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Performance Metrics Comparison of CT with PET/CT Reports in Lymphoma Patient Follow-Up

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Abstract: ***The incidence of Hodgkin's lymphoma (HL) and non-Hodgkin's lymphoma (NHL) is rising annually, necessitating effective monitoring strategies. Computed Tomography (CT) and Positron Emission Tomography/Computed Tomography (PET/CT) are pivotal in this regard but differ in diagnostic accuracy due to their distinct imaging capabilities. This retrospective study evaluates 56 lymphoma patients using both modalities at Al-Ahli Hospital, Hebron, Palestine, from 2020 to 2023. Demographic and clinical data, alongside imaging findings, were analyzed. Results indicate PET/CT's superiority over CT alone, with higher sensitivity, specificity, precision, Accuracy where CT findings were 20%, 30.61%, 0.72%, and 30.34% retrospectively compared with PET/CT findings. Gender-specific analysis revealed marginal associations, highlighting the need for tailored imaging strategies. The study underscores PET/CT's enhanced diagnostic performance in lymphoma surveillance, advocating its use for improved patient management and outcomes. Further research could refine these findings, addressing the evolving landscape of lymphoma imaging.***

Keywords: Computed Tomography; Positron Emission Tomography/Computed Tomography; Hodgkin's Lymphoma; Non-Hodgkin's Lymphoma; Sensitivity; Specificity; Performance Metrics.

1. Introduction

Hodgkin's lymphoma (HL) and non-Hodgkin's lymphoma (NHL) are lymphoproliferative disorders representing fewer than 8% of all malignancies but whose incidence has recently been rising by 3%–5% per year [1][2]–[14]. These malignancies are potentially curable with current treatment modalities, even in advanced or recurrent disease. The prognosis and survival of patients with lymphoma depend on 3 key points, 2 of which are determined at the moment of diagnosis: histologic grade and clinical stage. The third is response to treatment. Precise staging is crucial to follow up and choose the proper selection of therapy for these patients, to prevent over [15].

Computed Tomography (CT) scans technology use x-rays to create detailed 3D images of the body, aiding in measuring tumor size and detecting abnormalities in the lungs, lymph nodes, spleen, and liver. Contrast dye can enhance image quality, making it a key tool for staging and monitoring lymphoma. However, CT may have limitations in detecting changes in normal-sized lymph nodes and extra nodal disease [16][17]–[32].

Positron Emission Tomography (PET) or PET-CT scans technology create images of organs and tissues by injecting a small amount of radioactive sugar substance into the body" 18F-FDG." Active cancer cells absorb more of this substance, which is detected by a scanner. PET-CT combines PET with CT imaging, providing both structural and metabolic information about the tumor and surrounding tissues. It provides functional information, but its main drawback of showing few anatomic landmarks impedes precise localization of pathologic 18F-FDG up take In addition, there are some issues regarding specificity, because 18F-FDG is taken up not only by many malignant tumors but also by sites of active inflammation and physiologically by some organs [33][40]–[43],[34]–[39].

Effective follow-up and monitoring of lymphoma patients are crucial for timely and accurate assessment of disease progression or remission. Computed Tomography (CT) and Positron Emission Tomography/Computed Tomography (PET/CT) are two prominent imaging technologies used in this context. However, there is a need for a comprehensive comparison of their performance metrics to determine which modality provides superior diagnostic accuracy, sensitivity, specificity, and overall clinical utility in the follow-up of lymphoma patients. This study aims to address this gap by systematically evaluating and comparing the performance metrics of CT and PET/CT reports, thereby providing valuable insights to inform clinical decision-making and improve patient outcomes. The aim of current study is to systematically evaluate and compare the performance metrics of CT and PET/CT in the follow-up of lymphoma patients. By analysing diagnostic accuracy, sensitivity, specificity, and overall clinical utility of both imaging modalities, the study seeks to identify the most effective technology for monitoring disease progression or remission, ultimately enhancing clinical decision-making and patient outcomes.

