**REVIEW ARTICLE**

# ABDOMINAL LYMPHOMA: IMAGING WORK UP CHALLENGES AND RECOMMENDATIONS IN RESOURCE LIMITED SETUP

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## ABSTRACT

*Lymphoma management begins with an accurate diagnosis & staging. Major advances in imaging techniques, make cross sectional imaging and nuclear medicine technique an excellent tool for patient work up. However, limited access to modern imaging modality in resource limited set up and luck of standardized imaging work up challenged patient's management.*

*Assess the local lymphoma imaging work up and management challenges in patients with lymphoma and develop local imaging and reporting guideline.*

*A semistructured qualitative interview to six conveniently selected physicians (hematologists, oncologists & pathologists) who primarily takes care of lymphoma patient and literature review on the role of various imaging modalities, recommendation and experience of other countries were used as a methodology*

*Conventional and basic imaging modalities are used in the work up of patient in our set up. The imaging recommendation for these patients requires at least CT of the chest, abdomen and pelvis for initial diagnosis and FDG-PET and/or PET–CT for follow up and recurrence. Due to the comparable diagnostic potentials of US and its wide spread availability, makes US still the primary imaging modality. Luck of required information's and inconsistency in the radiologists report found to challenge physicians in their patient management.*

*The study concluded that US should still stay as the most important imaging modality in the initial treatment, staging and follow up patients in resource limited set up. It also recommended the general imaging work up and reporting framework.*

***Key words**: **Lymphoma, Ultrasound, Computed Tomography, FDG/PET, MRI***

## INTRODUCTION

Lymphoma is a general term for a group of cancers that originate in the lymphatic system and it is the most common hematopoietic malignancy. Overall incidence of lymphoma is increasing globally, with age-adjusted incidence rates for NHL being highest in developed countries. The incidence is also rising in sub-Saharan Africa where the prevalence of HIV is the highest in this part of the world (1).

Like any other disease, lymphoma appropriate management begins with an accurate and precise diagnosis; which depends on clinical, laboratory and imaging findings and criteria's. Traditionally, clinical findings and imaging like US and CT scan was used to make diagnosis and staging which usually necessitated a surgical biopsy specimen to obtain adequate tissue(2).

Major advances in imaging techniques, during the past two decades, make cross sectional imaging an excellent tool. Imaging is not only used to suggest diagnosis but is also essential to determine the staging of disease in patients with an established diagnosis of lymphoma. Such staging is critical in determining the type, nature, and aggressiveness of treatment options to be offered to patients, as well as predicting prognosis. Where needed, imaging is also used to assess the response of lymphoma to therapy and to determine the extent of the disease when recurrence is found. Such imaging role needs multimodality

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modern imaging which includes cross sectional imaging which is used to detect lymphadenopathy and the pattern of nodal involvement. Functional imaging, such as positron emission tomography (PET) using F-18-fluorodeoxyglucose (FDG), integrated with computed tomography has become widely used in the staging and evaluation of therapy response in lymphoma. It is also very useful in the follow-up of PET-avid lymphomas (2, 3).

Despite the development in imaging more than three-quarters of the world's population lives in circumstances in which the possibility of receiving even the most elementary radiological services is exceedingly remote (4). In Ethiopia, like other developing countries, radiological service is poorly developed. Plain radiographs and US are the most commonly available imaging modalities. CT is available in only in few centers and MRI is just appearing in the market. Nuclear medicine service is available in only one institution in Ethiopia (5). Services like gallium-67-citrate (Ga-67) scans and PET scans are farfetched at the current situation.

However, the problem is not only limited to unavailability of high tech modalities rather also lack of standardized imaging workup and reporting. Universally, the need for standardizing interpretation of imaging modalities is widely advocated so that consistent diagnosis, response assessment and follow up of patient can be made. Theoretically, any radiology report should be complete and include the structures involved, the extent of involvement, the appearance of the lesion, size and etc. The magnitude of lack of such standardized approach in our set up where basic and traditional imaging modalities employed in patient management aggravate the quality of the service rendered to patients.

