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Prospective Cross sectional study of Radio-Pathologic correlation of soft tissue tumors in patients evaluated at Tikur Anbessa specialized hospital and St Paul millennium medical college, Addis Ababa University, Addis Ababa, Ethiopia, 2019

Principal Investigator: Dr. Samuel Tadesse (MD, Radiology Resident)

A thesis report for preparation of senior paper to be submitted to the radiology department, college of health science, Addis Ababa University in preparation for partial fulfillment of the requirements for the post graduate study in radiology.

ADDIS ABABA, ETHIOPIA

August, 2019

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LIST OF ABBREVIATIONS

AJR=American journal of radiology

CHS - College of Health Science

CT =Competarized Tomography

Gd-DTPA=Gadolinium diethylenetriamine penta-acetic acid

IR= Inversion recovery

MRI= Magnetic Resonance Image

NPV=Negative predictive value

NVB= Neurovascular bundle

PPV=Positive predictive value

SE= Spin Echo

SI= Signl Intensity

STT= Soft tissue tumors

TASH - Tikur Anbessa Specialized Hospital

T1W MRI = T1 Weighting Magnetic Resonance Imaging

T2WMRI= T2 Weighting Magnetic Resonance Imaging

U/S= Ultrasound

ABSTRACT

Introduction: Soft tissue is the supportive tissue of various organs and the non-epithelial, extra skeletal structures exclusive of lympho-hematopoietic tissues. It includes fibrous connective tissue, adipose tissue, skeletal muscle, blood/lymph vessels, and the peripheral nervous system. Most soft tissue tumors are classified as ether benign and malignant there are also intermediate groups implying aggressive local behavior with low to moderate probability for metastasis. Soft tissue tumors are classified histologically on the basis of the adult tissue they resemble.

Objective: Assessment of radio-pathologic correlation of soft tissue tumors in patients evaluated at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia 2019.

Method: The study was conducted at TASH from May 2018-January 2019. Hospital based prospective cross sectional study was conducted at TASH to address the specific objective during study period. The Study was conducted among patients being evaluated at Tikur Anbessa Specialized Hospital oncology department who have both MRI and pathology result during study period. Data was collected by evaluating the MRI report and biopsy result from oncology department and also using structured questionnaires. The data was checked for clarity and completeness. Computerized data analysis was conducted by using SPSS version 25 software.

Result: Total of 73 cases evaluated with 60% malignant. The sensitive MRI parameters for malignancy are size >5cm (91%), necrosis (82%), bone involvement (80%). The specific MRI parameters include age>25yr (86%), necrosis (78%), heterogeneous enhancement (75%). From all the MRI parameters only necrosis had significant correlation with malignancy on imaging in our study.

Conclusion: The most sensitive and specific MRI parameter to predict malignancy in our study are size > 5cm, necrosis, heterogeneous enhancement. Necrosis had significant correlation for malignancy.

CHAPTER ONE

1. INTRODUCTION

1.1. BACKGROUND

Soft tissue is the supportive tissue of various organs and the non-epithelial, extra skeletal structures exclusive of lympho-hematopoietic tissues. It includes fibrous connective tissue, adipose tissue, skeletal muscle, blood/lymph vessels, and the peripheral nervous system. Soft tissue tumors constitute a large and heterogeneous group of neoplasms. Soft tissue tumors arise from twelve (12) different categories of tumor types, with each subdivided into benign, intermediate (locally aggressive, rarely metastasizing), and malignant subtypes (1).

These twelve categories include Adopcytic, Fibroblastic, so called fibro histiocytic, smooth and skeletal muscles, Peri-vascular, chondro-osseous, tumor of uncertain differentiation ,Gastrointestinal tumors, Peripheral nerve sheath tumors(PNST),Undifferentiated tumors with the last 3 categories are newly included in the recent 2013(4^{th}) edition WHO revised classification.(2)

The large majority of soft tissue tumors are benign, with a very high cure rate after surgical excision. Malignant mesenchymal neoplasm's contribute to less than 1% of the overall human burden of malignant tumors but they are life threatening and may pose a significant diagnostic and therapeutic challenge since there are more than 50 histological subtypes of STS, which are often associated with unique clinical, prognostic and therapeutic features (3).

Most soft tissue tumors are classified as ether benign and malignant there are also intermediate groups implying aggressive local behavior with low to moderate probability for metastasis. Soft tissue tumors are classified histologically on the basis of the adult tissue they resemble. Benign soft-tissue lesions outnumber their malignant counterparts by a factor of 100:1, but many are small and superficial and do not lead to imaging or biopsy. The annual clinical incidence of benign soft-tissue tumors is estimated at 300 per 100,000 (4). Soft tissue sarcomas are estimated to represent 1% of malignant tumors. The incidence of soft-tissue sarcoma revealed a rate of 2.7 cases per 100,000.4 The incidence of soft-tissue sarcoma increases significantly with age, and in patients 80 and older is 8 per 100,000 (5).

The radiologic evaluation of soft tissue masses has changed dramatically within the last two decades. Before the advent of computer-assisted imaging, assessment of soft-tissue masses was usually limited to radiographs. The emergence of CT improved this situation dramatically. Masses could be not only delineated with great confidence but are well-staged with excellent depiction of anatomic detail. However, diagnosis remained problematic, with images sufficiently characteristic to suggest the correct histology in only a minority of cases (4).

The initial imaging of patients with soft tissue tumor must be of the highest possible quality to afford the patient optimal care in terms of suggesting the diagnosis, staging the lesion, determining the biopsy site, and providing ultimate treatment (1). For this reasons the introduction of MR imaging was met with great enthusiasm because of the markedly improved soft-tissue contrast and multi-planar image acquisition capabilities. MRI is the modality of choice when it is used in conjunction with a systematic approach, one can correctly diagnose most masses.MR imaging has emerged as the preferred modality for evaluating soft-tissue lesions by providing superior soft-tissue contrast, it allows multi-planar image acquisition, obviates iodinated contrast agents and ionizing radiation, and finally is devoid of streak artifacts which is commonly encountered with CT (4).

To attain the goal of optimal treatment of patients with a soft-tissue mass, the radiologist must initially play an active role in imaging the patient and then must produce a report that identifies each of the features the clinician needs to form a reasonable plan of treatment. The radiologist can add value to the report by recommending the biopsy site that is most likely to yield representative tissue and the biopsy site should be that location where the lesion appears most aggressive (3).

Despite the superiority of MR imaging in delineating soft-tissue tumors, it remains limited in its ability to precisely characterize. Consequently, a correct histologic diagnosis is reached solely on the basis of MR imaging studies in only 25–35% of cases (4).

Soft-tissue lesions are frequently encountered by radiologists in everyday clinical practice. Characterization of these soft-tissue lesions remains problematic, despite advances in imaging. By systematically using clinical history, lesion location, mineralization on radiographs & signal intensity characteristics on magnetic resonance images, one can determine the diagnosis for the subset of determinate lesions that have characteristic clinical and imaging features and narrow the differential diagnosis for lesions that demonstrate indeterminate characteristics.

If a lesion cannot be characterized as a benign entity, the lesion should be reported as indeterminate, and the patient should undergo biopsy to exclude malignancy (1).

1.2 STATEMENT OF THE PROBLEM AND SIGNIFICANCE OF STUDY

Malignant soft tissue tumor comprises 1% of all malignancy but constitute for 2% of deaths from malignancy suggesting the lethal nature of these tumors (1).

Despite the initial fervor for the superiority of MR imaging in assessing soft-tissue tumors, MR imaging remains relatively limited in its ability to precisely characterize these tumors, with a correct histologic diagnosis reached on the basis of imaging studies in only approximately one quarter to one third of cases. Many sarcomas are poorly differentiated and, consequently, lack the microscopic features required to make a specific diagnosis. In such cases, immune-histochemical stains have aided pathologists in identifying their pattern of differentiation, allowing accurate classification. Despite the pathologist's best efforts, however, approximately 5–15% of soft-tissue sarcomas cannot be further classified (4).

As we all know MRI scanners have become widely available in developed countries however in developing countries like Ethiopia MRI is available in few centers. The objective of preoperative MRI of a soft tissue lesion is to maximize the information gained with the least amount of patient time and discomfort and also MRI series that are not useful are expensive for everyone MRI room time is costly, as is the radiologist's time required to review every series. The patient's discomfort from extended scanning time is also a factor, so this research also aims in identifying which patients to scan with MRI and also to have a general imaging protocol for patients with soft tissue tumors.

An important factor in the treatment planning of Soft tissue tumors is the accuracy of pre-therapeutic staging, so cross sectional imaging play great role for staging and this study will try to outline the role of radiologist in these patients.

Investigation and treatment of patients with soft tissue tumor needs strong cooperation between the treating clinician, radiologist and pathologist, this study will try to show the role of biopsy in these patients based on the correlation between the imaging appearance and biopsy results. There is also no research done, as per the knowledge of the principal investigator on this topic in our country so it can be used as base for the future research in this untouched territory of MSK.

CHAPTER TWO

2. LITERATURE REVIEW

As it has been said in the introduction the introduction of cross sectional imaging particularly MRI has revolutionized the knowledge and treatment plan of patient with soft tissue tumor. There are different researches done to evaluate the importance of MRI in evaluation of soft tissue tumors

A prospective research conducted on 548 untreated and proven STT or tumor-like lesions to study the Accuracy of MRI in characterization of soft tissue tumors and tumor-like lesions showed: From the 548 patients, 123 patients presented with a malignant STT and 425 patients presented with a benign one. Concerning phenotype characterization (type of tissue from which the tumor arises) , based on MRI diagnosis for benign lesions, showed sensitivity of 75%, specificity of 98%, NPV of 98%, PPV of 76% and accuracy of 97% were obtained. The phenotype's definition of malignant STT had a sensitivity of 37%, a specificity of 96%, NPV of 96%, PPV of 40% and an accuracy of 92% (6).

