Research Article

Whole Body Magnetic Resonance Imaging (MRI) in Staging and Follow up of Pediatric Patients with Lymphoma in a Tertiary Care Centre

Amber Goraya[1], Abid Ali Qureshi[2], Bushra Mohsin[3], Saira Rehman[4]

[1]Assistant Professor of Pediatric Radiology, The Children's Hospital & the Institute of Child Health, Lahore; [2]Associate Professor of Pediatric Radiology, The Children's Hospital & the Institute of Child Health, Lahore; [3]Senior Registrar of Pediatric Radiology, The Children's Hospital & the Institute of Child Health, Lahore; [4]Assistant Professor of Pediatric Radiology, The Children's Hospital & the Institute of Child Health, Lahore.

Abstract

Introduction: Lymphoma is a malignancy that can involve the lymphatic system or arise as extra nodal disease. In children Whole body scanning for Lymphoma was mostly performed with positron emission tomography (PET) , nuclear medicine and with computed tomography (CT). Ionizing radiation characteristic was common in these imaging methods, Therefore other methods like Whole body MRI which was radiation free was used and is important in pediatric radiology.

Objective: To determine the role of Whole body MRI in staging and follow up of pediatric patients with lymphoma.

Methods: A 6-month Retrospective study was conducted on 71 patients who underwent Whole body MRI for Lymphoma (from October 2016 to March 2017) in the Radiology Department of The Children's Hospital Lahore. Studies were performed at 1.5T Philips Medical system. Coronol T1W,STIR and, DWI sequences acquired and reconstructed with Mobiview technique.

Results: Out of 71 patients, 62(87.3%) were biopsy proven Hodgkin disease and 9 (12.7%) were Non Hodgkin Lymphoma. Out of 46 patients for follow up of HD, 42 (59.25%) had complete resolution on end of treatment WBMRI, 2(2.8%) had no response to treatment, and 2 had progressive disease. Among 7 patients who were followed up for NHL, 4 (5.6%) had complete resolution, 2(2.8%) had no response to treatment and 1 (1.4%) had progressive disease.

Conclusion: Whole body MRI had been successfully used as a radiation free modality in management of lymphoma for staging and assessment of treatment response.

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Corresponding Author | Dr. Amber Goraya, Assistant Professor of Pediatric Radiology, The Children's Hospital & the Institute of Child Health, Lahore. **Email:** amber.goraya@yahoo.com

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Introduction

Lymphoma is a malignancy arising from lymphocytes or lymphoblasts. It can involve the lymphatic system or arise as extra nodal disease. It is most common in developed countries and they account for 4% of all cancers.[1] Lymphoma is the third most common malignant neoplasia in the childhood, after leukemia and central nervous system tumors. It comprises 5% of all proportion of long term childhood cancer survivors in the Western world. It accounts for 10% of all cancer in children.[2]

Ann Arbor staging system is the best method for anatomic staging of lymphoma. Involvement of Single lymph node region or lymphoid structure is

called Stage I, involvement of two or more lymph node regions on the same side of the diaphragm called Stage II, Involvement of a lymph node region or structure on both sides of diaphragm called Stage III and the involvement of extra nodal site called Stage IV.[3]

Magnetic Resonance Imaging (MRI) is a good procedure to examine whole body and metastatic sites. Only a single examination of Magnetic Resonance Imaging (MRI) supports to decrease the number of patient visits to an imaging service, so reducing related costs.[(1)] Cancer is the important cause of natural death in the pediatric populations of developed countries. The cure rates are greater than 70%, when a cancer is diagnosed in its early stages. Current advances in magnetic reso-nance imaging methods have improved diagnostic and beneficial approaches, while avoiding the risks of ionizing radiation that are associated with most conventional radiological methods, such as computed tomography and positron emission tomography/ computed tomography.[4]

Magnetic Resonance Imaging (MRI) is a radiation-free imaging modality that allows for acquiring images with a high spatial resolution and outstanding soft tissue difference throughout the body. In children Whole body imaging was mostly done by scanning the whole Skeleton with positron emission tomography (PET). Furthermore, new technological advances have resulted in diagnostic sequences for whole-body MRI imaging (WB-MRI), including functional techniques such as diffusion weighted imaging.[5]

A study was conducted in Europe, 36 Patients came with newly diagnosed lymphoma prospectively underwent whole body MRI and CT for staging purpose. Whole body MRI was experienced as a more patient friendly technique than CT. According to this study MRI is a good method as compared to CT because CT has so much radiation, so patient should avoid this radiation. [6]

A study was conducted on Computed tomography (CT) and Whole body MRI Diffusion weighted imaging, for staging newly diagnosed lymphoma. Lymphoma stages result of WB-MRI without DWI were equal to those of CT in 66.6%, lower in 9.3%, higher in 24.1, and with DWI were equal to those of in CT 65.4% ,lower in 6.7%, higher in 27.9% . Whole body MRI can be a good alternative to CT if radiation exposure need to be avoided.[7]

Rationale of this study was to determine the role of WB-MRI in staging and follow up of pediatric patients with Lymphoma in Tertiary care hospital. As no local data existed in this aspect, this can help in staging and follow up of lymphoma patients without using ionizing radiation.