2. Methodology

2.1 Study Design

This retrospective study includes 56 patients diagnosed with HL and NHL who were treated at Al-Ahli Hospital in Hebron, Palestine, between June 30, 2020, and June 30, 2023. The follow-up assessment involved the use of FDG PET/CT examinations to monitor treatment response and CT examinations at specified intervals. The cohort consisted of 20 males and 36 females, with an average age of 46.7 years for male patients.

Demographic information collected for this study included the hospital name, patient age, gender, and ID number. Clinical information encompassed the type of lymphoma (HL or NHL), the location of the lymphoma or mass as detected by PET/CT, and the location as detected by CT scan. Imaging data included the dates of PET/CT and CT scans, as well as imaging findings, specifically the lesion locations identified by each modality.

The inclusion criteria for this study were patients diagnosed with either HL or NHL who had undergone treatment (chemotherapy, radiation therapy, etc.) and PET/CT imaging as part of their follow-up assessment. Patients of various age groups and both genders were included. Exclusion criteria comprised patients non-compliant with follow-up, those who had not undergone PET imaging for treatment response assessment, patients who had previously undergone diagnostic CT for initial staging, and patients with renal, hepatic, or other oncologic diseases, HIV infection, a history of allergic reaction to iodinated contrast media, comorbidities interfering with FDG PET/CT image interpretation, ongoing chemotherapy sessions, or pregnancy during the study period.

2.2 Statistical analysis

PET/CT and CT images were evaluated by a nuclear medicine physician and a radiologist, respectively with each has 5 years' experience. They assessed each modality randomly for every patient, considering nodal and extra-nodal disease based on morphologic CT and ^{18}F-FDG uptake criteria. Abnormal ^{18}F-FDG uptake was identified by its higher intensity outside normal structures. CT criteria were used when no pathologic ^{18}F-FDG uptake was present. Lesions were classified by region—cervical, thoracic, and abdominal/groin—and the number of sites affected was assessed. A lesion was classified as positive on PET if there was focally increased FDG uptake above background not explained by physiological activity. On CT, a lesion was classified based on lymph node size criteria (diameter >10 mm) or extra-nodal structural anatomical abnormality. Sensitivity and specificity calculations for PET/CT and CT scans involved comparing results to a reference standard, typically histology or clinical follow-up.

The sensitivity of CT compared to PET/CT findings was calculated as the ratio of true positives (TP) to the sum of true positives and false negatives (TP/ (TP + FN)). Specificity was determined by the ratio of true negatives (TN) to the sum of true negatives and false positives (TN/ (TN + FP)). Precision was calculated as the ratio of true positives to the sum of true positives and false positives (TP/ (TP + FP)). Accuracy was calculated as the ratio of the sum of true positives and true negatives to the total number of cases (TP + TN)/ (TP + TN + FP + FN).

In this context, true positives (TP) refer to findings that are correctly identified by both PET/CT and CT. True negatives (TN) refer to findings correctly identified as negative by both modalities. False positives (FP) are findings that are incorrectly identified as positive by CT but not by PET/CT. False negatives (FN) are findings that are incorrectly identified as negative by CT but positive by PET/CT.

The statistical analysis included basic descriptive statistics, and tests were conducted using Microsoft Excel 2016 and SPSS software version 23.0, employing independent samples tests, Chi-Square tests, and Fisher's Exact Test.

3. Results and Discussion

Table 1 presents the distribution of gender and type of cancer among the participants. The data includes frequency, percent, valid percent, cumulative percent, mean age, and standard deviation of age. The table illustrates that out of the total participants, 35.7% were male and 64.3% were female. The mean age of participants with male was 41.8 years with a standard deviation of 20.2, whereas for those with female, the mean age was 46.75 years with a standard deviation of 16.77. Regarding the type of cancer, 48.2% of participants were diagnosed with Hodgkin's lymphoma (HL), while 51.8% were diagnosed with non-Hodgkin's lymphoma (NHL). The mean age of participants with HL was 35.52 years with a standard deviation of 17.647, whereas for those with NHL, the mean age was 53.79 years with a standard deviation of 13.558.

Table 1. Distribution of Gender and Type of Cancer among Participants.

