Sudan University of Science and Technology
College of Graduate Studies and Scientific Research

ASSESSMENT OF RADIATION EFFECTS IN BLOOD COMPONENTS FROM TC-99^M FOR BONE SCINTIGRAPHY

تقويم الاثر الاشعاعى على مكونات الدم من التكنيشيوم- ٩٩ لفحص العظام با لطب النووى

A research Submitted for Partial fulfillment for the Requirement of M. Sc. Degree in Nuclear Medicine Technology

By:
Amira Omer Hamed Ali Nasir
B. Sc. in Nuclear Medicine

Supervisor:
Dr. Mohammed Ahmed Ali Omer

June 2011

DEDICATION

THIS WORK DEDICATES

To My Father.

To My Mother.

To My Husband.

To Dr. Mohammed Ahmad Ali

To Dr. Mohmad ELfadil Mohamed

To My Sisters Salma and Heba.

To My Brother Mohmad.

To The University Of Sudan.

To The Department of Nuclear Medicine of (RICK)

To Ahmed Albadry(nurse) at the Nuclear Medicine Department of (RICK).

To Labrotory of Hematology of Khartoum hospital.

To Labrotory of Heamatology of(RICK).

To All my Teatchers at all level Studies.

To My Friend Razan.

To My Collquaes in The university in Sudan.

To My all Friends

Acknowledgement

I am grateful to Dr. Mohammed Ahmed who supervised this study because he used to present huge aids which are: he encouraged the idea of this study, supported this study with information, he helped me to analyze the data and he made physical efforts to direct this study.

I thank Dr. Mohamed Elfadil because he encouraged me and gave me some recommendations to go ahead in this study.

I thank my father Omer Hamad Ali Nasir because, he has enhanced me to complete my educations and he has presented all supports which indeed.

I thank s my mother Nadia Ismaeil Mohamed Osman because she has encouraged me all times for education and she has help me since young.

I thank my husband Khalid because, he dedicate me the chance of this study.

I thank the family of the Nuclear Medicine in Sudan that includes the colleagues and management.

Abstract

This study has been carried out in Radiation and Isotopes Center of Khartoum and Khartoum hospital, it's aim was to the assessment of the effect of radiation in Blood Components from Tc-99m/MDP Bone Scintigraphy, such as the effects in WBCs, RBCs, PLT, HCT, MCV, LYM and HGB in addition to geographical distribution of cancer and highlighting the most common cancer in Sudan. The study conducted on 50 patients (50) as 76% female and 24 % male with different ages that candidate to the bone Scintigrophy with different indications except the patients who have proliferative disease in (RICK). Some data were obtained which were :geneder,weight,height, recent diagnoses, address, actual dose (admistrated dose-residual dose) and the interval time(time of the second sample collection-time of the administration dose) .The samples of blood were taken from the patients before and after the bone Scintigrophy were analyzed as complete blood counts in (RICK) and Khartoum hospital laboratories.

The result shows that there were reduction effects in the counts of the blood components in the second samples. The decrement of the blood components from initial counts as 3.8% inWBCs, 3.6% in RBCs , 3.1% in HGB ,4.9% in HCT, 12.5% in PLT,10.3% in LYM and 1.5% in MCV . The result shows there are not significant or weak correlations between age and blood components like:RBCs,HGB and HCT before and after interval time of the bone scan.The weak correlations above show in the following equations as:$Y=432.11X+5E+06(R^2=9E-05)$ and $Y=392.87X+4E+06(R^2=9E-05)$ for RBCs,$Y=0.0017X+12.258(R^2=0.0002)$ and $Y=-0.002X+12.081(R^2=0.0004)$ for HGM and $Y=0.0011X+38.679(R^2=1E-05)$ and $Y=-0.0175X+37.772(R^2=0.0033)$for HCT before and after interval time of the bone scan

respectively where, y represents the blood component and x represents the age. that there were some correlations between age, interval time and the BMI versus the blood components before and after the administrated dose. Which reveal that: as the age increases as the reduction in WBC% increases following the equation of the form: $y = 0.03x + 2.7$ where x refers to Age in year and y refers to reduction in WBC%. Also the reduction in WBC% increases as the interval time of bone scintigraphy increases and the correlation could be fitted in the following equation: $y = 0.02x + 3.5$ where x refers to interval time of bone scintigraphy and y refers to reduction in WBC%.

In addition to, the WBC count also increases as the BMI increases with a correlation could be fitted in the following equation: $y = 14.6x + 5323$ where x refers to BMI and y refers to WBC count.