Therefore, recommendation in standardizing diagnostic imaging approach and report with lymphoma promotes evidence-based practice and provides guidance to clinicians about which imaging techniques are the most appropriate in our set up to use in the workup and management of their patients. It also help the radiologist to understand the existing problem and guide them on how to make comprehensive & helpful comment for better patient management.

Thus the objectives of the review were to assess the imaging modalities used in patients with abdominal lymphoma and suggest the optimal imaging approach to be used in the local circumstances,. It also assess the challenges in reporting and attempts to develop local imaging and reporting guide line in patients with abdominal lymphoma.

## MATERIALS AND METHODS

Combinations of different methodological approaches were used in this study. The first method is reviewing literature on the role of various imaging modalities, recommendation and experience of other countries.

The second methodology used was conducting a semi structured qualitative interview with physicians who are involved in routine care of lymphoma patients.

***In reviewing literatures:*** the English language evidence published on imaging abdominal lymphoma was searched through MEDLINE using the following words "lymphoma, imaging, and imaging treatment response". The pertinent literatures' identified are cross referenced to select further articles. Besides the above, no other specific search strategy was adopted. Those articles with a definitive recommendation on the imaging approaches, articles which has evidence on value of various imaging modalities are reviewed to assess the significant role of each modality. Local expert opinion was incorporated in the development of the recommendations.

A Pre-prepared format were used for the semi structured qualitative interview and done on conveniently selected two pathologists, two hematologists and two oncologists who are involved in managing lymphoma patients. The interview emphasized on their local experience on diagnosis, staging, follow up, treatment response and imaging related challenges.

## RESULTS AND DISCUSSION

***Local lymphoma imaging work up & challenges:*** Universally hematologists, oncologists, internists and pediatricians are involved in the management of patients with lymphoma. In our set up, primary management of lymphoma patients depends on age of the patients, disease localization, disease stage, predominant site involved, type of lymphoma, patient preference, and availability of the specialty and referral preference of the primary caring doctor.

In an interview with the physicians, more than two third of the patients are primarily managed by hematologists, either pediatric or adult. The process of

referral is not different from any other disease. Patients if suspected or diagnosed at different outpatient clinic are referred to the hematology team or oncology team. These clinicians are responsible for staging, treating and follow up of the patient. The oncologists, in our set up, usually take full responsibility, if disease is localized to specific organ or site or adjuvant radiotherapy is necessary. In addition, they are very much involved in managing abdominal lymphoma. Both oncologists and hematologist administer systemic anti lymphoma medication.

No joint clinic or interdepartmental management sessions specifically arranged for the management of these patients in our hospital. However, tumor board meeting with pathologists and oncologists and sometimes surgeons is done fairly regularly. It is unfortunate no radiologist is a member of this team. According to one of the oncologist lack of enthusiasm from the radiologists is the reason for not including them. The need for the presence of radiologist in the team is believed essential by all.

There are few studies done, in our set up, assessing the prevalence of lymphoma. During the interview one of the oncologist revealed that his group is reviewing fourteen years data of 13,800 patients with malignancy in oncology department. In this unpublished review, hematologic malignancy account for 1.5% of 13,800 patients of which lymphoma is the dominant (Dr. Wondimagegn, Department of Oncology/radiotherapy, AAU).

Older study done by Shamebo M et al showed that hematologic malignancies account for about 3% of hospital admissions. Among the hematological malignancies lymphoma and leukemia account for 56 % (9). According to the experience of our hematologists, approximately 5 - 9 patients/month are seen and most patients arrive late in their disease. Oncologists claim that they manage less than 2 to 3 cases of lymphoma per month. The prevalence of the disease in any given health institution depends on the level of service and availability of the specific personnel. Diagnosis is based on FNA, verification and cell marker determination done from specimen biopsy, rarely by immunohistochemistry.