Methods

This Retrospective Observational study was conducted from October 2016 to March 2017 in Radiology Department of the Children Hospital & the institute of child health Lahore. A total of Seventy one children of both genders in department who underwent WB-MRI for staging and follow up were included in this study by using non probability purposive sampling technique. Sample size of 71 is calculated with 80% power of test and 5% level of significance by taking expecting 4% of all cancer in developed countries[1] using this formula.

$$n= Z^2(p)\ (1-p)/d^2$$

Studies were performed at 1.5T Philips Medical system, with body coils and head/neck coils. Coronal T1W, STIR n DWI sequences were acquired and reconstructed with MobiView tech. Baseline and end of treatment studies were evaluated for sites of nodal involvement, hepatosplenomegaly, focal defects in liver and spleen, gut and bone involvement. All MRI were interpreted by a single consultant radiologist to avoid reporting bias.

Statistical analysis was performed using SPSS v21 to look for the significance of stages of lymphoma. Qualitative variable like gender, biopsy proven lymphoma and four stages of lymphoma were presented as frequency and percentage. Quantitative variable like age were presented as mean and standard deviation. Chi square test was used to compare the stages with follow up HD and NHL. P value <0.05 was taken as statistically significant

Results

About 71 patients were enrolled in this study. There

were 19 male and 52 females . The mean age of the patient 8.345y+ 2.803y SD. 15 male and 47 female had HD. 4 male and 5 female had NHL .

Of 71 patients of lymphoma, 62(87.3%) had HD patient and 9 were NHL. (Table 1).18 patients were for staging. 7 had stage I, 1(had stage II and 8 had stage IV in HD patients. As compare to NHL patient only 2 were in stage IV.

Among 46 patients who were followed up for HD. out of 46, 42 had complete resolution, 2 showed no response to treatment and 2 had progressive disease. Among 7 patients who were followed up for NHL. Out of 7, 4 patients had complete resolution, 2 were no response to treatment and 1 had progressive disease. (Table 2)

Chi square test was applied, to compare the stage and follow up for HD and NHL p-value 0.0001, which is ≤ 0.05, and hence it is significant statistically.

Discussion

Most of the studies established that PET-CT is the most sensitive of current imaging studies, and is highly specific, not only for response assessment, but for pretreatment determination of disease localization. Staging system is most valuable when it assures reproducibility over extended period of time.[8]

There are several possible benefits of Diffusion weighted MRI in staging of lymphoma. MRI is a substitute of CT without ionizing radiation. CT has an ability to find and stage disease, detect lymph nodes greater than 1.2 cm and also have an ability to assess the presence or absence of disease. Exposure to ionizing radiation, may increase the risk for secondary neoplasia in children.[9]

WB-MRI has been confirmed to be a very suitable method for different types of cancer disease. According to this study MRI is a powerful tool specifically in pediatric oncology, avoiding radiation exposure associated disease and being more available to these patients.[10]

Lymphoma staging results of WB-MRI without DWI were equal to CT in 66.6% (lower in 9.3%, higher in 24.1%) and with DWI were equal to CT in 65.4% (lower in 6.7%, higher in 27.9%) as in our study 18 patients were for staging. 7 had stage I, 1 had stage II and 8 had stage IV in HD patients.7

A study was published in European journal in 2014 to asses and compare patient experience of WBMRI to that of CT. Total 36 lymphoma patients were enrolled in the study. Wilcoxon signed rank tests were applied to determine statistically significant differences in patient discomfort between two examinations. Patients were relaxed before and after whole body MRI examination as compared to CT. As a result patients stated that WB- MRI was friendly technique when compared to CT.[7]

In a study on Hodgkin Lymphoma in childhood, according to Ann Arbor staging system 11.9 % patient were having stage one.32.2% were Stage two, 42.4% were stage three and 13.6% were stage four..11 In difference, our study total 18 patient were for staging 9.9% were stage one, 1.48% were stage two and 11.3% were stage four.

Whole-body MRI is a fast modality for the detection of disease all over the body. Whole-body MRI imaging is not intended to replace dedicated MR examinations or dedicated chest CT, which provide more detailed evaluation of individual organ systems. whole-body MRI as an accurate alternative to conventional multimodality evaluation for staging purposes. Whole body MRI including DWI may be a radiation free alternative for assessing treatment response. It is an including DWI has been found to have equivalence to conventional imaging and PET/CT for pediatric lymphoma staging.[13]

In western Countries, All are economically developed countries. 75% patients have initial disease at presentation (stage one-two) [12].

The use of WB MRI in pediatric oncological clinical practice is limited in some cases. Some limitation was faced such as small size of sample size and the impossibility of histological confirmation of the abnormalities characteristics at MRI.

