cm in greatest dimension
T2	Tumour 2-5cm in greatest dimension
T3	Tumour >5cm in greatest dimension
T4A	Extension to the chest wall not including pectoralis muscle invasion
T4B	Ulceration/ipsilateral satellite nodule/edema including peau d'orange which do not meet criteria for inflammatory carcinoma
T4C	Both T4a and T4b
T4D	Inflammatory carcinoma

<b>N STAGE</b>	<b>DESCRIPTION</b>
N0	No regional nodes
N1	Metastasis to ipsilateral mobile level 1,2 axillary nodes
N2A	Metastasis to ipsilateral matted level 1,2 axillary nodes
N2B	Metastasis to ipsilateral internal mammary nodes in the absence of axillary lymphnodes
N3A	Metastasis in ipsilateral infraclavicular nodes
N3B	Metastasis in ipsilateral axillary and internal mammary nodes
N3C	Metastasis in ipsilateral supraclavicular nodes

<b>M STAGE</b>	<b>DESCRIPTION</b>
MX	Metastasis could not be assessed
M0	No evidence of metastasis
M1	Clinical/radiological evidence of metastasis

STAGE 0	T0	N0	M0
STAGE 1A	T1	N0	M0
STAGE 1B	T0	N1mi	M0
	T1	N1mi	M0
STAGE 2A	T0	N1	M0
	T1	N1	M0
	T2	N0	M0
STAGE 2B	T2	N1	M0
	T3	N0	M0
STAGE 3A	T0	N2	M0
	T1	N2	M0
	T2	N2	M0
	T3	N1	M0
	T3	N2	M0
STAGE 3B	T4	N0	M0
	T4	N1	M0
	T4	N2	M0
STAGE 3C	ANY T	N3	M0
STAGE 4	ANY T	ANY N	M1

**TABLE: TNM GROUP STAGING**

**The stages highlighted constitute LABC (locally advanced breast carcinoma)**

## DIAGNOSTIC STUDIES FOR BREAST CARCINOMA PATIENTS

INVESTIGATION	Stage 0	Stage 1	Stage 2	Stage 3	Stage4
History & physical	*	*	*	*	*
Blood investigations		*	*	*	*
X-ray			*	*	*
Mammogram	*	*	*	*	*
Hormone receptor study	*	*	*	*	*
HER-2/neu		*	*	*	*
Bone scan				*	*
Ultrasound abdomen				*	*

## **MANAGEMENT**

### **EARLY BREAST CANCER**

- Surgery-Lumpectomy
- Radiotherapy
- Axillary node management(SLND/ALND)
- Chemotherapy
- Hormonal therapy
- Immunomodulators

Disease free survival is equivalent to mastectomy if patient is carefully selected. Even though sounds simple, BCS is more complicated than MRM.

## **LOCALLY ADVANCED BREAST CANCER:**



**Fig: Locally Advanced Breast Cancer**

### **Tumour:**

T3: Lump >5cm

T4a : Extension to chest wall

T4b : Skin involvement

T4c : T4(a+b)

T4d : Inflammatory Carcinoma

**Nodal status:**

N2a : Ipsilateral Fixed/ matted axillary nodes

N2b : Ipsilateral Internal Mammary Nodes

(Axillary Node negative)

N3a : Ipsilateral Infraclavicular

N3b : N2(a+b)

N3c : Ipsilateral Supraclavicular nodes

**Metastasis**

M0

**CLINICAL PRESENTATION:**

Lump >5cm

**Grave Signs:**

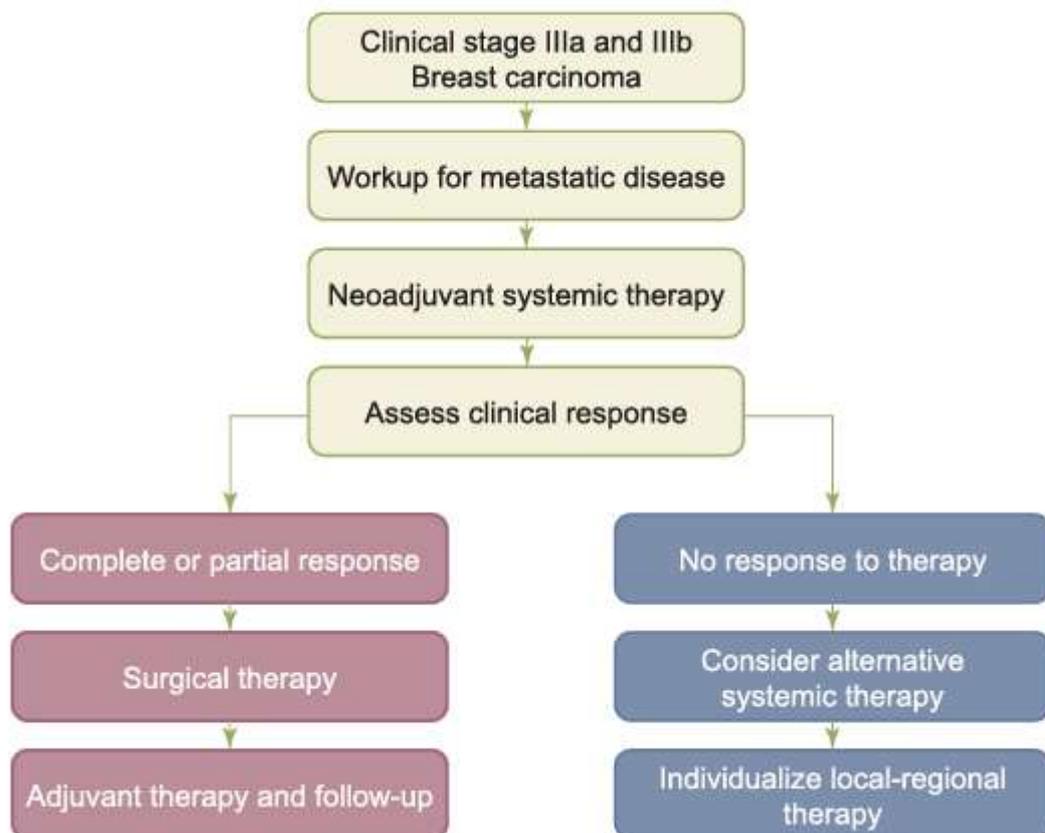
- ⊙ Skin Edema
- ⊙ Skin ulceration
- ⊙ Chest wall Fixity
- ⊙ >2.5cm Axillary Node
- ⊙ Fixed Axillary node

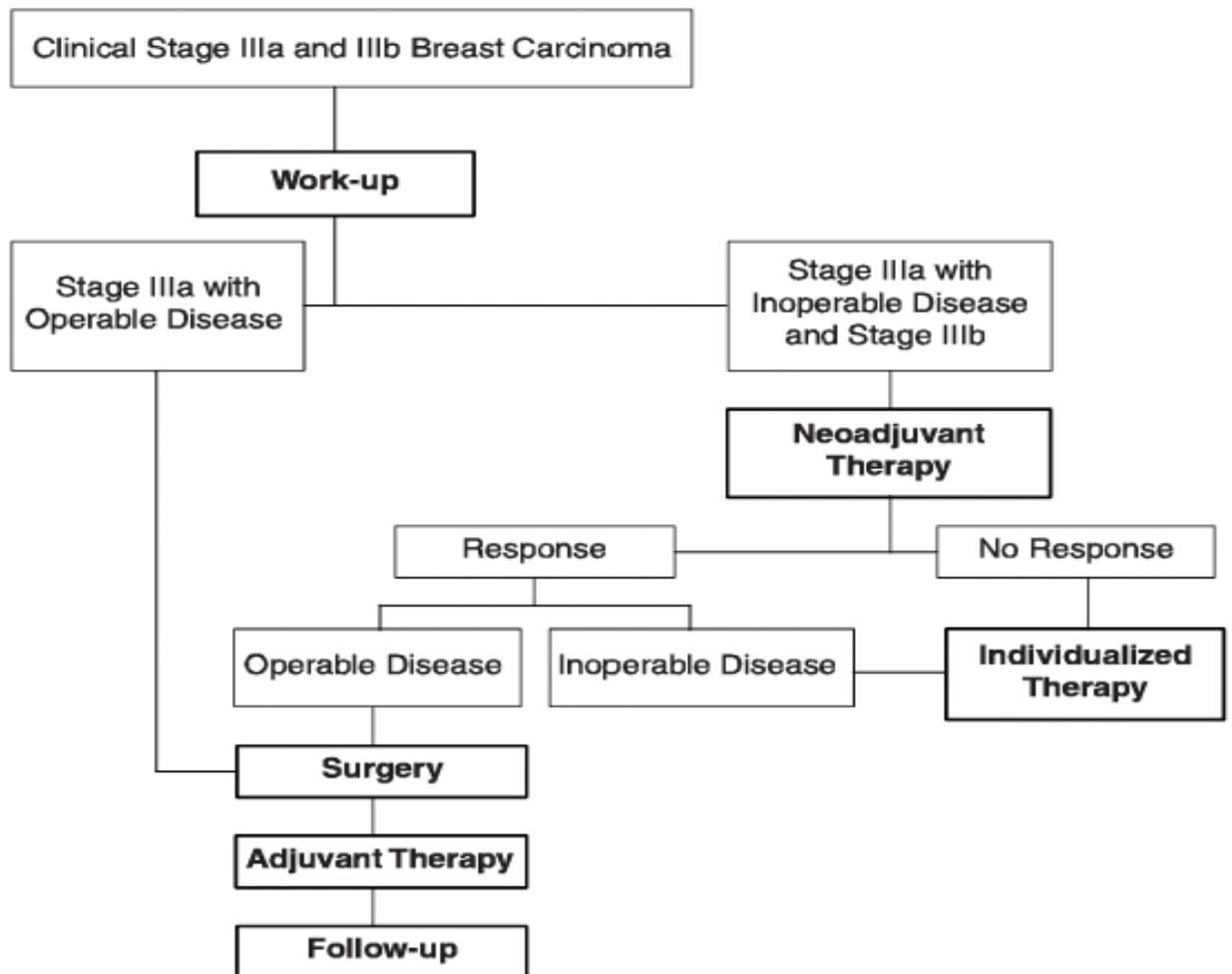
⊙ Satellite skin nodules

⊙ Infraclavicular, Internal Mammary, Supraclavicular nodes

### **INVESTIGATIONS: (as necessary)**

- Mammography
- Trucut biopsy
- CT chest and abdomen
- Skeletal survey
- MRI scan
- PET CT





**Table 1&2: Treatment pathways for LABC**

## **MANAGEMENT:**

- Surgery
- Chemo therapy
- Radio therapy
- Hormonal therapy
- Monoclonal antibodies

