

Dedication

To my father.....

To my mother.....

To these who facilitated to me barriers and obstacles.

To my sister, brothers.....

And my friends.....

To all these I present my humble research.

-

Acknowledgement

After my thanking to Allah thank goes to the to my sublime supervisor, Dr.Kouther Elhaj Mohamed in particular and of being generous, humble and patient until my research has came to live.

My thanks are also extended to the Sudan University of Science and technology, Department of Physics.

I do not miss to hail generously, the vital contribution of (RICK) family and Institute of Nuclear Medicine, Molecular Biology &Oncology Oncology Department in Al-Jazeera.

Thanking also goes to University of Alfasher and its gentile chancellor professor Abd-Elhai and Department of Physics in particular.

List of contents

<i>Title</i>	<i>Page</i>
--------------	-------------

	NO
Dedication	I
Acknowledgment	II
List of contents	III
List of contents	IV
List of tables	V
List of figures	VI
List of abbreviations	VII
Abstract (in Arabic)	VIII
Abstract (in English)	IX
Chapter 1 Introduction	
1.1 Problem of study	2
1.2 Hypotheses	2
1.3 Methodology	3
1.4 Literature review	3
Chapter 2 Theoretical back ground	
2.1 Quality	5
2.2 Quality audit	5
2.3 Quality Assurance (QA)	5
2.4 Quality Controls (QC)	6
2.5 Requirements on accuracy in radiotherapy	6
2.6 Defining Cancer	7
2.7 Radiation therapy	9
2.8 Treatment machines for external beam radiotherapy	10
2.9 Simulator unit	15
2.10 Radiation dosimetry	18
2.11 Output factors	21
Chapter 3 Materials and methods	
3.1 Introduction	26
3.2 QA programme for cobalt-60 Teletherapy machines	26
3.3 QA program for treatment simulators	28
3.4 Material used in Radiotherapy in (RICK)	30
3.5 Material used in Institute of Nuclear Medicine, Molecular Biology & Oncology department	34

3.6 Methods of quality controls on medical aspects co-60	37
3.7 Methods of quality controls on medical aspects for simulator	42
3.8 Radiation protection	46
Chapter 4 Results	
4.1 Introduction	49
4.2 Result of Institute of Nuclear Medicine, Molecular Biology & Oncology Oncology Department in (Al-Jazeera hospital)	50
4.3 Result of CO-60 in (RICK) hospital	53
4.3.1 Result of the Output of absorbed dose Measurement for cobalt-60(MDS) in (RICK)	57
Chapter 5 Discussions, conclusions, Recommendation	
5.1 Discussions	59
5.2 Conclusions	61
5.3 Recommendation	62
-References	63
-Appendix	66

List of tables

<i>Title</i>	<i>Page No</i>
2.1 Physical properties of radionuclide used in (EBR)	12
2.2 Radiation Units and Conversion Factors	21
2.3 Reference condition for the determination absorbed dose to water in co-60	24
3.1 Sample QA program for co-60 unit (AAPM TG40)	26
3.2 Sample QC program for simulator (AAPM TG40)	28
3.3 Illustrate select the appropriate KV& mA	43
3.4 Dose limits recommended by ICRP (1991)	48
4.1 QC tests for co -60 (Cirus)	50
4.2 QC Tests for simulator (Varian)	51
4.3 Heating of the film by Radiography mode	52
4.4 QC tests CO-60 (MDS)	53
4.5 QC tests CO-60 (Equinox)	55
4.6 Results of electrometer reading of chamber	57

List of figures

<i>Title</i>	<i>Page No</i>
1.1 Handling of the quality system well organizes the five aspects	1
2.1 Loss of normal growth control	8
2.2 Co-60 radio nuclides	13
2.3 Calculating geometric penumbra	14
2.4 Headrests used in external beam radiotherapy	16
2.5 Immobilization of brain and head and neck patients	17
2.6 Relationship of Absorbed Dose to Exposure	20
2.7 Photon percentage depth dose comparison	25
3.1 Cobalt-60 teletherapy machine	31
3.2 Isocentric set-up allows movement of all components	32
3.3 Schematic diagram of typical therapy x- ray tube	35
3.4 Main Component of simulation and their possible movement	36
3.5 Field size machine test	38
3.6 Leads Test object – fluoroscopic image	43
3.7 Image paper of quality assurance	43

