

**Sudan University of Science and Technology  
College of Graduated Studies**

**Evaluation of Common Carotid Arteries Changes  
in Sudanese Smokers Using Medical Ultrasound  
(B-Mode and Doppler)**

**تقييم تغيرات الشرايين الودجيه الرئيسيه لدي المدخنين السودانيين  
باستخدام الموجات الصوتيه الطبيه  
(نمط السطوع ونظام دوبلر)**

**A Thesis Submitted for the Fullfilment of the Reqirent of the  
Awardance the Philosophy Doctorate Degree by Research in  
Medical Diagnostic Ultrasound**

**By:**

**Mustafa Zuhair Mahmoud Alhassen**

**Supervision:**

**Supervisor: Prof. Dr. Mutasim Elsaïd**

**Co-supervisor: Dr. Mohammed Ahmed Ali**

**(July 2010)**



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# DEDICATION

This thesis is dedicated to my father Zuhair, who taught me that the best kind of knowledge to have is that which is learned for its own sake. It is also dedicated to the soul of my mother Afaf, who taught me that even the largest task can be accomplished if it is done one step at a time.

I dedicate the benefits of this humble work to my beloved sisters Marwa and Nahla whom pray always for my success. Sisters I am indebted to you.

My sincere gratitude and dedication for my friends, colleagues and also my students of the College of Medical Radiologic Science, for their endless support, great motivation and sincere encouragement to do this thesis.

# ACKNOWLEDGMENT

First of all, I would like to say thank to Allah, for giving me the strength and health to do this project work until it done completely.

I express my gratidue to Prof. Dr. Muatasim Elsaid my supervisor of this study for his steadfast support was greatly needed and deeply appreciated.

I would like to express my utmost gratitude to Dr. Mohammed Ahmed Ali my co-supervisor who guided me through this thesis, my thanksfull is for his sage advice, insightful criticisms, and patient encouragement aided the writing of this thesis in innumerable ways.

My thanks extended also to Dr.M.Elfadeil; cheif of Radiotherapy department and Dr.Abd.E.Adam; cheif of Basic science department in the College of Medical Radiologic Sciences, Sudan University of Science and Technology for their abundantly helpful and usefull advices, complete support and guidance.

Special thanks to Dr. A.Ahmed; Dean and Dr.C.Edward; vice dean of the College of Medical Radiologic Science for their continuous encourage during the period of this thesis wishing me ever success.

Abstract of the thesis presented to the Senate of Sudan University of Science and Technology in fulfilment of requirement for the degree of Doctor of Philosophy

## **Evaluation of Common Carotid Arteries Changes in Sudanese Smokers using medical ultrasound (B-Mode and Doppler)**

By  
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### **Abstract**

The findings of this research which is about diagnostic ultrasound evaluation of common carotid arteries changes in Sudanese smoker groups, has been obtained out of the correlation of smoking status (1-4, 5-9 and  $\geq 10$  cigarettes per day) versus the Intima media thickness (IMT), peak systolic velocity (PSV), end diastolic velocity (EDV), resistive index (RI) and pulsatility index (PI) among the former and current smoking groups in addition to the effect of IMT in the PSV, EDV, RI and PI for the former and current smoking groups and the effects of smoking groups in IMT, PSV, EDV, RI and PI. Specifically could be synopsis as:

The smoking status effectively increases the IML, specifically and respectively in current and former smokers as from 0.09 and 0.08 cm among those who smoked 1-4 cigarettes/day to 0.095 and 0.09 cm among those who smoked 5-9 cigarettes/day up to 0.11 and 0.10 cm among those who smoked  $\geq 10$  cigarettes/day for the left common carotid artery (Lt CCA) and from 0.08 and 0.08 cm among those who smoked 1-4 cigarettes/day to 0.09 and 0.084 cm among those who smoked 5-9 cigarettes/day up to 0.10 and 0.09 cm among those who smoked  $\geq 10$  cigarettes/day for the right common carotid artery (Rt CCA). The increment of the IMT for the Lt CCA is usually greater than the right one with a value of 0.01cm among current

smokers and 0.01 cm among former smokers. Also it increases the PSV from 115.84 and 114.52 cm/sec among those who smoked 1-4 cigarettes/day to 117.26 and 115.71 cm/sec among those who smoked 5-9 cigarettes/day up to 118.23 and 117.08 cm/sec among those who smoked  $\geq 10$  cigarettes/day for the Lt CCA and from 102.41 and 101.01 cm/sec among those who smoked 1-4 cigarettes/day to 104.18 and 103.15 cm/sec among those who smoked 5-9 cigarettes/day up to 106.39 and 104.98 cm/sec among those who smoked  $\geq 10$  cigarettes/day for the Rt CCA, specifically and respectively in current and former smokers. The increment of PSV for the Lt CCA is usually greater than the right one with a value of 12.57 cm/sec among current smokers and 12.72 cm/sec among former smokers.

