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Original Article

# The use of Deauville criteria in follow-up assessment of response to therapy in extra-nodal Non-Hodgkin's lymphoma

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ABSTRACT

*Objective:* Our aim was evaluate the role the PET/CT in the assessment of response to therapy in patients with Non-Hodgkin extra-nodal lymphoma: in particular, a five-point scale (Deauville criteria), which can be employed for early- and late-therapeutic response assessment.

*Methods:* Sixty patients with pathologically confirmed Non-Hodgkin lymphoma (NHL) were enrolled in this prospective study. All patients underwent the following PET/CT examinations: initial PET/CT for staging, interim PET/CT and end of treatment PET/CT. Response assessment was done using new Cheson's guidelines and five-point scale (Deauville criteria).

*Results:* All patients were evaluated for response to therapy in the early interim, followed by late interim, as well as end treatment assessment for the overall response. We found good concordance of response assessment according to the Deauville criteria classification with International Harmonization Project (IHP) classification. After early interim 48/60 patients had concordant designations (91.7%, 83.3%, 70%, and 33.3%) and 12 patients had discordant designations. After late interim, 56/60 patients had concordant designations (100%, 100%, 80%, and 50%) and four patients had discordant designations. After end of treatment, 54/60 patients had concordant designations (100%, 100% and 71.4%) and six patients has discordant designations.

*Conclusion:* Response assessment according to the Deauville criteria classification showed good concordance with IHP classification. According to our findings, we recommend the use of Deauville criteria in reporting of PET/CT for staging and assessment of response to treatment.

## 1. Introduction

Lymphoma is the most frequent primary hematopoietic malignancy. Non-Hodgkin lymphoma accounts for approximately 5% of all cases of cancer with greater predilection to disseminate to extra-nodal sites [1].

The extra-nodal involvements are compromising in approximately 40% of patients. The term extra-nodal involvement refers to lymphomatous infiltration of anatomic sites aside from the lymph nodes [2]. It is due to the regional spread of nodal disease or blood dissemination [3].

The advantage of metabolic imaging is its ability to distinguish viable metabolically active tissue from scars. Additionally, it has the potential to detect functional changes in response to chemo- or radiotherapy before any change in clinical or radiological size of a mass occurs [4].

Assessment of response to treatment is considered one of the most important issues in lymphomas imaging. How to differentiate fibrosis from viable tumor within residual masses, represents a dilemma of interpretation for lymphomatous lesions. Therefore, accurate staging is critical for the selection of a proper therapeutic approach, in order to prevent further un-needed treatment, and to lessen morbidity caused by the therapy applied [5].

The most common response evaluation guideline in lymphoma was carried out as per the International Workshop Criteria (IWC, 1999) guidelines and revised response criteria by International Harmonization Project (IHP) [6].

The aim of this work was to evaluate the role the PET/CT in the assessment of response to therapy in patients with Non-Hodgkin extra-nodal lymphoma: particularly, a five-point scale (Deauville criteria) to grade response utilizing PET/CT.

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**Table 1**
Criteria of therapeutic response by international harmonization project (IHP) [6].

| Response | Definition | Nodal masses | Spleen and liver | Bone marrow |
|---|---|---|---|---|
| Complete response | No evidence of disease | Previously enlarged FDG-avid lymph nodes size decreased to normal (≤1.5 cm) | Diminution in size, and disappearance of nodules | No infiltrate at repeat biopsy |
| Partial response | Regression of disease and no newly developed sites | ≥50% diameter decrease of up to six of the largest masses, no increase in size of other nodes | ≥50% decrease in size of nodules | Irrelevant if findings are positive before therapy, the type of cell should be specified |
| Stable disease | Failure to attain CR/PR or PD | PET positive at previous sites of disease and no new sites at CT or PET | | |
| Relapse or progressive disease | Newly developed lesions or increase by 50% of previous lesions | Appearance of one or more new lesions > 1.5 cm, ≥50% increase in size of more than one node; new FDG-avid lesions | > 50% increase in size of any previous lesions | New or recurrent involvement |

**Table 2**
Criteria of therapeutic response by Modified Deauville Criteria [5].

| Score | PET/CT scan result |
|---|---|
| 1 | No uptake above background |
| 2 | Uptake at an initial site that is lower than or equal to mediastinum |
| 3 | Uptake at an initial site that is more than mediastinum but lower than or equal to liver |
| 4 | Uptake at an initial site that is moderately increased in comparison to the liver |
| 5 | Uptake at an initial site that is markedly increased in comparison to the liver |

## 2. Patients and methods

The study was performed in a private Radiology centre, and all patients agreed to participate in the study. During two years duration, we prospectively evaluated 60 patients with pathologically confirmed NHL. This study included 44 males and 16 females, ranging in age from 20 and 78 years old (mean age 51 ± 17.4 years). Patients underwent the following PET/CT examinations: initial PET/CT for staging, interim PET/CT and end of treatment PET/CT.

