Ratios of Maximum Standardized Uptake Values is not a Predictor of Mediastinal Lymph Node Pathology

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INTRODUCTION

Beginning with the presence of non-small cell lung cancer, metastatic disease can become a concern. Lung cancer primarily metastasizes through the N2 mediastinal lymph nodes. Lymph node biopsies are invasive procedures that are used to determine the pathology of suspicious lymph nodes. At any point in a diagnosis, it is of importance to avoid as many invasive procedures as possible. This study attempts to make obsolete the need for biopsies in determining mediastinal lymph node pathology.

This is a retrospective study of a group of 817 patients who were scanned at Clinical P.E.T. of Ocala for lung cancer. It is desired that quantitative information from the scans can be used to predict the pathology of mediastinal lymph nodes, and thereby forego the need for an invasive biopsy.

SCANNING PROTOCOL

The scanner used was an integrated fluorodeoxyglucose-positron emission tomography-computed tomography (FDG-PET/CT) scanner. Patients were instructed to fast the morning of the scan. Patients were then injected with 15 ± 1.5 mCi of FDG. After an hour of rest to allow the FDG to distribute throughout the body, patients were scanned for 20 ± 2 min. The scan was performed from mid-cranium to mid-thigh.

ELIGIBLE PATIENTS

Patients whose archived charts indicated their scan showed PET positive results (i.e. abnormal FDG uptake was visualized apart from FDG avid organs) were included in the study. Patients with diabetes were excluded from the study.[1]

After eliminating patient cases who were determined to be PET negative, a total of 417 patients remained who had PET positive scans.

OBTAINING VALUES

All 417 patient PET scans were examined to obtain maximum standardized uptake values (maxSUVs). Standardized uptake values are a measure of the amount of radiation uptake at a given pixel in the PET image. At any given pixel, the maxSUV is calculated using Equation 1.

$$\max SUV = \frac{C(\mu Ci / ml)}{\dfrac{ID(\mu Ci)}{w(kg)}}. \qquad (1)$$

Where C is the activity concentration at the given pixel, ID is the injected activity, and w is the patient's mass.

First, the primary tumor was sought. A normal lung field has very little FDG concentration, and therefore does not appear as an intense shade of white. The color scheme used for activity interpretation progressed from black to red to white, least uptake to greatest uptake. So, any suspicious areas were very noticeable within the lung field. If a suspicious area was visualized, the largest maxSUV from the area was recorded.

Then, any suspicious uptake in the mediastinal region was noted. If intense uptake was seen, the largest maxSUV of the intense area was recorded. A ratio was then taken as in Equation 2.[2]

$$.R = \frac{\max SUV(lymph\ node)}{\max SUV(primary\ tumor)}. \qquad (2)$$

This was done for every patient scan. If no primary tumor or lymph node was seen, the patient scan was excluded from the study. After reading all 417 patient scans, a total of 88 showed an N2 mediastinal lymph node and primary tumor. Out of these patients, 42 pathology reports were obtained.

RESULTS

The resulting ratios were organized according to pathology. The three most recurring diagnoses were analyzed: adenocarcinoma, squamous cell carcinoma, and inflammation. The average ratios corresponding to adenocarcinoma, squamous cell carcinoma, and inflammation were 0.66 (0.34 – 1.18), 0.76 (0.31 – 1.36), and 0.99 (0.75 – 1.18).

The range of values for all three diagnoses encompasses all three average ratio values. This, coupled with the fact that a single standard deviation of the adenocarcinoma data conflicts with the average squamous cell value, and that a single standard deviation of the

squamous cell data conflicts with the average inflammation value, shows that the ratio of the maxSUV of the mediastinal lymph node to the maxSUV of the lung lesion cannot be used to predict N2 mediastinal lymph node pathology.

Reasons for the non-unique ratio values for pathology could include variations in scan time and injected dose, and human error in obtaining the maxSUV from the PET scan. Regardless, this analysis does not provide any grounds to forego the need for a biopsy to determine pathology.

Table 1. Average ratios of SUVs as computed from Eq. 2 along with standard deviation and minimum and maximum values.

	Pathology		
	Adeno-carcinoma	Squamous Cell	Inflammation
Mean	0.66	0.76	0.99
Std Dev	0.29	0.40	0.16
Minimum	0.34	0.31	0.75
Maximum	1.18	1.36	1.18

REFERENCES

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