While it decreases the EDV from 18.01 and 18.10 cm/sec among those who smoked 1-4 cigarettes/day to 15.20 and 16.90 cm/sec among those who smoked 5-9 cigarettes/day up to 10.57 and 16.24 cm/sec among those who smoked  $\geq 10$  cigarettes/day for the Lt CCA and from 17.10 and 17.80 cm/sec among those who smoked 1-4 cigarettes/day to 13.05 and 16.36 cm/sec among those who smoked 5-9 cigarettes/day up to 8.36 and 15.06 cm/sec among those who smoked  $\geq 10$  cigarettes/day for the Rt CCA, specifically and respectively in current and former smokers. The increment of EDV for the Lt CCA is usually greater than the right one with a value of 1.76 cm/sec among current smokers and 0.67 cm/sec among former smokers.

The smoking status increases the RI from 0.74 and 0.72 among those who smoked 1-4 cigarettes/day to 0.78 and 0.75 among those who smoked 5-9 cigarettes/day up to 0.81 and 0.78 among those who smoked  $\geq 10$  cigarettes/day for the Lt CCA and from 0.71 and 0.70 among those who smoked 1-4 cigarettes/day to 0.75 and 0.73 among those who smoked 5-9 cigarettes/day up to 0.77 and 0.76 among those who smoked

$\geq 10$  cigarettes/day for the Rt CCA, specifically and respectively in current and former smokers. The increment of RI for the Lt CCA is usually greater than the right one with a value of 0.03 among current smokers and 0.02 among former smokers. And it is also increases the PI from 1.22 and 1.18 among those who smoked 1-4 cigarettes/day to 1.30 and 1.22 among those who smoked 5-9 cigarettes/day up to 1.37 and 1.26 among those who smoked  $\geq 10$  cigarettes/day for the Lt CCA and from 1.18 and 1.15 among those who smoked 1-4 cigarettes/day to 1.21 and 1.19 among those who smoked 5-9 cigarettes/day up to 1.25 and 1.22 among those who smoked  $\geq 10$  cigarettes/day for the Rt CCA, specifically and respectively in current and former smokers. The increment of PI for the Lt CCA is usually greater than the right one with a value of 0.08 among current smokers and 0.03 among former smokers.

The IML increases the PSV from 115.84 cm/sec up to 118.23 cm/sec when the IMT increases from 0.09 cm to 0.11 cm respectively for Lt CCA and from 102.41 cm/sec up to 106.39 cm/sec when the IMT increases from 0.08 cm to 0.10 cm respectively for the Rt CCA among current smokers. And also it increases the PSV from 114.52 cm/sec up to 117.08 cm/sec when the IML increases from 0.08 cm to 0.10 cm respectively for the Lt CCA and from 101.01 cm/sec up to 104.98 cm/sec when the IMT increases from 0.08 cm to 0.09 cm respectively for the Rt CCA among former smokers. While it decreases the EDV from 18.01 cm/sec up to 10.57 cm/sec when the IMT increases from 0.09 cm to 0.11 cm respectively for Lt CCA and from 17.10 cm/sec up to 8.36 cm/sec when the IMT increases from 0.08 cm to 0.10 cm respectively for the Rt CCA among current smokers. And also it decreases the EDV from 18.10 cm/sec up to 16.24 cm/sec when the IML increases from 0.08 cm to 0.10 cm respectively for the Lt CCA and from 17.80 cm/sec up to 15.06 cm/sec when the

IMT increases from 0.08 cm to 0.09 cm respectively for the Rt CCA among former smokers.