The study showed that the effects of radiation in RBCs were the semi constancy along the age period of man with an average of (4560800) cells/mm^3 in contrast with the normal range $4.8 \times 10^6 - 5.8 \times 10^6$ cells/mm^3 (male) and $4.2 \times 10^6 - 5.2 \times 10^6$ cells/mm^3 (females).

Also the study reveal that shows that the RBCs count has been increases as the BMI increases but usually remain within the normal range and the correlation fitted in the following equation: $y = 19635x + 10^6$ where x refers to BMI and y refers to RBCs count.

While the correlation between RBCs and the interval time reveals that the RBCs% decreases by the increment of interval time of bone Scintigraphy and the correlation could be fitted in the following equation: $y = -0.02x + 4.1$ where x refers to interval time of bone scan and y refers to reduction in RBs %.

The studying of radiation effect in hemoglobin shows that the amount of hemoglobin in g/dl doesn't have significant effect by aging generally and their correlation could be fitted in the following equation: $y = x + 12.3$ where x refers to age and y refers to HGB count.

Regarding the correlation versus BMI, the study reveals that there is strong correlation ($R^2 = 1$) between HGB count and the BMI which shows that the HGB count increases as the BMI increases which follows the following equation: $y = 0.09x + 10.1$ where x refers to BMI and y refers to HGB count.

The study also showed that the HGB decreases as the interval time of bone scan increases and the correlation could be fitted in the following equation: $y = -x + 0.4$ where x refers to interval time and y refers to HGB count.

Regarding the hematocrit HCT, the study reveal that there is no significant effect relative to aging, but in case of BMI correlation, the study showed that the HCT% increases as the BMI increases and their correlation could be fitted in the following equation: $y = 0.24x + 32.6$ where x refers to BMI and y refers to HCT %. While there was a decrease in HCT % following the increment of interval time of bone scan and their correlation could be given by the equation: $y = 0.03x + 2.7$ where x refers to interval time of bone scan and y refers to reduction in HCT %.
Regarding the platelets (PLT), the study reveal that the PLT count does not influenced by the aging normally. While it reveals that the PLT count % normally decreases as

the BMI increases, following the equation: $y = -7817x + 53637$ with significant correlation at $R^2 = 0.09$, where x refers to BMI and y refers to PLT %. And also there was a reduction in PLT%, which increases as the interval time of bone scan increases with a correlation fitted in the following equation: $y = 2E6x + 3E8$ with a significant correlation point at $R^2 = 0.02$, where x refers to interval time in years and y refers to reduction in PLT.

Regarding the lymphocyte (LYM), the study reveal that Lymphocytes count generally decreases following the aging and their correlation could be given by the following equation: $y = -0.07x + 37.4$ where x refers to age in years and y refers to Lymphocytes %.While in correlation versus BMI, the data reveals that the lymphocytes % increases following the increment of BMI before and after interval time of bone scan with the following equation: $y = 0.4x + 23.6$ and $y = 0.4x + 19.1$ respectively. And also reduction in Lymphocytes % increases as the interval time of bone scan increases which is follows the equation of the form: $y = 0.4x + 2.5$ where x refers to interval time of bone scan and y refers to reduction in lymphocytes %

Regarding the mean cell volume (MCV), the study shows that the MCV decreases following the aging generally according to equation: $y = x - 86.0$ where x refers to age in years and y refers to MCV in fl. While the correlation versus BMI shows that the MCV% increases as the BMI increases in a correlation of the form: $y = 0.08x + 83.7$ (before interval time of bone scan) and in the form of $y = 0.09x + 82.3$ (after interval time of bone scan) where x refers to BMI and y refers to MCV %. But in case of interval time of exposure, the data shows that the MCV % decreases as the interval time of bone scan increases and their correlation could be given by the equation: $y = -0.02x + 1.9$ where x refers to interval time and y refers to reduction in MCV %.

The study also reveals that the breast cancer represented 52% relative to all cancer types in current study, while prostate recorded as 25%, thyroid cancer and sarcoma represented 6.3% for each, squamous cell carcinoma represented 4.2% and 2.1% recorded for the cancer of cervix, maxilla and nasopharyngeal carcinoma. While the geographical distribution of cancer in the Sudan showed that 45.6% in Omdurman, 18.8% in Khartoum, 14.6% in the north of Sudan, 8.3% in the west of Sudan, 6.3% in Aljazeera, 4.2% in Aldowiam and 2.1% in the east of Sudan.

