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Comparative Study on Myocardial Perfusion Scintigraphic Agents

(^{201}Tl-Thallous-Chloride, ^{99m}Tc-MIBI, and ^{99m}Tc-Tetrofosmin)

Thesis submitted in Partial Fulfillment of M.Sc Degree in Nuclear Medicine

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DEDICATION

I would like to dedicate this work to my family that continues to amaze me.

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First, I thank my supervisor Dr. Adam Khatir Sam, for his continuous support in the M.Sc. program. Sam was always there to listen and to give advice. He taught me how to ask questions and express my ideas. He showed me different ways to approach a research problem and the need to be persistent to accomplish any goal. He was always there to meet and talk about my ideas, to proofread and mark up my papers and chapters, and to ask me good questions to help me think through my problems (whether analytical or computational).

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ABBREVIATIONS

>	Greater than
<	Lesser than
=	Equal
ATP	Adenosine Triphosphate
AV node	Atrioventricular node
B^-	Beta emitter
Ca^{2+}	Calcium
CI	Cardiac Index
cm	centimeter
CO_2	Carbon dioxide.
COP	Cardiac Output
EC	Electron Capture
ECG	Electrocardiography
FDA	Food and Drug Administration.
g	gram
QC	Quality Control
GIT	Gastrointestinal Tract
H	Hydrogen
Hg	Mercury element
HL	Half Life
HPLC	High-performance liquid chromatography
IV	Intravenous
K^+	Potassium
keV	Kilo electron Volt
LAL	Limulus Amebocyte Lysate

LD	Lethal Dose
Lt	left
MBq	Mega Bicurille
mCi	millicurie
MeV	Mega electron Volt
mGy	Milli Gray
MIBI	Methoxy-Isobuty1 Isonitrile
ml/min	milliliter per minute
MPI	Myocardial Perfusion Imaging
^{99}Mo	molybdenum -99
MVO_2	Myocardial Oxygen Consumption
N	Neutron
Na^+	Sodium
NM	Nuclear Medicine
NRC	Nuclear Regulatory Commission
O_2	Oxygen
P	Proton
Pb	Lead element
pH	Potential of Hydrogen
Rt	right
SA node	Sinoatrial node
SPECT	Single Photon Emission Computed Tomography
^{99m}Tc	Technetium-99m
^{201}Tl	Thallium
TLC	Thin-Layer Chromatography
USP	United States pharmacopeia.
Y	Gamma ray

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CHAPTER SIX: SPECIFICITY, SENSITIVITY AND ACCURACY OF MYOCARDIAL PERFUSION AGENTS

ABSTRACT

Myocardial perfusion imaging plays an important role in the evaluation of coronary artery diseases. As the title suggests, the central aim of this comparative study is to pinpoint the most ideal tracer for myocardial perfusion imaging from among several radiopharmaceuticals now available for routine nuclear medicine practice, namely ^{201}Tl-Thallous Chloride, ^{99m}Tc-Sestamibi, and ^{99m}Tc-Tetrofosmin. This study attempts to present comprehensive review for each radiopharmaceutical about its chemistry and preparation, quality control, pharmacokinetics (administration, Biodistribution, mechanism of localization, and clearance routines), contraindications and radiation dosimetry. This comparative review revealed that ^{99m}Tc-Sestamibi and ^{99m}Tc-Tetrofosmin have similar characteristics and superior over ^{201}Tl-thallous chloride with respect to sensitivity and specificity. The ^{99m}Tc-Sestamibi was found to be the most ideal radiopharmaceutical for myocardial perfusion imaging because of its long myocardial resistance time as well as adequate myocardial extraction that allow enough time to accomplish the study, providing images of higher counts density and superior quality compared with thallium-201 or tetrofosmin, optimum radiation dosimetry, availability which is very important factor that make its superior of all.

ملخص

تصوير أوعية عضلة القلب يلعب دورا هاما في تحديد درجة اصابة عضلة القلب بالأمراض. يتضح من عنوان هذه الدراسة البحثية المقارنة ان الهدف منها هو الوصول الي أفضل مادة صيدلانية موسومة بمادة أشعاعية (*Radiopharmaceutical*) من بين عدة مواد تستخدم في تصوير عضلة القلب موجودة حاليا في مجال الطب النووي وهي(^{99m}Tc-*MIBI* و ^{99m}Tc-*Tetrofosmin* و $^{201}TlCl$). في هذا البحث نحاول تقديم أستعراض شامل عن كل المواد الصيدلانية المستخدمة كل على حدا،متناولين الخصائص الكيميائية ، طرق تصنيعيها وتحضيرها، ضبط الجودة ، كيفية اعطاؤها ،توزيعها الحيوي وتخلص الجسم منها ، الجرعة الممتصة و الأعراض الجانبية. وضحت هذه الدراسة أن كل من ^{99m}Tc-*MIBI* و ^{99m}Tc-*Tetrofsmin* اشتراكهما في الصفات أكثر من اختلافهما، لكن استخدامهما في نفس الوقت أفضل من أستخدام مادة ^{201}Tl *Cl* وذلك وفق نتائج الحساسية والنوعية. وجدنا من خلال هذة الدراسة أن أفضل مادة صيدلانية يمكن أستخدامها لتصوير عضلة القلب هي ^{99m}Tc-*MIBI* نسبة لسرعة أمتصاصها وطول بقائها داخل انسجة العضلة مما يتيح زمن كافي لانجاز الفحص، ايضا يعطي صور دقيقة وذات نوعية عالية بالمقارنة مع تلك التي تعطيها المركبات الأخرى، زد على ذلك قلة الجرعة الممتصة، وتعد وفرته تجاريا من أهم الأسباب التي جعلته الافضل من غيره.