		Frequency	Percent	Valid Percent	Cumulative Percent	Mean (Age)	S.D (Age)
Gender	Male	20	35.7	35.7	35.7	41.8	20.20
	Female	36	64.3	64.3	100.0	46.75	16.77
Type of Cancer	HL	27	48.2	48.2	48.2	35.52	17.65
	NHL	29	51.8	51.8	100.0	53.79	13.56
Difference Time between CT and	Within 3 months	35	62.5	62.5	62.5	35	62.5
	More than 3 months	21	37.5	37.5	100.0	21	37.5
	Total	56	100.0	100.0			

Table 2 displays the crosstabulation of gender and type of cancer among the participants, along with the corresponding percentages. The table indicates that among male participants, 17.85% were diagnosed with HL, and an equal percentage were diagnosed with NHL, constituting 35.71% of the total male population. In contrast, among female participants, 30.35% were diagnosed with HL, while 33.92% were diagnosed with NHL, totaling 64.28% of the total female population. In addition, among participants, the difference in timing

between CT and PET scan was 62.5%, while 37.5% were Followed between two scans were more than 3 months.

The distribution reflects variability in the follow-up intervals, which could be influenced by various factors such as clinical recommendations, patient health status, and logistical considerations. The shorter follow-up period (within three months) for the majority suggests a proactive approach in monitoring the treatment response and disease progression [44].

Table 2. Gender and Type of Cancer Crosstabulation among the participants.

		Type of Cancer		Total
		HL (%)	NHL	
Gender	Male	10 (17.85%)	10 (17.85%)	20 (35.71%)
	Female	17 (30.35%)	19 (33.92%)	36 (64.28%)
Total		27	29	56

Additionally, the results of the Chi-Square Tests for the association between gender and type of cancer are presented in Table 3. Chi-square tests were conducted to assess the association between gender and type of cancer. The Pearson Chi-Square value was calculated as .040 with 1 degree of freedom, yielding an asymptotic significance of .842. The likelihood ratio and linear-by-linear association tests also produced similar results, indicating no significant association between gender and type of cancer diagnosis ($p > .05$). Furthermore, Fisher's Exact Test yielded a two-sided significance value of 1.000, supporting the finding of no significant association.

The analysis demonstrates that there is no statistically significant relationship between gender and the type of cancer diagnosed among the participants. These findings suggest that gender may not be a determining factor in the likelihood of developing either HL or NHL in this population. Further research with larger sample sizes and diverse demographic characteristics may provide deeper insights into the factors influencing cancer diagnosis [45].

Table 3. Chi-Square Tests Analyzing for predicting the differences between gender and type of cancer.

	Value	**df**	**Asymptotic Significance (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
Pearson Chi-Square	.040a	1	.842		
Continuity Correctionb	.000	1	1.000		
Likelihood Ratio	.040	1	.842		
Fisher's Exact Test				1.000	.531
Linear-by-Linear Association	.039	1	.843		
N of Valid Cases	56				
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.64.					
b. Computed only for a 2x2 table					

Overall Diagnostic performance metrics between PET an CT in HL and NHL

Table 4 presents the crosstabulation of CT finding and PET finding along with the diagnostic performance metrics including specificity, sensitivity, precision, and accuracy. The table displays the counts of CT findings which considered ad predicted value (Yes/No) against PET findings which considered as actual value (Yes/No). For CT findings, 94 cases were positive (Yes) and 231 cases were negative (No). Similarly, for PET findings, 4 cases were positive and 1 case was negative. The diagnostic performance metrics for the CT device were calculated compared to PET imaging in HL and NHL patients, and the results were as follows: Specificity: 0.28923 (28.92%); Sensitivity: 0.2 (20%); Precision: 0.00431 (0.431%); and Accuracy: 0.28788 (28.78%).

The presented diagnostic performance metrics for the CT device underscore its limitations compared to PET imaging in the context of HL and NHL patients. The lower specificity and sensitivity indicate challenges in distinguishing between true positives and negatives, while the low precision suggests a notable proportion of false positives. These metrics collectively highlight the need for careful interpretation and consideration of these factors when using CT as a diagnostic tool in lymphoma patients [46].

