

بسم الله الرحمن الرحيم





شبكة المعلومات الجامعية التوثيق الالكتروني والميكروفيلم



جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



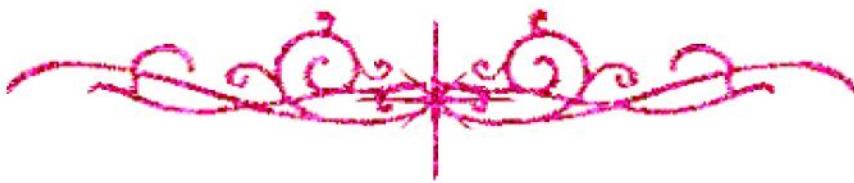
يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار





بعض الوثائق الأصلية تالفة





بالرسالة صفحات
لم ترد بالأصل





ROLE OF PET/CT IN DIAGNOSIS AND FOLLOW UP OF NON-HODGKINS LYMPHOMA AND ASSESSMENT OF EXTRANODAL LYMPHOMA

Thesis

*Submitted for Partial Fulfillment of
Master Degree in Radiodiagnosis*

Presented By

Maggie Salah Abd Elgawad

(M.B.B.Ch.)

Faculty of Medicine, Alexandria University

Supervised By

Prof. Dr. Abeer Maghawry Abd Elhameed

Professor of Radiodiagnosis

Faculty of Medicine - Ain Shams University

Dr. Samar Ramzy Ragheb

Lecturer of Radiodiagnosis

Faculty of Medicine - Ain Shams University

*Faculty of Medicine
Ain Shams University*

2020

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قَالَ

سُبْحَانَكَ لَا عِلْمَ لَنَا
إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ
الْعَلِيمُ الْعَظِيمُ

صدق الله العظيم

سورة البقرة الآية: ٣٢

Acknowledgments

*First and foremost, I feel always indebted to **Allah** the Most Beneficent and Merciful.*

*I wish to express my deepest thanks, gratitude and appreciation to **Prof. Dr. Abeer Maghawry Abd Elhameed**, Professor of Radiodiagnosis, Faculty of Medicine, Ain Shams University, for her meticulous supervision, kind guidance, valuable instructions and generous help.*

*Special thanks are due to **Dr. Samar Ramzy Ragheb**, Lecturer of Radiodiagnosis, Faculty of Medicine, Ain Shams University, for her sincere efforts, fruitful encouragement.*

I would like to express my hearty thanks to all my family for their support till this work was completed.

Maggie Salah Abd Elgawad

List of Contents

Title	Page No.
List of Abbreviations.....	5
List of Tables.....	5ii
List of Figures	9
Introduction	- 1 -
Aim of the Work	18
Review of Literature	
▪ Radiological Anatomy of the Lymph Nodes	19
▪ Pathophysiology and Classification of Non Hodgkin`s Lymphoma	28
▪ Physical Background and Technical Aspects of PET/CT	31
▪ Practical Points in the Interpretation of PET/CT Scans	45
▪ PET/CT Manifestations of Extra-Nodal Lymphoma.....	56
Patients and Methods.....	84
Results.....	90
Case Presentation	106
Discussion	115
Summary	123
Conclusion	127
Recommendations	128
References	129
Arabic Summary	

List of Abbreviations

Abb.	Full term
μ map.....	Attenuation map
^{18}F	Fluorine 18
2D-	2 Dimmension
3D	3 Dimmension
6P	6-phosphate
ACFs	Attenuation-correction factors
AJCC	American Joint Committee on Cancer
CECT.....	Contrast Enhanced Computed Tomography
CNS	Central nervous system
CT.....	Computed Tomograpgy
DLBCL	Diffuse large B cell lymphoma
DLCL.....	Diffuse large B-cell lymphoma
DNA.....	Deoxyribonucleic acid
EBV	Epstein bar Virus
ENL	Extra nodal Lymphoma
FDG	Fluorodeoxyglucose
FL	Follicular Lymphoma
FNAC.....	Fine Needle Aspiration
FOV	Field Of View
Ga	Gallium
GC.....	Germinal Center
Ge.....	Germanium
GIT	Gastrointestinal tract
Glut.....	Glucose transporter
GUT.....	Genitourinary tract
HL.....	Hodgkin Lymphoma
HLA	Human leukocyte antigen
HU	House Field Unit
IV	Intravenous

List of Abbreviations cont...

Abb.	Full term
<i>Kev</i>	<i>Kilo Electron Volt</i>
<i>LBCL</i>	<i>Large B Cell Lymphoma</i>
<i>LDH</i>	<i>Lactate dehydrogenase.</i>
<i>MALT</i>	<i>Mucosa-associated lymphoid tissue</i>
<i>MCi/kg</i>	<i>Millicurie / Kilogram</i>
<i>MCL</i>	<i>Mantle Cell Lymphoma</i>
<i>Mins</i>	<i>Minutes</i>
<i>MIP</i>	<i>Maximum intensity projection</i>
<i>ML</i>	<i>Milliliter</i>
<i>MM</i>	<i>Millimeter</i>
<i>MR</i>	<i>Magnetic Resonance</i>
<i>MRI</i>	<i>Magnetic Resonance Imaging.</i>
<i>MSK</i>	<i>Musculoskeletal system</i>
<i>NCI</i>	<i>National Cancer Institution</i>
<i>NHL</i>	<i>Non Hodgkin Lymphoma</i>
<i>NK</i>	<i>Natural killer</i>
<i>NLPHD</i>	<i>Nodular lymphocyte predominant Hodgkin disease</i>
<i>PET</i>	<i>Positron Emission Tomography</i>
<i>REAL</i>	<i>Revised European–American Lymphoma</i>
<i>SUV</i>	<i>Standardized uptake value.</i>
<i>T1/2</i>	<i>Short half-life</i>
<i>UICC</i>	<i>Union for International Cancer Control</i>
<i>US</i>	<i>Ultrasonographic</i>
<i>WHO</i>	<i>World Health Organization</i>
<i>μCi/ml</i>	<i>Microcurie. / Milliliter</i>