Since MRI can accurately depict the anatomic spaces ad compartment involved by the tumor using 3 different planes, RI has an additional value in local staging and this is well studies and seen in study published on AJR(7).

There are different studies done to compare the two cross sectional studies available for patients with STT mainly CT versus MRI

A study done by Petasnick and his colleagues on Soft-tissue masses of the locomotor system by comparing MR imaging with CT where they evaluated 35 patients and compared them for image contrast, demonstration of bone destruction, and display of extent and anatomic relationships of the masses. MR was better than CT in demonstrating size and extent of most tumors and their relationships to vascular and nonvascular structures due to its superior inherent image contrast and its ability to provide direct sagittal and coronal images. However, bone destruction was more difficult to see with MR. Except for fatty tumors, MR was not helpful in identifying tissue type. The Study concluded that MR is superior in evaluating soft-tissue masses of the locomotor system and CT is needed when bone involvement is suspected (8).

Another similar prospective study was also done in 20 patients with extremity soft tissue tumors to compare MRI & CT scans by Change and his colleagues. They evaluated tumor relationship with major neurovascular, skeletal structures and contrast difference between tumor muscle and vessels. They found that MRI is superior to CT in the above mentioned parameters in tumor relationship with neurovascular (80% and 70%, respectively) and skeletal (80% and 75%, respectively). Only CT and MRI were comparable in demonstrating contrast between tumor and fat. Their conclusion was MRI offer several advantage over CT in evaluation of extremity STT (9).

A paper published in skeletal radiology done by Hudson and his colleagues by comparing MRI and CT imaging of 31 patients with bon and STT. They found that MRI is superior in delineating bone tumor from adjacent muscle, and in showing the relationships to bone in deep seated STT. When it comes to delineating margin of most STT and bone tumors from fat an adjacent bone both MRI and CT are equally effective(10).

When comparing MR and CT in determining the extent of disease in patients with soft tissue sarcoma a prospective study was done by Demas and his colleagues published in AJR. The study was carried out in 40 patients who had histologically proved soft tissue sarcomas of the extremities. With regards to measuring maximal tumor diameter, detecting tumor depth and tumor delineation, and relationship with adjacent structures. Evaluation of anatomic compartment and individual muscle involvement was more accurately accomplished with MR imaging; nine (23%) of 40 MR studies showed tumor involvement of one or more individual muscles that appeared normal in CT scans. These results suggest that MR imaging may be the staging procedure of choice in patients with soft-tissue sarcomas of the extremities (11).

Once we have seen the importance and differences of these two cross sectional studies in STT there will be some questions to consider the importance of MRI in differentiating benign from malignant STT ,Several studies have been done to answer this question as differentiating the two is crucial in patients treatment.

One study done by Brequist and his colleagues suggested that MR imaging can differentiate benign from malignant masses in more than 90% of cases on the basis of the morphology of the lesion by studying 95 STT lesions. From the 95 cases 50 were benign and 45 malignant. The specificity and accuracy of diagnosis averaged 90% for both benign and malignant lesions. Negative predictive value for malignancy averaged 94% .In the study Criteria used for benign lesions included smooth well-

defined margins, small size, and homogeneous signal intensity, especially on T2- weighted MR images. Their conclusion was MRI is the technique of choice for characterizing STT and in majority of cases benign or malignant nature of mass can be determined. (12).

Malignancies, by virtue of their very nature and potential for autonomous growth, are generally larger and more likely to outgrow their vascular supply with subsequent infarction, necrosis, and heterogeneous signal intensity on T2-weighted spin-echo MR imaging. Consequently, the larger a mass is the greater its heterogeneity, the greater is the concern for malignancy. In one of large sample size study done by Olaf Myhre-Jense included 1331 benign STT in a consecutive 7yr series and compared it with 72 sarcoma cases detected in the same period. They found that most benign STT were small size (<5cm). Only 5% exceeded 5cm in diameter, and >50% malignant cases were large i.e. >5cm in diameter. All benign STT were located superficially. In addition most malignant tumors are deep seated with only 1% benign STT located deep. The study concluded that the two factors to discriminate benign from malignant are tumor size and location (13).

Another retrospective study of 83 STT using MRI to differentiate between benign and malignant done by Crime and his colleagues using 2 readers. The mean sensitivity for benign and malignant cases was 50% and 80% respectively. Tumor margin, SI, size, NVB encasement and bone invasion were all reliable to differentiate from benign and malignant in this study. Majority of malignant and benign masses has heterogeneous SI and irregular border. The study concluded that main value of MRI in STT is to evaluate true extent of and biopsy is requested in moss masses to differentiate between benign& malignant cases (19).

De Schepper et al. performed a multivariate statistical analysis of 10 imaging parameters, in 141 STT. Total of 141 soft tissue tumors (84 benign, 57 malignant)were evaluated by wide variety of MRI features (size, margins, signal homogeneity, shape, signal intensity, neurovascular and bone involvement, degree and pattern of enhancement and evidence of necrosis after injection of Gd-DTPA. Malignant lesions predominantly had partially irregular (54%) or irregular (26%) margins, while the majority of benign lesions had well-defined (55%) or partially irregular (26%) borders. Although homogeneous signal intensity on both T1 and T2 weighted sequences was Seen in 41 and 25% of benign lesions, respectively, a large number presented with some in-homogeneity (33 and 42%) or were obviously inhomogeneous (26 and 33%). On the contrary, malignant lesions were rarely homogeneous on T1-weighted images (10%) and almost never on T2 (5%) Neurovascular encasement or bone

involvement was seen in 33% of malignant and 6% of benign lesions. For both groups of lesions, no predominant Pattern of enhancement was observed after administration of Gd-DTPA and both showed moderate or strong enhancement pattern. Evidence of necrosis was noted in 29 cases (31 %). The overwhelming majority of them (98%) were malignant. These researchers concluded that malignancy was predicted with the highest sensitivity when a lesion had high signal intensity on T2-weighted MR images, was larger than 33 mm in diameter, and had heterogeneous signal intensity on T1-weighted MR images. Signs that had the greatest specificity for malignancy included tumor necrosis, bone or neurovascular involvement, and mean diameter of more than 66 mm (15).

Gadolinium-enhanced imaging has also been proposed as useful in differentiating benign and malignant soft-tissue lesions, with malignant lesions showing a greater enhancement as well as a greater rate of enhancement (16). But one study done by Benedikt and his colleagues to assess the role of contrast enhancement in MRI imaging of STT. They evaluated 30 cases (22 benign, 8 malignant) with 3 enhancement pattern. Homogeneous (11% benign, 25% malignant), Inhomogeneous (61% benign, 75% malignant), peripheral (28% benign, no malignant). The study concluded benign and malignant STT could not be differentiated solely on the basis of enhancement pattern (16).
Similar study in assessing the Contrast enhancement pattern of STT in study done by Gruber and his colleagues showed promising result. They studied 255 STT cases with 4 enhancement pattern and found absent or homogeneous Contrast enhancement was specific for benign (96%) and in homogeneous contrast enhancement pattern was moderately specific for malignancy (54%) (26)

Once the patient is imaged the next step would be biopsy to help in reaching specific diagnosis of STT. Histologic grade is considered to be the most important prognostic parameter for the initial management of soft tissue sarcomas (17).

A study done in 215 Archived cytologic report cases from 2009 up to 2015 of which 157 were malignant 16 were suspicious and 42 were benign. They found that CNB is a reliable modality for evaluating soft tissue neoplasm's, with high histologic concordance rate (96.9%) in correctly diagnosing STT as malignant. The sensitivity and specificity of CNB was 98.5% & 87.5%. (18).

A study done in Department of Radiology, Innsbruck Medical University, Austria To assess technical and lesion related factors affecting the quality of ultrasound guided core needle biopsy (CNB)of 223 musculoskeletal soft tissue tumors the findings were Overall diagnostic yield was 94.6%. The most important aspects to achieve constant high quality results with ultrasound guided CNBs in the work-up of musculoskeletal STT are expertise concerning identification and targeting of viable tumor components and strict adherence to a quality controlled biopsy procedure. Once this is achieved, technical factors have almost no effect on the quality of CNB (20).

Surprisingly U/S has a role in patient's evaluation and it has been studied to correlate well with histologic findings. A prospective study consisting of 57 patients with palpable soft tissue tumor were studied both by radiologist and pathologists for comparison. The findings were the echo texture of the soft tissue tumor correlates well with the cellular distribution and arrangement: the greater the number of cells and the more regular their arrangement as seen histologically, the greater is the hypo echogenicity on U/S. The echogenicity of the STT also correlated well with the presence of fat cells, hemorrhage, cartilage, and osteoid tissue all of which cause an increase in echogenicity (21).

CHAPTER THREE

3. OBJECTIVES

3.1 GENERAL OBJECTIVE

- To assess Radio-Pathologic correlation of soft tissue tumors in patients evaluated at Tikur Anbessa Specialized Hospital and St Paul millennium medial collage, Addis Ababa, Ethiopia.

3.2 SPECIFIC OBJECTIVES

- To assess role of imaging (MRI) to differentiate benign and malignant soft tissue tumors.
- To assess degree of coherence between MRI parameters and pathology.
- To describe the general imaging feature of both benign and malignant soft tissue tumors

CHAPTER FOUR

4. METHODS AND MATERIALS

4.1 Study area and period

The study was conducted at TASH and St Paul millennium medical college, Addis Ababa Ethiopia. TASH is located in the nation's capital Addis Ababa and is the largest referral as well as a main teaching hospital in Ethiopia. The hospital provides a tertiary level referral treatment with 24hrs emergency services. St Paul millennium medical collage was started in Ethiopian millennium (12yrs) with vastly growing service for the health care system. The study was conducted from May2018 – January 2019G.C

4.2 Study design

Prospective cross sectional Hospital based study was employed.

4.3 Population

4.3.1 Source population

The source population was all patients with soft tissue tumor who are being evaluated during the specified study period.

4.3.2 Study population

The study population was all patients with soft tissue tumor who have both pathology and MRI image and report being evaluated at Oncology department in TASH and St Paul during study period.