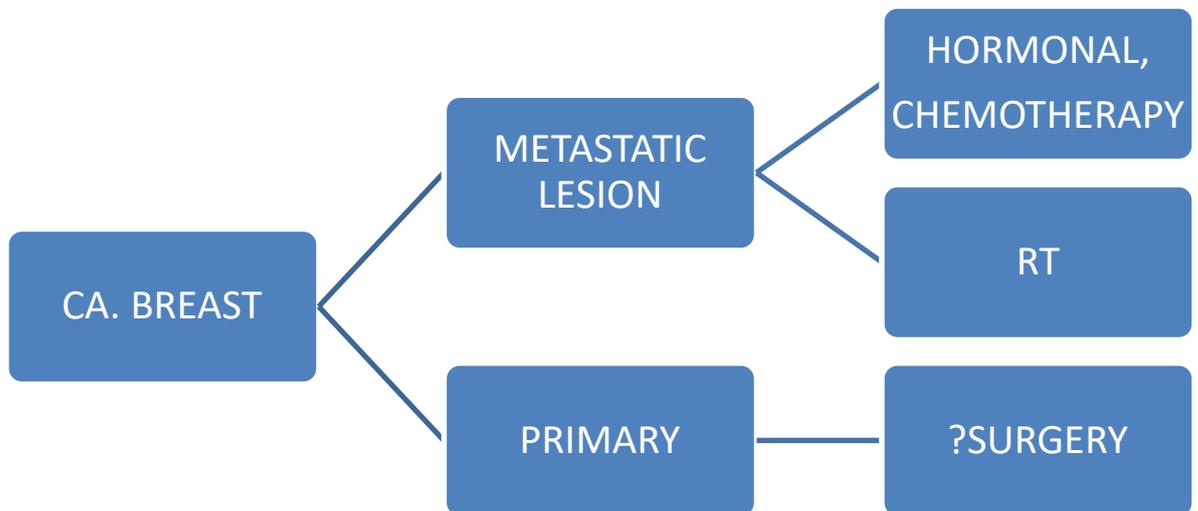
Women presenting with stage IIIa and IIIb breast cancer have advanced locoregional breast cancer but have no clinically detected distant metastases. In an effort to provide optimal loco regional control as well as distant disease control for these women, surgery is integrated with radiation therapy and chemotherapy. Stage IIIa patients are divided into those who have operable disease and those who have inoperable disease. Surgical therapy for women with operable stage IIIa disease is usually a modified RM, followed by adjuvant chemotherapy, followed by adjuvant radiation therapy. Adjuvant chemotherapy is used to maximize distant disease-

free survival, while radiation therapy is used to control locoregional disease.

In selected stage IIIa patients, initial (neoadjuvant) chemotherapy is used to reduce the size of the primary cancer and permit conservation surgery. For inoperable stage IIIa and for stage IIIb breast cancer, neoadjuvant chemotherapy is used to decrease the loco regional cancer burden and can permit subsequent surgery to establish loco regional control. In this setting, a modified Radical Mastectomy followed by adjuvant chemotherapy and adjuvant radiation therapy

#### **STAGE 4 DISEASE:**

Metastatic breast carcinoma includes any T, any N with metastasis to contralateral breast, axilla, supraclavicular region, skeletal and soft tissue metastasis, visceral metastasis. Patients present with various presentations which may include bone pain, neurological weakness, bladder& bowel dysfunction, rectal deposits causing hematochezia, loss of consciousness, dyspnoea and chest pain.



**Fig: management outline for metastatic disease**

The 5 year survival rates for stage 4 disease is around 22% among which TRIPLE NEGATIVE disease is more likely to recur and present with metastasis in first 5 year. Skeletal tissue metastasis have better prognosis.

**TREATMENT OBJECTIVES:**

Breast cancer has excellent prognosis provided detected at an appropriate time and managed. Hence it becomes imminent to accurately identify and stage the disease. The management of

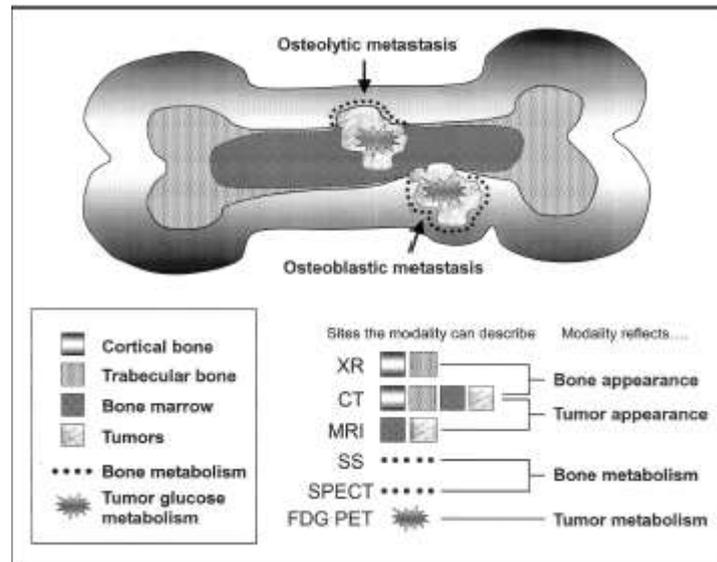
metastatic disease aims at Control of tumor burden, Reduction in cancer related symptoms or complications, Maintenance of quality of life & function.

### **BONE METASTASIS:**

Isolated bone metastasis due to breast carcinoma has an excellent survival rate of 39% at 5 years.

The skeletal metastasis may occur at:

- Spine
- Pelvis
- Femur
- Humerus
- Ribs
- Skull



**FIG: Types of bone metastasis, bone structure and appearance in various investigations.**

### **SPINE METASTASIS:**

The deposition of tumour cells in the spine occurs by the blood stream especially through the venous plexuses which are in continuity with the spinal plexuses called the **Batson's plexus**. These are low pressure venous plexuses in communication with the vertebra and the pelvis via azygos veins. Tumour seedling occurs even with increased abdominal pressures like coughing and straining. The incidence of vertebral depositions of tumour cells is as high as 84% and is the most common site of deposits in carcinoma breast. Among the spine, thoraco dorsal spine or dorsolumbar spine is the most common site followed by cervical

spine and the pelvis. As soon as the tumour seedling occurs the abundant growth factors present in the spinal columns initiate further events leading to widespread vertebral metastasis. The percentage of patients affected with occult spine metastasis are 2% in stage 1, 6-10% in stage 2, and 16-20% in stage 3 and upto 40% in metastatic disease.

The various presentations of spine metastasis that can occur due to breast carcinoma are,

1. Isolated low back pain of recent onset
2. Epidural spinal cord compression (ESCC)
3. Radiculopathy
4. Brachial plexopathy
5. Myelopathy

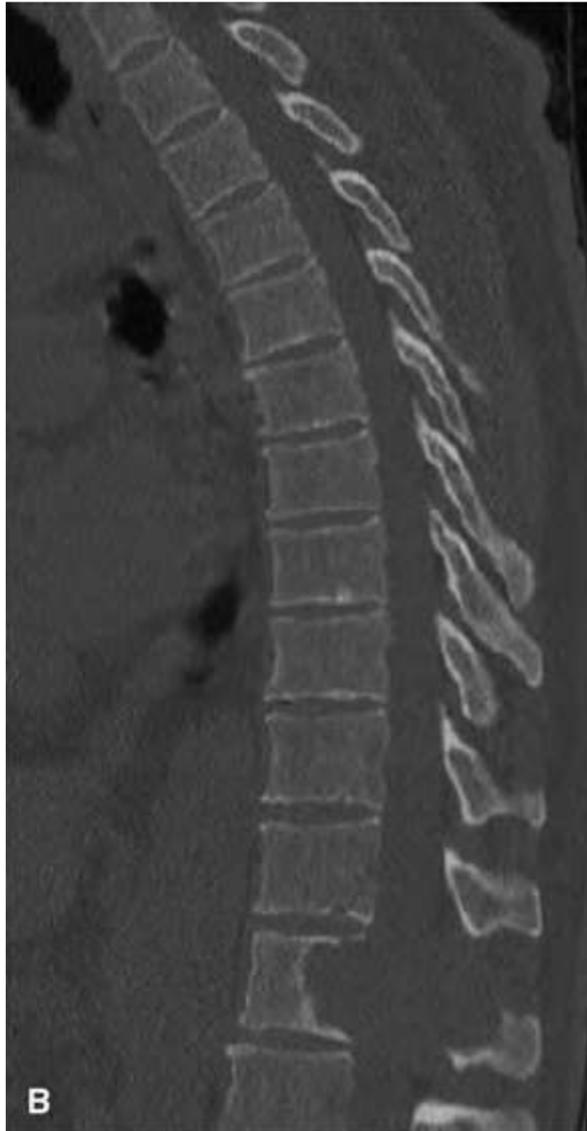
**Isolated low back pain:**

This is the most common symptoms presentation in early metastasis which is recent in onset . patient should be highly suspected for spine metastasis and should be well evaluated. Plain X-Ray of axial skeleton should be done. A CT spine can demonstrate bony lesions. However an MRI can delineate soft

tissues better than CT and hence should be employed wherever possible.

### **1. Epidural spinal cord compression (ESCC)**

The tumour cells via the bloodstream gets deposited in the spinal epidural space triggering a neurological emergency. The symptoms commonly present is only back pain of recent onset usually 7 days or more. The identifications of such patients is important to prevent further neurological damage or slow down the progression if not reversible. The epidural spinal compression in breast cancer usually follows vertebral metastasis and rarely occurs directly. Hence identification of vertebral metastasis at an early stage can prevent further damage with prompt treatment.



**Fig: Sagittal CT scan demonstrating lytic destruction of the  
T12 vertebral body due to a breast metastasis**



**Fig: T2-weighted sagittal MRI demonstrating the T12 breast metastasis and the severe spinal cord compression. The spinal fluid appears white on this sequence. The tapering of the spinal fluid on the sagittal image in the region of the mass is characteristic of compression from an extradural mass**

## **Most common symptoms and presentation of epidural compression**

<b>Symptoms</b>	<b>Description</b>
Back pain	95%
Weakness	35-75%
Inability to walk	50-68%
Sensory deficit	50-70%
Autonomic disturbance	50-60%

### **2. RADICULOPATHY:**

Radiculopathy when present indicates a possible metastasis in the spine in the range of 44-63%. An abnormal X-Ray of spine with radiculopathy symptoms is indicative of almost 90% chance of metastasis.

### **3. PLEXOPATHY:**

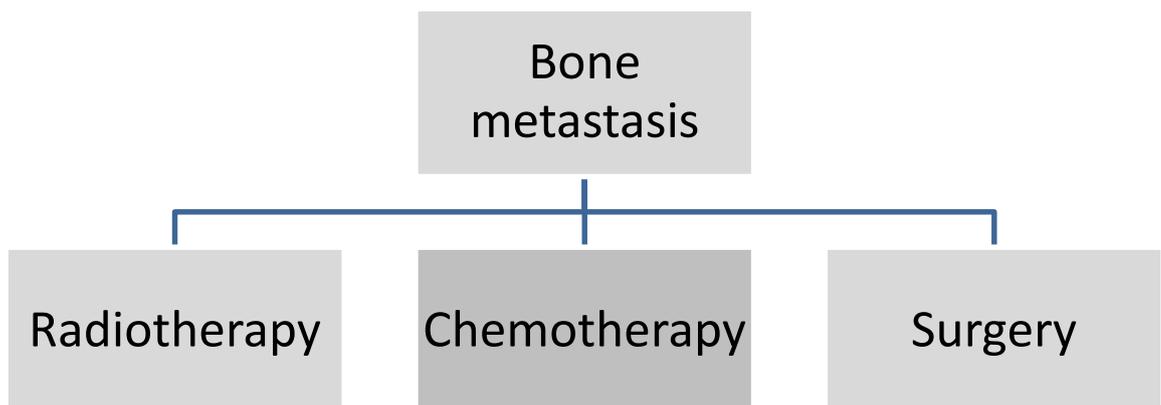
Brachial plexus lesions present with pain and weakness of upper limbs. On further progression, the lower limbs are also affected. Horner's syndrome strongly indicates brachial

plexopathy. The other symptoms are lymphedema and parasthesias.