Table 4. Crosstabulation Finding with Diagnostic Performance Metrics between CT and PET findings

CT Finding	PET-CT Finding		**Total**	**Specificity**	**Sensitivity**	**Precision**	**Accuracy**
	Yes	No					
Yes	94	4	98	0.2892	0.2	0.004	0.288
No	231	1	232	28.9%	20%	0.43%	28.8%
Total	325	5	330				

Table 5 presents the Chi-square tests were conducted to evaluate the association between CT findings and PET findings. The Pearson Chi-Square value was calculated as 6.153 with 1 degree of freedom, yielding an asymptotic significance of .013. The likelihood ratio test and continuity correction also showed significant associations with p-values of .019 and .047, respectively. Fisher's Exact Test further confirmed the significance of the association ($p = .029$).

The analysis suggests a significant association between CT findings and PET findings. This indicates that the presence or absence of certain CT findings may correlate with the presence or absence of PET findings. These results may have implications for clinical decision-making and further investigation into the diagnostic utility of CT and PET imaging modalities in tandem. Further research and validation studies are warranted to corroborate these findings and explore their clinical relevance in diagnostic radiology [47].

Table 5. Chi-Square Tests Analyzing for predicting the differences between CT Findings and PET findings in HL and NHL patients.

	Value	df	Asymptotic Significance (2-	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.153a	1	.013		
Continuity Correctionb	3.950	1	.047		
Likelihood Ratio	5.507	1	.019		
Fisher's Exact Test				.029	.029
N of Valid Cases	330				
a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.48.					
b. Computed only for a 2x2 table					

Diagnostic performance metrics between PET an CT in HL and NHL among Gender

The table 6 presents the findings related to CT and PET scans and their association with gender in terms of specificity, sensitivity, precision, and accuracy. For males, the table shows that among those who had a CT finding, 32 individuals tested positive (Yes), while 78 individuals tested negative (No). The specificity for CT findings in males was 29.09%, indicating that CT findings correctly identified the absence of the condition. However, the sensitivity and precision was 0, suggesting that the CT findings failed to identify any positive cases accurately. The overall accuracy for CT findings in males was 28.82%.

For females, the table reveals that out of the individuals who had a CT finding, 62 tested positive (Yes), while 153 tested negative (No). The specificity for CT findings in females was 28.83%, indicating accurate identification of negative cases. The sensitivity for CT findings was 25%, suggesting that the CT scan successfully identified a quarter of the positive cases. The precision for CT findings in females was 0.649%, indicating a very low proportion of correct positive identifications. The overall accuracy for CT findings in females was 28.76%.

Table 6. Crosstabulation Finding with Diagnostic Performance Metrics between CT and PET findings among the gender.

Gender			PET-CT Finding		Total	Specificity	Sensitivity	Precision	Accuracy
			Yes	No					
Male	CT Finding	Yes	32	1	33	0.29	0	0	0.288
		No	78	0	78	29.1%			28.8%
	Total		110	1	111				
Female	CT Finding	Yes	62	3	65	0.288	0.25	0.006	0.287
		No	153	1	154	28.8%	25%	0.65%	28.8%
	Total		215	4	219				

The Chi-Square tests were conducted in table 7 to determine the association between gender and CT and PET findings. For males, the Pearson Chi-Square test yielded a value of 2.385 with 1 degree of freedom, resulting in an asymptotic significance of .122. The continuity correction was computed as .198, and the likelihood ratio was 2.448, both indicating a lack of significant association between gender and CT and PET findings. The Fisher's Exact Test also showed no statistically significant association (2-sided p-value: .297).

For females, the Pearson Chi-Square test yielded a value of 4.010 with 1 degree of freedom, resulting in an asymptotic significance of .045. The continuity correction was computed as 2.103, and the likelihood ratio was 3.567, both suggesting a significant association between gender and CT and PET findings at a significance level of .05. The Fisher's Exact Test also indicated a marginal association (2-sided p-value: .079). It is important to note that for both males and females, some cells in the 2x2 table had expected counts less than 5, violating the assumption of the Chi-Square test. This limitation should be taken into consideration when interpreting the results.