3.8 Source storage	48
4.1The relationship between (reading & number) of the Dos1	68

List of abbreviations

<i>Quantity</i>	<i>symbol</i>
AAPM	American Association of Physicists in Medicine
CT	Computed Tomography
IAEA	International Atomic Energy Agency
ISO	International Organization for Standardization
IEC	International Electrotechnical Commission
TPS	Treatment Planning System
Isocentre	Intersection of the axes of collimator and gantry rotation
SAD	source to Axis Distance
Linac	linear accelerator
QA	Quality Assurance
QC	Quality Control
SSD	Source-Surface Distance
NTCP	Normal Tissue Complication Probability
TCP	Tumour Control Probability
HVL	Half Value Layer
Co	Cobalt-60
SD	Standard Deviation
RICK	Radiation and Isotopes Center

	Khartoum
NOC	National Oncology Centers
SDD	Source Difragme Distance
Ci	Stands for Curie
Gy	Stands for Gray
R	Stands for Roentgen
N	Number of radioactive atoms

Abstract

This study addresses Evaluation of quality control in radiotherapy departments of the (NOC), In Sudan. The general objective was to ensure the quality of the cobalt-60(Equinox, MDS) in (RICK) and Co-60(Cirus), simulator in Al-Jazeera machines, A radiation dosimeter shall ensure that exposure minimum is normal tissue during radiotherapy and apply of QC includes minimum radiation to staff and public.

To achieve that 19 QC tests were applied to CO-60(MDS, Equinox and Cirus) machines, the majority passed the following mechanical checks successfully which are: Safety interlocks control, Hand switch box, lamp indicator, Door interlock, Emergency switch, Table movement, Gantry rotation, Power supply, SSD accuracy=100cm, Treatment stop timer, Field size indicator, Audio visual monitor, Light radiation coincidence, Wedges, collimator; gantry and couch rotation isocenter. But the Co-60(Cirus) failed in rotation of couch isocenter, Lamp indicator all broken ,Laser Damage lateral damage, Co-60 (MDS) failed in laser and the Co- 60(equinox) is stopping because SSD is not functional, gantry rotation isosenter at 180^0 , SSD is not functional ,laser low intensity .

The Result of the 17 QC tests of simulator machine explained that this machine suffer from some problems such as Lamp light, Hand switch difficult and the stopping of Couch rotate isocenter field size error 4mm not

accepted.

Finally, CO-60 (MDS) passed measurements of absorbed dose and output constancy successfully with error 1% of the standard value.

الخلاصة

تناولت هذه الدراسة تقييم ضبط الجودة في أقسام العلاج الإشعاعي بمراكز علم الأورام في السودان للمحاكي والكوبالت-60. هدفت إلى ضمان الجودة للأجهزة الكوبالت-60 (Equinox, MDS) في الخرطوم و الكوبالت-60 (Cirus) والمحاكي في الجزيرة، وفقاً لمعدلات قبول لفترة حياة أطول. وتضمنت الدراسة مقياس التعرض الإشعاعي الذي يقلل تعرض الخلايا العادية للإشعاع أثناء التعرض الإشعاعي، وكذا تطبيق برنامج ضبط جودة يضمن أقل جرعة للعاملين والجمهور.

تم تطبيق 19 اختبار ضبط جودة على أجهزة الكوبالت-60 MDS, Equinox and 60 (Cirus) و 17 اختبراً للمحاكي، وقد وضحت نتائج الـ 19 اختباراً للكوبالت أنه قد اجتازت الغالبية العظمى الاختبارات الميكانيكية التالية بنجاح: دائرة التشابك لباب غرفة الكوبالت، لوحة التحكم اليدوي، مؤشر المصباح، مفتاح الطوارئ، حركة الطاولة، الموقت، قياس المسافة بين المصدر والجلد على بعد 100 سم، دوران قن الإشعاع، الاتصال الصوتي والمرئي، مؤشر زاوية الطاولة، دقة مؤشر قن الإشعاع، مركز تساوي الجلد، المحدد، الطاولة. بيد أن الكوبالت-60 (Cirus) فشل في عدم دوران مركز تساوي الطاولة، مؤشر المصباح متوقف والليزر الجانبي غير مضبوط والكوبالت-60 (MDS) فشل في عدم دقة الليزر والكوبالت-60 (Equinox) فشل لعدم ضبط المسافة بين المصدر والجلد.

أوضحت نتائج الـ 17 اختباراً المتعلقة بضبط الجودة على جهاز المحاكى أنه يعاني من مشاكل مثل انخفاض ضوء المصباح وصعوبة تحريك زر لوحة التحكم اليدوي ثم تثبيت مركز تساوي دوران الطاولة مع خطاً 4 لمؤشر قن الإشعاع. وأخيراً اجتاز جهاز الكوبالت-60 (MDS) مقاييس الجرعات المعطاة بنجاح حيث بلغت نسبة الخطأ في ثبات الجرعة 1% من القيمة المقاسة.