

List of contents

Contents	page
List of contents	I
DEDICATION	V
Acknowledgement	VI
Abstract – English	VII
Abstract – Arabic	VIII
Abbreviations	IX
List of tables	X
List of figures	XI
Chapter one	1
1.1 Introduction	2
1.2 Stroke	3
1.3 Smoking	8
1.3.2 Dangers of smoking	9
1.3.2.2 Other Conditions caused by Smoking	10
1.4 Problem of the study	11
1.5 Objectives of the study	11
1.7 Significance of the study	12

1.8 Overview of the study	12
Chapter two	13
2.1 Anatomy of carotid artery	14
2.1.1 The common carotid artery	14
2.1.2 carotid sheath	16
2.1.3 The internal carotid arteries	17
2.1.4 External Carotid Arteries	18
2.2 Atherosclerosis	18
2.2.1 Stages of atherosclerosis	19
2.2.2 Causes of atherosclerosis	20
2.2.3 Risk factors for Atherosclerosis	21
2.2.4 Carotid atherosclerosis	21
2.2.4.2 Mechanism of symptoms	22
2.2.4.3 Diagnostic modalities	23
2.3.1 Doppler ultrasound	24
2.4 Carotid duplex ultrasonography (CUS)	26
2.4.2 Physics	29
2.4.3 Properties of waves	30

2.4.4 Tissue attenuation	31
2.4.5 Hemodynamic	31
2.4.6 Volume flow	32
2.4.7 Doppler effect	33
2.4.8 Doppler Equation	33
2.4.9 Doppler Angle	34
2.4.10 Limitations	35
2.4.11 Artifacts	35
2.4.12 Instruments	36
2.4.13 Technique	38
2.4.14 Vessels identification	44
2.4.15 Determining Degree of Stenosis	47
2.4.16 Intima-Medial Thickness	50
2.5 Previous studies	53
Chapter three	55
3.1 Materials	56
3.2 Methods: Ultrasound technique & measurements... etc.	56
3.3 Data collection and statistical analysis	58

3.4 Ethical consideration	58
Chapter four	60
Results	61
Chapter five	75
5.1 Discussion	76
5.2 Conclusion & recommendations	78
5.3 Limitations	79
5.4 recommendations	79
References	80
Attachments	84

DEDICATION

To my parents.....

To my wife and children.....

To my grand family.....

To everyone who helped and supported me...

Acknowledgement

I hereby thank Allah The all merciful for continuous successful I used to offer throughout every step of my life.

Sincere thanks and most grateful appreciation are owed to king Abdul -Aziz specialty hospital, KSA. mainly to my supervisor Dr. Abdul Rahman Al - Oufi for his good guidance and support. Also the colleagues at radiology Dept. at the same hospital for their co operation. Thanks extends to my co-supervisor Dr. Elsafi Ahmed Abdalla for his good guidance also and help through this Dissertation.

My gratitude thanks extended to everyone who supported me and provided me any type of help through my study.

Abstract – English

Background: Smoking has been found to be associated with carotid atherosclerotic disease. Since it is an important public health problem, The objective of this study was to explore the powerful of this association, the researcher investigated smoking as an important suspected risk factor for carotid atherosclerosis. **Methods:** In observational cross-sectional study, 121 participants were investigated by B- mode and Doppler ultrasound, 92 smokers and 29 were control group. The mean age was 40.8 ± 21.5 (range from 19 to 100 years old). Carotid arteries for all participants were examined by using 7MHz linear transducer according to the carotid ultrasound protocol. **Results:** The frequency of carotid plaques was 22.8% (of 92). The high frequency registered in group that smoke > 20 cigarettes per day. Plaques were registered in age of 54 years old. There was strong association between duration of smoking and the presence and increases of plaque size, $P = .000$. The mean thickness of IMT in smokers was 0.88 ± 0.4 mm. While it was 0.5 mm in control group. There was strong statistical association between the frequency of smoking & plaque and the increase in IMT, $P = .000$. The duration & frequency of smoking increase the percentage of carotid stenosis by 0.34% and 0.31% per year respectively.

