Sudan University of Science and Technology

College of Graduate Studies

Thesis submitted in partial fulfilment for the requirement of M.S.c degree in nuclear medicine technology

Diagnosis of Renal Failure Using Ultrasound and Renal Radioistope Scan

تشخيص الفشل الكلوي باستخدام الموجات فوق الصوتية والمسح بالنظائر المشعة

Prepared by:

Saad Eldien Mohammed Ali

Under Supervision:

Dr. Anas Osman Ahmed Hamdoun

Sudan – Madeni 2007

قال تعالى:

(هُلْ هَلْ يَسْتَوِي الَّذِينَ يَعْلَمُونَ وَالَّذِينَ لَا يَعْلَمُونَ)

صدق الله العظيم

سورة الزمر الآية 9

To my parents

My teachers

And friends

For giving me never-ending gifts of encouragement, love and patience

Acknowledgement

I would like to thank every one who assists by one way or another to bring this study to the light.

I am grateful to my supervisor Dr. Anas Osman Ahmed Hamdoun, for his valuable and continuous help and guidance. My thanks extend also to colleagues in Institute

Of Nuclear Medicine, Molecular Biology And Oncology , colleagues in renal hospital and all staff of Medical Radiological College Library.

List of Figures

Figure 2-1 The human Excretory System……. 4

Figure 2-2 The cross structure of the cut surface of kidney……. 6

Figure 2-3 The nephron ……. 7

Figure 2-4 The chronic renal failure diagnosed in nuclear medicine 38

Figure 2-5 The water path ultrasound canner…… 43

Figure 2-6 The transducer …… 48

Figure 2-7 The chronic renal failure diagnosed by ultrasound 59

Figure2-8 The acute renal failure diagnosed by ultrasound 60

Figure 4-1 The percentage age of males to females……... 71

Figure 4-2 Shows the age of the patients…….. 73

Figure 4-3 The sensitivity, specificity and accuracy of NM and US……78

List of tables

1.1 causes of acute tubular necrosis
1.2 comparative between US and NM
1.3 A lower dose of activity
4-1 The percentage of male to female
4-2 A summary of the results of NM and US compared with clinical follow up and laboratory.
4-3 The patients diagnosed by NM and US.
4-4 The sensitivity &specificity & accuracy of US and NM

Abstract

In this study the researcher assessed the effectiveness of ultra-sound and nuclear medicine images in diagnosis of renal failure and compared between two images modalities (nuclear medicine and ultra sound), when they are applied for the same cases.

This study is conducted in INMO nuclear medicine department and renal hospital.

Random sample of thirty patients, 16 males and 14 females with different ages were chosen, ultra sound and nuclear medicine images done to demonstrate renal failure.

Most of these cases, were diagnosed correctly by the two imaging modalities, while 6 patients were diagnosed only by nuclear medicine. The sensitivity of nuclear medicine is 96% and ultrasound 80% .On the other hand we found that the ultrasound and nuclear medicine have the same specificity and accuracy (100%). From these results we concluded that ultra sound has a role in the diagnosis of renal failure but nuclear medicine scanning is more sensitive.

However, because ultrasound is good in assessing morphological changes (e.g renal failure due to bilateral renal stones) and nuclear medicine is good in assessing function, both imaging modalities when performed together help to obtain accurate morphological and functional changes (i.e. they are complimentary rather than competitive).

الخلاصة

فى هذ ه الدراسة تم قياس فعالية الموجات فوق الصوتية و الطب النووى فى تشخيص الفشل الكلوى والمقارنة بين التقنيتين عند اجرائهما معا(الموجات الصوتية والطب النووى)

اجريت هذه الدراسة فى قسم الطب النووى بمعهد الطب النووى والاحياء الجزيئية وعلاج الاورام , وعيادات الموجات فوق الصوتية , ومستشفى الكلى بمدنى.

اخذت عينة عشوائية من المرضى (نساء ورجال) تتكون من ثلاثين مريض من مختلف الاعمار والاعراض , خضع كل المرضى لاجراء الفحصين (الموجات الصوتية والطب النووى) لتوضيح التشخيص للفشل الكلوى.

كان هنالك توافق بين الموجات الصوتية والطب النووى فى التشخيص ما عدا سته حالات تم تشخيصها بفحص الطب النووى دون الموجات فوق الصوتية.الا اننا وجدنا حساسية الطب النووى 96% والموجات الصوتيه 80%- اى ان الطب النووى اكثر حساسيه .

لذا يمكن القول انه يمكن تشخيص الفشل الكلوى باجراء الفحصين معا للحيصول على التشخيص الدقيق لاظهار التغيرات التشريحية والوظيفيه-اى ان الفحصين يكملان بعضهما البعض.