### 2.1. Imaging protocol

All examinations were acquired using a combined PET/CT in-line system (Syngo PET VG 50A Biograph 20 VA 44A, Siemens Medical Solutions, Berlin, Germany). All patients administered one liter of negative oral contrast agent (5% mannitol) approximately one hour before the examination. 370–555 MBq (10–20 mCi) (3–5 MBq/kg) 18F-FDG was IV administered 45–90 min prior to the examination.

First non contrast low dose CT images were obtained. This was followed by whole body PET scan in 3D mode. Lastly, a diagnostic contrast-enhanced CT scan was obtained with an application of 100 mL nonionic contrast agent (Optiray 350 [Ioversol 74%], Covidien, Germany) in porto-venous phase (70 s delay). The whole acquisition time for an integrated PET/ CT scan was approximately 25 min.

### 2.2. Timing of exam

Post-therapy PET/CT examinations were performed not less than 4–6 weeks after surgery or chemotherapy and 8–12 weeks after external beam radiation therapy or radio-immunotherapy. These intervals minimize the chances of false-negative (FN) and false-positive (FP) findings.

### 2.3. PET/CT interpretation

All PET/CT examinations were analyzed by two experienced observers (Radiologist and nuclear medicine specialist). The PET images and the volume of CT scans were assessed for the existence and extent of 18F-FDG-positive lymphoma in different lymph node groups, the presence of extra-nodal lymphomatous infiltrates, as well as the presence of non FDG avid residual soft-tissue abnormalities.

Patients were staged according to the Ann Arbor classification [7]. Response assessment was performed using new Cheson's guidelines (Table 1) [6] and five-point scale (Deauville criteria) (Table 2) [5].

FDG avid residual masses of 2 cm or more with maximum SUV exceeding that of mediastinal structures are considered PET positive, whereas masses 1.1–1.9 cm are considered PET positive only if their metabolic activity is higher than the surrounding background activity. A smaller residual mass or a normal-sized lymph node (e.g. < 1 × 1 cm) should be considered positive for disease if its activity is higher than that of the surrounding background.

Diffuse splenic involvement was diagnosed when the splenic activity exceeded that of the liver. Splenic or hepatic lesions which are larger than 1.5 cm on CT should be considered as positive lymphomatous lesion if their uptake is higher than or equal to that of the liver or spleen.

If there was a diffusely increased FDG uptake of the bone marrow, the patient was considered as PET positive. Diffuse FDG uptake after chemotherapy, can be due to reactive bone marrow hyperplasia, consequently, thorough history taking was essential. A delay of 3–4 weeks after end of therapy permits the physiologic marrow activity to abate [8].

## 3. Results

On the basis of the IHP after early interim, 24 patients had a complete response (CR), 10 had progressive disease (PD), 20 had a partial response (PR) and 6 had stable disease (SD). In comparison, on the basis of Deauville criteria, 26 patients had a CR, 12 had PD, 18 had a PR and four had SD (Table 3). Overall, 48 out of 60 patients had concordant

**Table 3**
Response designations according to the IHP and Deauville criteria classifications after early interim treatment.

| | | IHP after early interim | | | |
|---|---|---|---|---|---|
| | | CR (n = 24) | PD (n = 10) | PR (n = 20) | SD (n = 6) |
| Deauville after early interim | CR (n = 26) | 22 (91.7%) | 0 (0%) | 4 (20.0%) | 0 (0%) |
| | PD (n = 12) | 0 (0%) | 10 (83.3%) | 0 (0%) | 2 (33.3%) |
| | PR (n = 18) | 2 (8.3%) | 0 (0%) | 14 (70.0%) | 2 (33.3%) |
| | SD (n = 4) | 0 (0%) | 0 (0%) | 2 (10.0%) | 2 (33.3%) |