Conclusion

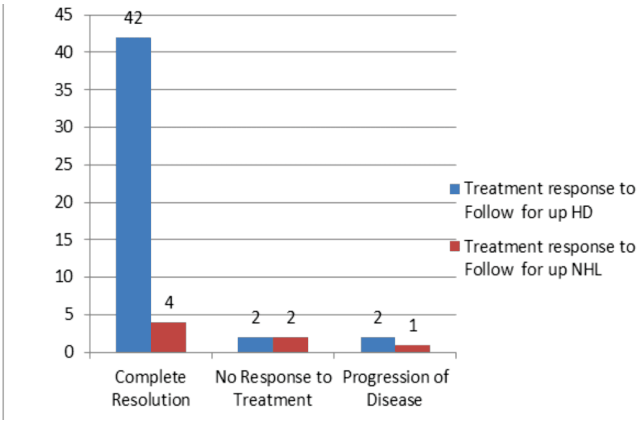
In this study whole body diffusion weighted MRI had been used for staging and assessment of treatment response. MRI is capable to provide total body coverage, high soft tissue contrasts in reasonable time frame without using radiation. Whole body MRI plays an important role in true staging, adopt new treatment strategies and evaluation of treatment response and detection of relapse.

Table 1: *Treatment Response*

Lymphoma	Frequency	Percent
HD patients	62	87.3%
NHL patients	9	12.7%
Total	71	100.0%

Table 2:

Treatment response to Follow up	HD	NHL	P value
Complete Resolution	42(59.25)	4 (5.6%)	0.0001
No Response to Treatment	2(2.8%)	2(2.8%)	0.01
Progression of Disease	2(2.8%)	1(1.5%)	0.0015



Graph1: *Comparison of Treatment Response*

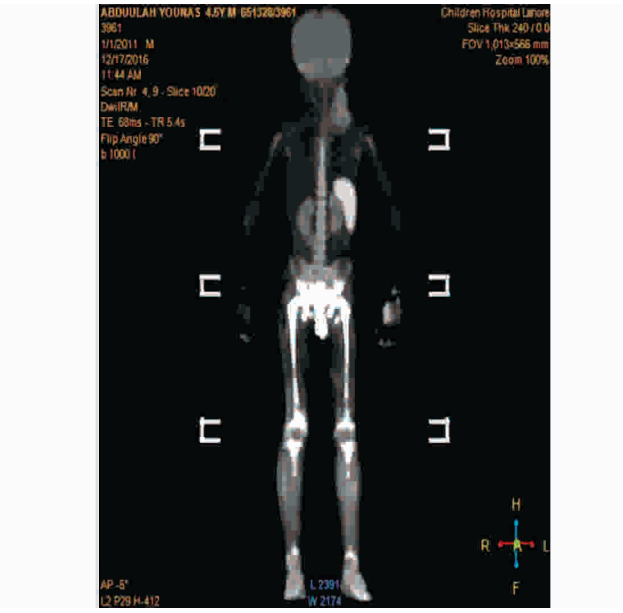


Fig. 1: *Pre Chemotherapy DW Whole Body Imaging Showing Left Cervical and Supra Clavicular Lymphadenopathy Categorized as Stage I*

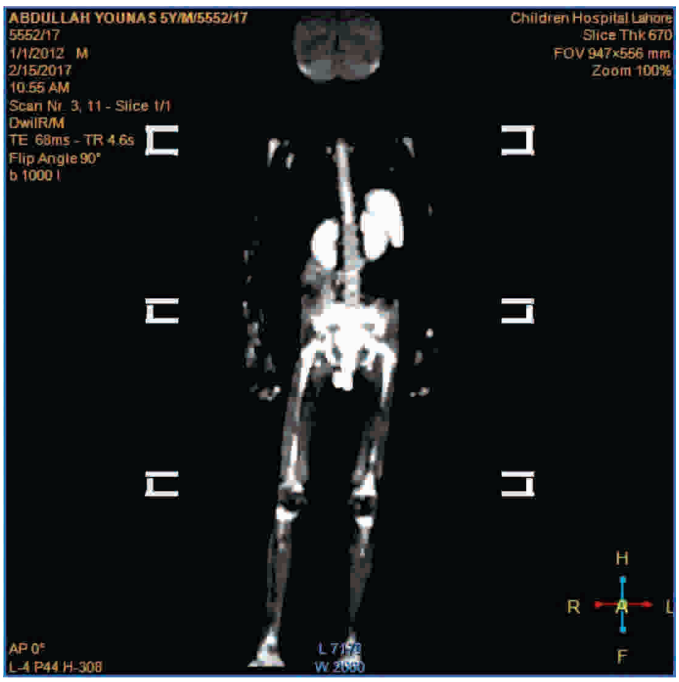


Fig. 2: *Same Patient Post Chemotherapy DW Whole Body MRI Shows no Left Sided Cervical and Supra-Clavicular Lymphadenopathy Suggesting Complete Resolution*

Ethical Approval: Given
Conflict of Interest: None
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