List of Tables

Table No.	Title	Page No.
Table 1:	Rouviere classification of cervical lymph node distribution	20
Table 2:	WHO classification of NHL.....	29
Table 3:	Showing the modified Ann Arbor Staging System for Hodgkin's and Non-Hodgkin's Lymphoma	30
Table 4:	Radio nuclides used in PET	38
Table 5:	Distribution of the studied cases according to demographic data (n = 30)	90
Table 6:	Distribution of the studied cases according to Pathological type of NON-Hodgkin lymphoma. (n =30).....	91
Table 7:	Distribution of the studied cases according to the clinical presentation* (n=30).....	92
Table 8:	Distribution of the studied cases according to the morphology and the size of affected lymph nodes* (n=30)	93
Table 9:	Distribution of the studied cases according to site of nodal affection (n=30)*	95
Table 10:	Distribution of extra nodal lesions detected by PET/CT in comparison to detected by CECT (n= 33 lesions).....	97
Table 11:	Distribution of the studied cases according to SUV baseline (n = 30)	98
Table 12:	Descriptive of the studied cases according to SUVmax value (n = 20)	99
Table 13:	Distribution of the studied cases according to Staging by (CECT) versus (PET/CT) staging (n=30).....	100
Table 14:	Relation between (PET/CT) staging and CECT scan staging (n = 30)	101

List of Tables *cont...*

Table No.	Title	Page No.
Table 15:	Distribution of change in staging according to PET/CT compared to initial CECT (n = 30)	102
Table 16:	Distribution of the studied cases according to follow up study after treatment (n=20)	103
Table 17:	Relation between PET/CT follow up and CECT follow up (n = 20)	104
Table 18:	Sensitivity and specificity of PET	105
Table 19:	Sensitivity and specificity of CECT	105

List of Figures

Fig. No.	Title	Page No.
Fig. 1:	Neck as seen from left anterior view	20
Fig. 2:	(a) Drawing illustrates mediastinum lymph node stations in the frontal projection	22
Fig. 3:	Diagram showing the distribution of the abdomino-pelvic lymph nodes.....	26
Fig. 4:	External iliac lymph nodes	27
Fig. 5:	Inguinal lymph nodes	27
Fig. 6:	Illustrative diagram of combined PET/CT scanner components and PET/CT scanner seen from above.....	33
Fig. 7:	Schematic of PET/CT scanner design	35
Fig. 8:	Typical imaging protocol for combined PET/CT	35
Fig. 9:	Positron-electron annihilation reaction	37
Fig. 10:	Glucose and fluorodeoxyglucose structure	39
Fig. 11:	Uptake of 18F-FDG.....	39
Fig. 12:	Mean positron range and annihilation angle blurring.....	44
Fig. 13:	Normal distribution of 18F-FDG.....	47
Fig. 14:	Physiologic muscle activity	48
Fig. 15:	Bowel uptake.....	49
Fig. 16:	(A) 61-y-old patient with lung cancer who ingested barium for an esophagogram 1 d before PET/CT scan. (B) High CT numbers of residual barium overcorrect attenuation of PET emission data and mimic increased 18 F-FDG uptake on PET image with CT attenuation correction. (C) No increased 18 F-FDG uptake is seen on image without attenuation correction.....	51

List of Figures *cont...*

Fig. No.	Title	Page No.
Fig. 17:	(A) High-density metallic implants generate streaking artifacts and high CT numbers (arrow) on CT image. (B) High CT numbers will then be mapped to high PET attenuation coefficients, leading to overestimation of activity concentration (C) PET images without attenuation correction help to rule out metal-induced artifacts.....	52
Fig. 18:	Curvilinear cold artifact (arrow) is commonly seen on dome of diaphragm/liver or at lung base because of respiration mismatch on PET images with CT attenuation correction	53
Fig. 19:	(A) 58-y-old man with colon cancer. (B) Image without attenuation correction shows that all lesions are confined to liver	54
Fig. 20:	(a) Attenuation-corrected axial fused 18F-FDG PET/CT image shows a focus of hypermetabolism in the left axilla (arrow). (b) Attenuation-uncorrected fused 18F-FDG PET/CT image obtained at the same level shows lack of activity in the intensely enhancing (high-attenuation) left axillary vein (arrow)	55
Fig. 21:	37-year-old woman with large B-cell lymphoma involving spleen. Axial fused PET/CT image shows diffuse increased 18F-FDG uptake in normal-sized spleen (arrow), indicating splenic involvement.....	58
Fig. 22:	Splenic involvement by NHL.....	58