The IML increases the RI from 0.74 up to 0.81 when the IMT increases from 0.09 cm to 0.11 cm respectively for Lt CCA and from 0.71 up to 0.77 when the IMT increases from 0.08 cm to 0.10 cm respectively for the Rt CCA among current smokers. And also it increases the RI from 0.72 up to 0.78 when the IML increases from 0.08 cm to 0.10 cm respectively for the Lt CCA and from 0.70 up to 0.76 when the IMT increases from 0.08 cm to 0.09 cm respectively for the Rt CCA among former smokers. And also it increases the PI from 1.22 up to 1.37 when the IMT increases from 0.09 cm to 0.11 cm respectively for Lt CCA and from 1.18 up to 1.25 when the IMT increases from 0.08 cm to 0.10 cm respectively for the Rt CCA among current smokers. And also it increases the PI from 1.18 up to 1.26 when the IML increases from 0.08 cm to 0.10 cm respectively for the Lt CCA and from 1.15 up to 1.22 when the IMT increases from 0.08 cm to 0.09 cm respectively for the Rt CCA among former smokers.

The influence of smoking groups increasing the IML from 0.07 cm among non smoker to 0.10 cm among former smokers up to 0.11 cm in mean, among current smokers for the Lt CCA and from 0.06 cm among non smoker to 0.09 cm among former smokers up to 0.10 cm in mean, among current smokers for the Rt CCA. Also it increases the PSV from 110.2 cm/sec among non smoker to 114.51 cm/sec among former smokers up to 116.44 cm/sec in mean, among current smokers for the Lt CCA and from 98.04 cm/sec among non smoker to 101.2 cm/sec among former smokers up to 102.88 cm/sec in mean, among current smokers for the Rt CCA.

While it decreases the EDV from 19.09 cm/sec among non smoker to 18.04 cm/sec among former smokers up to 16.25 cm/sec in mean, among current smokers for the



Lt CCA and from 19 cm/sec among non smoker to 17.63 cm/sec among former smokers up to 16.07 cm/sec in mean, among current smokers for the Rt CCA.

The smoking groups increase the RI from 0.74 among non smoker to 0.78 among former smokers up to 0.85 in mean, among current smokers for the Lt CCA and from 0.71 among non smoker to 0.76 among former smokers up to 0.80 in mean, among current smokers for the Rt CCA. And also it increases the PI from 1.21 among non smoker to 1.32 among former smokers up to 1.40 in mean, among current smokers for the Lt CCA and from 1.19 among non smoker to 1.25 among former smokers up to 1.30 in mean, among current smokers for the Rt CCA.

## الخلاصه

نتائج هذه البحث الذي هو عن تقييم تغيرات الشرايين الودجيه الرئيسيه للمدخنين السودانيين باستخدام نمط السطوع وموجات دوبلر فوق الصوتيه التشخيصيه، وقد استخلصت هذه النتائج من الارتباطات بين حاله التدخين (1-4،5،9،10 ≤ سجائر في اليوم) و سمك الطبقتين الخارجيه والمتوسطه، السرعه القصوي لسريان الدم عند انقباض عضله القلب، السرعه الدنيا لسريان الدم عند انبساط عضله القلب، معامل ممانعه الانتشار الدموي في العضوه ومعامل معدل تغير سرعه سريان الدم في الوعاء الدموي للشرايين الودجيه الرئيسيه لمجموعه المدخنين السابقين والحاليين. وايضاً تأثيرات مجموعات التدخين (سابقين وحاليين) علي سمك الطبقتين الخارجيه والمتوسطه، السرعه القصوي لسريان الدم عند انقباض عضله القلب، السرعه الدنيا لسريان الدم عند انبساط عضله القلب، معامل ممانعه الانتشار الدموي في العضوه ومعامل معدل تغير سرعه سريان الدم في الوعاء الدموي للشرايين الودجيه الرئيسيه.

الحاله التدخينه تؤثر بزياده سمك الطبقتين الخارجيه والمتوسطه للشرايين الودجيه الرئيسيه، وبالاخص وعلي التوالي في المدخنين الحاليين والسابقين من 0.09 سم و 0.08 سم للذين يدخنون 1-4 سيجائر في اليوم الي 0.095 سم و 0.09 سم للذين يدخنون 5-9 سيجائر في اليوم حتي 0.11 سم و 0.10 سم للذين يدخنون  $10 \leq$  سيجائر في اليوم بالنسبه للشريان الودجي الايسر، ومن 0.08 سم و 0.08 سم للذين يدخنون 1-4 سيجائر في اليوم الي 0.09 سم و 0.084 سم للذين يدخنون 5-9 سيجائر في اليوم حتي 0.10 سم و 0.09 سم للذين يدخنون  $10 \leq$  سيجائر في اليوم بالنسبه للشريان الودجي الايمن. الزياده في سمك الطبقتين الخارجيه والمتوسطه للشريان الودجي الايسر دائماً اكبر من نفس الطبقتين في الشريان الايمن بمقدار 0.01 سم للمدخنين الحاليين وبمقدار 0.01 سم في المدخنين السابقين.

