Sensitivity of Gallium Scintigraphy for Evaluation of Recurrent Lymphoma: Comparison of Planar and SPECT Imaging

Original Article

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(Received 29 October 2009, Revised 29 November 2009, Accepted 8 December 2009)

ABSTRACT

Introduction: Although PET scanning using F-18[FDG] is considered the superior radiotracer for tumnor imaging, Gallium-67 is still in use for some malignancies such as lymphoma and hepatoma. One of the strategies to improve the diagnostic accuracy of Gallium is to perform SPECT which is reported to be more sensitive compared to planar imaging. In this study we compared the sensitivity of SPECT and planar imaging in patients suspicious of thoracic recurrent lymphoma.

Methods: 129 patients with suspicious recurrent lymphoma of the thorax were included into the study. All patients received 10 mCi Gallium-67-citrate intravenously. Twenty four and 48 hours post injection whole body and thoracic SPECT imaging was performed. The final diagnosis of recurrence was achieved by combination of clinical and imaging findings or pathologic examination whenever possible.

Results: The final diagnosis of 83 (64.3%) patients was recurrence of lymphoma in the thoracic area and the remainder 46 (35.7%) were in remission. The sensitivity of planar and SPECT imaging for diagnosis of recurrent lymphoma was 63% ([52-73%] with 95% confidence intervals) and 87% ([79-94%] with 95% confidence intervals), respectively.

Conclusion: In our study, 20 patients with the final diagnosis of lymphoma recurrence in the thoracic area had negative planar despite positive SPECT imaging. This showed an increase of 24% in sensitivity of the scan (from 63% to 87%) by adding SPECT imaging to the procedure. Our recommendation is integrating SPECT modality into all gallium scintigraphy for lymphoma recurrence.

Keywords: Gallium-67, Planar imaging, SPECT, Sensitivity, Lymphoma

Iran J Nucl Med 2010;18(1):45-51

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INTRODUCTION

Lymphoma is a common malignancy of the hematopoietic system which usually presents with lymphadenopathy in various sites (1, 2). Management of the lymphoma patients usually involves using imaging modalities such as sonography, CT scanning, MRI, and nuclear medicine techniques (3-6). Usually anatomical imaging such as CT scanning is not that accurate for staging or recurrence of lymphoma since it cannot distinguish between viable and non-viable tumors in the lymph nodes (7), however it is proven functional imaging such as nuclear medicine techniques can be very useful in this regard (3, 8). Although PET scanning using F-18[FDG] is considered the superior radiotracer for lymphoma imaging (9), lack of PET facilities in our country has forced the physicians to continue using alternative functional imaging such as Gallium-67.

Gallium-67 is a group IIIb element which is in use for tumor imaging since 30 years ago (10). As mentioned above, this radiotracer has been replaced mostly by PET techniques for most tumors, however it is still in use for some malignancies such as lymphoma and hepatoma with reported to have overall sensitivity of 80% (11, 12). One of the strategies to improve the diagnostic accuracy of Gallium is to perform SPECT which is reported to be more sensitive compared to planar imaging (13-16).

To the extent of our knowledge no comparison study has been performed in Iran for SPECT and planar gallium scintigraphy. In this study we compared the sensitivity of SPECT and planar imaging in patients suspicious of thoracic recurrent lymphoma.

METHODS

We retrospectively studied 129 patients referred to our department for evaluation of suspicious recurrent lymphoma in the thorax with Gallium-67 scintigraphy (from April 2004 to January 2008). All patients received 10 mCi Gallium-67-citrate intravenously. Twenty four and 48 hours post injection whole body and thoracic SPECT imaging was performed for the patients using dual head variable angle gamma camera (E.CAM Siemens). In case of any suspicious activity (for example in the abdomen), complementary projections as well as delayed imaging were done. The camera was centered on Gallium-67 photopeaks with 20% window (namely 93, 184, 300, and 393 KeV) and was equipped with a medium energy collimator. Whole body scanning was performed with the speed of 10 cm/min. SPECT imaging was performed with a 64×64 matrix and 64 steps (30sec/step). Iterative processing was used for SPECT images. Two nuclear medicine physicians blinded to the final diagnosis reviewed the planar and SPECT images separately.

The final diagnosis of recurrence was achieved by combination of clinical (the presence of palpable lymph nodes; the presence of symptoms such as fever, night sweats, anorexia, and weight loss; and the presence of elevated liver function tests and sedimentation rate) and imaging findings (chest radiography, computed tomography (CT), ultrasonography (US)) or pathologic examination whenever possible (17). In 59 patients the final diagnosis was made by tissue biopsy. Any new lymphadenopathy in the CT scan and in the proper clinical setting was considered as recurrence. If the diagnosis was not certain, follow up of the patients (mean duration of 8 months) was used. The final diagnosis was made by the referring oncologist.