#### **4. MYELOPATHY:**

Autonomic And Sensory Disturbance Like Bowel, Bladder Dysfunction Point Towards Myelopathy.

#### **MANAGEMENT:**



Medical management of bone metastasis includes bisphosphonates therapy. Zoledronic acid (bisphosphonates), denosumab and lapatinib are used where the latter two are monoclonal antibodies.

Patients presenting with bone pain are subjected to radiotherapy provided there is no cord compression. Patients presenting with cord compression symptoms as described later are subjected to radiotherapy and steroids.

Patients at risk of fracture are planned for elective prophylactic stabilization and patients presenting with fractures require fracture fixation as an emergency to prevent neurological damage.

### **IMAGING IN BONE METASTASIS:**

The marrow of the vertebrae undergoes constant remodeling and therefore the bone lesions in breast carcinoma can occur as bone destruction (osteolytic), new bone forming changes (osteoblastic) and mixed types.

## **THE SEED AND SOIL HYPOTHESIS:**

The bone environment represents a “fertile soil” in which some, but not all, cancer cell types (seeds) can flourish. This was proposed by **STEPHEN PAGET** in 19<sup>th</sup> century.

Most deposits from breast carcinoma induces osteolytic changes in the vertebrae by activation of osteoclasts indirectly by multiple factors. Indirect stimulation is mediated by up-regulation of RANK-RANKL signaling, either by osteoblast-mediated osteoclastogenesis or *via* stimulation of host immune cells by factors such as PTHrP. In addition, bone breakdown releases previously deposited growth factors and cytokines within the matrix. This has a proliferative effect on the metastatic cells, thus creating a vicious sequence of bone resorption.

The osteoblastic component has three mechanisms.

1. The tumor cells influences other cells like stromal cells in its microenvironment which differentiates into osteoblasts.
2. Metastatic cells secrete factors which directly stimulate osteoblast production and bone formation.

3. The natural local bone response to increased bone destruction.

Thus the resultant lesion is variable, causing the degree of overall bone distortion by the infiltrating metastatic tumor.

### **IMAGING MODALITIES:**

1. X-ray plain
2. CT plain
3. MRI
4. SKELETAL SCINTIGRAPHY(SS)
5. PET-CT
6. SPECT

There are various imaging modalities available to detect vertebral metastasis but multiple factors like sensitivity, specificity, availability, feasibility, cost effectiveness has to be considered before selecting an appropriate investigation for patients especially in developing nations like India.

<b>IMAGING MODALITY</b>	<b>SENSITIVITY(%)</b>	<b>SPECIFICITY(%)</b>
18 NaF-PET/CT	100	97
MRI	95	90
SPECT	87	91
CT	74	56
BONE SCINTIGRAPHY	78	48
X-RAY	60	50

### **X-Ray spine:**

Plain x-rays are the first investigations done to detect vertebral abnormalities and to stratify the risk of pathological fractures in patients with symptoms. However, plains x-rays are low in sensitivity and specificity to detect and delineate occult metastasis of the spine. Less contrast between trabecular and cortical bone makes this detection difficult by plain x-rays.

## **ADVANTAGES OF X-RAY SPINE:**

- Ready availability
- Low cost
- Useful for mass screening

## **DISADVANTAGES OF X-RAY SPINE:**

- Low sensitivity – atleast 50-70% bone lysis should occur to be detected by X-Ray which converts into 3-6months period after symptoms.
- Low specificity
- Do not provide soft tissue metastatic deposit status

Therefore a normal x-ray film doesn't rule out a metastatic deposit triggering a further look out for additional modalities.

## **CT SPINE:**

CT scan is excellent for cortical destruction which delineates the anatomy well compared to x-ray. CT requires very less period from onset of symptoms to detection of vertebral lytic

lesions but is poor in detecting marrow and soft tissue lesions which occur well ahead of bone destruction. The sensitivity is 74% and it is 56% specific.

### **ADVANTAGES OF CT:**

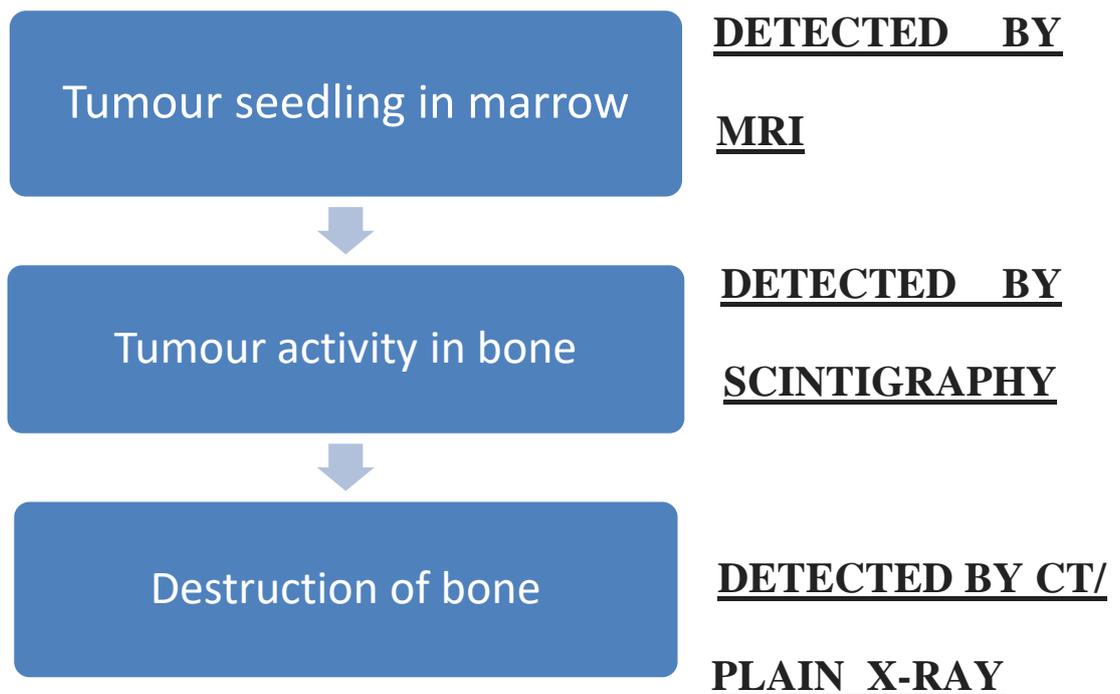
- Manipulate bone specific image techniques to acquire images which increases sensitivity (window width and level, multiplanar imaging).
- Can be used for staging simultaneously
- Quick to perform
- Low cost
- Easy availability

### **DISADVANTAGES:**

- Low sensitivity and specificity comparatively.
- Radiation exposure
- Inability to detect soft tissue lesions

## **MRI SPINE:**

MRI has an excellent soft tissue resolution. The signal intensity variations can detect tumour cells in the bone marrow which is ahead of cortical bone destruction. Hence MRI is a very useful investigation modality to detect spine metastasis at an early stage.



The sensitivity and specificity for MRI are 95% and 90% respectively.

MRI technology has evolved dramatically in recent years with excellent techniques to acquire whole body images with reduced scanning times.

## **CONCEPT OF MRI IN SPINE METASTASIS:**

MRI has certain specific signal intensity variations to detect marrow tumour cell seedling though these are common for other bone metastasis also.

Fat demonstrates high signal intensity in T1 weighted images. As the normal marrow contains high fat content there is hyperintensity in T1W images in a normal patient whereas a metastatic deposit may cause low intensity (hypointensity) signals in T1 Weighted images due to replacement of fat by the tumour cells.

Bone metastasis has increased water content and therefore appear as hyperintense on T2 Weighted images. On giving gadolinium contrast, there is enhancement due to increased vascularity. A compromised oedematous spinal cord will demonstrate abnormal focal high T2 and turbo-short tau inversion recovery (STIR) signal which can differentiate pathological vertebral body fracture from cord compression. **Fast pulse sequence** is a newer MRI technique to acquire whole body imaging rapidly over multiple anatomic locations.

## **ADVANTAGES OF MRI:**

- Easy to perform whole body scans
- No ionizing radiations
- Can differentiate malignant deposits from osteoporotic lesions
- Assess treatment response on repeat scans applying the quantitative

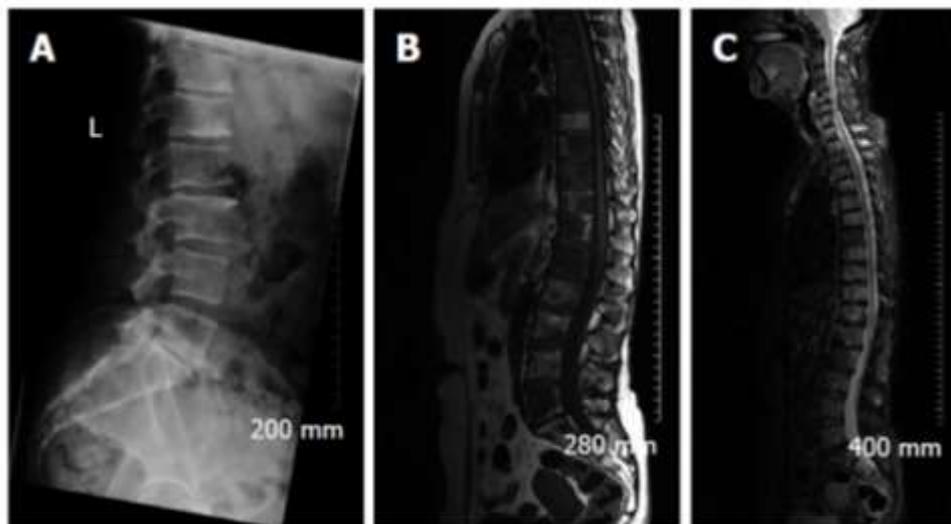
## **DIFFUSION WEIGHTED IMAGING(DWI).**

- Additional tumors in the index breast (multifocal or multicentric disease)
- Selecting patients for partial breast irradiation techniques
- Screening breasts of high-risk young females

## **DISADVANTAGES:**

- High cost
- Availability and accessibility
- Less information on cortical bones compared to CT

MRI	T1	T2	GADOLINIUM CONTRAST
NORMAL	hyperintense	hypointense	Non enhanced
METASTASIS	hypointense	hyperintense	enhances



**FIG: subtle sclerotic changes in T12,L1 on plain film; MRI shows metastatic deposits not visible in plain film**

## **TECHNIQUES OF MRI**

Breast MRI studies should be performed on 1.5T magnets or higher. The high field strength allows for rapid acquisition with high-resolution imaging. There is a linear relationship between magnetic field strength and signal-to-noise ratio (SNR). With greater field strength, the SNR is higher, and higher spatial resolution images can be obtained with shorter acquisition times. The high field strength also makes homogeneous fat suppression possible enabling detection of subtle enhancing lesions. Although 1.5T magnets remain the standard in breast MRI imaging, 3T magnets are commercially available. The higher field strength allows for higher SNR, with more rapid imaging speed and resolution. However, there is no definitive evidence that 3T magnets are superior to 1.5T for clinical breast imaging.