According to the pathologists, Ann Arbor method of lymphoma classification is used. Once the diagnosis is proved pathologically, all patients are routinely staged, but if there are difficult or equivocal cases telemedicine technology (iPath) is used to get expert opinion. Nearly all physicians interviewed use both clinical and imaging findings (usually CXR and US) when staging. All of them claimed that CT is rarely used in abdominal lymphoma and no MRI or any nuclear medicine techniques are used. In a review suspected 69 lymphoma patients only 9 % of these patients had CT and most of them have CXR & US (Asfaw et al. in publication process). This is in contradistinction to the routine practice elsewhere; they suggested the use of CT chest, abdomen and pelvis, PET/CT and MRI (6, 7, 8, 10, 11). Strong financial implications for routine use of CT scan & MRI and unavailability of nuclear medicine techniques forced them to entirely rely on plain radiographs and ultrasound.

In addition to the challenges of limited availability of variety of imaging modalities, the degree of information the clinicians obtained from the radiologists report is disappointing, as per the clinicians. They claimed that the reports are grossly unstandardized and the information critically wanted for staging the disease are sparsely mentioned and sometimes not mentioned at all.

As per the opinion of one of the oncologists;

> "We can't even make radiotherapy planning due to the limited information from the report and the hard copy images sent with the report, which do not sometimes include the area of interest. According to his opinion, we practically have very limited assistance from imaging despite its potential".

When all the six physicians are inquired on the contribution of luck of adequate clinical information to the radiologist poor reporting? They concur with the need for information for the radiologist especially in the situation where EMR is not available. However, none of them consider it as a justification for the poor quality of radiology report.

Among the missing information from the reports, according to the physicians; poor description about the positive finding, absence of information on the extent of involvement of anatomic regions, lack of measurement of size of the pathology, deficiency of negative finding, nonexistence of recommendation on further imaging, staging, and management are included as important. They recommended the need for a standardized report and they emphasized the points mentioned above to be included. Our review could not find similar study done in developing country whether similar problem exist. However, we suppose similar problem might be seen due to the busy schedule of the limited number of radiologist.

The situation is worse in the follow up of the patients

where they claim that for practical purpose they do not use imaging. They, nearly all, claimed that they stopped relying on single reports and send patients to different private and public imaging centers so that to confirm negative or positive findings. Occasionally, they entirely rely on their clinical findings in patient follow up. They also claimed, "Absence of informative, complete and standardized report is a consistent opinion of most practicing doctors for all type of imaging and disease". This finding should be a biggest wake up call for radiologists who are involved in the examination of patients.

The physicians, claimed that the follow up of patients with lymphoma depends on the clinical condition and outcome of the patients , the extent of systemic involvement, the type of lymphoma, the regions involved and the individual clinician (specially the specialty type, oncologists in general reevaluate earlier). Imaging is also used to see the change or appearance of newer lesions during follow up.

According to, nearly all, clinicians' interviewed, the current practice where residents examining and reporting independently with limited supervision on patient's diagnostic images contribute for the incomplete and un-standardized report. They recommended the need for close supervision as a possible solution. Even though, this is not verified by the opinion of the radiologists, the authors agree that this is the current practice in the studied hospital.

The question whether to develop a standardized format, specific for lymphoma patients was positively entertained by the physicians. However, they questioned the practicality, in a situation where luck a subspecialist group of radiologist to particularly deal with these patient. They rather suggested having a format for all patients with abdominal ultrasound and specific findings like lymph node enlargement or any mass lesions or lesion in any abdominal organs to be described exhaustively irrespective of the type of disease. Most of the clinicians recommended to identify specific lesion in a particular area of the organ to be measured and this specific lesion to be measured during follow up. This is believed to be very critical in situation like ours, where EMR is not available.

***Literature review: on Imaging for diagnosis, staging and treatment response of patients with abdominal lymphoma:***

Review of literature was made on the role and the recommendation of the various types of imaging used for diagnosis, staging and assessing response to therapy with abdominal lymphoma patients. Twenty one articles and peer reviewed papers and recommendations were reviewed. These articles included thirteen General review and modality based articles and eight consensus papers which suggest various recommendations and guidelines (Table).

***The role of various imaging modalities in abdominal lymphoma:*** All reviewed literatures stated diagnostic imaging modalities to have a fundamental role in the staging of lymphomas and owing to major advances during the past two decades, make surgical staging unnecessary in most cases. Cross-sectional imaging techniques believed to be excellent tools for evaluating the extent and sites of disease in lymphomas. Despite the stated value, concern is raised in the developed countries that many imaging studies ordered during active treatment among patients with cancer for uncertain reasons and that, in some cases, results may have little or no impact on clinical care. In contrary, developing countries face challenge of luck of variety of imaging modalities.