4.3.3 Inclusion and exclusion criteria

4.3.3.1 Inclusion criteria

All patients with Soft tissue tumor having both pathology and MRI imaging or report during the study period.

4.3.3.2 Exclusion criteria

All patients with soft tissue tumor having pathology or MRI imaging /report during the study periods.

4.4 Sampling technique and sample size

Since our total population is very small we used non probability convenience sampling technique. We selected all patients with soft tissue tumor having both MRI imaging or report and Histo-pathologic result during the study period were included in the study.

4.5 Study variables

4.5.1 **Dependent variable**:

- MRI report (benign and malignant)

4.5.2 Independent variables:

- Socio-demographic characteristics
- Adjacent bone or joint involvement
- Adjacent NVB encasement
- Signal Intensity (T2)
- Size of the lesion
- ADC and DWI
- Post contrast enhancement pattern
- Necrosis

4.5 Data collection

Data was collected by the principal investigator using structured questionnaire. Patient's chart was identified from the oncology clinics registry archives. The MRI images, report including histopathology result were reviewed by the principal investigator. Using the questionnaire, data was retrieved and filled

4.6 Data quality control

In order to evaluate the clarity of the questionnaire, validity of the instruments and after the pretest, the findings and observations obtained was used to modify the questionnaire and the data collection process accordingly

4.7 Data analysis and interpretation

The data were entered into Epi-Info (version 7) then exported to Statistical Product and Service Solutions (SPSS) (version 25) to prepare and organize data for cleaning and analysis to test significance levels between variables at 0.05% level of significance. Data were also analyzed using binary logistic regression analysis. The finding of the study were reported on the basis of objectives.

4.8 Ethical considerations

In order to respect patient's right, and the regulation of the hospital where the study was conducted, ethical considerations was taken in to account. Any piece of information was kept confidential by not recording names of patient. Written formal letter was obtained from the respective authorities and formal letter was written from radiology department to Oncology department before commencing the data collection process.

CHAPTER SIX

5. Result

Socio demographic characteristics

A total of 73 participants were investigated with age range from 4-75 year with mean age of 33.4yr. Majority of the participants 43 (58.9%) in the study are in the age group between 25 – 64 years of age. From all clients 38 (52.3%) of them were male with approximate male to female ratio of 1:1. In Both sexes malignant soft tissue tumor cases predominate benign cases (malignant in male and female each 24/33% and 21/29% respectively.)

Table 2 socio demographic characteristics of all clients with soft tissue tumor at Tikur Anbessa& St Paul Hospital, May 2018-May 2019 G.C

Variables		Sex					
		Female		Male		Total	
		No	%	No	%	No	%
Age in years	0 -14 years	1	1.4 %	2	2.7 %	3	4.1 %
	15 – 24 years	10	13.7 %	14	19.2 %	24	32.9 %
	25 - 64 years	24	32.9 %	19	26 %	43	58.9 %
	>65 years	0	0 %	3	4.1 %	3	4.1 %
	Total	35	47.9 %	38	52.1 %	73	100 %

From all clients who participate in this study 71 (97 %) of them came with the clinical presentation of swelling in there extremity with 40% presenting in between 1 to 5yr duration of symptom. One case presented with epistaxis who had nasal Angiofibroma. The patient who presented with lower limb weakness had intra-Dural extra-medullary mass involving the cervical cord which turned out to be Low grade peripheral nerve sheath tumor on excisional biopsy.

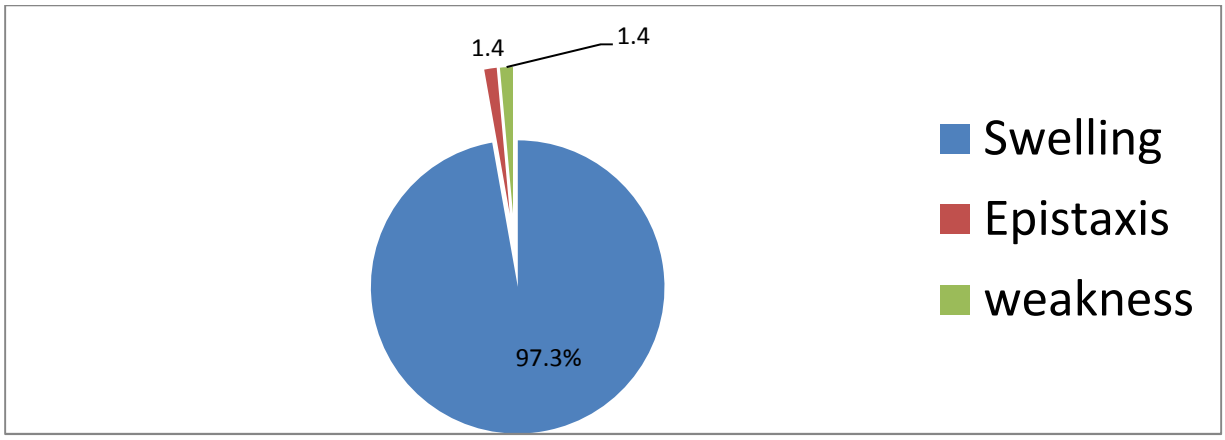


Figure 3 clinical presentation of All the clients with STT in Tikur Anbessa &St Paul Hospital, May 2018-May 2019 G.C

Table 2 Distribution based on Location of all STT detected by MRI at Tikur Anbessa & St Paul Hospital, May 2018-2019G.C

Location		Biologic behavior					
		Benign		Malignant		Total	
		No	%	No	%	No	%
Specific Location	**Lower extremity**	15	20 %	23	31 %	38	52 %
	Upper extremity	10	14 %	6	8 %	16	22 %
	Pelvis	0	0 %	3	4 %	3	4 %
	Abdomen	0	0 %	2	3 %	2	3 %
	Head &Neck	1	1%	3	3 %	4	6 %
	Genital	0	0%	5	7%	5	7%
	Vertebra	1	1%	2	3%	3	4%
	Spinal cord	1	1%	0	0%	1	1%
	Axilla	0	0%	1	1%	1	1%
	Total	28	38%	45	62%	73	100%

The most commonly involved locations by the soft tissue tumors were lower extremity 38/73(52%) followed by upper extremity 16/73(22%) and genital area 5/73(7%). The Common location for benign soft tissue tumors is still lower extremity 15/28(53%) which is also true for malignant tumors 23/45(52%) followed by upper extremity 10/28(35%) for benign and 16/73(22%) for malignant

tumors. Malignant tumors predominate when they are located in the abdomen and pelvis, head and neck, Genital and vertebra region. The Commonest benign mass involving the extremity are benign PNST (8cases), lipoma and hemangioma (each 5 cases) and the commonest malignant extremity mass include Undifferentiated pleomorphic sarcoma(5cases) followed by synovial sarcoma and undifferentiated High grade sarcoma each 4cases).

When we see the biological categories of the soft tissue mass 46/73 (63 %) of them were Malignant. Benign cases account for the remaining 27/73(37%). Most of the client's 67 /73 (91.8 %) had biopsy examination for histopathology confirmation with 5/73(7%) FNAC done. One patient had both biopsy and FNAC.

TABLE 3: Histopathologic Diagnoses of 73 Soft-Tissue Masses

Type of Mass (No of Pts)

Malignant	**Benign**
Extra-skeletal ES/PNET (4)	Giant cell tumor of bone with ABC features (1)
Fibrosarcoma (2)	Benign Angiofibroma (1)
Synovial sarcoma (4)	Hemangioma (5)
Undifferentiated pleomorphic sarcoma (10)	Tendon sheath GCT (2)
High grade sarcoma (6)	Lipoma (5)
Pleomorphic liposarcoma (1)	Benign PNST Schwanoma (4)
Dedifferentiated liposarcoma (1)	Benign PNST Neurofibroma (5)
Myxoid liposarcoma (1)	Low grade intramuscular myxoma (1)
Malignant spindle cell sarcoma (1)	Total……24
Leiomyosarcoma (5)	
Malignant PNST (3)	
Epithelioid sarcoma (1)	
Rhabdomyosarcoma (4)	
Botroides sarcoma (1)	
High Grade Extrasekletal Osteosarcoma (1)	
High grade Myxoid sarcoma (1)	
Total…46	

Intermediate
Hemangiopericytoma (1)
Solitary fibrous tumor (2)
Total…3

The 3 most common malignant STT detected were Un-differentiated pleomorphic sarcoma (10cases), High grade sarcoma (6 cases) and Leiomyosarcoma (5 cases). The 3 most common benign STT detected were Hemangioma, Neurofibroma and Lipoma (each 5cases) and Schawanoma (4cases).

ADC & DWI

From the total clients for (68) 93.1% of them ADC and DWI was not done. A total of only 5 (7%) cases had DWI and ADC done, where 4 cases are malignant [Fibro-sarcoma, malignant spindle cell sarcoma, Botroides sarcoma and pleomorphic liposarcoma] cases each showing restriction. The benign case for which DWI and ADC done was Nasal Angiofibroma which didn't show restriction.