## **FAT SUPPRESSION**

On MRI an enhancing lesion may be difficult to detect in a background of fat. Therefore, fat suppression will improve the conspicuity of small enhancing lesions. This can be accomplished with either active or passive fat suppression. Using “active” fat suppression where the signal from fat is removed prior to the injection of intravenous contrast. There are a variety of available fat suppression techniques. Alternatively, passive fat suppression can be accomplished with post processing image subtraction (subtracting the precontrast from the postcontrast image). This requires that there be no patient motion between the pre- and the postcontrast sequences. Both methods of fat suppression (chemical fat suppression and image postprocessing image subtraction) can be used together.

## **TEMPORAL AND SPATIAL RESOLUTION:**

Sensitivity for the detection of small enhancing foci improves with increasing spatial resolution, but this requires longer imaging times. The high temporal resolution needed for

dynamic contrast enhancement is obtained at the cost of a loss of spatial resolution, signal to noise, and/or volume of the breast imaged. For optimal spatial resolution, a pixel size of less than 1.0 mm in each in-plane direction is necessary with 3-mm or less slice thickness.

For optimal temporal resolution, the first post contrast images should be obtained in less than 2 minutes following contrast injection, with subsequent scans obtained over the following 5 to 7 minutes to evaluate the shape of the enhancement curve. Different methods may be utilized to optimize these two competing factors. One is using a higher field strength magnet. 3T magnets are available for commercial use.

Theoretically, compared to 1.5T magnet, a 3T magnet should provide double the SNR and therefore allowing for faster image acquisition. However, there is no conclusive clinical evidence that 3T is superior to 1.5T in terms of diagnostic performance. Image acquisition time may also be reduced while preserving spatial resolution by using parallel imaging. Parallel imaging allows for simultaneous acquisition of spatial

information from both coils, thus reducing the time to acquire the spatial information. Combination of imaging methods may be used as well. Parallel imaging techniques may be further optimized on a 3T magnet.

## **DIFFUSION WEIGHTED IMAGING**

Diffusion-weighted imaging (DWI) may be used to increase the specificity of MRI. Although DWI should not be the primary method used for lesion analysis, it can be helpful when the other imaging parameters such as lesion morphology and kinetic information are equivocal. The concept of diffusion is based on random and thermal motion of water in tissue, also known as Brownian motion. Tissues with high cellularity restrict the motion of water whereas tissues with low cellularity allow for more free movement of the water molecules. Tumors tend to have higher cellularity and hence have restricted motion. On DWI, the restricted motion results in a higher signal intensity. The technique that is most commonly used to generate DWI imaging is T2-weighted echo planar imaging. Due to the higher cellularity

of carcinomas, there is restricted diffusion in invasive cancers relative to benign lesions and normal parenchyma, resulting in relatively brightness of malignant lesions compared to benign lesions.

The most common benign lesions of the vertebra which MRI can accurately identify are as follows:

### **Osteoblastoma of spine:**

Osteoblastoma is a benign bone forming tumour. Osteoblastomas tend to be larger in size (>2 cm), often present with cortical breakthrough and a soft tissue mass, and may rarely undergo malignant transformation. Spinal osteoblastomas account for 30–40% of all osteoblastomas. Osteoblastoma originates in the neural arch and then extends to the vertebral body. Thoracic, cervical, and lumbar segments are equally affected. The most common symptom is pain. Radiological presentation of osteoblastoma may vary. Osteoblastoma may be similar to osteoid osteomas, with a radiolucent nidus and surrounding sclerotic changes. The aggressive variant radiographs may show bone expansion with matrix calcifications, cortical bone

destruction, paravertebral and epidural extension. MRI is the most useful technique for evaluation of the potential mass effect of the tumor on neural elements. The imaging characteristics on MRI are on T1-Weighted image, the lesion is hypointense with mixed signal on T2-Weighted Image and an intense enhancement.

### **Hemangiomas of vertebra:**

Vertebral hemangiomas are the most common benign tumors in the spine, accounting for 2% of skeletal benign tumors. Vertebral hemangiomas are most frequently in the thoracic spine, followed by the lumbar region, and rarely in the cervical and sacral segments.

On radiographs, hemangiomas cause rarefaction of the trabeculae which may be thickened causing vertical striation. On CT, these vertical striations interspersed with fatty attenuation cause the so-called *polka dot* on axial images or *corduroy* appearance on coronal or sagittal reformatted images respectively. On MRI, fatty hemangiomas represent inactive forms. Low T1 signal intensity indicates a more active lesion with the potential to compress the spinal cord. Haemangiomas show avid enhancement. Aggressive hemangiomas

involve the entire vertebral body with extension to the neural arch,  
cortical expansion, irregular honeycombing, soft tissue mass and  
contrast enhancement

## **OSTEOPOROSIS**

**Osteoporosis** is a metabolic skeletal disease defined as a reduction of bone mineral density below a defined lower limit of normal.

On MRI, Bone marrow signal takes on a assorted appearance with rounded focal fatty lesions replacing normal marrow with coalescence often occurring <sup>5</sup>:

- **T1**: heterogeneously hyperintense
- **T2**: variable signal

Therefore MRI can efficiently distinguish benign and metastatic disease as described above. There are several other benign lesions of the spine all of which can be identified by characteristic MRI appearance.

## **NUCLEAR SCANS:**

The concept of nuclear medicine lies in the quantitative functioning of the tumour cells or bone without any anatomy details though some scans like PET can be combined with CT for structural details. So, the radiotracers used in bone scans deposits wherever there is increased bone activity irrespective of the etiology-benign or malignant.

The various agents used as tracers are:

1. Osteotropic agents like technetium 99,  $^{18}\text{NaF}$ (sodium fluoride).
2.  $^{99\text{m}}\text{Tc-MDP}$ (methylene diphosphanate)
3. Oncotropic radio isotopes like iodine 123 or iodine 131
4. Indium 111(somatostatin receptor scintigraphy)
5. Gallium 68

Despite the high sensitivity they are not specific for metastasis.

## **BONE SCINTIGRAPHY:**

Skeletal scintigraphy is the widely agreed technique for metastatic spine deposits. The radionuclide uptake depends upon multiple factors like blood flow, the activity of the bone-clastic

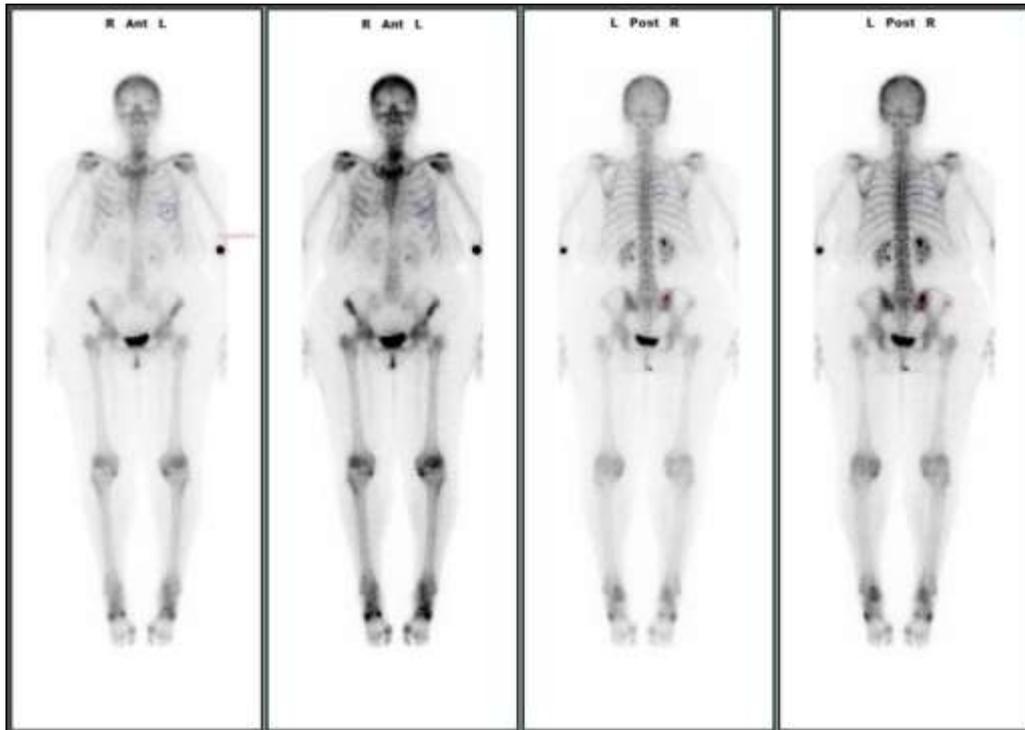
or blastic and extraction efficiency. The sensitivity and specificity are 78% and 48% respectively.

### **ADVANTAGES:**

- Whole body survey facilitates metastasis detection in the entire skeleton
- High sensitivity
- Only 5-10% alteration in bone structure is needed to detect lesions hence can detect lesions 18 months earlier than x-ray.

### **DISADVANTAGES:**

- Assesses osteoblastic activity only. Hence tumour seedling without bone activity are missed.
- High false positivity rate (non specific)
- Poor spatial resolution
- Needs another diagnostic modality to correlate and confirm diagnosis.
- No anatomic details



**FIG: A bone scintigraphy**

**Diagnostic modality of choice:**

As we have discussed above, there is no single investigation modality of choice to detect occult spine metastasis in breast cancer patients. However depending upon the various factors as mentioned there can be predilection towards CT, MRI and bone scan.

**WHY WE COMPARED CT AND MRI?**

We selected CT and MRI based upon the concept of recent technical advances in MRI which includes but not limited to STIR, FLAIR etc.,

The low specificity of scintigraphy and other disadvantages as mentioned made us reconsider the diagnostic modality of choice. As medical advances are evolving, the 'choice' factors should be evaluated time to time.

Cost & availability factors were also taken into consideration. Patients presenting to our institution are far from affordable for PET-CT/SPECT and bone scan. Asymptomatic patients were investigated with x-ray skeletal survey and CT if suspicious. But as CT may fail to reveal metastasis, we have compared MRI and CT scan- the two modalities available and feasible in our institution.

Again, we selected patients with LABC owing to the significant incidence of occult metastasis in these patients compared to other stages. For obvious reasons stage 4 disease was omitted from the study.