Cross-sectional imaging (CT scan, MR imaging, US) is primarily used to detect lymphadenopathy and the pattern of nodal involvement (10, 12, 13, 14). Patients require routine follow-up to assess tumor shrinkage in response to therapy and to decide on treatment modification, if required. In most lymphoma patient's lymph node or lesion size determination before and after treatment has been suggested as a means for follow up. Measurements of lesions should be bi-dimensional. Most of these measurements are relatively easy but might be difficult in cases of irregular edges or infiltrating lesions. In some patients, lymph node attenuation values may decrease as a response to treatment with or without overall reduction in lymph node size(15-17).

The following are details, according to the reviewed literatures, illustrating the roles & limitation of various imaging modalities in imaging lymphoma.

***Computed tomography:*** Most western literatures suggested clinical management of lymphoma to be decided based on either contrast enhanced CT or PET. CT scan is the most commonly used imaging modality for the detection, staging, and follow-up of lymphoma. The role of CT scan in lymphoma is multifold. It is used to (1) define the full extent of disease to allow accurate staging; (2) assist in treatment planning (i.e., determine the site of nodal biopsy, create radiation planning portals, and select chemotherapy protocols); (3) evaluate response to therapy; and (4) monitor patient progress and possible relapse.

Contrast-enhanced computed tomography is advised in patients with abdominal lymphomas for distinguishing lymph nodes from non-opacified bowel loops and vessels, and where more precise measuring of node size is indicated. In rare cases with head and neck involvement, CECT may be useful to differentiate physiologic uptake from enlarged cervical lymph nodes(2, 6).

Various studies evaluated the use of CT, the accuracy of CT staging of abdominal lymph nodes compared with postoperative clinical stage was found to be 75%. However, poor performance of CT was described in aggressive tumors by Mikhaeel et al (11) and the reason postulated was its inability to correctly identify an early response, since it depends largely on the reduction in size of the enlarged lymphadenopathy or masses.

In a study by Zinzani et al (12) 59 patients with NHL, presenting with abdominal involvement had CT scans at diagnosis and during follow-up (median 24 months). The accuracy of CT was found to be very low, at 25%, because of the many false positives, which may be due to the CT scan inability to differentiate between active residual disease and fibrotic changes from curative therapy in patients with abdominal masses.

Moreover, other pitfall with CT is the increasing number of reports on the presence of normal sized lymph nodes with early lymphoma which affect disease staging. To overcome this pitfall comparison with the most recent CT study is suggested, however, this is often not sufficient because the growth becomes obvious only if serial studies are compared. Even then, small difference in measurement (approximately 15%) in near normal-sized lymph nodes between two CT examination is often related to ‘‘plane of section’’ artifact (i.e. related to slice section) and also a follow-up study in 3 months is not sufficient for follow-up of slow-growing lymphoma (2,10,11,13).

CT-based criteria of response were defined for NHL but are also often used for HL. Recommendations include separate definitions for complete remission; complete remission (unconfirmed or uncertain); partial response; stable diseases; and progressive disease. Progressive disease, for example, includes the appearance of new lesions or an increase of more than 50% in known lesions. An increase of more than 50% in the greatest diameter of any previously identified node that was greater than 1 cm also represents progressive disease (18).

***MRI imaging:*** Comparative studies showed the accuracy of MR imaging in detecting lymph node and organ involvement is similar to that of CT. Etsoro-Tess et al studied the role of MRI in staging patients with lymphoma. They evaluated 72 previously untreated patients with chest, abdominal, and pelvic MRI. The overall sensitivity of MRI for all lymph nodes was consistent at 87%, with the majority of under staged nodes located in the para-aortic area (75%).

