

الآية

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قال الله تعالى: (اقْرَأْ بِاسْمِ رَبِّكَ الَّذِي خَلَقَ * خَلَقَ الْإِنْسَانَ مِنْ عَلَقٍ * اقْرَأْ وَرَبُّكَ

الْأَكْرَمُ * الَّذِي عَلَّمَ بِالْقَلَمِ * عَلَّمَ الْإِنْسَانَ مَا لَمْ يَعْلَمْ)

الآيات من (1 - 5)

سورة العلق

صدق الله العظيم

Dedication

I dedicate this work to the soul of my parents,

To my wonderful and lovely wife for her patience, encouragement

and continues support,

**To my children; Mohamed, Abdulla and Fatima for dreaming
proudly.**

About their father holding a PhD degree

To my brothers and sisters

To my best friends for their

Cheers.

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ABSTRACT

Cardiac catheterization is an interventional procedure used for the diagnosis and treatment of coronary arteries diseases. Patients are exposed to prolong radiation exposure during the procedure. Tissue reaction (erythema) effects are now well documented as one of the serious complications of extended radiation exposure procedures. Radiation dose up to 479.88Gy.cm² were reported. Therefore, accurate dose optimization is recommended to keep the radiation dose as low as reasonably achievable. This study aimed to measure radiation and effective doses of the patients during three types of cardiac catheterization. A total of 346 patients were examined for different clinical indication in this study including [(187 Diagnostic Coronary Angiographic (DCA) (54%), 118 Percutaneous Coronary Intervention (PCI) (34.1%), and 41 Pacemaker (PM) (11.9%)]. WMHC: 188 patients; compromise 54.3% from the total number of patients, its distribution as: 97 DCA (51.6 %), 59 PCI (31.4%), and 32 PM (17%), SHC: 110 patients; compromise 31.8% from the total number of patients, its distribution as: 63 DCA (57.3%), 42 PCI (38.2%), and 5 PM (4.5%), FSH: 48 patients; compromise 13.9% from the total number of patients, its distribution as: 27 DCA (56.3%), 17 PCI (35.4%), and 4 PM (8.3%). Calibrated X-ray machines were used to perform all the procedures. Patient dose measurements were performed using Dose Area Product (DAP) meter. The mean and range of patient age (year), weight (kg), and height were 49.2 (0.04-85) and 88.1(1-179), and 109.9 (46-183) respectively. While the mean and range exposure parameters were 81.5(53-125) kVp, 444.2 (61.6-898) mA and 4.3 (0.016-8) s for tube potential, tube current and time, respectively. The mean and range of the number of films per procedure is 8.3 (1-47) and the mean and range of the mean fluoroscopic time was 6.6 (0.33-57.03) min. The mean and range of the number of frames per procedure was 475.78(5-2434). The mean cumulative average dose (CAD) was 36.94 (0.1225-479.88) Gy.cm². Patients exposed to different dose values based on their clinical indications. Although, no patients developed tissue reaction effect, optimization of patient doses in important especially for young patients.

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ملخص البحث

قسطرة القلب هي إجراء تداخلي يستخدم لتشخيص وعلاج أمراض الشرايين التاجية للقلب. يتعرض فيها المرضى أثناء العملية للإشعاع لفترات طويلة. وقد تم توثيق تأثيرات تفاعل الأنسجة مع الإشعاع (إحمرار الجلد) باعتبارها واحدة من المضاعفات الخطيرة للتعرض الإشعاعي المستمر أثناء العملية. وقد تم تسجيل جرعات إشعاعية وصلت حتى 67.38 قراي/سم²، ولذلك، يوصى بأمثلة الجرعات الإشعاعية للحفاظ عليها منخفضة بقدر ما يمكن تحقيقه بشكل معقول.

هدفت هذه الدراسة لقياس الجرعات الإشعاعية والفعالة للمرضى خلال ثلاثة أنواع من قسطرة القلب. في هذه الدراسة تم فحص 346 مريضاً لأسباب مرضية مختلفة وكانت النتائج كالتالي: [187 قسطرة تشخيصية بنسبة (54%)، 118 قسطرة علاجية تداخلية بنسبة (34.1%)، و 4 جهاز تنظيم ضربات القلب بنسبة (11.9%)، وتوزيع المرضى بلمستشفيات كالتالي: مركز القلب مدني: 188 مريضاً؛ ويشكلون نسبة 54.3% من العدد الكلي للمرضى، وتوزيعهم كالتالي: 97 قسطرة تشخيصية بنسبة (51.6%)، 59 قسطرة علاجية تداخلية بنسبة (31.4%)، و 32 جهاز تنظيم ضربات القلب بنسبة (17%)، مركز السودان للقلب: 110 مريضاً؛ ويشكلون نسبة 31.8% من العدد الكلي للمرضى، وتوزيعهم كالتالي: 63 قسطرة تشخيصية بنسبة (57.3%)، 42 قسطرة علاجية تداخلية بنسبة (38.2%)، و 5 جهاز تنظيم ضربات القلب بنسبة (4.5%)، مستشفى الفيصل التخصصي: 48 مريضاً، ويشكلون نسبة 13.9% من العدد الكلي للمرضى، وتوزيعهم كالتالي: (27 قسطرة تشخيصية بنسبة 3%)، و 17 قسطرة علاجية تداخلية بنسبة 9%)، و 4 جهاز تنظيم ضربات القلب بنسبة 8.3%).