## **RESEARCH PROPOSAL**

**TITLE** : Prospective study comparing the effectiveness of CT and MRI spine in detecting occult metastasis in patients with locally advanced breast carcinoma

**AIMS & OBJECTIVES:** To ascertain the best imaging modality to detect occult spine metastasis in LABC patients therefore ensuring early metastasis diagnosis and appropriate management.

**DESIGN OF STUDY:** PROSPECTIVE STUDY

**PERIOD OF STUDY:** 1 YEAR

**COLLABORATING DEPARTMENT:** RADIOLOGY

**SELECTION OF STUDY SUBJECTS:** Patients attending surgical OPD in our hospital who satisfy the study criteria and consent to the study.

**DATA COLLECTION:** History, Clinical examination and investigations including radiology reports and biopsy reports.

**ETHICAL CLEARANCE:** OBTAINED

**CONSENT:** Individual written and informed consent

**CONFLICT OF INTEREST:** NONE

**FINANCIAL SUPPORT:** NIL FROM THE INSTITUTION

**PARTICIPANTS:** Patients from surgical OPD /wards, who consent to the study.

**INCLUSION CRITERIA:**

1. Patients presenting with stage III carcinoma breast to surgical OPD in GRH Madurai.
2. Patients consented for inclusion in the study according to designated proforma
3. No clinical evidence of metastasis

**EXCLUSION CRITERIA:**

1. Patients presenting with early breast carcinoma
2. Patients presenting with evident metastasis (Stage IV).
3. Prior chemotherapy/Radiotherapy during first presentation
4. Patients Unwilling for the study.
5. Pregnant patients

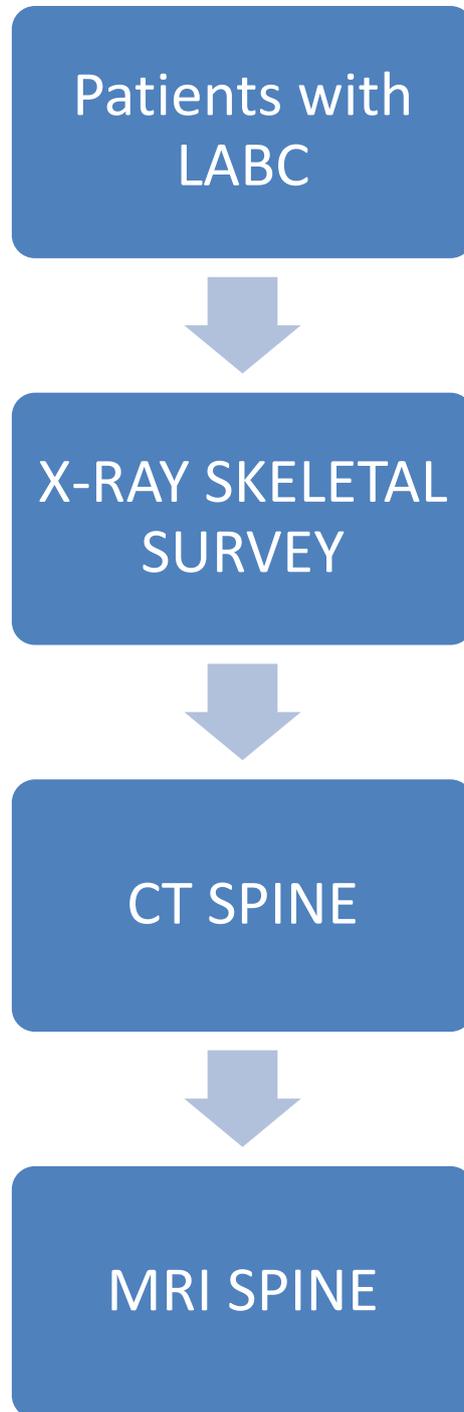
## **METHODOLOGY**

The patients presenting with carcinoma breast in GRH Madurai will be recruited for this study. Following consent, a questionnaire will be filled to record the patient's demographic data, duration of disease, symptoms, & treatment history. After diagnosis and study criteria confirmation, patients will undergo CT Spine and MRI Spine.

## **DATA ANALYSIS:**

Chi square test – p value (<0.05 IS TAKEN SIGNIFICANT)

## PROTOCOL



<b>INCLUSION CRITERIA</b>	<b>EXCLUSION CRITERIA</b>
<ul style="list-style-type: none"> <li>• Patients present with stage III carcinoma breast</li> <li>• Patients consented for the study</li> <li>• No clinical evidence of metastasis</li> </ul>	<ul style="list-style-type: none"> <li>• Patients presenting with early breast carcinoma</li> <li>• Patients presenting with evident metastasis (Stage IV).</li> <li>• Prior chemotherapy/Radiotherapy during first presentation</li> <li>• Patients Unwilling for the study.</li> <li>• Pregnant patients</li> </ul>

# **DATA FORM**

**NAME:**

**AGE/SEX:**

**IP:**

**FNAC:**

**TRUCUT:**

**DIAGNOSIS:**

**T N M**

**CO MORBIDITIES:**

**CHRONIC DRUG INTAKE:**

**BONE PAIN/FRACTURES:**

**RECENT BONE PAIN:**

**DURATION OF BREAST DISEASE:**

**NODES:**

**MAMMOGRAM:**

**U/S BREAST:**

**U/S ABDOMEN:**

**TOTAL BILI**

**mg%**

**SGPT**

**U/L**

**ALP U/L**

**DIRECT BILI**

**mg%**

**SGOT**

**U/L**

**S. calcium**

**mg%**

**PRIOR CHEMOTHERAPY:**

**PRIOR RADIOTHERAPY:**

**X-RAY FINDINGS:**

**CHEST:**

**CERVICAL SPINE:**

**THORACIC SPINE:**

**LUMBPSACRAL SPINE:**

**PELVIS:**

**SKULL:**

**MRI FINDINGS:**

**SPINE:**

**CT FINDINGS:**

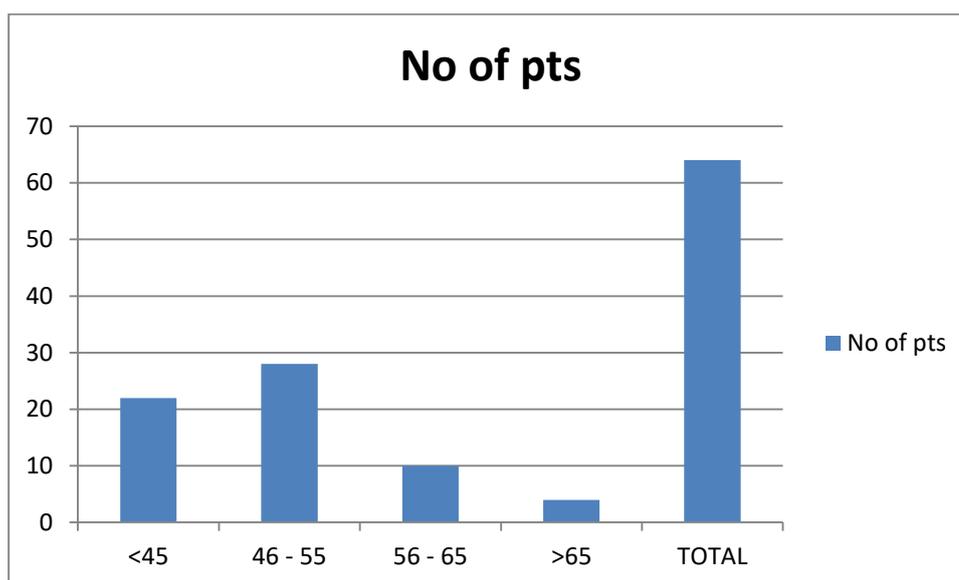
**DL SPINE:**

**SACRAL AND CERVICAL SPINE:**

**REMARKS:**

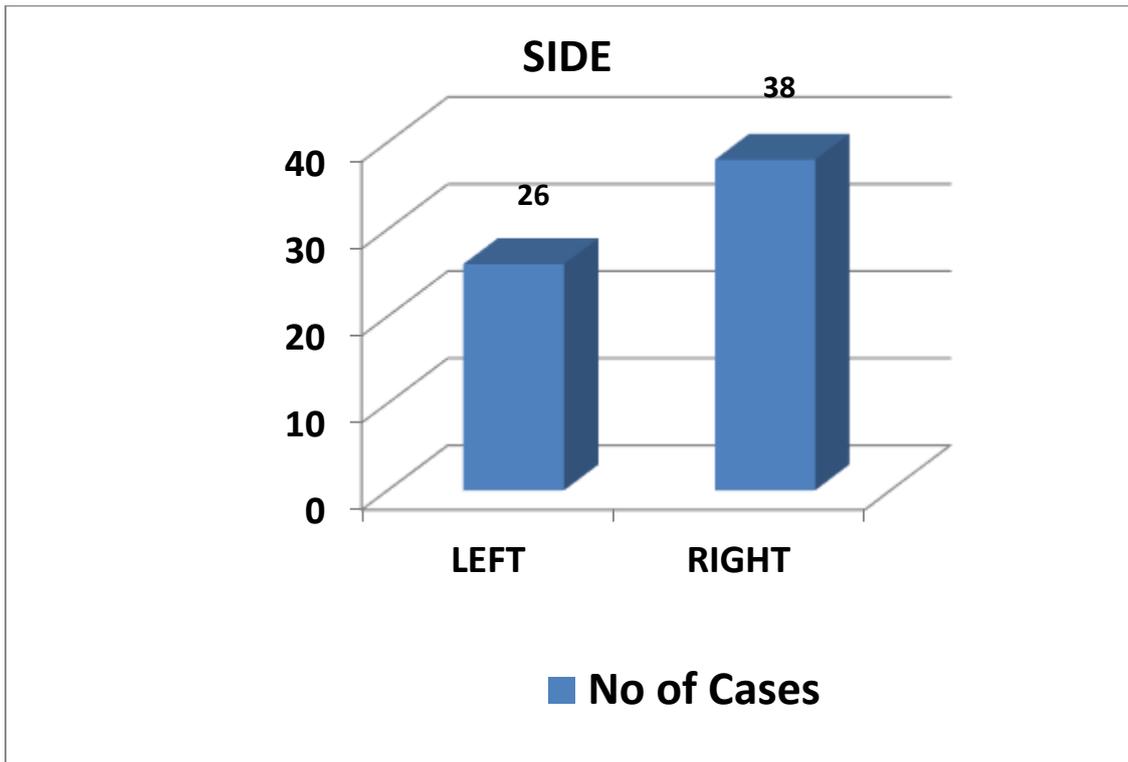
## OBSERVATION AND RESULTS:

64 patients were subjected to the study. All patients underwent both MRI and CT spine. The age distribution is as follows.