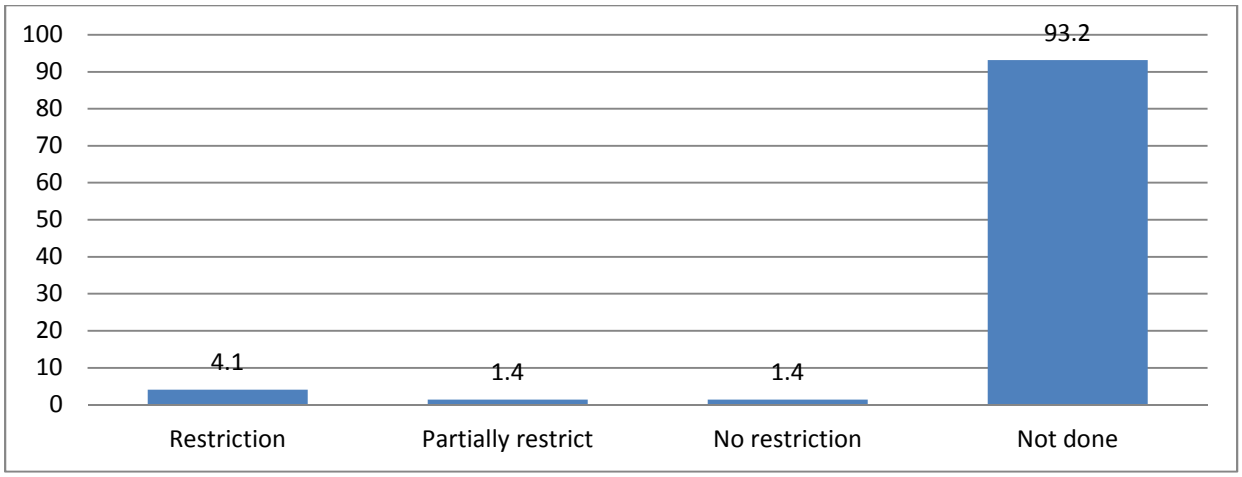


Figure 4 ADC and DWI results of all clients with soft tissue tumor at Tikur Anbessa& St Paul Hospital, May 2018-May 2019 G.C

From all the client's 30 malignant and 13 benign case were seen in the adult age group constituting almost one third (58%) of the cases. When we see the commonest benign lesions at this age group lipoma (4/13) is first followed by PNST, GCT, hemangioma each (2/13) cases. High grade sarcoma (8/30), liposarcoma (6/30) and UPS (5/30) are the commonest malignant tumors in the adult age group. When we see the extreme age groups there were a total of 4 cases (5.5%) with two malignant (mesenteric leiomyosarcoma and thigh synovial sarcoma) on children and only one malignant (testicular high grade sarcoma) on the old age category. Adolescent age group take the remaining 24 cases (33%) with equal benign and malignant STT, RMS (3/12) and synovial sarcoma (2/12) being the commonest malignant tumor, PNST and hemangioma being the commonest benign tumors in the adolescent group.

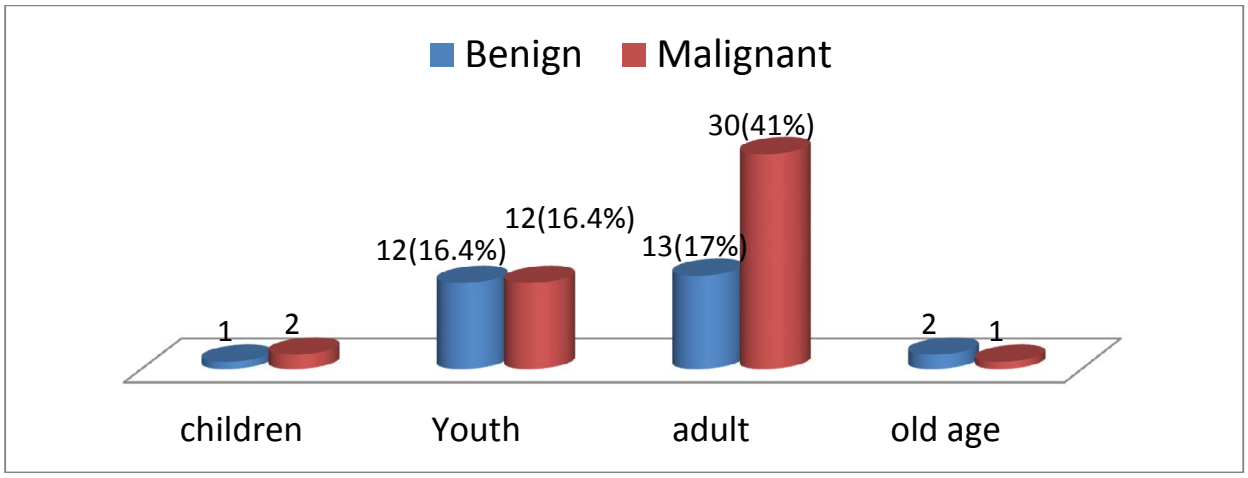


Figure 3 Correlation of biological category and Age classification of clients with STT at Tikur Anbessa &St Paul Hospital, May 2018-May 2019 G.C

The commonest soft tissue tumor category seen in adults was undifferentiated (14/42, 33%) and Adipocytic (7/42, 6.7%). The commonest STT in youth age group include PNST (8/24, 33%) and undifferentiated category (5/24, 20%) comprising half the total cases in these age group. When we see children's they had one case of vascular, smooth muscle and undifferentiated category each. Old age group patients had to vascular category and one undifferentiated category of STT. Undifferentiated category of STT is seen in all age groups.

Table 4 Comparison of category of soft tissue tumor with age group among clients at Tikur Anbessa & St Paul Hospital, May 2018-May 2019 G.C

		Age				Total
		Children	Youth	Adult	Old age	
Category of Soft tissue mass	Adipocytic	0	0	7	2	9(12.3%)
	peripheral nerve sheath tumor	0	8	4	0	12(16.4%)
	tumors of uncertain differentiatiation	1	5	3	0	9(12.3%)
	undifferentiated/unclassified sarcoma	0	2	14	1	17(23.2%)
	Fibro-blastic	0	2	4	0	6(8.2%)
	Fibro-histiocytic tumor	0	0	3	0	3(4%)

	smooth muscle tumors	1	1	3	0	5(6.8%)
	skeletal muscle tumor	0	3	2	0	5(6.8%)
	vascular tumor	1	3	2	0	6(8.2%)
	Chondro-osseous tumors	0	0	1	0	1(1.3%)
Total		3	24	43	3	73(100%)

The three most common benign STT based on the STT category belong to PNST (9/28, 32%), Vascular tumor (6/28, 21%) and Adipoctytic (5/28, 18%) groups. The three most common malignant STT based on the category are undifferentiated/unclassified (17/45, 38%), tumors of uncertain differentiation (8/45, 18%) smooth muscle and skeletal muscle (5/45, 11%) each.

There was only one malignant case of Chondro-osseous category involving the right forearm with biopsy result suggestive of extra-skeletal osteosarcoma. There was also only one benign case of tumors of uncertain differentiation category occurring in the thigh with biopsy result intramuscular myxoma, the remaining cases were malignant. There was no benign smooth, skeletal muscle and un-differentiated category STT in our research. There were no malignant cases of fibro-histiocytic and vascular category of STT.

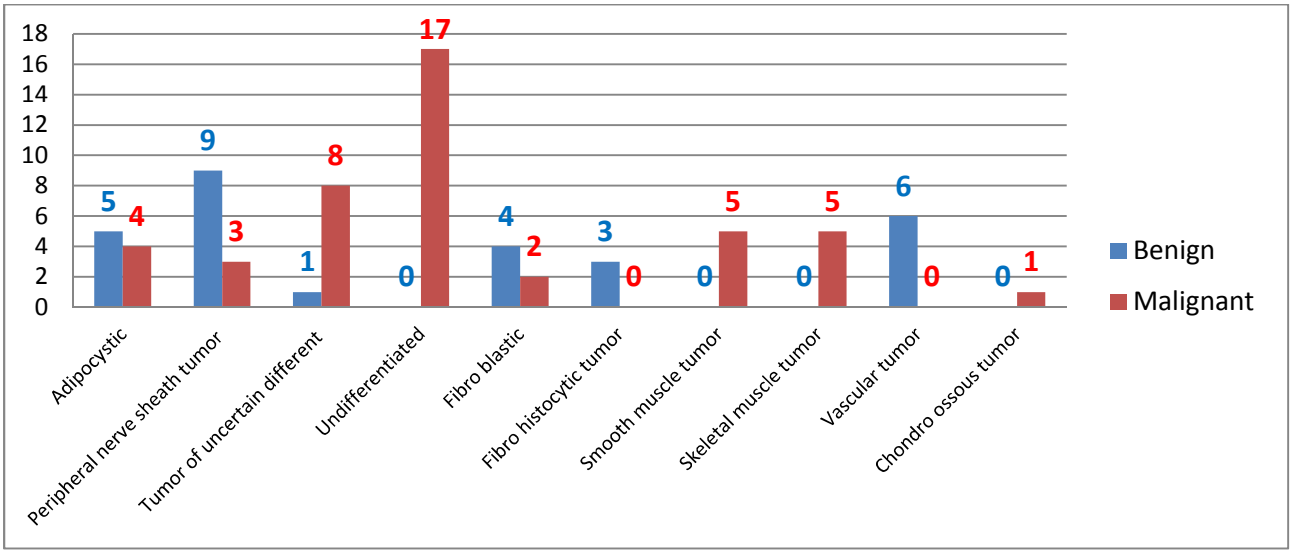
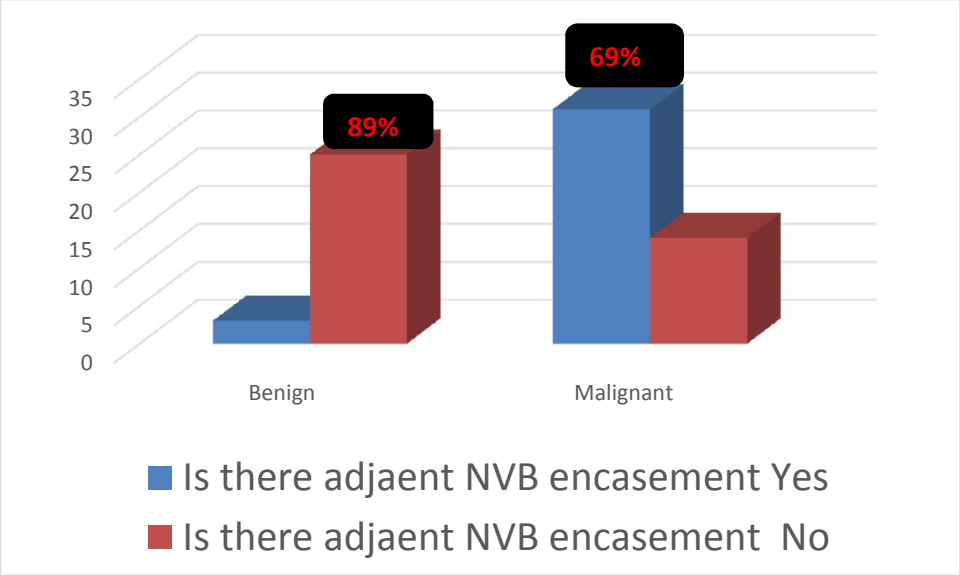


Figure 4 category of soft tissue mass vs histopathology category of clients with soft tissue tumor at Tikur Anbessa & St Paul Hospital, May 2018-May 2019 G.C

Comparison of NVB encasement between benign and malignant STT

Among our patients with soft tissue tumor most benign [25 (89.3%)] cases didn't encase adjacent NVB and 31 (69%) of Malignant cases had encased adjacent NVB. NVB Encasement is defined by

contact >180 degree, enhancing tumor thrombus and complete encasement of vessel. NVB abutment and displacement is regarded as no NVB encasement.