The analysis suggests that the association between gender and CT and PET findings is not statistically significant for males, while there is a marginal association for females. However, the overall diagnostic measures, including specificity, sensitivity, precision, and accuracy, indicate suboptimal performance of CT findings in both genders in accurately identifying positive cases. Further research and investigation are warranted to improve the reliability and effectiveness of PET scans in diagnosing the condition in different genders [48].

Table 7. Chi-Square Tests Analyzing for predicting the differences between CT Findings and PET findings in HL and NHL patients among the gender.

Gender		Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Male	Pearson Chi-Square	2.385a	1	.122		
	Continuity Correctionb	.198	1	.656		
	Likelihood Ratio	2.448	1	.118		
	Fisher's Exact Test				.297	.297
	N of Valid Cases	111				
Female	Pearson Chi-Square	4.010c	1	.045		
	Continuity Correctionb	2.103	1	.147		
	Likelihood Ratio	3.567	1	.059		
	Fisher's Exact Test				.079	.079
	N of Valid Cases	219				
a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .30.						
b. Computed only for a 2x2 table						
c. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.19.						

Diagnostic performance metrics between PET an CT among HL and NHL

The table 8 presents the CT and PET findings and diagnostic measures for HL and NHL in terms of specificity, sensitivity, precision, and accuracy. For HL, among the individuals who underwent a PET scan with CT findings, 45 tested positive (Yes), while 98 tested negative (No). The specificity for CT findings in HL was 31.46%, indicating that only a small proportion of negative cases were accurately identified. However, the sensitivity was 0, suggesting that the CT findings failed

to identify any positive cases accurately. The precision for CT findings in HL was 0, indicating that no positive identifications were correct. The overall accuracy for CT findings in HL was 31.03448%.

For NHL, out of the individuals who had a PET scan with CT findings, 48 tested positive (Yes), while 133 tested negative (No). The specificity for CT findings in NHL was 26.51%, indicating a low proportion of accurate negative identifications. The sensitivity for CT findings was 33.33%, suggesting that approximately one-third of the positive cases were correctly identified. The precision for CT findings in NHL was 0.746%, indicating a very low proportion of correct positive identifications. The overall accuracy for CT findings in NHL was 26.63043%.

Table 8. Crosstabulation Finding with Diagnostic Performance Metrics between CT and PET findings among the type of cancer.

Type of Cancer			PET-CT Finding		Total	Specificity	Sensitivity	Precision	Accuracy
			Yes	No					
HL	CT Finding	Yes	45	2	47	0.31	0	0	0.31
		No	98	0	98	31.5	0	0	31.0
	Total		143	2	145				
NHL	CT Finding	Yes	48	2	50	0.27	0.33	0.01	0.27
		No	133	1	134	26.5	33.3	0.75	26.6
	Total		181	3	184				

The Chi-Square tests in table 9 were conducted to determine the association between the type of cancer (HL and NHL) and CT and PET findings. For HL, the Pearson Chi-Square test yielded a value of 4.229 with 1 degree of freedom, resulting in an asymptotic significance of .040. The continuity correction was computed as 1.679, and the likelihood ratio was 4.565, both suggesting a significant association between the type of cancer and PET findings at a significance level of .05. The Fisher's Exact Test indicated a marginal association (2-sided p-value: .104).

For NHL, the Pearson Chi-Square test yielded a value of 2.404 with 1 degree of freedom, resulting in an asymptotic significance of .121. The continuity correction was computed as .803, and the likelihood ratio was 2.066, both indicating a lack of significant association between the type of cancer and PET findings. The Fisher's Exact Test also showed no statistically significant association (2-sided p-value: .180).

It is important to note that for both HL and NHL, some cells in the 2x2 table had expected counts less than 5, violating the assumption of the Chi-Square test. This limitation should be taken into consideration when interpreting the results.

The analysis suggests a significant association between the type of cancer and CT and PET findings for HL, while no significant association was observed for NHL. However, the diagnostic measures, including specificity, sensitivity, precision, and accuracy, indicate suboptimal performance of CT findings in accurately identifying positive cases for both HL and NHL. Further research and investigation are warranted to improve the reliability and effectiveness of CT scans in diagnosing these types of lymphomas [49].