الخلاصة

تكمن هذه الدراسة في تقييم الاثر الاشعاعى لمكونات الدم وذلك باستخدام التكنيشيوم ٩٩ الغير مستغر فى المسح الذرى للعظام بعد خلطه بمادة صيدلانية تعرف ب (MDP)وذلك لان الجرعة المستخدمة فى هذا الفحص يتوقع لها ان تحدث تأثيرا على مستوى الدم وهذا يستوحى من الدراسات السابقة التى تناولت دراسة تاثير الاشعاع الخارجى على مكونات الدم مما ادى الى التفكير فى هذا الموضوع من حيث التعرض الداخلى لأشعة جاما رغما عن مميزاتها المعروفة مما جعل احتمالية حدوث التاثير على مستوى مكونات الدم ممكنه.اضافة الى ذلك ، يعتبرالمسح الذرى للعظام من اكثر الفحوصات شيوعا بعد فحوصات الغدة فى الاونه الاخيره.

الهدف من هذه الدراسة هو معرفة ما اذا كانت المادة المشعة التى تعطى للمريض المتقدم لفحص العظام وذلك لتحقيق اى غرض من اغراض الفحص تؤثر على مكونات الدم مثل:كريات الدم البيضاء والحمراء بالاضافة للصفائح الدموية و الهيموقلوبين وبقية المكونات الاخرى.هذا بالاضافة معرفة علاقة التغير فى مكونات الدم مع عوامل اخرى مثل :عمر المريض،وزن المريض،الجرعة، الزمن(هو الزمن الذى يفصل بين زمن حقن المريض وزمن اخذ عينة الدم الثانية من المريض وذلك بعد الفحص ويتراوح هذا الزمن بين ساعتين الى ست ساعات)و التشخيص الحالى للمريض. و يتم كذالك تقييم الجرعة الفعلية التى يتناولها كل مريض وذلك بطرح الجرعة المتبقية من المريض بعد الحقن من الجرعة المعده لحقن المريض مباشرة بو اسطة جهاز معاير الجرعة وايضا من الاهداف الاخرى للبحث هو تقييم انواع السرطان فى السودان واماكن انتشاره.

لأجراء هذا البحث ،تم اختيار خمسين مريضا بصورة عشوائية ٢٤% من الذكور و٧٦% من الاناث من المرضى اللذين توافدوا الى المركز السودانى للعلاج بالاشعة والطب النووى (RICK)بغرض المسح الذرى للعظام وذلك لمتابعة مستوى علاج السرطان وانشاره او لاى غرض اخر ولكنه تم استبعاد المرضى اللذين يعانون من امراض فى الدم.تم اخذ عينتىن من الدم لكل مريض، الأولى قبل الحقن والثانية عقب المسح الذرى.وتتم قراءة عينات الدم بواسطة جهاز يعرف بال Sysmex system فى معمل الدم بمستشفى الخرطوم التعليمى.

من نتائج هذا البحث ،انخفاض مستوى مكونات الدم فى العينات الثانية(بعد الاشعاع) وذلك على النحو التالى : انخفاض كريات الدم البيضاء (WBCs) الى٣.٨%، كريات الدم الحمراء(RBCs) الى ٣.٦%،الصفائح الدموية(PLT) الى ١٢.٥%،(HGB) الى٣.١%،(HCT) الى ٤.٩%،(LYM) الى ١٠.٣% وال(MCV) سجل اعلى مقاومة فكان مستوى الانخفاض الى ١.٥% مقارنة بمستوى القراء ات الاولى(قبل الاشعاع).توجد علاقة طردية بين زيادة معدل الانخفاض و زيادة الزمن والعمر فى كل من (WBCs)، (HGB)،، (HCT) ، (LYM) و (MCV) .اما زيادة معدل الانخفاض و زيادة الزمن يحدث ايضا فى (RBCs) ولكن قلما يتاثر بالعمر. كما وضحت هذه الدراسة،علاقة الزمن،العمر ونسبة وزن الجسم الى طوله قبل الفحص وبعده لكل مكون من مكونات الدم اعلاه على النحو التالى:تنخفض ال(WBCs) مع زيادة العمر وفق المعادلة

