

Nuclear Medicine

A Guide for Healthcare
Professionals and Patients

Dibya Prakash



Springer

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ISBN 978-81-322-1825-8 ISBN 978-81-322-1826-5 (eBook)
DOI 10.1007/978-81-322-1826-5
Springer New Delhi Heidelberg New York Dordrecht London

Library of Congress Control Number: 2014937323

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Printed on acid-free paper

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Preface

Nuclear medicine (NM) procedures involve administration of radioactive material into human body, which mimics certain physiological mechanism of the body. Few interfering medications and diet may alter uptake of radiopharmaceuticals by target organ, and can lead to misinterpretation of images. Though optimum level of radioactivity is used in Nuclear medicine, knowledge of subject will help significantly reduce radiation doses to other organs. Many apprehensions and doubts arise in the minds of patients during procedures, such as the amount of radiation dose received in a procedure, do Nuclear medicine scans have some side effects, what are radiation effects and risk estimates in Nuclear medicine scans etc. Therefore, proper education of patients becomes pertinent before any procedure. This book will address all the issues mentioned above and provide a broad idea about particular investigation, therapy or palliation to patients.

Paramedical staff or healthcare professionals often send patients for NM procedures to Nuclear Medicine Department without proper preparation due to lack of knowledge about the subject. Some patients, when prescribed any procedure by the doctor, are very enthusiastic to know everything about it and ask their questions to paramedical staff posted in that ward. This book will concisely describe and educate paramedical staff about the subject so that they are able to send patients with proper preparation and answer queries asked by them to build trust in them.

Generally, doctors are not very familiar with Nuclear Medicine and therefore unable to use it for diagnostic and therapeutic purpose and miss the beauty of it. This book will give them a broad idea about the subject by explaining procedures in brief with common indications to perform and precautions before and after. They will also be able to know how normal and abnormal scans look like with all the information contained in it. Things have been intentionally kept in short, because all the doctors are forced to study too much about their own speciality and does not have sufficient time to know about other speciality. They can learn only what is required to them.

There are more than fifty procedures are performed in Nuclear Medicine, and remembering everything with precision is very difficult by NM professionals. This book can help them by being a ready reckoner. They can know how procedure is performed with type and amount of radioactivity to be used. They can remind themselves about set of instructions to be given to the patients before, during and after the procedure.

This book aims to be understood by all personnel including non-medical persons; therefore language and terminologies used have been kept as simple as possible. The information included in this book are: a brief idea about Nuclear Medicine, apprehensions which generally arise in the mind of patients, with answers, common abbreviations and terminologies used in Nuclear Medicine, a broad outline of procedure with indications and instructions to the patients before, during and after the procedure, a guideline about breast feeding and pregnancy, type and dose of radio-pharmaceuticals and method involved.

Most of the international guidelines such as Society of Nuclear Medicine and Molecular Imaging guidelines, European Association of Nuclear Medicine procedure guidelines, American College of Radiology guideline, International Atomic Energy Agency guidelines for radiation safety, and many Nuclear Medicine books and websites have been referred to make procedures simple and convenient. However, practically in some cases, these procedures may not be feasible to be performed due to some other situational problems such as patient's inability to cooperate, limitations on available resources, or advances in knowledge or technology subsequent to publication of these guidelines etc. Therefore, the ultimate judgment about the propriety of any specific procedure or course of action must be made by the physician when considering the circumstances presented.

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Disclaimer

The generic instructions and procedures enumerated in this book cannot be rigidly applied to all patients in practice and can vary from patient to patient. These guidelines should not be taken as authority; hence, Nuclear Medicine professionals are advised to refer to the latest guidelines and not to completely rely on this book. However, we have tried to give the best possible and commonly performed procedure details for Nuclear Medicine professionals.

I would like to thank my family for supporting me in this endeavor and sparing me for completing this work.

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Acknowledgments

Many thanks go to Colonel (Dr.) MJ Jacob, MD, DRM, without whose support and guidance, writing of this book would not have been possible. It is a pleasure and privilege to work with him. I would also like to thank my colleagues Sub Lieutenant T Hari Babu, Sub Lieutenant P Chandrashekhar, Abhay Kumar (POM), Dileep Kumar TP (POM), Harish S Nair (LMA), and Rajeev Kumar (LMA) for their continuous support. A special thanks to Dr. BL Malpani, Scientific Officer (F), Radiation Medicine Centre, Bhabha Atomic Research Centre, Parel, Mumbai, for his valuable suggestions in writing this book.