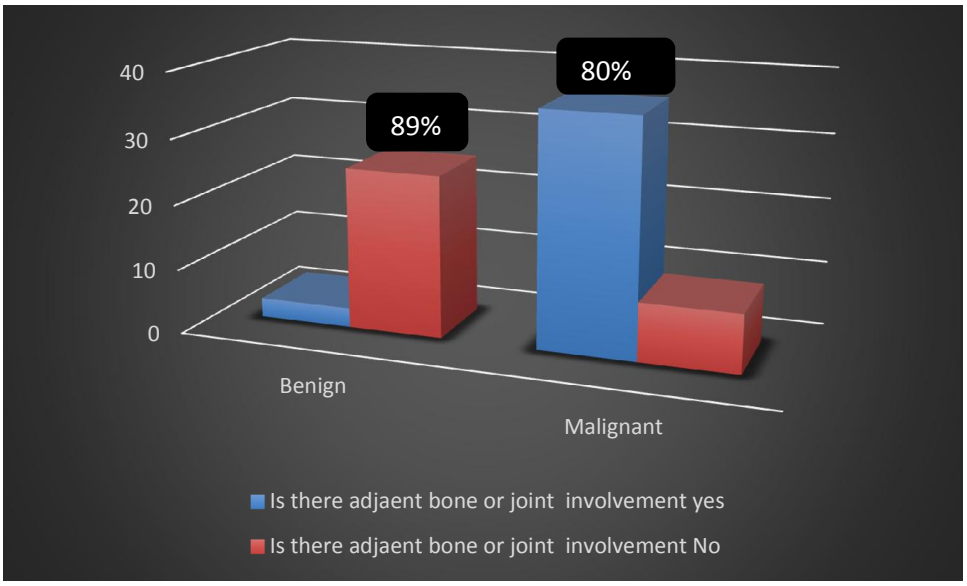


	Benign	Malignant
Is there adjacent NVB encasement Yes	3	31
Is there adjacent NVB encasement No	25	14

Figure 5 comparison of adjacent NVB encasement and biological categories of clients with soft tissue tumor at Tikur Anbessa & St Paul Hospital, May 2018-May 2019 G.C

Comparison of bone and joint involvement between benign and malignant STT

Among our patients with soft tissue tumor most benign [25 (89.3%)] cases didn't show bone or joint involvement and 36 (80%) of Malignant cases had adjacent bone or joint involvement. Bone or joint involvement is defined as cortical and marrow signal intensity change with no clear fat plane between the mass and adjacent bone.



	Benign	Malignant
Is there adjacent bone or joint involvement yes	3	36
Is there adjacent bone or joint involvement No	25	9

Figure 6 comparison of adjacent bone or joint involvement and biological categories of clients with soft tissue tumor at Tikur Anbessa &St Paul Hospital, May 2018-May 2019 G.C

Comparison of Size between benign and malignant STT.

The size range of all the STT tumors range from 7mm (tendon sheath GCT) to 30cm (High grade sarcoma) with mean size of 10.7cm. All benign cases had size range from 0.7cm to 21 cm. The commonest size range for benign cases belong to 5-10cm (14/28, 50%). All the malignant cases had a size range from 1.8cm to 30cm. The commonest size range for malignant cases also belong to 5-10cm (16/45, 35%). Benign cases having size greater than 5cm were (22/28, 78.5%). Malignant cases less than 5 cm were (4/45.11%). There was no benign case with the size greater than 25 cm.

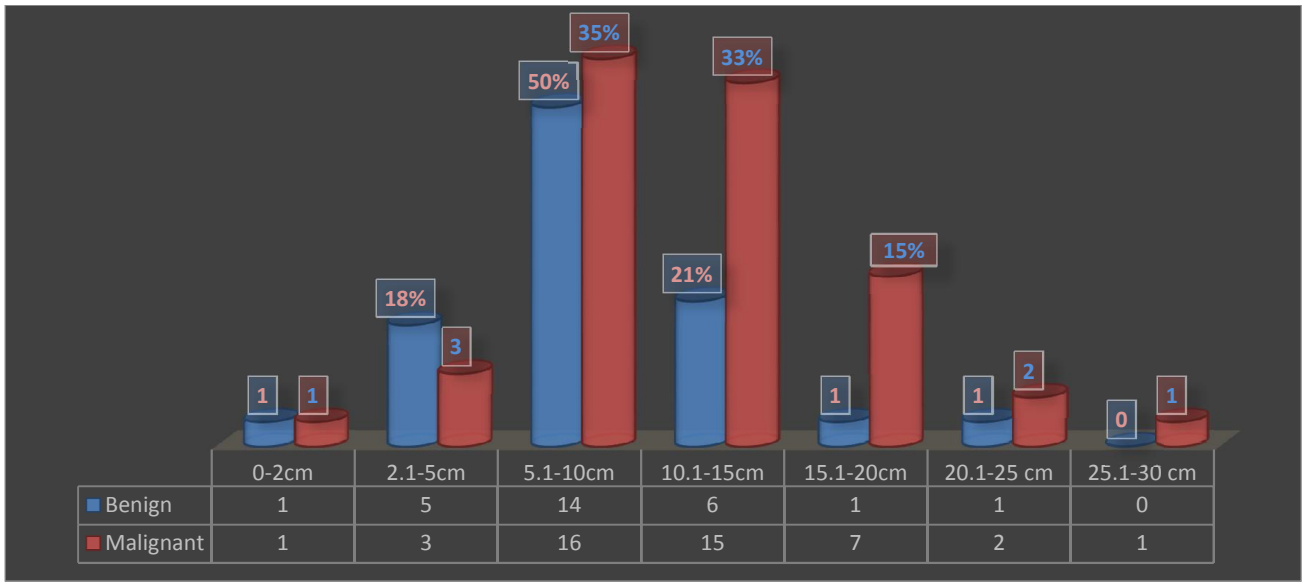


Figure 7 Comparison of Biological category with size of the lesion of clients with soft tissue tumor at Tikur Anbessa & St Paul Hospital, May 2018-May 2019 G.C

<u>Comparison of margin of tumor between benign and malignant STT</u>

The Margin of the lesion in most malignant cases (26/57.8 %%) was irregular followed by well-defined margin (18/20%). Most benign lesions (23/82%) had well defined margin. Only few cases had infiltrative nature in both benign and malignant tumors.

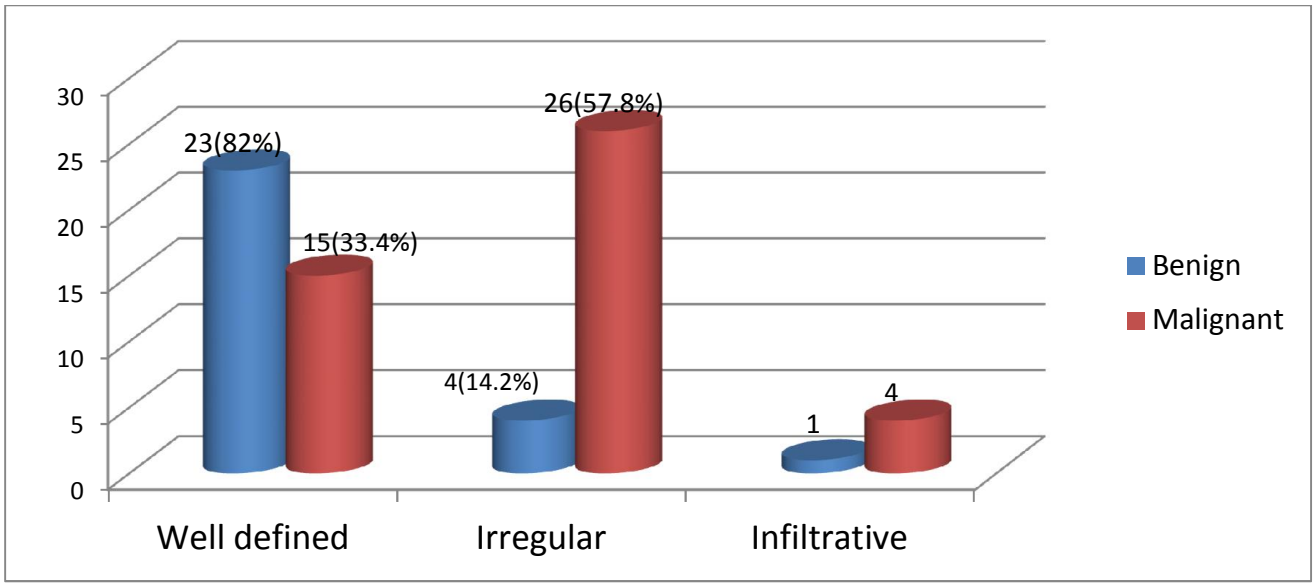


Figure 8 Comparison of Biological category with margin of the lesion of clients with soft tissue tumor at Tikur Anbessa & St Paul Hospital, May 2018-May 2019 G.C

Comparison of T2 signal intensity between benign and malignant STT

In most malignant 77.8 % (35) cases the signal Intensity (T2) was heterogeneous and only one case had homogenously isointense signal intensity on T2. When we see benign cases almost 2/3rd cases (18/28, 64.3%) had homogeneously hyper intense T2 signal intensity and 1/3rd had T2 heterogeneous signal intensity (8/28, 28.5%).