الحاله التدخينه ايضاً تزيد من السرعه القصوي لسريان الدم عند انقباض عضله القلب للشرايين الودجيه الرئيسيه، وبالاخص وعلي التوالي في المدخنين الحاليين والسابقين من 115.84 سم/ث و 114.52 سم/ث سم للذين يدخنون 1-4 سيجائر في اليوم الي 117.26 سم/ث و 115.71 سم/ث للذين يدخنون 5-9 سيجائر في اليوم حتي 118.23 سم/ث و 117.08 سم/ث للذين يدخنون  $10 \leq$  سيجائر في اليوم بالنسبه للشريان الودجي الايسر، ومن 102.41 سم/ث و 101.01 سم/ث للذين يدخنون 1-4

سيجائر في اليوم الي 104.18 سم/ث و 103.15 سم/ث للذين يدخنون 5-9 سيجائر في اليوم حتي  
106.39 سم/ث و 104.98 سم/ث للذين يدخنون  $10 \leq$  سيجائر في اليوم بالنسبه للشريان الودجي  
الايمن. ايضاً الزيادة في السرعة القصوي لسريان الدم عند انقباض عضله القلب للشريان الودجي  
الايسر دائماً اكبر من نفس السرعة في الشريان الايمن بمقدار 12.57 سم/ث للمدخنين الحاليين  
وبمقدار 12.72 سم/ث في المدخنين السابقين. بينما الحاله التدخينيه ايضاً تنقص اقل سرعه لسريان  
الدم عند انبسط عضله القلب، وبالاخص وعلني التوالي في المدخنين الحاليين والسابقين من 18.01  
سم/ث و 18.10 سم/ث للذين يدخنون 1-4 سيجائر في اليوم الي 15.20 سم/ث و 16.90 سم/ث  
للذين يدخنون 5-9 سيجائر في اليوم حتي 10.57 سم/ث و 16.24 سم/ث للذين يدخنون  $10 \leq$   
سيجائر في اليوم بالنسبه للشريان الودجي الايسر، ومن 17.10 سم/ث و 17.80 سم/ث للذين يدخنون  
1-4 سيجائر في اليوم الي 13.05 سم/ث و 16.36 سم/ث للذين يدخنون 5-9 سيجائر في اليوم حتي  
8.36 سم/ث و 15.06 سم/ث للذين يدخنون  $10 \leq$  سيجائر في اليوم بالنسبه للشريان الودجي الايمن.  
ايضاً الزيادة في اقل سرعه لسريان الدم عند انبسط عضله القلب للشريان الودجي الايسر دائماً اكبر  
من نفس السرعة في الشريان الايمن بمقدار 1.76 سم/ث للمدخنين الحاليين وبمقدار 0.67 سم/ث في  
المدخنين السابقين.

الحاله التدخينيه ايضاً تزيد من معامل ممانعه الانتشار الدموي في العضوه للشرايين الودجيه الرئيسيه،  
وبالاخص وعلني التوالي في المدخنين الحاليين والسابقين من 0.74 و 0.72 للذين يدخنون 1-4  
سيجائر في اليوم الي 0.78 و 0.75 للذين يدخنون 5-9 سيجائر في اليوم حتي 0.81 و 0.78 للذين  
يدخنون  $10 \leq$  سيجائر في اليوم بالنسبه للشريان الودجي ، ومن 0.75 و 0.73 للذين يدخنون 1-4  
سيجائر في اليوم الي 0.71 و 0.70 للذين يدخنون 5-9 سيجائر في اليوم حتي 0.77 و 0.76 للذين  
يدخنون  $10 \leq$  سيجائر في اليوم بالنسبه للشريان الودجي الايمن. ايضاً الزيادة في معامل ممانعه  
الانتشار الدموي في العضوه للشريان الودجي الايسر دائماً اكبر من نفس المعامل في الشريان الايمن  
بمقدار 0.03 للمدخنين الحاليين وبمقدار 0.02 في المدخنين السابقين.