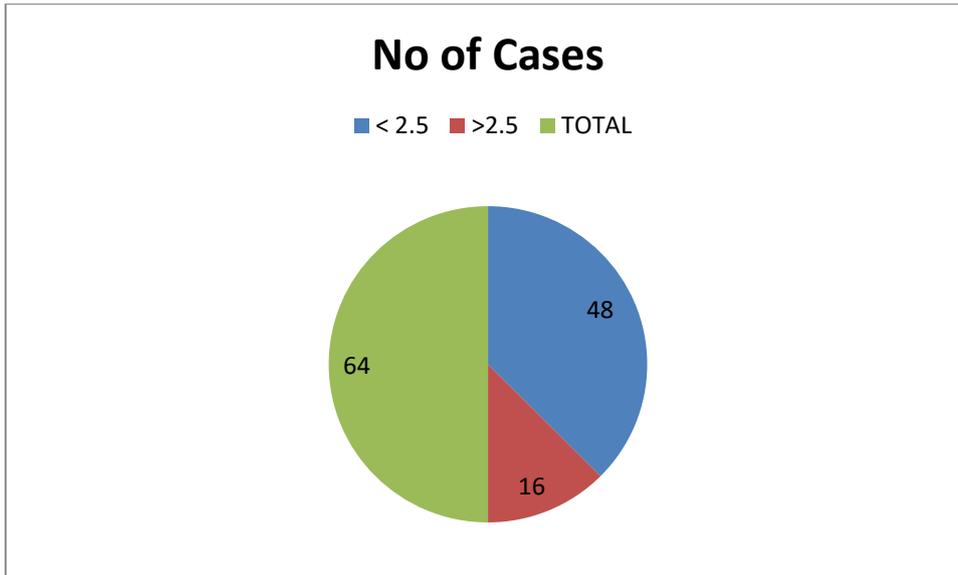
Out of the 64 patients most common age group was <56 years.

AGE	No of pts	%
≤45	22	34.38
46 - 55	28	43.75
56 - 65	10	15.63
>65	4	6.25
TOTAL	64	100.00



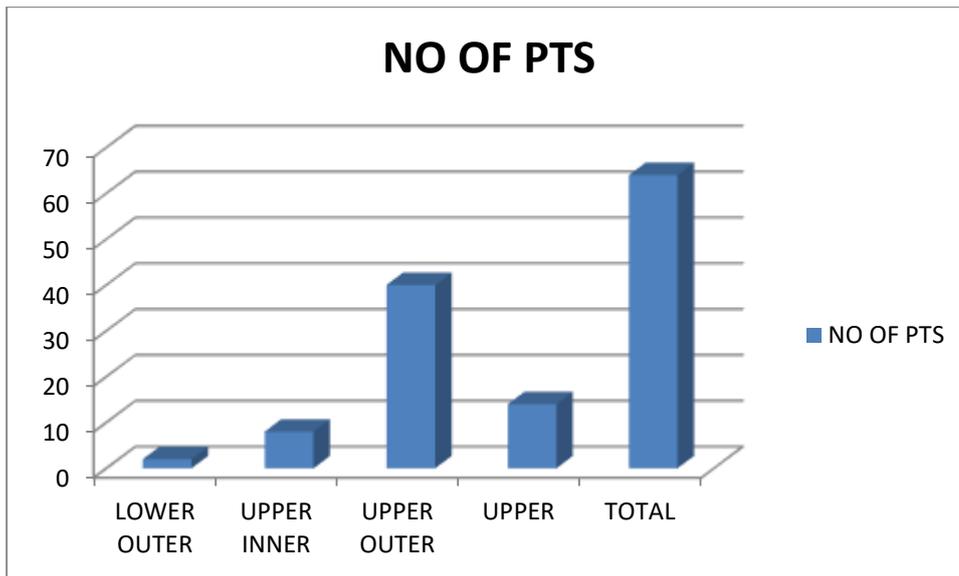
Right sided predominance was seen among our patients keeping in line with the global cues.

SIDE	No of Cases	%
LEFT	26	40.63
RIGHT	38	59.38
TOTAL	64	100.00



The mean duration of presentation of our patients was 2.5 months(0.5-5 months). Hence the patients were categorized accordingly with predominant patients presenting in less than 2.5 months duration.

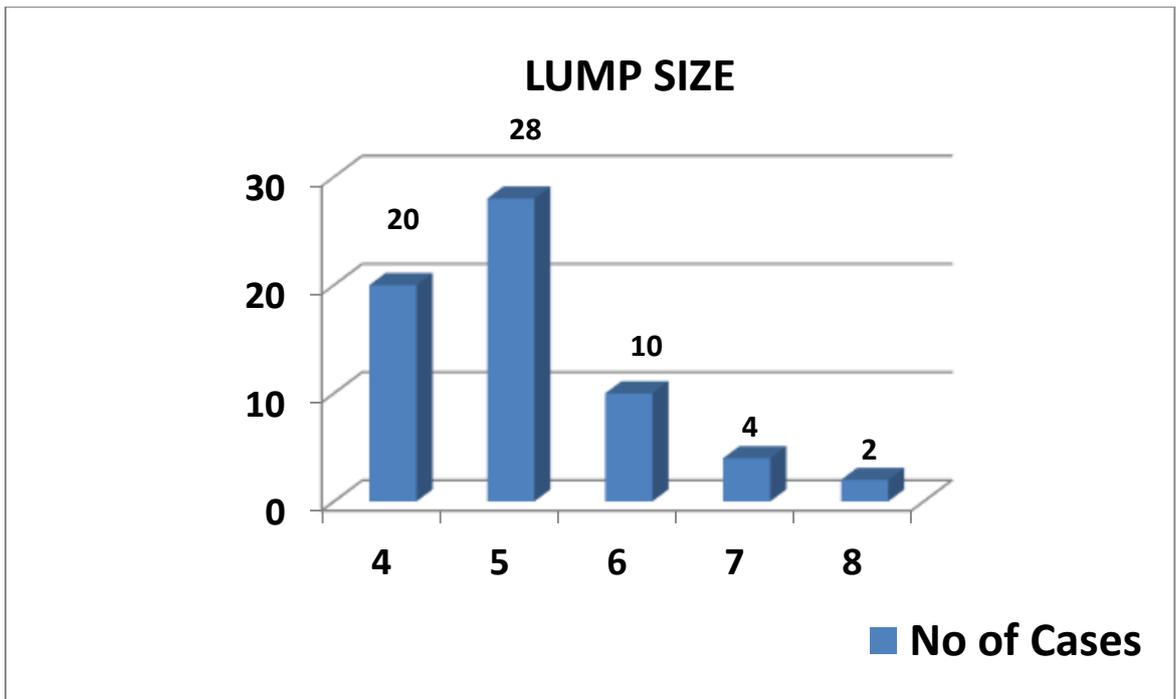
<b>DURATION OF DISEASE (MONTHS)</b>	<b>No of Cases</b>	<b>%</b>
< 2.5	48	75.00
>2.5	16	25.00
TOTAL	64	100.00



As high as 40 patients out of 64 presented with lump in the upper and outer quadrant, the most common quadrant for carcinoma.

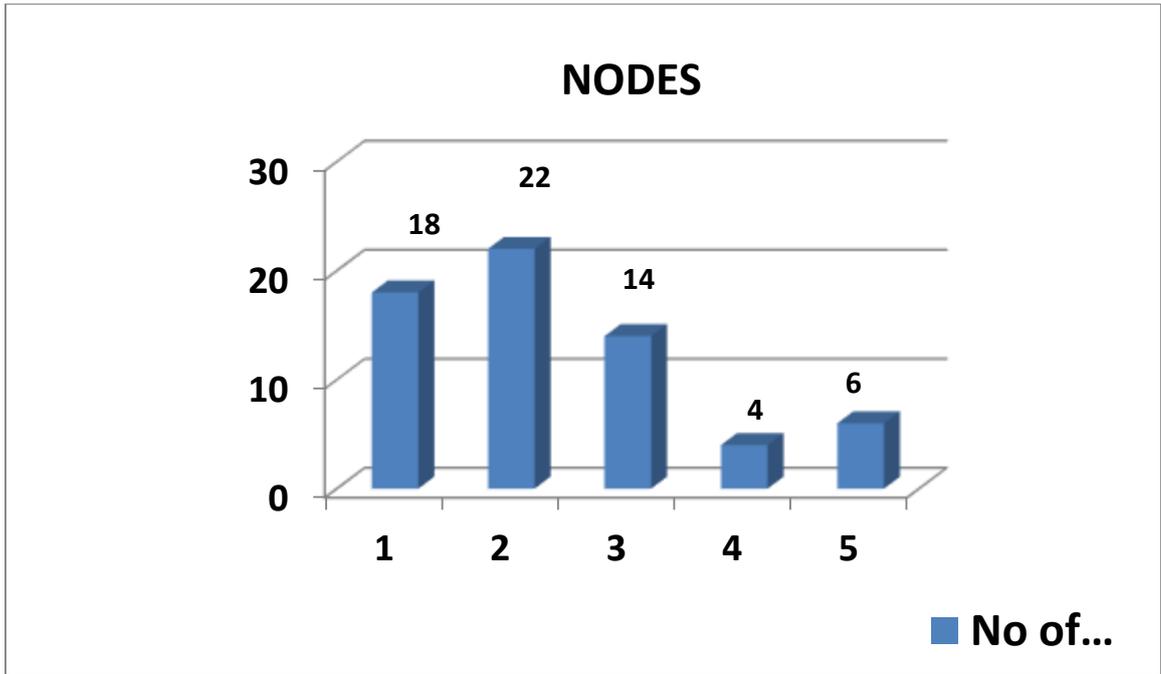
The upper quadrant tops overall.

QUADRANT	NO OF PTS	%
LOWER OUTER	2	3.13
UPPER INNER	8	12.50
UPPER OUTER	40	62.50
UPPER	14	21.88
TOTAL	64	100.00



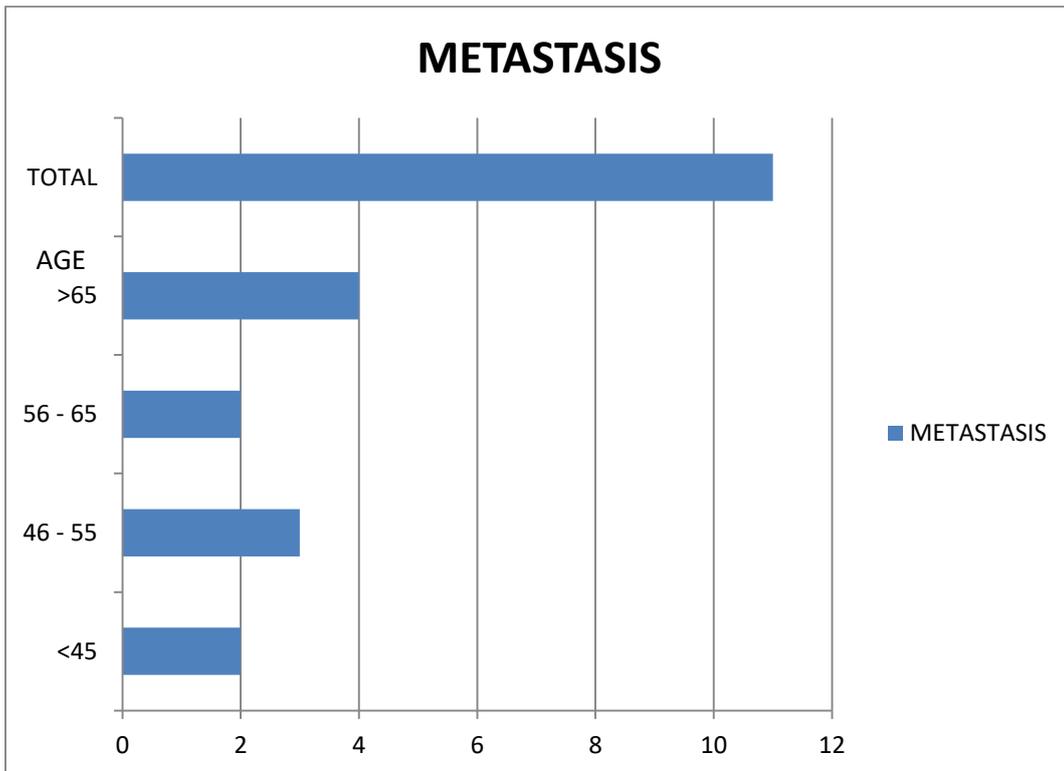
The mean lump size was 5cms (4-8cms).