وقد تمت معايرة جميع أجهزة الأشعة السينية التي استخدمت لإجراء هذه الفحوصات من قبل معهد السلامة الإشعاعية بهيئة الطاقة الذرية السودانية. وقد تم قياس الجرعة الإشعاعية للمرضى باستخدام مقياس مضروب الجرعة في وحدة المساحة. وكان متوسط ومدى عمر المريض (سنة) والوزن (كجم) والارتفاع (سم): 49.2 (85-0.04) و 88.1 (179-1)، و 109.9 (183-46) على التوالي. في حين كان متوسط ومدى عوامل التعريض الإشعاعي: 81.5 (125-53) كيلوفولت، 444.2 (898-61.6) مللي أمبير و 4.3 (8-0.016) ثانية جهد الأنبوب، تيار الأنبوب والزمن، على التوالي. وكان متوسط ومدى عدد الأفلام لكل فحص هو 8.3 (47-1) وكان متوسط ومدى وقت التعريض الفلوري 6.6 (57.03-0.33) دقيقة. وكان متوسط ومدى عدد الإطارات لكل فحص هو 475.78 (2434-5)، كما أن متوسط ومدى الجرعة التراكمية 36.94 (479.88-0.1225).

تم تعريض المرضى لجرعات إشعاعية مختلفة بناء على دواعي الفحص المطلوب. على الرغم من أن المرضى الذين تعرضوا لهذه الجرعات الإشعاعية لم تظهر عليهم تأثير أو رد فعل في الأنسجة (إحمرار الجلد مثلاً)، تظل أمثلة الجرعات الإشعاعية للمرضى ضرورة قصوى خاصة للمرضى صغار السن.

List of contents

Content	Page No
الأية	I
Dedication	II
Acknowledgements	III
Abstract (English)	IV
Abstract (Arabic)	V
List of contents	VII
List of Tables	XII
List of figures	XIV
List of abbreviations	XVI
Chapter One: Introduction	
1.1. History of Medical Diagnosis and Diagnostic Imaging	1
1.2 Interventional Radiology: Applications and advantages.	2
1.2.1 Applications of interventional radiology (IR)	4
1.2.2 Advantages of interventional radiology (IR)	5
1.2.3 Disadvantages of interventional radiology (IR)	5
1.3 Patients exposure	6
1.3.1 Introduction and Overview	6
1.4 Problem of the study	7
1.5 Objectives	8
1.5.1 General Objectives	8
1.5.2 Specific Objectives	8
1.6 Thesis arrangement	8
1.7 Thesis outcomes	8
1.7.1 Publications	8
Chapter Two: Theoretical Background	
2. Radiation classifications (ionizing radiation and sources)	10
2.1 Introduction to Radiation	10

2.3 X-ray Equipment (fluoroscopy)	11
2.3.1 Functionality	11
2.3.2 Fluoroscopic Imaging Chain Components	12
2.3.2.1 The Image Intensifier	12
2.3.2.2 Input Screen	12
2.3.2.3 Electron optics	15
2.3.2.4 The Output Phosphor	15
2.3.3 Characteristics of Image Intensifier Performance	17
2.3.3.1 Conversion factor	17
2.3.3.2 Brightness Gain	17
2.3.3.3 Field of View/Magnification Modes	17
2.3.3.4 The contrast ratio	18
2.3.3.5 Quantum Detection Efficiency (QDE)	19
2.3.3.6 S distortion	19
2.3.4 Optical Coupling	19
2.3.4.1 Distribution Mechanism	19
2.3.4.2 Lenses	19
2.3.5 Video Cameras	21
2.3.5.1 General Operation	21
2.3.5.2 Video Resolution	22
2.3.5.3 Flat panel Digital fluoroscopy	23
2.3.6 Peripheral equipment	24
2.3.6.1 Photo-Spot Cameras	24
2.3.6.2 Digital photo-spot	25
2.3.6.3 Spot-Film Devices	25
2.3.6.4 Cine-Radiography Camera	25
2.3.7 Fluoroscopy Modes of Operation	26
2.3.7.1 Continuous fluoroscopy	26
2.3.7.2 High Dose Rate Fluoroscopy	26

