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

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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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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.¹

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.⁰ 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 resonance 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.⁴

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 using this formula.

\[ n = \frac{Z^2(p)(1-p)}{d^2} \]

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 localiza-
tion. Staging system is most valuable when it assures
reproducibility over extended period of time.

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 sec-
dary neoplasia in children.

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

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.8

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 imag-
ing is not intended to replace dedicated MR exami-
nations 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.9

In western Countries, All are economically developed
countries. 75% patients have initial disease at
presentation (stage one-two)10.
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

<table>
<thead>
<tr>
<th>Lymphoma</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD patients</td>
<td>62</td>
<td>87.3%</td>
</tr>
<tr>
<td>NHL patients</td>
<td>9</td>
<td>12.7%</td>
</tr>
<tr>
<td>Total</td>
<td>71</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 2:

<table>
<thead>
<tr>
<th>Treatment response to Follow up</th>
<th>HD</th>
<th>NHL</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete Resolution</td>
<td>42(59.25)</td>
<td>4 (5.6%)</td>
<td>0.0001</td>
</tr>
<tr>
<td>No Response to Treatment</td>
<td>2(2.8%)</td>
<td>2(2.8%)</td>
<td>0.01</td>
</tr>
<tr>
<td>Progression of Disease</td>
<td>2(2.8%)</td>
<td>1(1.5%)</td>
<td>0.0015</td>
</tr>
</tbody>
</table>

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

Graph1: Comparison of Treatment Response

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References