<b>LUMP SIZE (CM)</b>	<b>No of Cases</b>	<b>%</b>
4	20	31.25
5	28	43.75
6	10	15.63
7	4	6.25
8	2	3.13
<b>TOTAL</b>	<b>64</b>	<b>100.00</b>

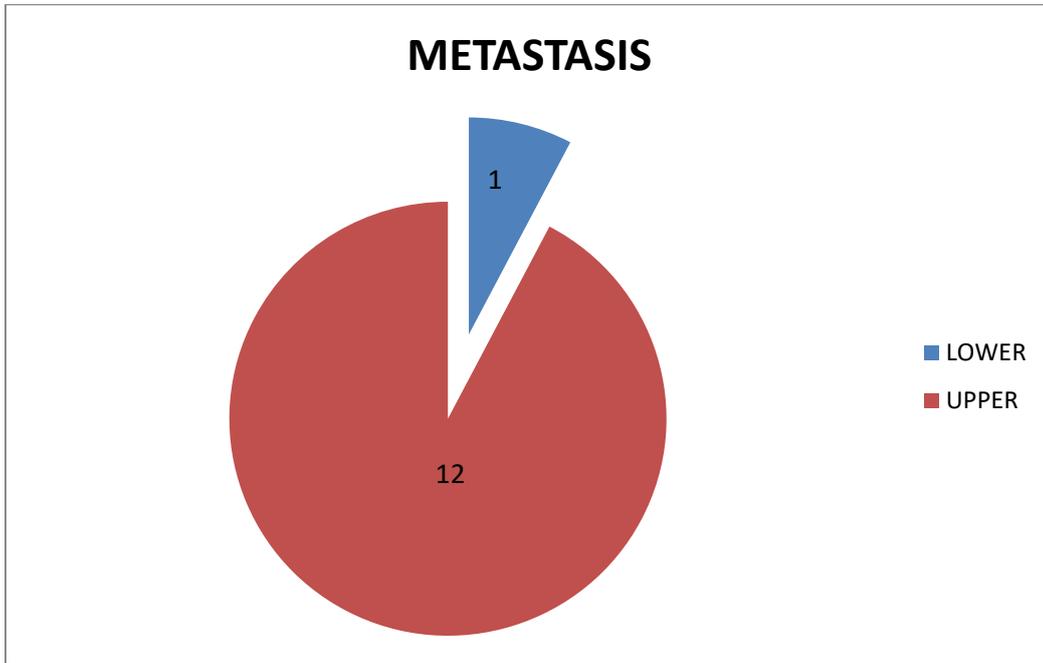


80% patients presented with nodes 3 or less. Almost all patients had clinically palpable nodes.

<b>NODES</b>	<b>No of Cases</b>	<b>%</b>
1	18	28.13
2	22	34.38
3	14	21.88
4	4	6.25
5	6	9.38
<b>TOTAL</b>	<b>64</b>	<b>100.00</b>

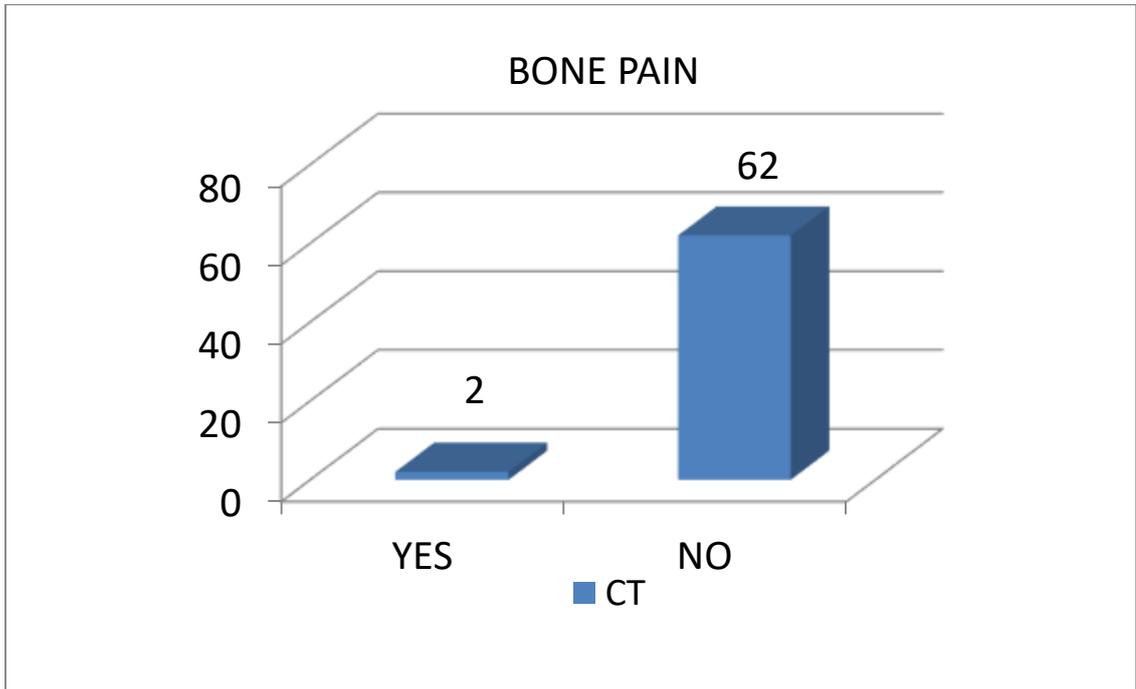


Metastasis was most common in age 46-55yrs. All patients above 65 years had metastasis.

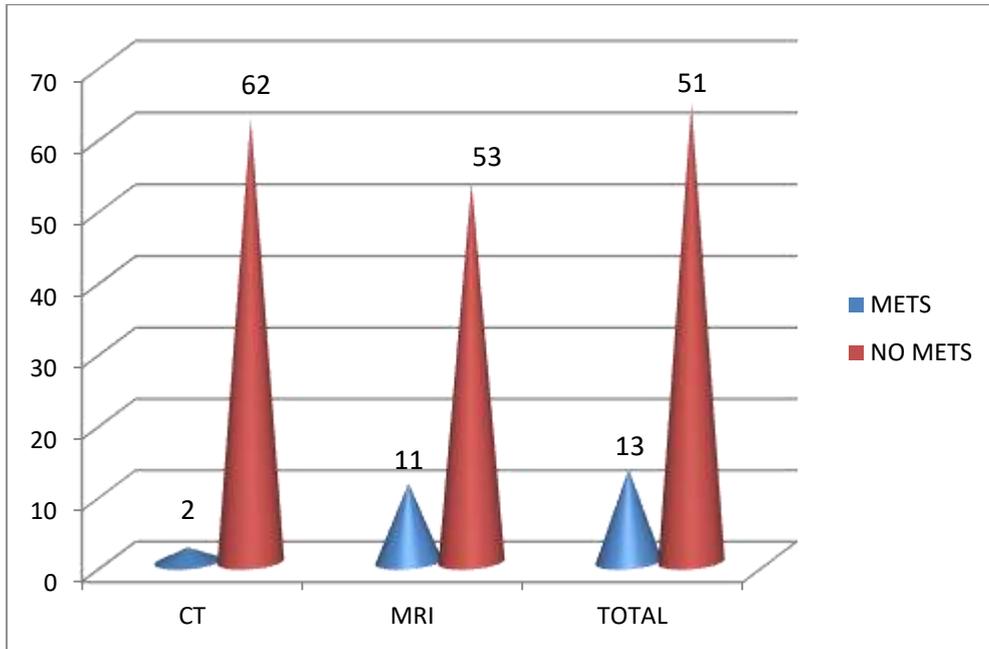


Almost all the patients with metastasis had their primary lump in the upper quadrant except 1 patient who had in lower quadrant.

P value=0.023

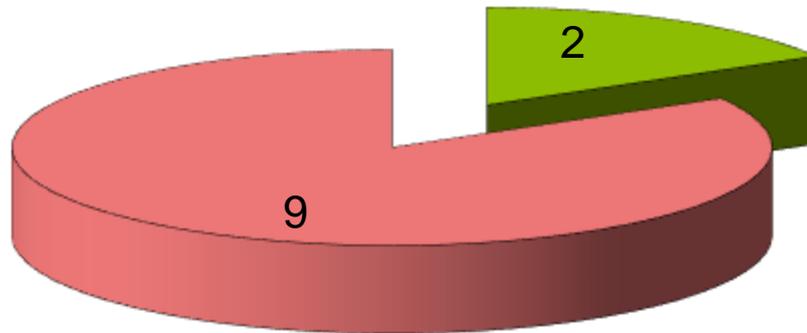


Bone pain was present in only 2 patients whereas 62 patients were asymptomatic at presentation



CT identified metastasis in two patients whereas MRI identified metastasis in 11 patients. The p value is **0.038** (significant).

## DURATION OF DISEASE VS MRI FINDINGS



**p value: 0.042**

**<2.5months =2**  
**>2.5months = 9**

The duration of disease presentation correlated with MRI findings in which 9 patients who had duration of disease more than 2.5 months from presentation had metastasis compared to only 2 patients in the other category. p value is **0.042** (significant).

## DISCUSSION

In our study, MRI was significant in detecting occult spine metastasis compared to plain CT spine.

All patients above the age of 65 had metastasis. However this is statistically insignificant (**p value = 0.72**). The second most common age in which metastasis was detected was 46-55years.

All The patients with spine metastasis had their primary lump in the upper quadrant which is significant (**p value =0.001**)

The lump size had an influence in the metastatic deposits as most patients with spine metastasis had a lump size of >5cms. This was also statistically significant with a **p value of 0.03**

X-Ray skeletal survey failed to detect any patient with metastasis whereas CT detected 2 patients with metastasis.

MRI detected metastasis in 11 patients including the 2 detected by CT. (p value=0.038)

The co morbidities like diabetes and hypertension does not seem to play a role in metastasis. The number of nodes and metastasis showed a wide variation with no specific relation to metastasis.