List of contents

Contents	
Dedication	III
Acknowledgements	IV
Lists of figure	V
Abstract	VI
List of contents	IX

List of abbreviations	XII
Chapter One	**1**
1-1 Introduction	2
Chapter Two	3
2-1 The Human Excretory system	4
2-1-1 Renal anatomy	**5**
2-1-2 The nephron	6
2-1-3 Measuring GFR	11
2-1-3-1 Substances used to measure GFR	12
2-1-3-2 Characteristics of substances suitable of measuring the GFR by determining its clearance	12
2-1-3-3 Normal GFR	12
2-2 Renal function	13
2-3 Clinical aspect of renal disease	16
2-3-1 The nephritic syndrome	16
2-3-2 The acute nephritic syndrome	17
2-3-3 Asymptomatic proteinuria.	17

2-3- 4 Painless haematuria	17
2-3- 5 Hypertension	17
2-3- 6 Renal failure	18
2-3- 7 Acute renal failure and acute tubular necrosis	18
2-3-7-1Pre renal	19
2-3-7-2Obstructive	19
2-3-7-3 Parenchymal	19
2-3-7-4 Acute tubular necrosis	20
2-3-7-5 Causes of acute tubular necrosis	21
2-3-7-6 Pathological changes	22
2-3-7-7 Pathogenesis	22
2-3-7-7-1 Anteriolar vasoconstriction	23
2-3-7-7-2 Increasing glomerular permeability	23
2-3-7-7-3 Tubular obstruction	23
2-3-7-7-4 Back leak of tubular fluid	23
2-3-8 Chronic renal failure	24
2-3-8 -1 Associated problems and treatment	26
2-3-8 -2 Evaluation	28
2-3-8 -2-1 Laboratory	28
2-3-8 -2-2 Radiographic evaluation	29
2-3-8 -2-3 Bone evaluation	29
2-3-8 -3 Pre –dialysis treatment	29
2-3-8 -3-1 Maintain normal electrolytes	29
2-3-8 -3-2 Reduce protein intake to 0.6gm/Kg body weight	30
2-3-8 -3-3 Underlying disease	30
2-3-8 -3-4 Ramipril in non diabetic proteinuria nephropathy	31
2-3-8 -4 Hem dialysis	31
2-3-8 -4-1 Indication	31
2-3-8 -4 -2 Procedure for chronic Hem dialysis	31
2-3-8 -5 Chronic hem dialysis medication Imaging	32
2-4 Renography	33
2-4-1 Position images	40
2-4-2 Image interpretation	40
2-4-3 Normal characteristics of renal scan Ultrasound	41
2-5 Physical aspect	41
2-5-1 Historical perspective of Ultrasound	41
2-5-2 Production of Ultrasound	43
2-5-3 Interaction of U/S with matter	44
2-5-3-1 Reflection	45
2-5-3 -2 Scatter	46

2-5-3 -3 Diffraction	46
2-5-3 - 4 Refraction	46
2-5-3 -5 Attenuation	47
2-5-4 U/S transducer	47
2-5-4-1 Types of transducer	48
2-5-5 Ultrasound resolution	49
2-5-6 Display modes	49
2-5-7 Doppler	50
2- 5-8 color flow Doppler	51
2- 5-9 Diagnostic U/S , advantage and disadvantages	51
2- 5- 9-1 Advantages	51
2- 5-9-2 disadvantages	52
2- 6 Rend songraphy	52
2-6-1 Examination technique	52
2 -6- 2 Normal songraphic appearances of adult kidney	53
2-6-3 Normal renal measurements	54
2-6-3-1 Adult	54
2-6-3-2 pediatric	55
2-6-4 Medical renal diseases	56
2-6-5 Features of acute renal failure (ARF)	56
2-6-6 Chronic renal failure (C.R.F)	**58**
2-6-7 Comparative between U/S and NM	**61**
Chapter Three	**62**
3- Material and Method	63
3-1 Population of study	63
3-1-1 Sample size	63
3-1-2 date collection	63
3-1-3 sampling	64
3-1-4 equipment used	64
3-1-5 Study period	64
3-1-6 Date Analysis	64
3-1-7: Renal Scintigraphy Study	65
Chapter Four	69
4- Results	70
4-1 Gender:	70
4-2 Age:	71
Discussion	78
Limitations	80
Conclusion	81
Recommendations	83
References	84

GFR	Glomerular Filtration Rate
U/S	Ultrasound
NM	Nuclear Medicine
ERPF	Effective Renal Plasma Flow
BUN	Blood Urea Nitrogen
CRF	Chronic Renal Failure
ARF	Acute Renal Failure
ATN	Acute Tubular Necrosis
ESRD	End Stage Renal Disease
CT	Computerized tomography
DTPA	Diethylene tri amine penta acetic acid
GHA	Glucoheptonate
MAG3	Marco profanely triglucine
OHI	Orthoiodohippurate
HTN	Hypertension

List of abbreviations