2.3.7.3 Variable frame Rate Pulsed Fluoroscopy	26
2.3.7.4 Frame Averaging	27
2.3.7.5 Last-Frame-Hold	28
2.3.7.6 Road Mapping	28
2.3.8 Automatic Brightness Control (ABC)	29
2.3.9 Image quality	30
2.3.9.1 Spatial Resolution	30
2.3.9.2 Contrast Resolution	31
2.3.9.3 Temporal Resolution	32
2.3.10 Fluoroscopy Suites	33
2.3.10.1 Gastrointestinal Suites	33
2.3.10.2 Remote Fluoroscopy Rooms	33
2.3.10.3 Peripheral Angiography Suites	34
2.3.10.4 Cardiology Catheterization Suite	35
2.3.10.5 Biplane Angiographic Systems	35
2.3.10.6 Portable Fluoroscopy-C Arms	35
2.4 Radiation Dosimetry for patient method dose measurement (DAP)	35
2.4.1 Patient Dose	35
2.4.2 Factors influencing dose in radiography	36
2.4.2.1 Beam energy	36
2.4.2.2 Grids	36
2.4.2.3 Patient size	36
2.4.3 Operational dose quantities	37
2.4.3.1 KERMA and Dose	37
2.4.3.2 Incident Air Kerma (IAK)	37
2.4.3.3 Entrance-surface air kerma (ESAK)	37
2.4.4 Effect of scatter	37
2.4.4.1 Influence of (Back Scattered) BS radiation on measurements	37
2.4.5 Absorbed dose in soft	39
2.4.6 Detectors for X-Ray dose measurements	39

2.4.6.1 Ionization Chambers	39
2.4.6.1.1 Parallel Plate Ionization Chamber	40
2.4.6.1.2 Transmission chamber	41
2.4.6.2 Semiconductors dosimeters	42
2.4.6.2.1 Polar response of different detectors	42
2.4.6.2.2 Multi-meters	42
2.5 X-Ray System	43
2.5.1 X-Ray Tube Output	43
2.5.2 Measurement set-up	43
2.5.3 Measurements with diodes	44
2.5.4 Dependence of Output on kVp	45
2.5.5 Incident Air Kerma	45
2.5.6 Entrance Surface Air Kerma	46
2.5.7 Half Value Layer	47
2.6 Calibration of KAP meter	49
2.6.1 X-ray field	49
2.6.2 Parameters and conditions	49
2.6.3 Accuracy and stability	50
2.6.4 Correction Factor (CF)	50
2.6.5 AAPM TG-190	50
2.6.6 Working measurement proposal	50
2.7 Radiation risks in Interventional radiology	50
2.7.1 Commentary	50
2.7.2 Current trends in interventional radiology-the radiologists'	51
2.7.3 Doses to patients	53
2.7.4 Staff doses	56
2.7.5 Equipment factors and program set-up	59
2.7.6 Education and training	62

2.7.7 Conclusions and future work	64
2.7.8 Dose Area Product (DAP)	64
2.7.8.1 How is DAP measured?	65
2.7.8.2 The Cardiovascular System: Anatomy, Physiology, Pathology	66
2.7.8.2.1 Anatomy and Physiology	66
2.7.8.2.2 Pathology of the heart	67
2.12 Literature Review (Previous Studies)	68
Chapter Three: Materials and Methods	
3. Materials and Methods	98
3.1 Study area and duration	98
3.2 Sample size	99
3.2 X-ray machines	100
3.3 Patient data measurement	100
3.4 Imaging protocol	101
3.4.1 4.4.1 Procedure Issues	101
3.5 statistical analysis	103
Chapter Four: Results	
4.1 Results	104
Chapter five: Discussion, Conclusion, Recommendations	
5.1 Discussion	111
5.2 Conclusion	114
5.3 Recommendations	115
References	116
Appendices	120