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Abbreviations

AERB	Atomic Energy Regulatory Board
AFP	Alpha fetoprotein
AMAb	Antimyosin antibody
ATN	Acute tubular necrosis
BET	Bacterial endotoxin test
BMIPP	β -methyl-p-iodophenyl-pentadecanoic acid
BRIT	Board of Radiation and Isotope Technology
CEA Scan	Carcino Embryonic Antigen Scan
CSF	Cerebrospinal fluid
DAE	Department of Atomic Energy
DMSA	Dimercaptosuccinic acid
DOTATOC	1, 4, 7, 10-Tetraazacyclododecane-N ^I , N ^{II} , N ^{III} , N ^{IV} , - tetra acetic acid (D)-Phel ¹ -Tyr ³ -octreotide
DRCUG	Direct radionuclide cystoureterography
DTPA	Diethylenetriaminepentaacetic acid
¹⁸ F-DOPA	3,4-dihydroxy-6-18 F-fluoro-L-phenylalanine
EC	Ethylene dicysteine
ECD	Ethylene cysteinyl dimer
EF	Ejection fraction
ERPF	Effective renal plasma flow
Fab	Fragment of antigen-binding
FDG	Fluorodeoxyglucose
FHMA	Ferric hydroxide macroaggregates
FLT	Fluorothymidine
GFR	Glomerular filtration rate
GHA	Glucoheptonate
GIT	Gastrointestinal tract
HAM	Human serum albumin microsphere
HAMA	Human anti-mouse antigen
HBNI	Homi Bhabha National Institute
HCG	Human chorionic gonadotropin
HD	Hodgkin's disease
HIDA	Hepatic iminodiacetic acid
HIG	Human immunoglobulin G

HMPAO	Hexamethylpropyleneamine oxime
HVL	Half-value layer
HYNIC	Hydroxyethyl nicotinamide
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IRC	Indirect radionuclide cystography
LAL	Limulus ameocyte lysate
LVEF	Left ventricular ejection fraction
MAA	Macroaggregated albumin
MAG3	Mercaptoacetyl triglycine
MCT	Medullary carcinoma of the thyroid
MDP	Methylene diphosphonate
MEK	Methyl ethyl ketone
MIBG	Metaiodobenzylguanidine
MIBI	Hexakis 2-methoxyisobutyl isonitrile
MIRD	Medical internal radiation dosimetry
MUGA	Multigated acquisition
NHL	Non-Hodgkin's lymphoma
NSCLC	Non-small cell lung carcinoma
PE	Pulmonary embolism
PET-CT	Positron emission tomography-computed tomography
PyP	Pyrophosphate
RAC	Radioactive concentration
RAIU	Radioiodine uptake
RBC	Red blood cell
rCBF	Regional cerebral blood flow
rCGM	Regional glucose metabolism
RCP	Radiochemical purity
RCR	Regional Centre for Radiopharmaceuticals
RES	Reticuloendothelial system
RHT	Reduced hydrolyzed technetium
RIGS	Radioimmunoguided surgery
RIS	Radioimmunosintigraphy
RIT	Radioimmunotherapy
RMC	Radiation Medicine Centre
Rn-HEDP	Rhenium-hydroxyethylidene diphosphonate
RNP	Radionuclide purity
RNT	Radionuclide therapy
ROI	Region of interest
RPAD	Radiological Physics and Advisory Division
RSD	Radiation Safety Division
RVEF	Right ventricular ejection fraction
RVH	Renovascular hypertension
Sm-EDTMP	Samarium-ethylene diamine tetramethylene phosphonate

SPECT-CT	Single photon emission computed tomography-computed tomography
ST	Sterility test
SUV	Standard uptake value
T ₃	Triiodothyronine
T ₄	Thyroxine
^{99m} Tc	^{99m} Technetium
TAAg	Tumor-associated antigen
TLC	Thin layer chromatography
TLD	Thermoluminescent dosimeters
TSH	Thyroid-stimulating hormone
TVT	Tenth value thickness
USFDA	United States Food and Drug Administration
VQ Scan	Ventilation and perfusion scan
WBC	White blood cell

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Nuclear Medicine is boon of technological advancement which uses safe, painless, and cost-effective techniques to image the body and treat disease. It involves application of radioactive substances in very tiny amount to human body by injection, ingestion, or inhalation. In nuclear medicine procedures, a chemical compound labeled with (mixed in a specific manner) radioactive material, called radiopharmaceuticals or tracer, is administered into the human bodies that can target and localize in specific organs or cellular receptors. Because of its inherent chemical properties, similar to the body, they mimic certain physiological mechanism of the body. Once localized, the radiopharmaceutical is detected by special types of cameras that work with computers to provide precise pictures about the area of interest of the body. For example, some images are depicted in Figs. 1.1, 1.2, 1.3, 1.4, and 1.5.

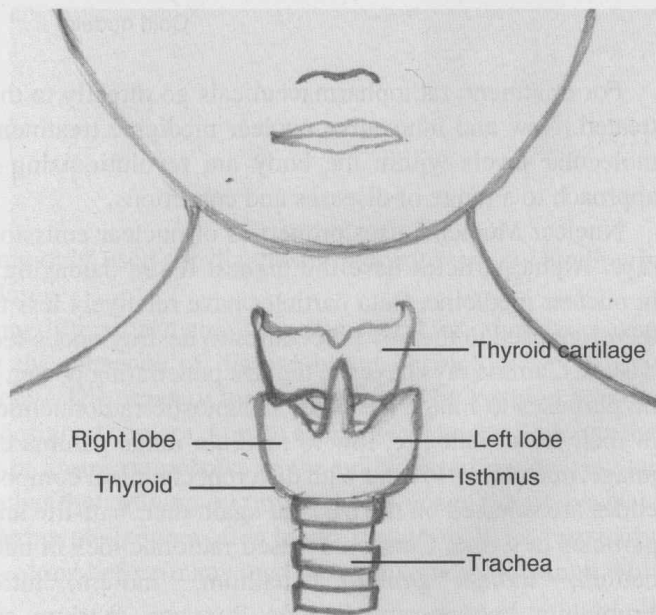


Fig. 1.1 Thyroid gland