الحاله التدخينيه ايضاً تزيد من معدل تغير سرعه سريان الدم في الوعاء الدموي للشرايين الودجيه  
الرئيسيه، وبالاخص وعلني التوالي في المدخنين الحاليين والسابقين من 1.22 و 1.18 للذين يدخنون  
1-4 سيجائر في اليوم الي 1.30 و 1.22 للذين يدخنون 5-9 سيجائر في اليوم حتي 1.37 و 1.26

للذين يدخنون  $\leq 10$  سيجائر في اليوم بالنسبة للشريان الودجي الايسر، ومن 1.18 و 1.15 للذين يدخنون 1-4 سيجائر في اليوم الي 1.21 و 1.19 للذين يدخنون 5-9 سيجائر في اليوم حتي 1.25 و 1.22 للذين يدخنون  $\leq 10$  سيجائر في اليوم بالنسبة للشريان الودجي الايمن. ايضاً الزيادة في معدل تغير سرعه سريان الدم في الوعاء الدموي للشريان الودجي الايسر دائماً اكبر من نفس المعامل في الشريان الايمن بمقدار 0.08 للمدخنين الحاليين وبمقدار 0.03 في المدخنين السابقين.

وجد ان الزيادة في سمك الطبقتين الخارجيه والمتوسطه تزيد السرعه القصوي لسريان الدم عند انقباض عضله القلب، بحيث تزيد السرعه القصوي لسريان الدم عند انقباض عضله القلب من 115.84 سم/ث الي 118.23 سم/ث عندما يزيد سمك الطبقتين الخارجيه والمتوسطه من 0.09 سم الي 0.11 سم توالياً في الشريان الودجي الرئيسي الايسر كما تزيد السرعه القصوي لسريان الدم عند انقباض عضله القلب من ومن 102.41 سم/ث الي 106.39 سم/ث عندما يزيد سمك الطبقتين الخارجيه والمتوسطه من 0.08 سم الي 0.10 سم توالياً بالنسبه للشريان الودجي الرئيسي الايمن في المدخنين الحاليين. كما ان الزيادة في سمك الطبقتين الخارجيه والمتوسطه تزيد السرعه القصوي لسريان الدم عند انقباض عضله القلب من 114.52 سم/ث الي 117.08 سم/ث عندما يزيد سمك الطبقتين الخارجيه والمتوسطه من 0.08 سم الي 0.10 سم توالياً بالنسبه للشريان الودجي الرئيسي الايسر ومن 101.01 سم/ث الي 104.98 سم/ث عندما يزداد سمك الطبقتين الخارجيه والمتوسطه من 0.08 سم الي 0.09 سم توالياً بالنسبه للشريان الودجي الرئيسي الايمن في المدخنين السابقين.

بينما الزيادة في سمك الطبقتين الخارجيه والمتوسطه تنقص اقل سرعه لسريان الدم عند انبسط عضله القلب من 18.01 سم/ث الي 10.57 سم/ث عندما يزيد سمك الطبقتين الخارجيه والمتوسطه من 0.09 سم الي 0.11 سم توالياً في الشريان الودجي الرئيسي الايسر كما تنقص اقل سرعه لسريان الدم عند انبسط عضله القلب من ومن 17.10 سم/ث الي 8.36 سم/ث عندما يزيد سمك الطبقتين الخارجيه والمتوسطه من 0.08 سم الي 0.10 سم توالياً بالنسبه للشريان الودجي الرئيسي الايمن في المدخنين الحاليين. كما ان الزيادة في سمك الطبقتين الخارجيه والمتوسطه تنقص اقل سرعه لسريان الدم عند انبسط عضله القلب من 18.10 سم/ث الي 16.24 سم/ث عندما يزيد سمك الطبقتين الخارجيه والمتوسطه من 0.08 سم الي 0.10 سم توالياً بالنسبه للشريان الودجي الرئيسي الايسر ومن 17.80

سم/ث الي 15.06 عندما يزداد سمك الطبقتين الخارجيه والمتوسطه من 0.08 سم الي 0.09 سم توالياً بالنسبه للشريان الودجي الرئيسي الايمن في المدخنين السابقين.