Table 9. Chi-Square Tests Analyzing for predicting the differences between CT Findings and PET findings among each type of cancer.

Type of Cancer		Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
HL	Pearson Chi-Square	4.229a	1	.040		
	Continuity Correctionb	1.679	1	.195		
	Likelihood Ratio	4.565	1	.033		
	Fisher's Exact Test				.104	.104
	N of Valid Cases	145				
NHL	Pearson Chi-Square	2.404c	1	.121		
	Continuity Correctionb	.803	1	.370		
	Likelihood Ratio	2.066	1	.151		
	Fisher's Exact Test				.180	.180
	N of Valid Cases	184				
a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .65.						
b. Computed only for a 2x2 table						
c. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .82.						

Diagnostic performance metrics between PET an CT among time differences between two scans

Table 10 presents the crosstabulation of CT Finding and PET Finding by the difference in time between CT and PET scans. The table also includes measures such as specificity, sensitivity, precision, and accuracy. For scans conducted within 3 months, among individuals with CT findings, 60 tested positive (Yes) for PET, while 136 tested negative (No). The specificity for PET findings within 3 months was 30.61%, indicating that only a small proportion of negative cases were accurately identified. The sensitivity was 0.2, suggesting that 20% of the positive cases were correctly identified. The precision for PET findings within 3 months was 0. 729%, indicating a very low proportion of correct positive identifications. The overall accuracy for PET findings within 3 months was 30.34%.

For scans conducted more than 3 months apart, among individuals with CT findings, 34 tested positive (Yes), while 95 tested negative (No). The specificity for PET findings more than 3 months apart was 26.357, indicating a low proportion of accurate negative identifications. There were no positive cases identified, resulting in a sensitivity and precision of 0. The overall accuracy for PET findings more than 3 months apart was 26.35%.

Table 10. Crosstabulation Finding with Diagnostic Performance Metrics between CT and PET findings among the time between scans.

Difference Time between Ct and PET			PET-CT Finding		Total	Specificity	Sensitivity	Precision	Accuracy
			Yes	No					
Within 3 months	CT Finding	Yes	60	4	64	0.306	0.2	0.01	0.3
		No	136	1	137	30.61	20	0.73	30.4
	Total		196	5	201				
More than 3 months	CT Finding	Yes	34		34	0.263		0	0.27
		No	95		95	26.35		0	26.4
	Total		129		129				

The Chi-Square tests in table 11 were conducted to examine the association between the difference in time between CT and PET scans and PET findings. For scans conducted within 3 months, the Pearson Chi-Square test yielded a value of 5.480 with 1 degree of freedom, resulting in an asymptotic significance of .019. The continuity correction was computed as 3.440, and the likelihood ratio was 5.055, both suggesting a significant association between the difference in time and PET findings at a significance level of .05. The Fisher's Exact Test indicated a significant association (2-sided p-value: .036).

For scans conducted more than 3 months apart, no statistics were computed because PET Finding is a constant. Therefore, no association analysis could be performed.

It is worth noting that for the scans conducted within 3 months, two cells in the 2x2 table had expected counts less than 5, violating the assumption of the Chi-Square test. The minimum expected count was 1.59. This limitation should be considered when interpreting the results.

The analysis suggests a significant association between the difference in time between CT and PET scans conducted within 3 months and PET findings. However, no association could be assessed for scans conducted more than 3 months apart due to the absence of variability in PET findings. The diagnostic measures, including specificity, sensitivity, precision, and accuracy, provide insights into the performance of PET findings based on the difference in time between scans. Further research and investigation are necessary to understand the clinical implications and optimize the timing of CT and PET scans for accurate diagnosis and treatment planning [50].

Table 11. Chi-Square Tests Analyzing for predicting the differences between CT Findings and PET findings among each type of cancer.

Difference Time between Ct and PET		Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Within 3 months	Pearson Chi-Square	5.480a	1	.019		
	Continuity Correctionb	3.440	1	.064		
	Likelihood Ratio	5.055	1	.025		
	Fisher's Exact Test				.036	.036
	N of Valid Cases	201				
More than 3 months	Pearson Chi-Square	.c				
	N of Valid Cases	129				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.59.

b. Computed only for a 2x2 table

c. No statistics are computed because PET Finding is a constant.