List of Tables

List of Table	Page No
Table 2.1 Typical Limiting Spatial Resolution in Fluoroscopy	32
Table 2.2 Backscatter factors (water)	38
Table 2.3: Radiation doses in interventional radiology procedures: the data are abstracted from the RAD-IR study	54
Table 2.4: Indicative staff dose summary for radiology/cardiology	57
Table 3.1: Gender Clinical indications	99
Table 3.2 Clinical indications and Distribution of cases by hospitals	100
Table 3.3 Classifications and specifications of X-ray machines	101
Table 4.1 illustrates the mean and range of demographic data for adult patients undergoing diagnostic coronary angiography (DCA) procedures	106
Table 4.2 illustrates the mean and range of demographic data for adult patients undergoing pacemaker (PM) procedures	106
Table 4.3 illustrates the mean and range of demographic data for adult patients undergoing percutaneous intervention (PCI) procedures	106
Table 4.4 illustrates the mean and range of technique parameters for adult patients undergoing diagnostic coronary angiography (DCA) procedure	107
Table 4.5 illustrates the mean and range of technique parameters for pediatric patients undergoing diagnostic coronary angiography (DCA) procedure	107
Table 4.6 illustrates the mean and range of technique parameters for adult patients undergoing pacemaker (PM) procedures	107
Table 4.7 illustrates the mean and range of technique parameters for pediatric patients undergoing pacemaker (PM) procedures	108
Table 4.8 illustrates the mean and range of technique parameters for adult patients undergoing percutaneous intervention (PCI) procedures	108

Tables.4.9 illustrates the mean and range of technique parameters for pediatric patients undergoing percutaneous intervention (PCI) procedures	108
Tables.4.10 illustrates the mean and range adult patient dose as (CD rad.cm ²) for procedures which performed at Al-Faisal specialized hospital (FSH)	109
Table 4.11 illustrates the mean and range adult patient dose as (ED mGy and CDAP cGy.cm ²) for procedures which performed at Sudan Heart Center (SHC)	109
Table 4.12 illustrates the mean and range pediatric patient dose as (ED mGy and CDAP cGy.cm ²) for procedures which performed at Sudan Heart Center (SHC)	109
Table 4.13 illustrates the mean and range adult patient dose as (CAK mGy & CDAP mGy.cm ²) for procedures which performed at Wad Madani Heart Center (WMHC)	109
Table 4.14 illustrates the mean and range pediatric patient dose as (CAK mGy & CDAP mGy.cm ²) for procedures which performed at Wad Madani Heart Center (WMHC)	110

List of Figures

Figures	Page No
Figure 1.1 Factors That Affect Patient Exposure in a Radiographic Procedure	7
Figure 2.1: The electromagnetic spectrum	10
Figure 2.2 The fluoroscopic imaging chain with key components indicated.	14
Figure 2.3 the internal structure of an image intensifier	14
Figure 2.4 The input section of an image intensifier	14
Figure 2.5 rectilinear grid input and the output image demonstrate spatial distortion	15
Figure 2.6 The output window of an image intensifier	16
Figure 2.7 normal and magnification operation of the image intensifier	18
Figure 2.8 illustrates the kVp-dependent quantum detection efficiency	20
Figure 2.9 The closed circuit TV system used in fluoroscopy	22
Figure 2.10 The flat panel imaging system and the image intensifier	24
Figure 2.11 The concept of frame averaging	28
Figure 2.3.12 Automatic brightness control (ABC)	30
Figure 2.3.13 The modulation transfer function (MTF)	31
Figure 2.14 radiographic/fluoroscopic (R/F) and angiographic systems	34
Figure 2.15 Essential parameters influencing patient exposure	36
Figure 2.4.2 10 cm PMMA, 60x60 cm ² , beam quality RQR10	37
Figure 2.4.3 Backscatter factors; 25x25 cm ² ; 2.5 mm total filtration	37
Figure 2.16 Ionization Chambers	38
Figure 2.17 cylindrical shape	39
Figure 2.18: Schematic drawing of a plane parallel ionization chamber	39
Figure 2.19: Cut through a silicon diode radiation detector	40
Figure 2.20: Semiconductors dosimeter	41
Figure 2.21 Multi-meter	41
Figure 2.22 X-Ray System	42
Figure 20.23 Positioning of ionizing chamber and attenuating plate in relation to II and X-ray tube during measurement of skin entrance AK	43
Figure 2.24 Tube output is proportional to kVp	44

Figure 2.25 Incident and Entrance Surface Air Kerma measurements	45
Figure 2.26 measurements entrance Surface dose	46
Figure 2.27 measurement of the half value layer (HVL)	46
Figure 2.28 Transmission ionization chambers	47
Figure 2.29 mounting of ionization chamber on the X-ray tube	47
Figure 2.30 Transmission ionization chambers positioning	48
Figure 2.31 KAP is constant with distance since the cross section of the beam is a quadratic function which cancels the inverse quadratic dependence on dose	48
Figure 2.32 Calibration of KAP meter	49