الزيادة في سمك الطبقتين الخارجيه والمتوسطه يزيد من معامل ممانعه الانتشار الدموي في العضوه للشرايين الودجيه الرئيسييه ، بحيث يزيد معامل ممانعه الانتشار الدموي في العضوه من 0.74 الي 0.81 سم/ث عندما يزداد سمك الطبقتين الخارجيه والمتوسطه من 0.09 سم الي 0.11 سم توالياً في الشريان الودجي الرئيسي الايسر كما يزيد معامل ممانعه الانتشار الدموي في العضوه من 0.71 الي 0.77 عندما يزداد سمك الطبقتين الخارجيه والمتوسطه من 0.08 سم الي 0.10 سم توالياً بالنسبه للشريان الودجي الرئيسي الايمن في المدخنين الحاليين. كما ان الزيادة في سمك الطبقتين الخارجيه والمتوسطه تزيد معامل ممانعه الانتشار الدموي في العضوه من 0.71 الي 0.77 عندما يزداد سمك الطبقتين الخارجيه والمتوسطه من 0.08 سم الي 0.10 سم توالياً بالنسبه للشريان الودجي الرئيسي الايسر ومن 0.70 الي 0.76 عندما يزداد سمك الطبقتين الخارجيه والمتوسطه من 0.08 سم الي 0.09 سم توالياً بالنسبه للشريان الودجي الرئيسي الايمن في المدخنين السابقين.

ايضاً الزيادة في سمك الطبقتين الخارجيه والمتوسطه يزيد من معدل تغيّر سرعه سريان الدم في الوعاء الدموي للشرايين الودجيه الرئيسييه ، بحيث يزيد معدل تغيّر سرعه سريان الدم في الوعاء الدموي من 1.22 الي 1.37 عندما يزداد سمك الطبقتين الخارجيه والمتوسطه من 0.09 سم الي 0.11 سم توالياً في الشريان الودجي الرئيسي الايسر كما يزيد معدل تغيّر سرعه سريان الدم في الوعاء الدموي من 1.18 الي 1.25 عندما يزداد سمك الطبقتين الخارجيه والمتوسطه من 0.08 سم الي 0.10 سم توالياً بالنسبه للشريان الودجي الرئيسي الايمن في المدخنين الحاليين. كما ان الزيادة في سمك الطبقتين الخارجيه والمتوسطه تزيد معدل تغيّر سرعه سريان الدم في الوعاء الدموي من 1.18 الي 1.26 عندما يزداد سمك الطبقتين الخارجيه والمتوسطه من 0.08 سم الي 0.10 سم توالياً بالنسبه للشريان الودجي الرئيسي الايسر ومن 1.15 الي 1.22 عندما يزداد سمك الطبقتين الخارجيه والمتوسطه من 0.08 سم الي 0.09 سم توالياً بالنسبه للشريان الودجي الرئيسي الايمن في المدخنين السابقين.

تأثير المجموعات التدخينيه يؤدي الي زياده سمك الطبقتين الخارجيه والمتوسطه للشرايين الودجيه الرئيسيه من 0.07 سم الي 0.10 سم حتي 0.11 سم في المتوسط في غير المدخنين، المدخنين السابقين والمدخنين الحاليين علي الترتين بالنسبه للشريان الودجي الرئيسيه الايسر ومن 0.06 سم الي 0.09 سم حتي 0.10 سم في المتوسط في غير المدخنين، المدخنين السابقين والمدخنين الحاليين علي الترتيب بالنسبه للشريان الودجي الرئيسيه الايمن.

كما ان تأثير المجموعات التدخينيه يؤدي الي زياده السرعه القصوي لسريان الدم عند انقباض عضله القلب في الشرايين الودجيه الرئيسيه من 110.2 سم/ث الي 114.51 سم/ث حتي 116.44 سم/ث في المتوسط في غير المدخنين، المدخنين السابقين والمدخنين الحاليين علي الترتين بالنسبه للشريان الودجي الرئيسيه الايسر ومن 98.04 سم/ث الي 101.2 سم/ث حتي 102.88 سم/ث في المتوسط في غير المدخنين، المدخنين السابقين والمدخنين الحاليين علي الترتيب بالنسبه للشريان الودجي الرئيسيه الايمن. بينما تأثير المجموعات التدخينيه يؤدي الي انقاص اقل سرعه لسريان الدم عند انبساط عضله القلب في الشرايين الودجيه الرئيسيه من 19.09 سم/ث الي 18.04 سم/ث حتي 16.25 سم/ث في المتوسط في غير المدخنين، المدخنين السابقين والمدخنين الحاليين علي الترتين بالنسبه للشريان الودجي الرئيسيه الايسر ومن 19 سم/ث الي 17.63 سم/ث حتي 16.07 سم/ث في المتوسط في غير المدخنين، المدخنين السابقين والمدخنين الحاليين علي الترتيب بالنسبه للشريان الودجي الرئيسيه الايمن.