The Fisher's Exact Test is a statistical test used to determine the significance of the association between two categorical variables in a contingency table. It is particularly useful when dealing with small sample sizes or when one or more cells in the table have expected counts less than 5.

In the given analysis, the Fisher's Exact Test was applied to examine the association between the difference in time between CT and PET scans (within 3 months) and PET findings. The test calculates the probability of obtaining the observed distribution of data or a more extreme distribution, assuming that there is no association between the variables. It provides a p-value that represents the probability of obtaining the observed association (or a more extreme one) if there is no true association between the variables.

In this case, the Fisher's Exact Test yielded a p-value of .036 for scans conducted within 3 months. This indicates that there is a statistically significant association between the difference in time and PET findings at a significance level of .05. In other words, the likelihood of observing the association between these variables by chance alone, assuming no true association exists, is only 3.6%. Therefore, we can reject the null hypothesis of no association and conclude that there is evidence of an association between the difference in time and PET findings within 3 months. It is important to note that the Fisher's Exact Test is considered more accurate than the chi-square test when dealing with small sample sizes or sparse data, as it does not rely on any assumptions about the distribution of the data. However, it can be computationally intensive for larger contingency tables.

In summary, the Fisher's Exact Test was used in this analysis to determine the significance of the association between the difference in time between CT and PET scans and PET findings within 3 months. It provided evidence of a significant association, strengthening the findings of the study.

Table 12 illustrates the frequency and percentage distribution of lesion locations among patients diagnosed with a specific condition. The table showcases the distribution of lesion locations among patients, indicating the frequency and percentage of occurrence for each location. Among the most prevalent locations are bone (16.1%), others (18.2%), and right inguinal and pelvic (8.2%). Conversely, locations such as left pulmonary (0.9%) and left supraclavicular (1.5%) represent relatively fewer occurrences.

This distribution provides valuable insights into the anatomical involvement of the condition under study. Understanding the distribution of lesion locations can aid clinicians in diagnosing and managing the condition effectively, as certain locations may require specific treatment approaches or monitoring strategies. Further research may delve into the clinical implications of lesion location on disease prognosis and patient outcomes [51].

Table 12. Distribution of Lesion Location Among Patients.

Location Lesion					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Right cervical	7	2.1	2.1	2.1
	Left axillary	14	4.2	4.2	6.4
	Spleen	24	7.3	7.3	13.6
	Retroperitoneal	20	6.1	6.1	19.7
	Bone	53	16.1	16.1	35.8
	Mediastinal	15	4.5	4.5	40.3
	Diaphragmatic	8	2.4	2.4	42.7
	Right Inguinal and Pelvic	27	8.2	8.2	50.9
	Left Inguinal and Pelvic	25	7.6	7.6	58.5
	Hepatic	10	3.0	3.0	61.5
	Others	60	18.2	18.2	79.7
	Left Cervical	8	2.4	2.4	82.1
	Bilateral Cervical	16	4.8	4.8	87.0
	Right supraclavicular	6	1.8	1.8	88.8
	Left supraclavicular	5	1.5	1.5	90.3
	Right Pulmonary	5	1.5	1.5	91.8
	Left Pulmonary	3	.9	.9	92.7
	Bilateral Hilar	14	4.2	4.2	97.0
	Right axillary	10	3.0	3.0	100.0
	Total	330	100.0	100.0	

4. Conclusion

In conclusion, this research aims to address the critical need for understanding the comparative risks and benefits associated with CT and PET/CT modalities in the context of lymphoma management. By quantifying and comparing radiation doses, evaluating time efficiency, determining optimal follow-up periods, assessing diagnostic accuracy, and investigating the impact on treatment planning and long-term outcomes, this study seeks to provide valuable insights for clinicians. The findings will not only enhance patient safety by guiding appropriate imaging selection and frequency but also optimize patient management strategies, potentially leading to improved survival rates and quality of life for lymphoma patients. Moreover, this research sets the stage for further investigations into refining imaging strategies and ultimately advancing lymphoma care.

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