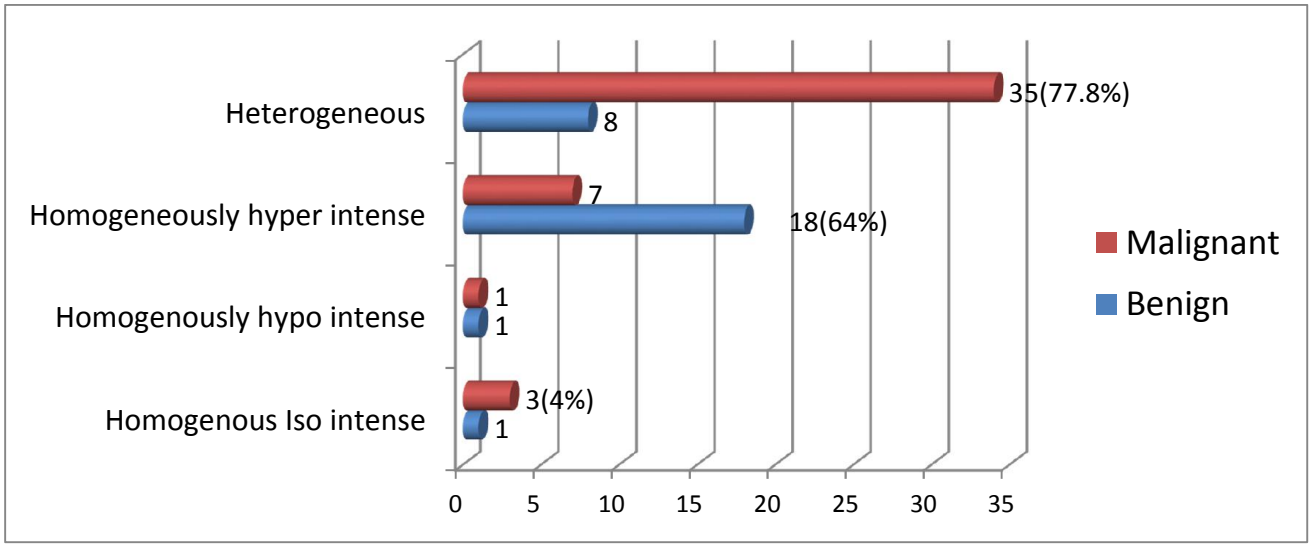


Figure 9 Comparison of Biological category with signal intensity (T2) of clients with soft tissue tumor at Tikur Anbessa & St Paul Hospital, May 2018-May 2019 G.C

Comparison of Central necrosis between benign and malignant STT

Central necrosis was present in 82% (37/45) of malignant STT as compared to 21% (6/28) in benign STT. Only 8 malignant cases (11%) didn't have central necrosis. One fourth benign cases showed central necrosis.

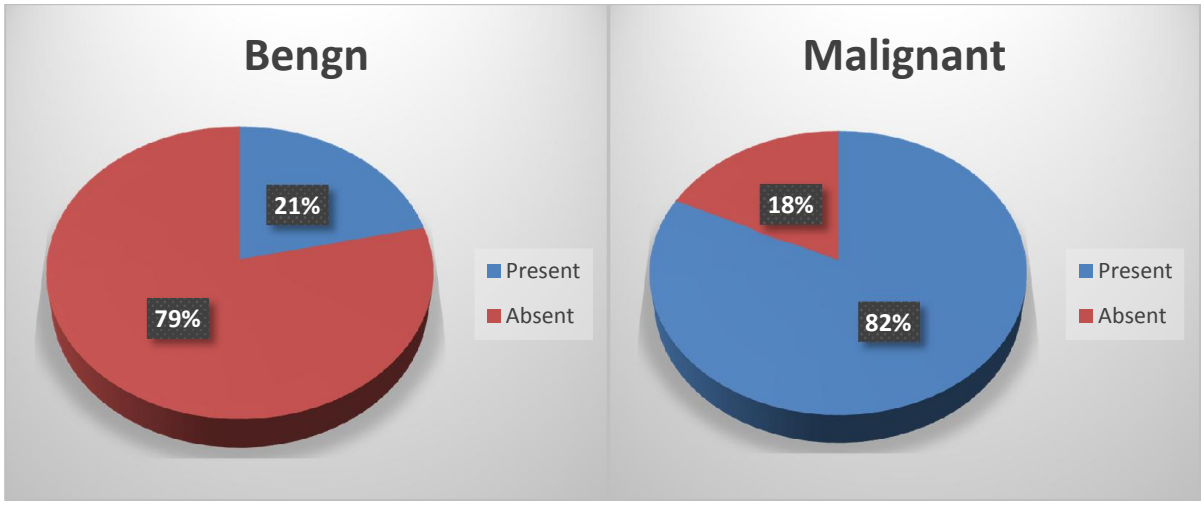


Figure 10 Necrosis vs the biologic nature of all soft tissue tumors in clients seen at Tikur Anbessa & St Paul Hospital May 2018-May 2019 G.C

Comparison of Enhancement pattern between benign and malignant STT

Most malignant (76%) cases had heterogeneous enhancement pattern and most benign (54%) cases had homogeneous enhancement pattern. We used 4 different enhancement pattern to categorize all STT cases.

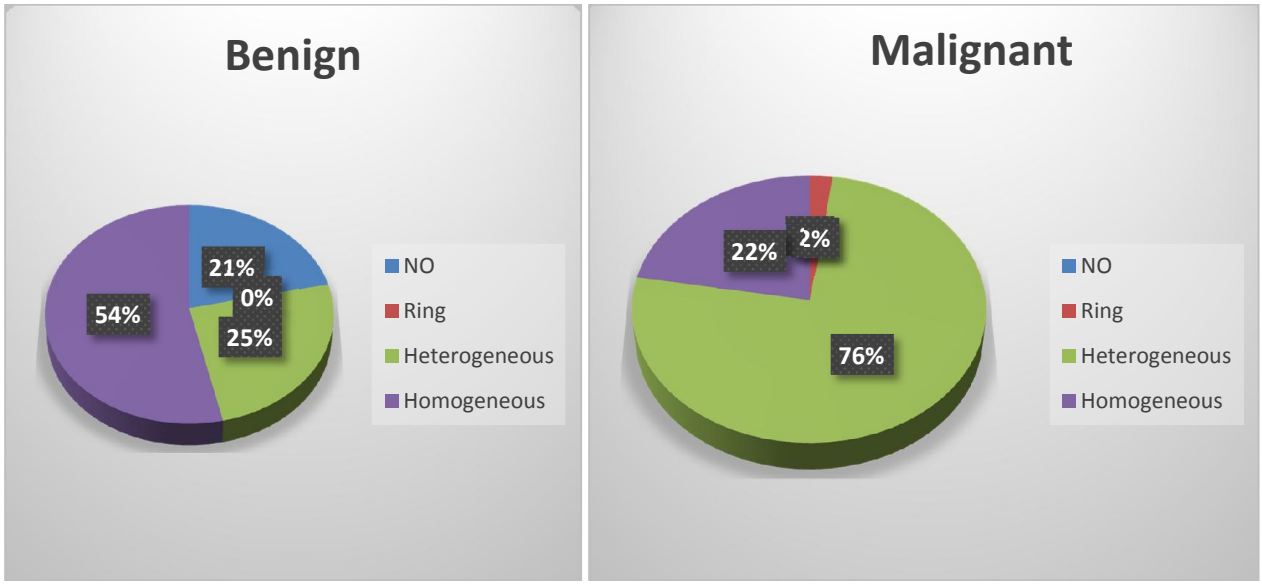


Figure 11 Enhancement pattern vs the biologic nature of all soft tissue tumors in clients seen at Tikur Anbessa &St Paul Hospital, May 2018-May 2019 G.C

Discrepancy between MRI imaging and histopathology result

There were 15(20%) cases having MRI report and histopathology result discrepancy, all cases were malignant based on their MRI parameters and when we see them they don't have specific imaging parameter to give specific tissue diagnosis on MRI only. There was no benign case from the list.

Table 5 Cases with MRI report and Histopathology discrepancy in all clients with STT at Tikur Anbessa & St Paul Hospital, May 2018-May 2019.