Overall, MRI influenced the staging (upgraded) in 11 of 74 patients (15%) and demonstrated the presence of unsuspected disease in nine of 42 patients (21%) (14). However, other multiple comparative studies showed no significant added value by the use of MRI and restricted its use whenever CNS lymphoma is suspected. Change in the signal related to fibroses and cystic change in follow up patient has been advocated by these studies. The inconsistency of the finding is the limitation of MRI as a tool to follow response to treatment except its help in assessing the nature of a residual mass detected by CT. In the future diffusion MR imaging in lymphoma patients by allowing the detection of water motion over small distances expected to add input in lymphoma management. In general, limited additional information acquired by MRI limits its wide spread use in abdominal lymphoma diagnosis and follow up (10, 14, 15).

***Ultrasound examination:*** Sonography is a straightforward and convenient technique to investigate lymphadenopathy. Superficial lymphadenopathy, like the region of the neck, is a common manifestation of lymphoma and detailed analysis of these glands help in suggesting the cause of the lymphnode enlargement. Most Lymphnodes in the abdomen are accessible and can be assessed transabdominally. This helps to assess which lymphnode groups are involved and assess the different US features which suggest the lymphomatous nodes. Features like size, shape, echo texture, internal architecture, presence of calcification, and color Doppler flow studies help in suggesting a lymphnode is lymphomatous or metastatic (2, 10, 17).

Sonography prove to be a useful initial investigation. However, the main disadvantages of sonography are the poor spatial resolution, its limited use in the thorax and deep retroperitoneum, and high operator dependency. Some of its limitations may be overcome by doppler sonography which offers functional imaging of the lymph node. Since feeding vessels determine tumor growth, color/power doppler sonography (US) may be used to differentiate lymphoma from

metastatic carcinoma (19). Giovagnorio and et al (20) have described that vessels could be identified in all lymph nodes in patients with lymphoma. The majority of the lymph nodes demonstrated hilar vascularity because lymphoma arises within the lymph nodes and progresses in a centrifugal fashion.

Reports suggest that intravenously administered microbubbles help the diagnosis of lymphadenopathy with accurate demonstration of vascular flow within a lymph node(21). Sonography is a noninvasive method for detecting splenic involvement in lymphoma (22). Ultrasound is also useful for the evaluation of the genitourinary tract, including possible testicular involvement. US-guided biopsies of focal lesions are useful for tissue sampling (2, 10, 13).

The studies done assessing the use of US are relatively older. Current studies done in developed nations emphasized the use of other cross sectional images like CT. No recent study, to our knowledge, recommend the use of US exclusively for staging, follow up and response assessment.

***Nuclear medicine techniques:*** Functional imaging reflects the metabolic activity of tissues that precede anatomical changes, allowing for a more expedient change to an alternative treatment. PET with 18F-FDG can provide functional information based on the increased metabolic demands of tumor cells requiring adenosine triphosphate generated by glycolysis. In addition to detection of tumor foci in the lymph nodes and spleen, PET imaging has the ability to differentiate between aggressive and low-grade lymphomas. Aggressive lymphomas tend to have a higher 18F-FDG uptake (23). The median sensitivity and specificity reported for PET is 90.3 percent and 91.1 percent, respectively. The maximum joint sensitivity and specificity was 87.8 percent [24). Other nuclear medicine techniques like gallium 67 have been used in lymphoma; however the sensitivity and specificity of FDG PET are superior to those of gallium 67 scintigraphy in all but indolent lymphoma (18).

However, PET imaging has numerous limitations such as absence of precise anatomic landmarks for accurate localization of lesions, inherent lack of specificity (18F-FDG can be taken up by lymphomatous nodes and sites of active inflammation and physiologically by some organs) and low-grade lymphomas may not demonstrate uptake or have a low 18FDG uptake (18).

FDG PET is important in both the primary diagnosis and the evaluation of therapy in lymphoma. It is also superior to CT&MRI in differentiation of viable tumor, necrosis, and fibrosis. Perhaps the clearest role for the use of PET in lymphoma is in post-treatment response assessment because of its ability to distinguish fibrosis or sclerosis from residual active disease. Early studies have demonstrated a role for post-therapy FDG-PET imaging in the prediction of aggressive NHL or HL recurrence (2, 10, 11, 18, 23, 25,26).