الاتية:Y=0.03X+2.7حيث ان X تمثل العمر،Yتمثل الانخفاض.كلما ذاد زمن الاشعاع فى الدم كلما ذاد معدل انخفاض ال(WBCs) كما موضح فى المعادلة التالية:y=0.02x+3.5 حيث x تمثل الزمن،y تمثل معدل الانخفاض.وايضا توجد علاقة تذ ايدية بين BMI(نسبة وزن الجسم الى طوله) موضحة فى المعادلة الاتية: Y=14.6X+5323 حيث X تشير الى BMI ،Y تشير الى WBCs.هناك شبه ثابتة فى ال(RBCs) عند تمثيلها مع العمر.يذيد معدل نقصان ال(RBCs) بزيادة الزمن وفق المعادلة التالية:Y= -0.02X+4.1 حيث Xتدل على الزمن،Yتدل على معدل الانخفاض.لايتأ ثر ال(HMG) با لعمر من خلال المعادلة الاتية:Y=X+12.3 حيث X تشير الى العمر ،Y تشير الى (HMG).توجد علاقة قوية بين ال(HMG) و ال(BMI)،R^2=1 موضحة فى المعادلة التالية:Y=0.9X+10.1 حيث X ترمز الى (BMI)، الى ترمزY (HMG).يذيد معدل انخفاض ال(HMG) كلما ذاد زمن التعرض ويكون ذلك فى المعادلة التالية:Y=-X+0.4 حيث X تشير الى الزمن،Yتشير الى HMG.اما با لنسبة لل(HCT) ،اشارة هذه الدراسة انه لايتاثر با لعمر. توجد علاقة تذايدية بين ال(BMI) و(HCT) موضحة بالمعادلة التالية:Y=0.24X+32.6حيث X تدل على BMI،Y تشير الى HCT.يذيد معدل الانخفاض كلما ذاد الزمن كما تشير اليه المعادلة الاتية:Y=0.03X+2.7 حيث X تمثل الزمن،Y تمثل معدل الانخفاض.لاتتأثر الصفائح الدموية(PLT) بالعمر ولكنه،توجد علاقة عكسية قوية R^2=0.09بين ال(PLT) وال(BMI) موضحة با لمعادلة التالية:Y=-7817X+53637حيث X تمثل BMI،Yتمثل PLT.يذيد معدل الانخفاض بذيادة الزمن ويكون واضحا فى المعادلة الاتية:Y=2E6X+3E8 حيث X توضح الزمن ،Y تمثل الPLT.هناك علاقة ايضا بين العمر و ال(LYM) تعرف با لمعادلة التالية:Y=0.07X+37.4حيث X تمثل العمر،Yتمثل LYM.اما العلاقة تربط بين الLYM و الBMI فهى علاقة تزايدية فى حالتى قبل ويعد الاشعاع يمثل بالمعادلتين: y=0.4x+١٩.١و y=0.4+23.6 على التوالى حيثx تمثل LYM وYتمثل BMI.ويذيد معدل الانخفاض مع ذيادة الزمن كما توضحه المعادلة الاتية: Y=0.4X+٢.٥حيث X تمثل الزمن،Yتمثل معدل الانخفاض.توجد علاقة تناقصية بين ال(MCV) والعمر وفق المعادلة الاتية:X حيثY=X-86.0 تمثل العمر،Yتمثل MCV.تنخفض الMCV بذيادة الزمن وذلك من خلال المعادلة التالية:Y=-0.02X+1.9حيثX تمثل الزمن ، Yتمثل MCV.

كما اظهر هذا البحث الى ارتفاع معدل الاصابة بسرطان الثدى الى٥٢% عند الاناث و سرطان البروستاتا الى٢٤% عند الذكور وانواع اخرى من السرطانات كانت على النحو التالى: ٦.٣% سرطان الغدة والاورام الفم و سرطان الانف والبلعوم.سجلت منطقة امدرمان اعلى معدلات الاصابة با لسرطان فى السودان بنسبة ٤٥.٦% تليها الخرطوم ١٨.٨% ،١٤.٦% فى الولايات الشمالية،٨.٣% فى غرب السودان،٦.٣% فى ولاية الجزيرة،٤.٢% فى الدويم و ٢.١% كان فى شرق السودان.

THE LIST OF ABBREVIATION

Prefix	Meaning
MDP	Methalene Di-Phosphonate.
CBC	Complete Blood Counts.
RICK	Radiation Isotope Centre of Khartoum.
WBCs	White Blood Cells
RBCs	Red Blood Cells.
PLT	Platelets
HGB	Heamoglobin.
HCT	Heamatocreat.
MCV	Mean Cell Volume.
MBI	Mass Body Index.
LYM	Lymphocyte.
TrHBMECs	Irradiated human bone marrow endothelial cells.
SICAM	Soluble Intercellular Adhesion Molecule.
PECAM	Platelet Endothelial Adhesion Molecule.
ECs	Endothelial Cells
CSF	Colony stimulating Factor.
BMEC	Bone Marrow Endothelial Cells.
EDTA	Ethyle Di-amin Tetra Acetate.

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