Cases	Age	Sex	MRI report	Histopathology result	FNAC Vs Biopsy
1.	23	F	Multiple Right anterior thigh masses with entering and exiting nerve sign and split fat sign consistent with PNST NB : Malignant PNST can't be ruled out	Malignant small round cell tumor in favor of extra skeletal ES/PNET	Biopsy
2.	35	F	Rt gluteal soft tissue mass Ddx: Intramuscular myxoma,PNST,MFH	Fibrosarcoma	Biopsy
3.	25	M	Malignant soft tissue mass likely Rhabdomyosarcoma DDx: Myxoid liposarcoma	High grade sarcoma(pleomorphic liposarcoma	Biopsy

4.	35	M	Left medial thigh malignant soft tissue mass with destruction of pelvic bone and pelvic extension	Giant cell tumor of bone with ABC features	Biopsy
5.	42	M	Large bony destructive mass with solid component having internal hemorrhage and pretentious component of femur distal metaphysis likely osseous lesion	malignant spindle cell sarcoma	Biopsy
6.	60	M	Lt proximal posterior compartment intramuscular soft tissue mass likely malignant fibrous histiocytoma MFH	Intermediate grade leiomyosarcoma	Biopsy
7.	27	M	Large paravertebral soft tissue mass with right sacral ala and intra-spinal canal component likely Malignant nerve sheath tumor	Small round blue cell tumor (PNET)	FNAC
8.	19	M	Large popliteal fossa lobulated mass with necrosis likely represent synovial sarcoma Ddx: Malignant PNST	Alveolar Rhabdomyosarcoma	Biopsy
9.	27	F	Heterogeneously enhancing expansile heterogonous lumbosacral region mass with solid and cystic component,hemorrhage,destrucion and expansion of bone secondary to ?Chordoma Ddx: myxopapilary ependymoma /Teratoma ,Metastasis	Solitary fibrous tumor	Biopsy
10.	46	F	Elongated mass n lateral muscular compartment of rt thigh beneath subcutaneous tissue likely post treatment inflammatory changes	Dedifferentiated liposarcoma	Biopsy
11.	25	M	Distal thigh femoral intramedullary lesion with cortical destruction and huge non uniform enhancing soft tissue mass likely metadiaphyseal malignant bone tumor with huge soft tissue mass, osteosarcoma	High grade undifferentiated pleomorphic sarcoma	Biopsy
12.	16	M	Rt frontal skull vault lesion likely suggest metastasis Ddx: primary malignant skull vault lesion like osteosarcoma	Small round blue cell tumor likely Rhabdomyosarcoma	Biopsy
13.	28	M	Distal medial thigh soft tissue heterogeneously enhancing mass contacting vessels and femoral bone Ddx: Malignant PNST,sarcoma	High grade sarcoma likely leiomyosarcoma	Biopsy
14.	35	M	Well defined lobulated mass in rt lateral proximal thigh ?Fibrosarcoma	Solitary fibrous tumor	Biopsy
15.	25	M	Lt thigh soft tissue mass ?RMS	Recurrent High grade pleomorphic sarcoma	Biopsy

Sensitivity and specificity of MRI parameters.

Table 6. Sensitivity and specificity of relevant MRI Variables (predicting malignancy).

Individual Parameters	Sensitivity (%)	Specificity (%)
Age >25 yr.	68	86
Size >5cm	91	21
Size >10cm	55	71
Bone Involvement	80	10
NVB Involvement	69	11
T1 Homogeneous SI	26	57
T2 Heterogeneous SI	77	71
Necrosis	82	78
Heterogeneous Enhancement	75	75

Best sensitivity for predicting malignancy is obtained for size >5cm, Necrosis, Bone involvement, T2 Heterogeneous SI and Heterogeneous enhancement. The best specificity for predicting malignancy is obtained for Age >25yr, Necrosis, Heterogeneous enhancement, T2 Heterogeneous SI and size > 10cm.

Association

T2 heterogeneity, central necrosis and heterogeneous enhancement pattern had significant correlation with malignancy when we see only the crude odds ratio. A person who presented with central necrosis were 70% less likely to develop benign tumor than malignant [AOR (95% CI): 0.3(1.294-146.68)]. All the other independent variables didn't show statistically significant association with benign and malignancy.

Table 7 MRI of soft tissue tumor association with other independent variables

Variables (n=73)	**Categories**	**Category of Soft tissue (MRI)**		**COR**	**AOR**
		Benign	**Malignant**		
Age	Children	1	2	1	
	Youth	12	12	.591(0.04-6.279)	
	Adult	13	30	.91(0.096-13.877)	
	Old age	2	1	.423(0.08-7.452)	
Sex	Female	14	21	.78(0.45-2.93)	
	Male	14	24	1	

Size	0-2cm	1	1	1	
	2.1-5cm	5	3	0.748(0.0027-13.58)	
	5.1-10cm	14	16	0.927(0.065-20.01)	
	10.1-15cm	6	15	0.54(0.134-46.77)	
	15.1-20cm	1	7	0.272(0.217-226.01)	
	20.1-25cm	1	2	0.711(0.051-78.25)	
	25.1-30cm	0	1	1(0.0-0.0)	
NVB	Yes	25	31	0.55(0.069-1.03)	
	No	3	14	1	
Adjust to bone	Yes	25	36	0.31(0.12-1.95)	
	No	3	9	1	
Post contrast enhancement	P1	6	0	1	1
	P2	0	1	1(0.0-0.0)	1(0.0-0.0)
	P3	7	34	1(0.0-0.0)	1(0.0-0.0)
	P4	15	10	**0.01(2.33-22.81)***	1(0.0-0.0)
T2W1	Homogenous iso intense	1	3	1	1
	Homogenous hypo intense	1	1	0.71(0.65-7.71)	0.39(0.03-9.98)
	Homogenous hyper intense	18	7	0.24(0.013-4.179)	0.19(0.13-2.42)
	Heterogeneous	8	34	**0.01(0.029-0.293)***	0.48(0.019-6.58)
Central necrosis	Present	6	37	**0.01((5.197-55.34)***	**0.3(1.294-146.68)***
	Absent	22	8	1	
Signal change	Present	51	19	0.52(0.27-13.52)	
	Absent	21	22	0.48(0.087-3.168)	
	NM	2	4	1	
Histopathology category of soft tissue	Adipocytic	5	4	1(0.0-0.0)	
	Peripheral nerve sheath tumor	9	3	1(0.0-0.0)	

	Tumor of uncertain different	1	8	1(0.0-0.0)	
	Undifferentiated	0	17	1(0.0-0.0)	
	Fibro blastic	4	2	1(0.0-0.0)	
	Fibro histiocytic tumor	3	0	1(0.0-0.0)	
	Smooth muscle tumor	0	5	1(0.0-0.0)	
	Skeletal muscle tumor	0	5	1(0.0-0.0)	
	Vascular tumor	6	0	1(0.0-0.0)	
	Chondro osseous tumor	0	1	1	

*(significantly associated)

CHAPTER SEVEN

6. Discussion

One of the common indication for MRI in MSK is to characterize the presence of soft tissue mass in detail using different parameters. Benign lesions tend to have homogenous signal intensity with well-defined margin and do not encase neurovascular structures or adjacent bone. Malignant lesions on the other hand have inhomogeneous signal intensity with irregular margins and encase neurovascular structures and bone. Our study and other study's showed that most benign lesions have well-defined margin, T2 homogenous SI and most malignant lesions have irregular outline with heterogeneous SI and enhancement [12, 15]

Our study is in agreement with those of Totty et al [21], Sundaram et al [22] and Kransdorf et al [16] that MR imaging appearance of both benign and malignant soft-tissue masses is nonspecific.

From all clients who participate in this study 71 (97 %) of them came with the clinical presentation of swelling in the extremity this is due to the fact that most STT in our case and in other study's involve the extremities(lower limb more than upper limb) presenting as a mass or swelling. In our study the majority of soft tissue tumors are located in lower extremity 38(52%) followed by lower extremity 16 (22%) and genital region 5(7%). Majority of malignant lesions (23/45, 52%) were in the lower extremity. This findings are in agreements with Berquist et al where the majority of all lesions were in the lower extremity: 57 (61 %) with the remainder of the lesions were in the upper extremity and trunk. The majority of malignant lesions (32/45, 71 %) also were in the lower extremity.[12]. Study done by petasnik, Brequest, Olaf, crime et al all showed comparable result with respect to common histopathology groups.

When we see the specific diagnosis of STT based on histopathology results our study showed the 3 most common Malignant tumors were [Undifferentiated pleomorphic sarcoma, High grade sarcoma and leiomyosarcoma] and benign cases were [hemangioma, nuerofibroma and lipoma]. Study done by De Schepper et al showed comparable result with our study where the commonest malignant case were [Liposarcoma, Undifferentiated pleomorphic sarcoma and Rhabdmyosarcoma] and the commonest benign cases were [Lipoma, Schwannoma and Haemangioma)][15]

Next we will see the important parameters used in our research to differentiate benign from malignant STT with other researches.

SIZE: In study done by crime et al from 81 cases(49 benign,34 malignant commonest size group for benign cases were 3-5cm(25/49) and for malignant cases most were >5cm(23/34) which is comparable to our study where the commonest size range for both benign and malignant lesions is in the range of 5-10cm.[19]. In our study most benign and malignant STT are in the size range of 5-10cm which is comparable with the study done by Brequist et al where most benign(50%) and malignant (87%)STT had size >5cm[12]. De Schepper et al also found the same result were most malignant cases from the total 141 cases ,malignant cases with size >5cm constitute the largest portion(67%) and most benign lesions belong to 1-3cm group(41%) with 27% in the >5cm group.

MARGIN: When comparing margins of the soft tissue tumors with Berquist et al most proportion of Malignant lesions had irregular margin both in our research and there (57% our vs 85% in there study). Most Benign tumors had also well-defined margin in our study (82% as compared to 56% in there study [12]. There is also the same finding in study done by de scheeper et al they found most benign cases have well defined margin(55% vs 82% in our study) and most malignant cases had irregular margin(80% vs 57% in our study)[15] .

A study done by crime et al showed most benign STT have smooth or well defined margin (82% in our study and 55% in there study. And most malignant STT had irregular or infiltrative margin (57% in our study, 42% in there study). We can also have benign tumors with irregular margin (18% in our study vs 48% in there study) and malignant tumors can also have well defined margin (33% in our study vs 40% in there study)[19] Our study didn't show strong correlation between the tumor margin and the benign and malignant nature of STT.

T2 SIGNAL INTENSITY: When we see signal intensity change Totty et al performed a non-blinded study of 32 soft-tissue masses, of which 10 were malignant. In that study, differences in signal intensity did not help to distinguish benign from malignant masses, and the majority of both benign and malignant masses showed inhomogeneous signal intensity [21]. In our study 77% and 27% benign cases had heterogeneous signal intensity on T2. A study done by berquest et al found most malignant tumors (71%) had heterogeneous SI and most benign STT (42%) had homogenous SI which is comparable to our study where most malignant tumors (77%) had heterogeneous SI and most benign cases (71%) had homogenous SI. The percent difference is due to the low number of benign cases in our study (28 vs 50 cases) [12]. This is also the same when we see De Schepper et al where Most malignant had T2 heterogeneous (53%) and most benign cases (42%) had homogenous signal intensity character [15]. Chung and his colleagues also found 87% malignant mass had T2 heterogeneous signal intensity, 7% in our study which is in agreement. [9]

ENHANCEMENT PATTERN: The most common Enhancement pattern for malignant tumors in our study was heterogeneous (76%)and for benign cases as homogenous (54%),this is true also for study done by De Schepper et al where they found the commonest enhancement pattern for malignant was heterogeneous(34%) and for benign cases are homogeneous enhancement pattern(69%). Similar study done by Gruber, benedikt also found malignant cases had heterogeneous enhancement and benign cases had homogeneous enhancement pattern, the same as r research. [26, 16]

NECROSIS: when we see necrosis most proportion of malignant cases had necrosis and most benign cases didn't show necrosis both in our study and De Schepper et al study.[malignant with necrosis in our study 82% vs 60% and benign with no necrosis 79% in our study Vs 98%][15].