The collected data were evaluated by SPSS software version 11.5. Sensitivity of SPECT and planar imaging was calculated using 2×2 cross tables. Continuous variables were expressed as mean ± SD. Chi-square test or Fisher's exact test were used for statistical

inference of categorical variables. For continuous variables independent sample t-test was used. For comparison of SPECT and planar imaging regarding sensitivity McNemar test was used. P-values less than 0.05 were considered statistically significant.

RESULTS

Of 129 patients included into the study, 61(47.3%) were female and 68 (52.7%) were male. 51 (39.5%) and 78 (60.5%) patients had Hodgkin's lymphoma and NHL respectively. Of 78 patients with NHL 5 had indolent and 73 had aggressive type of the disease. The age range of the patients was 11 to 55 years (26.76±8.1).

The final diagnosis of 83 (64.3%) patients was recurrence of lymphoma in the thoracic area and the remainder 46 (35.7%) were in remission. Planar imaging was positive in 52 patients with recurrence which amounts to the sensitivity of 63% ([52-73%] with 95% confidence intervals) for diagnosis of recurrence in the thorax. The SPECT imaging was positive in 72 patients with recurrence which gives the sensitivity of 87% ([79-94%] with 95% confidence intervals) for diagnosis of recurrence in the thorax. The sensitivity of the SPECT and planar imaging were significantly different for diagnosis of recurrent lymphoma (McNemar test p-value<0.001). Sensitivity of gallium scintigraphy was not statistically different between different ages, genders, and lymphoma types (Table 1).

DISCUSSION

Among different kinds of functional imaging modalities for management of lymphoma, FDG-PET imaging is the most accurate one (18). FDG-PET can overcome some of the limitations of gallium scan in the management of lymphoma (18); it can be completed in one-day and also has higher resolution and better dosimetry compared to gallium scan (19). For example, Shen et al. and Wirth et al. in two separate studies mentioned the superiority of FDG-PET scan over gallium scan in showing the tumour sites in both non-Hodgkin's lymphoma and Hodgkin's disease (20, 21). However, we should consider that PET scan is not yet universally available in most nuclear medicine centers (8) including our country, so practitioners should shift to other modalities such as gallium scintigraphy.

In 1969, gallium-67 was first used by Edward and Hays for tumor imaging and since then it has been in use to evaluate various types of solid tumours such as lymphoma (18, 22). Gallium uptake shows the presence of lymphoma while in necrotic and fibrotic sites, gallium scan is usually negative (23). It has also a high sensitivity and specificity to diagnose the early recurrence of malignancy (24-26).

Table 1. The result of gallium scan in different groups of patients (p-value<0.05 was considered significant).

		Total Number of patients	Sensitivity (for SPECT)	P-value
Gender	**Female**	61	86.9%	>0.05
	Male	68	85.3%	
Lymphoma Type	**Hodgkin's**	51	84.3%	
	NHL	78	83.3%	
	Indolent	5	80%	>0.05
	Aggressive	73	83.6%	