Abstract – Arabic

ملخص الدراسة

وجد أن للتدخين علاقة بأمراض تصلب الشريان السباتي. و بما أنه يعتبر من مشاكل الصحة العامة الهامة لكونه أهم عوامل الخطورة للإصابة بتصلب الشريان السباتي, فإن الهدف من هذه الدراسة هو اكتشاف مدى قوة هذه العلاقة وللقيام بذلك عمد الباحث في هذه الدراسة لاختبار التدخين كعامل خطورة هام لتصلب الشريان السباتي. في دراسة تعتمد الملاحظة 121 مشارك تم الكشف عليهم بالموجات فوق الصوتية 92 منهم كانوا مدخنين و 29 غير مدخنين. متوسط أعمارهم كان 40.8 عاما بانحراف معياري ± 21.5 . تم فحص الشرايين السباتية لكل المشاركين في الدراسة باستخدام ماسح خطي 7 ميغا هيرز حسب البروتوكول المتبع في تصوير الشريان السباتي. من أهم نتائج الدراسة أن معدل تردد حالات تصلب الشريان السباتي في المدخنين كان 22.8%. المعدل الأعلى كان في فئة المدخنين الذين يدخنون < 20 سيجارة في اليوم. تم تسجيل حالات تصلب الشريان في عمر 54 عاماً. عند التحليل الإحصائي وجد أن هنالك علاقة قوية بين مدة التدخين و ظهور حالات التصلب الشرياني, القيمة المطلقة 0.000. متوسط سمك جدران الشريان السباتي كان ± 0.88 ملم عند المدخنين بانحراف معياري ± 0.4 ملم في حين كان متوسط سمك جدار الشريان عند غير المدخنين 0.5 ملم. عند التحليل الإحصائي وجد أن هنالك علاقة قوية بين معدل التدخين اليومي والتصلب الشرياني مع زيادة سمك جدار الشريان السباتي , القيمة المطلقة كانت 0.000. مدة ومعدل التدخين اليومي يزيدان من ضيق الشريان السباتي بمعدل 0.34% و 0.31% علي التوالي.

Abbreviations

WHO	World health organization
KSA.	Kingdom of Saudi Arabia
WLF	World Lung Foundation
COPD	Cancers and chronic obstructive pulmonary disease
UK	United kingdom
CCA	Common carotid artery
ICA	Internal carotid artery
ECA	External carotid artery
Rt.	Right
Lt	Left
IMT	Intima media thickness
CUS	Carotid duplex ultrasonography
PW	Pulsed wave
Hz	Hertz
MHz	Megahertz
kHz	Kilohertz

List of tables

Tables	Title	Page
Table 1.1	Top leading causes of deaths worldwide	6
Table 4.1	Shows the frequency of plaques in smokers	64
Table 4.2	Shows the frequency of plaques/ sites	64
Table 4.3	Shows the status of the participants.	65
Table 4.4	Shows the frequency of stenosis in the participants.	65
Table 4.5	Shows the mean of study variables.	66
Table 4.6	Shows the frequency of type of smoking.	66
Table 4.7	Shows cross- tab of plaques and the mentioned variables.	67
Table 4.8	Shows T-test for the relation of plaques and variables.	67

List of figures

Figures	Title	Page
Figure 2.1	Carotid artery	14
Figure 2.2	Origin of common carotid artery	15
Figure 2.3	Lt. Internal carotid artery	17
Figure 2.4	Rt. external carotid artery	18
Figure 2.5	development of arterial atherosclerosis	19
Figure 2.6	Computed Tomographic angiography equipment	23
Figure 2.7	Color Doppler with spectral graph	24
Figure 2.8	Power Doppler flow at Carotid bifurcation	25
Figure 2.9	Spectral analysis for Lt. CCA.	28
Figure 2.10	The Doppler effect	33
Figure 2.11	Components of a duplex machine	36
Figure 2.12	Ultrasound machine	40
Figure 2.13	Common carotid with spectral analysis	45
Figure 2.14	External carotid artery as seen on spectral analysis	46
Figure 2.15	Internal carotid artery as seen on spectral analysis	46
Figure 2.17	Moderate-grade stenosis as seen on spectral analysis	49
Figure 2.18	Carotid plaque at left carotid bulb.	49
Figure 2.19	Measuring the Intima-media thickness in the Rt. CCA. Gray-scale	52
Figure 4.1	Shows the presence of plaque in relation with the frequency of smoking in the participants.	68
Figure 4.2	Shows a representative comparison of carotid artery	68

	velocities between the control group and smokers.	
Figure 4.3	Shows the site of plaques distribution.	69
Figure 4.4	Shows echogenic plaque in ICA.	69
Figure 4.5.	Shows internal carotid plaque and stenosis in 55 years old heavy smoker	70
Figure 4.6	B- mode & Doppler image shows Increased IMT with focal calcification in ICA of 49 years old smoker	71
Figure 4.7	B- mode & Doppler image shows CCA plaque in 59 years old smoker	72
Figure 4.8	Scatter plot for the relationship between the duration of smoking & Carotid stenosis	73
Figure 4.9	Scatter plot for the relationship between the frequency of smoking & Carotid stenosis.	73
Figure 4.10	Scatter plot for the relationship between the duration of smoking & Carotid PSV	74
Figure 4.11	Scatter plot for the relationship between the duration of smoking & Carotid EDV	74