## **CONCLUSION**

We conclude that MRI of spine is at present the practically best modality of choice in patients with locally advanced breast carcinoma to detect occult metastasis. Hence MRI spine should be incorporated and preferred over CT spine for metastatic work up of patients. Early detection of such occult metastasis can change the patients disease stageing altogether thereby influencing the management modality. With the rapid advancement in medical technologies MRI may further improve in its quality and can emerge as the investigation of choice for spine metastasis.

### **Limitations of the Study:**

The sample size is small. Due to non availability, bone scan couldn't be used to compare MRI findings.

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## MASTER CHART

S.No.	NAME	AGE	SEX	Right/Left	TYPE	DURATION OF DISEASE (MONTHS)	QUADRANT	LUMP SIZE (CM)	NODES	BONE PAIN	STAGE	XRAY	CT DL SPINE	MRI DL SPINE	DM	HTN
1	SUBATHRADEVI	51	F	LEFT	IDC	2	UO	5*3	2	NO	III	NO	NO	NO	NO	NO
2	RAJAMANI	70	F	LEFT	IDC	3.5	UO	4*4	3	YES	III	NO	NO	YES;	YES	NO
3	POTHUM PONNU	40	F	RIGHT	IDC	2	UO	5*4	3	NO	III	NO	NO	NO	NO	NO
4	RAMU	36	F	RIGHT	IDC	2	UI	5*4	5	NO	III	NO	NO	NO	NO	NO
5	SHANTHA	75	F	LEFT	IDC	4	UO	7*5	1	YES	III	NO	NO	YES;	NO	NO
6	JOTHILAKSHMI	43	F	LEFT	IDC	1	UO	5*4	2	NO	III	NO	NO	NO	YES	YES
7	NAGARAMMAL	43	F	RIGHT	IDC	2	UO/UI	5*3	1	NO	III	NO	NO	NO	NO	NO
8	VASANTHA	51	F	RIGHT	IDC	2.5	UO/UI	5*5	3	NO	III	NO	NO	YES;	NO	YES
9	PAPPATHI	49	F	RIGHT	IDC	2.5	UI	4*5	2	NO	III	NO	NO	NO	NO	NO
10	KARUPAYEE	45	F	RIGHT	IDC	2	UO	6*5	3	NO	III	NO	NO	NO	NO	NO
11	VEERAMMAL	40	F	LEFT	IDC	1.5	UI	5*4	2	NO	III	NO	NO	NO	NO	NO
12	SOORAYEE	42	F	RIGHT	IDC	0.5	UO	5*3	4	NO	III	NO	NO	NO	YES	YES
13	PREMA	60	F	RIGHT	IDC	3	UO/UI	5*4	3	NO	III	NO	NO	NO	NO	NO
14	SUDHA	42	F	LEFT	IDC	1	UO	4*3	2	NO	III	NO	NO	NO	NO	NO
15	KURUVAMMAL	50	F	LEFT	IDC	1.5	UO/UI	4*3	2	NO	III	NO	NO	NO	NO	NO
16	MADATHIYAMMAL	53	F	LEFT	IDC	2	UO/UI	6*5	1	NO	III	NO	NO	NO	NO	NO
17	VASANTHA	47	F	RIGHT	IDC	1	LO	4*5	2	NO	III	NO	NO	NO	NO	NO
18	SANTHANA MARY	49	F	LEFT	IDC	0.5	UO	4*4	1	NO	III	NO	NO	NO	NO	NO
19	NAJEEMA	43	F	RIGHT	IDC	1	UO	6*6	2	NO	III	NO	NO	NO	NO	NO

20	SELVI	49	F	RIGHT	IDC	4	UO/UI	7*5	2	NO	III	NO	NO	NO	NO	NO
21	RAKKU	60	F	RIGHT	IDC	3.5	UO	4*5	1	YES	III	NO	NO	YES;	YES	NO
22	MEENA	52	F	RIGHT	IDC	1.5	UO	5*5	2	NO	III	NO	NO	NO	NO	NO
23	LAKSHMI	56	F	LEFT	IDC	2	UI	4*6	3	NO	III	NO	NO	NO	NO	NO
24	BAKIYAM	48	F	RIGHT	IDC	1	UO	5*3	1	NO	III	NO	NO	NO	NO	NO
25	ALAGAMMAL	48	F	RIGHT	IDC	1	UO	6*4	5	NO	III	NO	NO	NO	NO	NO
26	MUTHULAKSMI	53	F	LEFT	IDC	0.5	uo	5*5	1	NO	III	NO	NO	NO	NO	NO
27	petchiammal	40	F	RIGHT	IDC	2	UO	4*6	3	NO	III	NO	NO	NO	NO	NO
28	TAMILARASI	55	F	LEFT	IDC	4	UO	6*8	4	NO	III	NO	NO	NO	NO	NO
29	DHANAM	44	F	RIGHT	IDC	3	UO	5*4	1	YES	III	NO	NO	YES;	NO	NO
30	PONNIAMMAL	65	F	RIGHT	IDC	2	UO	4*5	1	YES	III	NO	NO	NO	NO	NO
31	NAGAJOTHI	47	F	LEFT	IDC	1	UO	5*6	2	YES	III	NO	NO	YES;	NO	NO
32	CHELLAYEE	58	F	RIGHT	IDC	5	UO/UI	8*7	5	NO	III	NO	NO	NO	NO	NO
33	SIGAPPI	60	F	RIGHT	IDC	3.5	UO	4*5	1	YES	III	NO	NO	YES;	NO	NO
34	OCHAMMAL	52	F	RIGHT	IDC	1.5	UO	5*5	2	NO	III	NO	NO	NO	NO	NO
35	SARASWATHI	56	F	LEFT	IDC	2	UI	4*6	3	NO	III	NO	NO	NO	NO	NO
36	PALANI MUTHU	48	F	RIGHT	IDC	1	UO	5*3	1	NO	III	NO	NO	NO	NO	NO
37	AYESHA BEEVI	45	F	RIGHT	IDC	2	UO	6*5	3	NO	III	NO	NO	NO	NO	NO
38	OKKICHI	40	F	LEFT	IDC	1.5	UI	5*4	2	NO	III	NO	NO	NO	NO	NO
39	PACHIAMMAL	42	F	RIGHT	IDC	0.5	UO	5*3	4	NO	III	NO	NO	NO	NO	NO
40	ARASAMMAI	60	F	RIGHT	IDC	3	UO/UI	5*4	3	NO	III	NO	NO	NO	NO	NO
41	UMAYAL	42	F	LEFT	IDC	1	UO	4*3	2	NO	III	NO	NO	NO	NO	NO
42	RANGANAYAKI	50	F	LEFT	IDC	1.5	UO/UI	4*3	2	NO	III	NO	NO	NO	NO	NO
43	FATHIMA	48	F	RIGHT	IDC	1	UO	6*4	5	NO	III	NO	NO	NO	NO	NO
44	PATTU	53	F	LEFT	IDC	0.5	uo	5*5	1	NO	III	NO	NO	NO	NO	NO
45	ALAGU	40	F	RIGHT	IDC	2	UO	4*6	3	NO	III	NO	NO	NO	NO	YES
46	PONNAMMAL	55	F	LEFT	IDC	4	UO	6*8	4	NO	III	NO	NO	NO	NO	NO

47	DHANAM	51	F	LEFT	IDC	2	UO	5*3	2	NO	III	NO	NO	NO	NO	NO
48	POTHUMPONNU	70	F	LEFT	IDC	3.5	UO	4*4	3	YES	III	NO	NO	YES;	NO	NO
49	PECHIAMMAL	40	F	RIGHT	IDC	2	UO	5*4	3	NO	III	NO	NO	NO	NO	NO
50	PACKIALAXMI	36	F	RIGHT	IDC	2	UI	5*4	5	NO	III	NO	NO	NO	NO	NO
51	KANAGAMMAL	53	F	LEFT	IDC	2	UO/UI	6*5	1	NO	III	NO	NO	NO	NO	NO
52	LAKSHMI	47	F	RIGHT	IDC	1	LO	4*5	2	NO	III	NO	NO	NO	NO	NO
53	THOTICHI	49	F	LEFT	IDC	0.5	UO	4*4	1	NO	III	NO	NO	NO	NO	NO
54	PANGAJAM	43	F	RIGHT	IDC	1	UO	6*6	2	NO	III	NO	NO	NO	NO	NO
55	RASATHI	49	F	RIGHT	IDC	4	UO/UI	7*5	2	NO	III	NO	NO	NO	NO	YES
56	MUNIAMMAL	44	F	RIGHT	IDC	3	UO	5*4	1	YES	III	NO	NO	YES;	NO	NO
57	CHELLAM	65	F	RIGHT	IDC	2	UO	4*5	1	YES	III	NO	NO	NO	NO	NO
58	JEGADHEESWARI AMALORPAVA	47	F	LEFT	IDC	1	UO	5*6	2	YES	III	NO	NO	YES;	NO	NO
59	MARY	58	F	RIGHT	IDC	5	UO/UI	8*7	5	NO	III	NO	NO	NO	NO	NO
0	ANJALAI	75	F	LEFT	IDC	4	UO	7*5	1	YES	III	NO	NO	YES;	NO	NO
61	BARGATH NISHA	43	F	LEFT	IDC	1	UO	5*4	2	NO	III	NO	NO	NO	NO	NO
62	RUKKU	43	F	RIGHT	IDC	2	UO/UI	5*3	1	NO	III	NO	NO	NO	NO	NO
63	CHINNIAMMAL	51	F	RIGHT	IDC	2.5	UO/UI	5*5	3	NO	III	NO	NO	YES;	YES	NO
64	VEERAYEE	49	F	RIGHT	IDC	2.5	UI	4*5	2	NO	III	NO	NO	NO	NO	NO

# ETHICAL COMMITTEE CERTIFICATE



**MADURAI MEDICAL COLLEGE**  
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## **ETHICS COMMITTEE CERTIFICATE**

Name of the Candidate : Dr.Govindaraj D

Course : PG in MS., General Surgery

Period of Study : 2016-2019

College : MADURAI MEDICAL COLLEGE

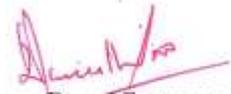
Research Topic : Comparative study on CT vs  
MRI in detecting bone  
metastasis in patients with  
locally advanced breast  
carcinoma

Ethical Committee as on : 23.01.2018

The Ethics Committee, Madurai Medical College has decided to inform  
that your Research proposal is accepted.

  
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This is to certify that this dissertation titled , **“PROSPECTIVE STUDY COMPARING CT vs MRI SPINE IN DETECTING OCCULT SPINE METASTASIS IN PATIENTS WITH LOCALLY ADVANCED BREAST CARCINOMA”** of the candidate **Dr.D.GOVINDARAJ** with registration number **221611109** for the award of **MS degree** in the branch of **GENERAL SURGERY**. I personally verified the urkund.com website for the purpose of plagiarism check. I found that the uploaded thesis file containing from introduction to conclusion pages shows 4% of plagiarism in the dissertation.

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