تأثير المجموعات التدخينيه يؤدي الي زياده معامل ممانعه الانتشار الدموي في العضوه للشرايين الودجيه الرئيسيه من 0.74 الي 0.78 حتي 0.85 في المتوسط في غير المدخنين، المدخنين السابقين والمدخنين الحاليين علي الترتين بالنسبه للشريان الودجي الرئيسيه الايسر ومن 0.71 الي 0.76 حتي 0.80 في المتوسط في غير المدخنين، المدخنين السابقين والمدخنين الحاليين علي الترتيب بالنسبه للشريان الودجي الرئيسيه الايمن.

كما ان تأثير المجموعات التدخينيه يؤدي الي زياده معدل تغير سرعه سريان الدم في الوعاء الدموي للشرايين الودجيه الرئيسيه من 1.21 الي 1.32 حتي 1.40 في المتوسط في غير المدخنين، المدخنين السابقين والمدخنين الحاليين علي الترتين بالنسبه للشريان الودجي الرئيسيه الايسر ومن 1.19 الي

1.25 حتى 1.30 في المتوسط في غير المدخنين، المدخنين السابقين والمدخنين الحاليين علي الترتيب بالنسبة للشريان الودجي الرئيسي الایمن.

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## LIST OF ABBREVIATIONS

$F_0$	Transmitted Ultrasound Frequency
$V$	Reflector Velocity
$c$	Speed of Sound
$\cos\theta$	Cosine of the Angle
$\pi$	Pi
3D	Three Dimension
A	Cross Sectional Area of a Vessel
Am	Ambair
A.L.	Antero-Lateral
A.M.	Antero-Medial
A/D	Analog-to-Digital
ADR.	Adrenaline
AIUM	American Institute of Ultrasound in Medicine
ARP	Absolute Refractory Period
PRP	Relative Refractory Period
AS	Atherosclerosis
AV	Atrial valve
B-Mode	Brightness Mode
CA	Carotid Artery
CCA	Common Carotid Artery
CCAs	Common Carotid Arteries
CW	Continuous Wave
DDT	Dichlorodiphenyltrichloroethane

DEDV	Decrease End Diastolic Velocity
ECs	Endothelial Cells
EDTA	Ethylene Diamine Tetraacetic Acid
EDV	End Diastolic Velocity
ESR	Erythrocyte Sedimentation Rate
FA	Femoral Artery
FD	Frequency of the Maximum Doppler
FFT	Fast Fourier Transform
FMF	Familial Mediterranean Fever
GE	General Electric
HDL	High-Density Lipoprotein
HIV	Human Immunodeficiency Virus
HR	Heart Rate
ICA-IMT	Internal Carotid Artery-Intima Media Thickness
IHD	Ischemic Heart Disease
IMT	Intima Media Thickness
IPSV	Increase Peak Systolic Velocity
J	Joule
KHz	Kilohertz
KPa	Kilopascal
L	length of the Vessel
LDL	Low Density Lipoprotein
Lt.	Left
M	Meter
MBP	Means Blood Pressure

MFV	Mean Flow Velocity
MHz	Megaheirtz
MI	Myocardial Infarction
Mv	Mega volt
N	viscosity of the Fluid
NOR.	Noradrenaline
P	Pressure
P.L.	Postero-Lateral
P.M.	Postero-Medial
P.W	Pulse Wave
PAD	Peripheral Arterial Diseases
PD	Power Doppler
PI	Pulsatility Index
PRF	Pulse Repetition Frequency
PSV	Peak Systolic Velocity
Q	Volume Flow
R	Radius of the Vessel
R	Resistance
RAP	Right Atrial Pressure
RI	Resistivity Index
RICA	Right Internal Carotid Artery
Rt.	Right
SAA	Serum Amyloid A Protein
SMCs	Smooth Muscles Cells
UPP	Ultrasound Printing Paper

$V_a$ and $V_b$	Identical Doppler Signals from the Separate Demodulators
VLDL	Very Low-Density Lipoprotein
Vs.	Versus
$\Theta$	Theta