The advent of PET-CT has remarkably improved the accuracy in the diagnostic work-up of patients with lymphoma. PET-CT provides dual modality imaging, which combines the functional information provided by PET and the excellent anatomic resolution offered by CT. Despite the mentioned role of various nuclear medicine techniques their absence or their poor development status in most developing countries makes them unthinkable in these countries.

***General consensus in imaging work up of lymphoma patient and adoption to local set up:*** Various agencies made recommendation on the use of various imaging modalities based on literature and local experience (7, 8, 10, 27 28, 29). The recommendations developed by radiology and oncology experts in Ontario are one such attempt (8). The recommendation was developed by performing detailed literature review, taking opinion of local experts and external reviewers. These expert groups recommended CT chest/abdomen/pelvic neck for staging in all patients and is generally accepted as the primary modality for suspected lymphoma and in selecting the site for surgical tissue diagnosis. For response assessment CT of at least involved area recommended, where this information alter the treatment plan. US and MRI recommended by this group to be used only in selected cases.

In following patients routine CT to be used for high-risk at presentation, after initial therapy if PET not available, those felt to be at risk of recurrence and in patients with incurable lymphoma. The role of MRI limited and used when CT is unclear, may be useful in identifying solid organ involvement. In some cases, it may show extra-nodal disease, such as bone marrow involvement when bone scan is equivocal. However US recommended to be used in few selected cases (7).
A number of agencies have developed consensus-based guidelines on the use of imaging in the follow-up of lymphoma. FDG PET is believed to be important in both primary diagnosis and the evaluation of therapy in lymphoma. The clear role for the use of PET in lymphoma is in post-treatment response assessment because of its ability to distinguish fibrosis or sclerosis from residual active disease is widely ad-

vocated. The current hybrid PET-CT provides dual modality imaging, which combines the functional information provided by PET and the excellent anatomic resolution offered by CT is the best modality for both diagnosis and follow up. Its limited availability limits its use (28).

The American College of Radiology (ACR) publishes the ACR Appropriateness Criteria, practice guidelines with a strong consensus component . The ACR Criteria for follow-up of Hodgkin's disease strongly recommended that, for those patients with IIA sub diaphragmatic HD, chest/abdomen/pelvic CT be performed either every six months for two years, then yearly for three years, or once a year for five years, citing the potential for early curative salvage therapy (29). The Canadian Association of Radiologists recommended that, if there is clinical suspicion of relapse or progression, a chest, abdomen, and pelvis CT examination would be appropriate, especially for NHL, and MRI is not indicated initially but may help to assess the nature of a residual mass detected by CT (27).

In the western world people has limited the use of US as the primary modality in lymphoma patients. Its use is limited for only initial evaluation of patients & guiding biopsies. The development of modern modalities with higher and better sensitivity and specific hindered its wide spread use. In addition sonography poor spatial resolution, its limited use in the thorax and deep retroperitoneum, and high operator dependency added impetus to its limited role.

However, US equipment and experts wide spread availability and its comparative role to CT in the abdominal imaging and the relatively large extent of information attained about the solid organs of the abdomen and other structures, US should not only be the initial imaging modality but the essential modality to be used for all patients in our set up. Its superior role in imaging superficial nodes and lesions, its role to guidimg biopsies, absence of radiation especially in children, portability and the opportunity to do repeat multiple studies is an additional tip in favor of its continued use.

Therefore, it become obvious that CT and US should be the modality to be used for assessing abdominal lymphoma patients, especially at the initial diagnosis and staging. Follow up study usually done after fourth cycle of therapy, as per the local practice; also require similar examination modalities for restaging. The tendency of its increased availability and reduction in cost in our set up makes CT to be more widely used. However use of proper technique and comprehensive and purposeful examination and standardized reporting system is essential.

The limited additional information's that can be attained by MRI in the abdomen, pelvis and its limited availability and cost restrict the routine use of this modality except in situation where CNS involvement is suspected.