NVB and BONE INVOLVEMENT: A study done by change and his colleagues showed involvement of bone by malignant mass on MRI was 25% and 45% on CT ,our study also showed most benign cases(85%) didn't show bone involvement and most malignant cases (80%)had bone involvement. Adjacent NVB involvement also showed that most benign didn't have adjacent NVB involvement and most malignant cases had adjacent NVB involvement, the same as study done by change. [9]

From all the parameters the one parameter that had statistically significant correlation ($p < 0.05$) is presence of necrosis which is also found in other study's.

When we compare the sensitivity and specificity for the different parameters there are some comparable results with research done by De Schepper et al. Highest sensitivity in both study is seen in diameter >5cm(91% vs >3mm,90%) . The highest specificity seen in both study is for necrosis (98%, 78% in our study. De Schepper et al study found Highest sensitivity obtained for absence of low signal intensity on T2 (100%), mean diameter >33mm (90%), and inhomogeneous signal on T1 (88 %). Highest specificity obtained for evidence of necrosis (98 %), bone or neurovascular involvement or (94%), and mean diameter >66 mm" (87%) [15]

Criteria of tumor margin, signal intensity homogeneity, size, peri-tumoral high signal intensity, apparent neuro-vascular bundle encasement or displacement, and bone invasion were not reliable in our series to differentiate benign from malignant masses at MR imaging. This is the same as research done by Crime et al. We did not find that size was useful in distinguishing benign from malignant tumors with no strong correlation. This is because the size at which a tumor is detected depends more on its location (superficial vs deep) than on its aggressiveness. [19]

Sundaram et al performed a non-blinded study of 53 soft-tissue masses, of which 23 were benign, 23 were malignant, and seven were intermediate .The author believed that there were no reliable criteria to distinguish benign from malignant masses. In our study also all the parameters [size, NVB encasement, bone involvement T2 signal intensity] didn't show strong correlation. [23]

The two factors that can explain the differences in results among the different studies are differences in patient population and differences in the expertise of the radiologists reading the images.

With the advent of DWI and ADC in the basic MRI sequences has helped in differentiating a mass with cellular component. In our study from all the patients these sequences were done for only 5 cases. In Soft tissue tumors DWI and ADC has more value in post-operative patient presenting with mass so as to differentiate a recurrent mass from scar tissue.

Conclusion

MRI imaging has become the premier method for identifying and staging soft tissue Masses of the musculoskeletal system. Although MR imaging is sensitive, many authors have reported that it is not useful in differentiating benign from malignant soft-tissue masses.

Our research showed most benign STT had well defied margin, no necrosis, no bone and adjacent NVB encasement, with homogeneous T2 SI and post contrast enhancement pattern. Most malignant STT had irregular margin, central necrosis, bone and adjacent NB encasement with heterogeneous T2 SI and enhancement pattern. The most sensitive and specific MRI parameter to predict malignancy are T2 heterogeneity, necrosis and heterogeneous enhancement. From all the parameters only necrosis had significant correlation.

Our experience indicates that certain image features are useful in differentiating Benign from malignant lesions using MRI as an investigative modality both for diagnostic and follow up. Most STT are rare compared to other malignant tumors and also have varied heterogeneous behavior. BLH as a tertiary hospital we believe management of a patient with STT needs multidisciplinary teams including an oncologist, surgical oncologist, pathologist, and radiologist, the radiologist plays a critical role in diagnosis, management, and follow-up.

Recommendation

- Further study with more sample size to see the correlation of other MRI parameters
- DWI and ADC to be done as a routine sequences in patients who present with recurrent soft tissue mass
- The role of radiologist in reporting MRI of soft tissue mass is to localize ,characterize and clearly describe the extent of the lesion in respect to the adjacent vital structures rather than giving tissue specific diagnosis especially in malignant soft tissue mases
- Use structured reporting format including the dimension, compartment, involvement of adjacent neurovascular structures, joint and bone extension and mention presence of proximal extension.
- Obtain baseline MRI imaging 3month after surgery and at 6month interval for the next 2year and the annually since most recurrence occur in the first 2yrs post operatively. Give special emphasis on the need to do DWI and ADC on all recurrent Soft tissue tumors to differentiate between post treatment changes and residual mass and recurrence.[24,25]
- Use Basic MRI protocols for imaging Soft tissue tumors involving the extremities. [T1 and T2 with and without fat saturation, STIR in areas where fat suppression is heterogeneous, DWI and ADC ,Post contrast T1 ,Axial planes for neurovascular relationship, Long axis planes[Sagital, coronal] to see extent of lesion and relationship with adjacent anatomic structures.[23]
- Recommend Biopsy site and post op imaging guideline.
- Use combination of different parameters together rather than single to reach a diagnosis in STT.

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Annex I DATA COLLECTION FORMAT (QUESTIONNAIRE)

DATA COLLECTION FORMAT (QUESTIONNAIRE)

Patient name: _____ Phone number: _____

Patient card No: _____

1.1 Age: _____ Sex: ___

1.2 Clinical presentation with :

_____

_____

1.3 -Which cross section done MRI or CT?

1.4 -If MRI done

1.4.1- SI of lesion (Pre contrast T1 and T2)

T1WI pre contrast: Homogenously iso intense: _____ homogenously hypo intense: _____
: Homogenously Hyper intense: _____ Heterogeneous: _____
T2WI : Homogenously iso intense: _____ homogenously hypo intense: _____
: Homogenously hyper intense: _____ heterogeneous: _____

1.4.2- Post contrast enhancement pattern of the lesion.
P1: No or thin rim like contrast enhancement: _____
P2: Peripheral enhancement sparing confluent center: _____
P3: Patchy and inhomogeneous enhancement: _____
P4: Homogenous enhancement: _____

1.4.3-ADC and DWI value and pattern if done:
Restriction: _____
Partially restrict: _____
No restriction: _____
1.4.4 Signal change in surrounding tissue:
Present: _____ Absent: _____
NM: _____

1.5. Site of Location of the lesion

Specify the location: _____

1.6. Is there adjacent NVB encasement? Yes: _____ No: _____

1.6.1-If there is please specify the NVB involved: _____

1.7. Is there adjacent bone or joint involvement seen? Yes: _____ No: _____
1.7.1- If there is specify involved bone /joint and destruction

1.8. Mass characterization

1.8.1-Greatest dimension of the lesion in cm: _____

1.8.2-Margins of the lesion

Smooth/Well defined: _____ partially smooth: _____

Irregular: _____ Infiltrative: _____

1.9. Central necrosis: Present: _____ Absent: _____

1.10 MRI report (choose /underline one)

_____
_____
_____
_____

1.11-Histopathology result

Histological diagnosis: _____

FNAC: _____

Excision biopsy: _____

1.12. Which category is the soft tissue ass grouped

1. Adipocytic
2. Fibroblastic/My fibroblastic
3. So called Fibrohistocytic tumors
4. Smooth muscle tumors
5. Pericytic/Perivascular tumors
6. Skeletal muscle tumors
7. Vascular tumors
8. Chondo-ssseous tumors
9. Gastrointestinal tumors
10. Peripheral nerve sheath tumors
11. Tumors of uncertain differentiation
12. Undifferentiated/Unclassified sarcoma

1.13. Which category is the soft tissue mass categorized based on the biologic potential

1. Benign
2. Intermediate [Locally aggressive]
3. Intermediate [Rarely metastasizing]
4. Malignant

- **Post diagnosis course**
- Was there any distant metastasis: Yes: _____ No: _____
- If yes specify the site:_____
- What was done?

  Surgery: _____
  Chemotherapy: _____
  Radiotherapy: _____
  Combination: _____

Surgical considerations when reporting MRI studies of soft tissue sarcoma of the limbs: Reporting checklist for MRI of soft tissue masses:

- Size, measured in all three dimensions [AP*W*CC]
- Location in relation to the fascia (superficial or deep)
- Compartment, muscle involvement, extension through the fascia and to skin
- Contour, [well-defined, irregular, infiltrative], presence of satellite lesions
- Signal characteristics, suggesting fatty, cystic or solid [T1/T2/STIR/PDW]
- Signal characteristic suggesting myxoid tissue or haemosiderin
- Peri-tumoral edema [present or absent] specify SI change if present
- Post contrast enhancement pattern [No, peripheral, homogenous, heterogeneous]
- DWI/ADC characteristics of mass [Restricting, no restriction, partially restricts]
- Neurovascular involvement (clear, abutting, displacing, contact <180 degree, contact >180 degree, complete encasement, Intra-luminal enhancing thrombus)
- Bone involvement [Signal intensity change in the adjacent cortex, bone marrow, No fat plane in between.]
- Lymph node involvement [present, ascent, if present largest dimension in short axis]
- Presence or absence of 'tail sign'.
- Extension into a joint (capsule, joint space)
- Prominent intra-tumoral vessels if present (may lead to pre-operative embolization)
- TNM Stage [Based on 8th edition AJCC staging manual]

NB: Do not forget to recommend biopsy site from the solid enhancing non -necrotic site specifically mention the site.

NB: In comparing treatment response compare the same **imaging modalities** when possible, compare size on the same dimension and mention **degree** of necrosis, presence of new solid enhancing component(if present),state all the new findings clearly.

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