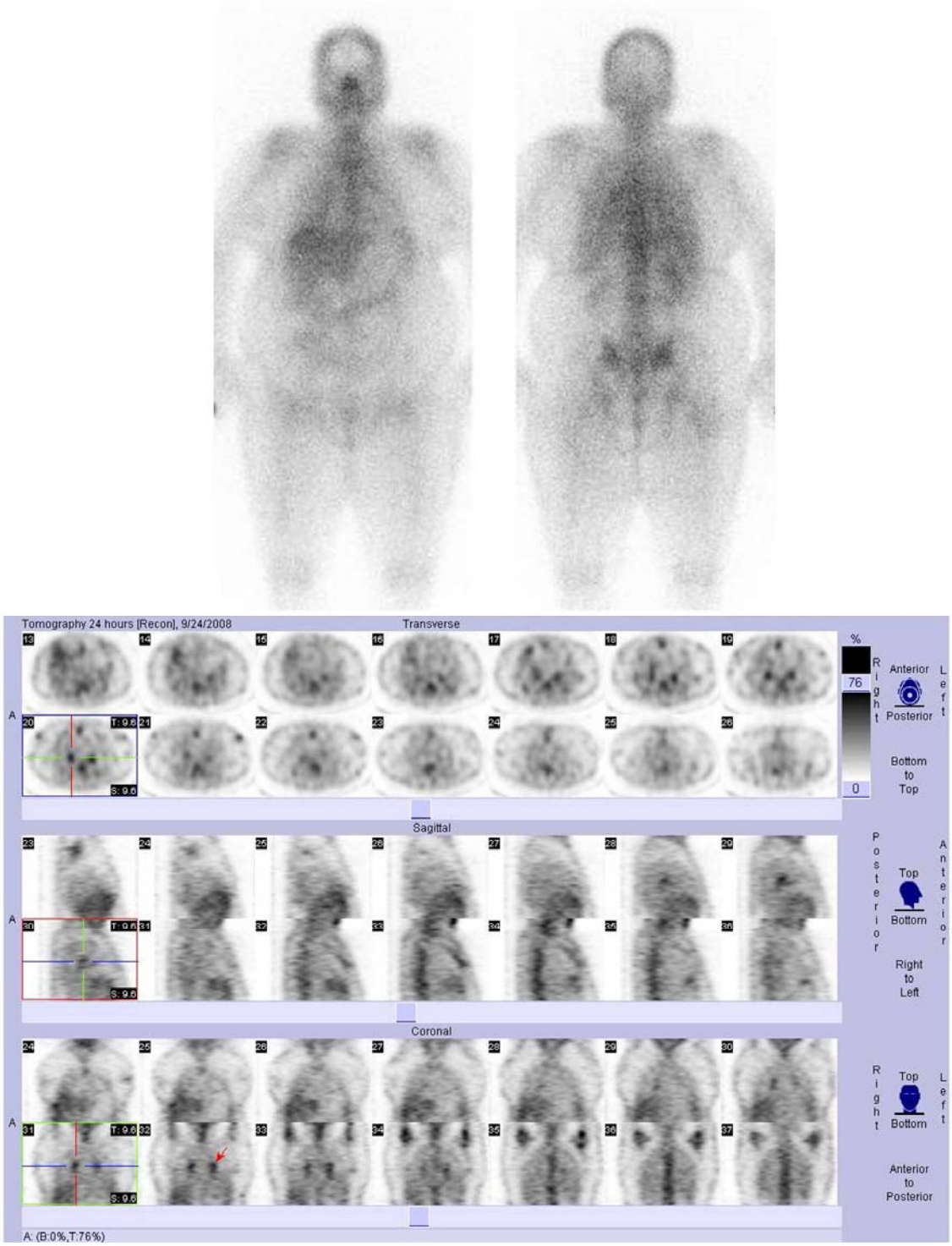

Figure 1. Example of a patient with negative planar and positive SPECT gallium imaging in the thorax. Upper part of the image shows the whole body of the patient. The bottom of the image shows the reconstructed SPECT slices of the thorax which is positive in hilar lymph nodes on both sides (cross and arrow).

Anderson et al. showed the accuracy of 96% for gallium-67 imaging in defining active disease sites in both Hodgkin and non-Hodgkin lymphoma. The sensitivity and specificity of gallium scan was more than 92% and the use of gallium-67 in the follow up of patients with lymphoma was recommended in their study (11).

Same as many other scintigraphies, gallium scan can be performed by SPECT method, which is reported to improve the diagnostic accuracy (compared to the planar imaging alone) in several studies (13, 14, 16).

Delcambre et al. showed the superiority of SPECT over planar gallium scan before and after chemotherapy of lymphoma. The sensitivity of SPECT was 85% and 92% before and after treatment respectively in contrast with planar scan which had 78% sensitivity before chemotherapy and 84% after that (27).

In another study, Alvarez Ruiz et al. compared the specificity and sensitivity of planar and SPECT methods in evaluation of lymphoma after treatment (lymphoma relapse). In this survey, the sensitivity of gallium scan was 66% in planar and 96% in SPECT imaging. This study also focused on abdominal lesions and showed the sensitivity of 69% and 85% for planar and SPECT imaging respectively (28).

Tumeh et al. determined the value of gallium-67 both in planar and SPECT images in 40 patients with Hodgkin's disease and non-Hodgkin's lymphoma. The results showed the sensitivity of 66% and 96% for planar and SPECT imaging respectively. These figures were 69% and 85% in the abdomen (13).

In our study, 20 patients with the final diagnosis of lymphoma recurrence in the thoracic area had negative planar despite positive SPECT imaging (Figure 1). This showed an increase of 24% in sensitivity of the scan (from 63% to 87%) by adding SPECT imaging to the procedure.

The sensitivity of gallium imaging for diagnosis of recurrent lymphoma was not statistically different in different ages or genders. This is in accordance with the previous studies in these patients (27, 28). There was not any significant difference between Hodgkin's and non-Hodgkin's lymphoma considering the sensitivity of the gallium scan for diagnosis of recurrence either. This is also in agreement of previous studies (13, 27). Although the sensitivity for indolent NHL lymphoma was not statistically different from aggressive one, the number of patients in this group was not enough to draw any conclusion regarding this group of patients.

CONCLUSION

We conclude that SPECT imaging of the thorax is an invaluable method for increasing the sensitivity of gallium scan for diagnosis of lymphoma recurrence. Considering the lack of PET facilities in Iran, in our opinion using this method to exploit most of the gallium scintigraphy diagnostic potential is rational. Our recommendation is integrating SPECT modality into all gallium scintigraphy for detection of lymphoma recurrence.

AKNOWLEDGEMENT

This study was supported by the vice-chancellor of research of Mashhad University of Medical Sciences and is the result of a thesis under the approval number of 87554.

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