***Recommendations:***

Based on the finding from the current survey and review of literature the following recommendation can be drawn in imaging management of lymphoma patients in resource limited set up;

1. Abdominal US to continue to be the prime diagnostic modality in the work up of lymphoma patients and as much as possible CT scan of the chest and abdomen including the pelvis has to be included in the work up of all patients with abdominal lymphoma.

2. Physicians must provide adequate information on the diagnosis, treatment status and clinical stage and the purpose of the current examination and images or brief description of the previous findings to the radiologist who perform or interpret the US and CT scans. This should be emphasized until such a time where EMR is widely used.

3. Patients with Lymphoma must be managed as a team and as far as possible joint management session should be set up to discuss individual. specially difficult cases.

4. Senior radiologist must examine/interpret and/or report or attend the examination of these patients and guide the junior staffs report

5. Every abdominal US or CT report of lymphoma patient must include the following points on their report

   • Status of all solid abdominal organs, even if, findings are negative.

   • Lesions or abnormalities should be characterized in terms of size, echo appearance vascularity and precise anatomic location. In follow up study of these patients, similar description and comparative comments must be given to the requesting physicians.
   • Report must include comment on the retroperitoneal structures, the peritoneum, mesentery and

omentum, even if found negative.

- All nodal regions has to be assessed and the regions of identified enlarged lymph nodes must be stated based on standard regional nomenclature and the uninvolved regions to be stated.

6. The following points must be stated on the status of identified nodes and or mass like node
   - The shortest and longest diameter of the dominant nodes
   - The dominant echo texture of most involved nodes
   - The presence or absence of calcifications, necrosis and other idiosyncrasies
   - Vascularity of the lesion based on power and color Doppler study
   - The relative relation of the involved nodes like the discreetness or matting and etc
   - Whether the node or mass like lesions relation with vascular and other abdominal organs
   - Presence of secondary effects on adjacent organs.
7. With additional clinical information and imaging findings of other body regions, radiologists are commended to suggest the possible disease stage, cautiously.
8. In the follow up study comparative evaluation must be the goal and all attempt must be undertaken to do that, if not possible, the need for the comparative evaluation must be communicated in the report.
9. Follow up study must state the development of new lesions and the relative condition of the previously identified lesion. In concluding the reports comment must be added the relative new status (improvement or not) and the current disease stage.
10. Limitation of the specific modality should be included, if decision on a specific finding or change cannot be determined.
11. It is not recommended to suggest specific cell type of lymphoma, even if findings suggest so.

At last we also recommend the need for further study and interdisciplinary consensus team to be formed so that they develop national lymphoma diagnosis and management guideline.

**Table :** ***Abdominal lymphoma diagnosis, staging and follow up reviews***

| Study subject area | Focus | Author/publication year |
|---|---|---|
| General review and modality based articles | US | - Carroll BA/Semin Ultrasound , 1982<br>-Tschammler A et al/ EurRadiol ,1999 |
| | Multimodality including CT | -Munker R etal/. Cancer 1995<br>-Mikhaeel NG/ Leuk Lymphoma. 2000<br>-Rademaker J/ PET Clinics 2006<br>- Zinzani PL et al/ Leuk Lymphoma. 2002<br>- Masahiro/ RadioGraphics 2010; 30:939–957 |
| | MRI | - Esoro-Tess JD et al/Eur J Radiol. ,1991 |
| | FDG/PET | - Schoder H et al/ J ClinOncol 2005<br>- Mikosch Pet al/ Acta Med Austriaca 2003 |
| | General review | - Mattew J et al/ ClinOncol 1989<br>- Munazza A et al/ RadiolClin N Am 46 (2008)<br>- Rankin SC et al/ Eur J Nucl Med Mol Imaging 2003 |
| Consensus paper | Diagnosis & staging | - Lister TA et al / ClinOncol 1989<br>- Cancer action Ontario/ Recommendation report 2008<br>- Canadian Association of Radiologists/2005<br>- ACR appropriateness criteria /2000 |
| | Post therapy follow up | -Cheson BD et al/ J ClinOncol 2007<br>-Expert Panel on Radiation Oncology/2007<br>-Cheson BD et al/ ClinOncol. 1999<br>-Bruce D/ RadiolClin N Am 46 (2008) |

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