List of Abbreviations

II	Image Intensifier
TV	Television
CT	Computed Tomography
IR	Interventional radiology
MRI	Magnetic Resonance Imaging
PTA	Percutaneous Transluminal Angioplasty
RFA	Radiofrequency Ablation
TIPS	Transjugular Intrahepatic Portosystemic Shunt
TDCs	Tunneled Dialysis Catheters
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
ICRP	International Commission on Radiological Protection
IAEA	International Atomic Energy Agency
DAP	dose area product
IC	interventional cardiology, Ionization Chambers
CNSC	Canadian Nuclear Safety Commission
TFT	Thin Film Transistor
FOV	Field-of-View
CsI	Cesium Iodide
ZnCdS	Ag Zinc Cadmium Sulfide doped with Silver
GI	Gastrointestinal
GU	Genitourinary

QDE	Quantum Detection Efficiency
kVp	Kilovoltage peak
CCD	Charge Coupled Device
mA	Milliampere
ABC	Automatic Brightness Control
MTF	Modulation Transfer Function
DSA	Digital Subtraction Angiography
SNR	Signal-to-Noise Ratio
PA	Postero-Anterior
ESAK	Entrance Surface Air Kerma
KERMA	Kinetic Energy Released in a Material
IAK	Incident Air Kerma
R/F	radiographic/fluoroscopic
Gy	gray
J/kg	joule per kilogram
BS	Back Scattered
KAP	Kerma-Area Product
SDs	Semiconductor Detectors
FFD	Focuses Film Distance
FDD	Focus Detector Distance
BSF	Backscatter Factor

HVL	Half Value Layer
IEC	International Electrotechnical Commission
FDA	Food and Drug Administration
DICOM	Digital Imaging and Communications in Medicine
UK	United Kingdom
CD	Cumulative Dose
IPEM	Institute of Physics and Engineering in Medicine
PTCA	percutaneous transluminal coronary angioplasty
DRLs	Diagnostic Reference Levels
TLDs	Thermoluminescent dosimeters
EDR	Extended Dose Range
FPDs	Flat Panel Detectors
KCARE	King's Centre for the Assessment of Radiological Equipment
ESD	entrance skin dose
RPS	Radiation Protection Supervisor
EAP	exposure-area product
CRCPD's	Committee of Radiation Control Protection Director's
NRPB	National Radiological Protection Board
ALARA	As Low As Reasonably Achievable
CK	Cumulative Kerma
FD	Flat Detector

CA	Coronary Angiography
LAO	Left Anterior Oblique
FGIs	Fluoroscopically Guided Interventions
SD	Standard Deviation
AP	Anteroposterior
CRA	Cranial
CAU	Caudal
LAT	Lateral
FT	Fluoroscopic Time
PCI	Percutaneous Coronary Intervention
BMI	Body Mass Index
IRP	Interventional Reference Point
PTMC	Percutaneous Trans-Mitral Commissurotomy
PSD	Peak Skin Dose
FPS	Frames per Second
RRP	Radiation Reduction Protocol
SAEC	Sudan Atomic Energy Commission
DCA	Diagnostic Coronary Angiography
TRA	Trans-radial
LLA	Lower Limb Arteriography

PMMA	Polymethylmethacrylate
CNR	Contrast-to-Noise Ratio
IRP	interventional reference point
EVAR	Endovascular Aneurysm Repair
ED	effective dose
CSD	Cumulative skin dose
AEC	Automatic exposure control
CESD	Cumulative Entrance Skin Dose
KIRP	Kerma in International Reference Point
KIRP	KIRP Tissue -Weighting Factor for Breast
EFD	Entrance dose in the patient plane measured at the distance
CRT	Cardiac resynchronization therapy
DDD	Dual pacing for both chambers
VDD	The pacemaker senses atrial and ventricular events
VVI	Single Chamber Ventricular Pacemaker
CC/LV	Cardiac Catheterization/Left Ventricular
RHC	Right Heart Catheterization
WMHC	Wad Madani Heart Center
SHC	Sudan Heart Center
FSH	Al-Faisal Specialized Hospital
DCA	Diagnostic Coronary Angiography

TRA	Trans-radial
LLA	Lower Limb Arteriography
PMMA	Polymethylmethacrylate
CNR	Contrast-to-Noise Ratio
IRP	interventional reference point
PDA	Patent ductus arteriosus
PS	Pulmonary stenosis
ASD	Atrial septal defect
VSD	Ventricular septal defect
COA	Co-arcetation of aorta
CAK	Cumulative Air Kerma
CDAP	Cumulative DAP