

ROLE OF HIGH FREQUENCY ULTRASOUND AND COLOR DOPPLER IN ASSESSMENT OF SKIN AND SUBCUTANEOUS TISSUE IN PATIENTS WITH SYSTEMIC SCLEROSIS

Thesis

Submitted for partial fulfillment for the Master Degree in radiodiagnosis

By

Saad Mohsin Abdul Hasan

Supervision

Asst. Prof. Dr. Hatem Mohamed El Azizi

Assistant Professor Of Radiodiagnosis

Faculty of Medicine-Cairo University

Dr. Ahmed Yousry Alamir

Lecturer of Radiodiagnosis

Faculty of Medicine-Cairo University

Dr. Kamal Ayman El-Garf

Lecturer of Rheumatology and Rehabilitation

Faculty of Medicine-Cairo University

Faculty of Medicine

Cairo University

2015

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قَالَ

سَبِّحْكَ لَا إِلَهَ إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ
الْعَلِيمُ الْعَظِيمُ

صدق الله العظيم

سورة البقرة الآية: ٣٢



Acknowledgement

*First and foremost, thanks to **Allah**, the most beneficent and most merciful.*

*I am so grateful and most appreciative to the effort of asst.Prof. **Dr. Hatem Mohamed El Azizi** assistant professor of radio-diagnosis, Faculty of Medicine Cairo University. No words can express what I owe him for his endless patience, continuous advice and support.*

*I wish to express my profound gratitude to **Dr.Ahmed Yousry Alamir**, Lecturer of Radiodiagnosis, Cairo University, for his instructive guidance, valuable suggestions, as well as his kindness.*

*I am also deeply grateful to **Dr.Kamal Ayman El-Garf**, lecturer of Rheumatology and rehabilitation, Cairo University, for his continuous encouragement, kindness and support.*

Saad Mohsin





Dedication

*To my father and my mother for their
never-ending support.*

*To my wife and my sons
for their love.*

Saad



Abstract

Introduction: Systemic sclerosis (SSc) is an autoimmune multi-systemic connective tissue disorder which is characterized by cutaneous and internal organ fibrosis. There are two forms of the disease, a diffuse and a limited form. The severity and extent of skin fibrosis is a useful indicator of overall disease activity. High frequency ultrasound is a noninvasive method which can reflect the severity of skin and subcutaneous tissue involvement in systemic sclerosis patients and periodic assessment of skin and subcutaneous tissue thickness and echogenicity can help to monitor the progression of the disease.

Aim of the work: To evaluate the skin and subcutaneous tissue thickness, echogenicity and vascularity in 30 SSc patients by using high frequency ultrasound and color Doppler, and compare it with healthy control group.

Patients and methods: Our study included 30 patients with SSc and 30 healthy age and sex matched control group. All patients and controls were subjected to full history taking. Skin and subcutaneous tissue thickness, echogenicity and vascularity were measured using 13 MHz ultrasound probe at six anatomical sites.

Results: the dermis was significantly higher in thickness and lower in echogenicity in SSc patients compared to the control subjects. Dermis was higher in thickness and lower in echogenicity in both the leg and chest in diffuse SSc compared to limited SSc. The hypodermis was lower in thickness and higher in echogenicity in SSc patients in both phalanx and hand compared to controls, also the hypodermis was lower in thickness in both phalanx and hand in diffuse SSc compared to limited SSc patients. There was a negative correlation between disease duration and dermis thickness except at the chest, also there was a negative

correlation between disease duration and hypodermis thickness in the phalanx, hand and chest. The Doppler shows no statistical difference between SSc patients and controls and between diffuse and limited types of SSc.

Conclusion: High frequency ultrasound is a reliable non invasive method that can reflects the severity of skin and subcutaneous tissue involvement in SSc patients periodic assessment of skin and subcutaneous tissue can help to monitor the progression of the disease.

Key words:

Color Doppler, high frequency ultrasound , echogenicity , skin thickness, subcutaneous tissue thickness , systemic sclerosis.

Contents

	Page
List of Abbreviations	I
List of Tables	II
List of Figures	III
Introduction and Aim of the Work	1
Review of Literature	
• Systemic sclerosis	4
• assessment of skin involvement in SSc:	15
• structure of the skin	20
• normal sonographic anatomy of the skin	23
• ultrasonography of the skin in SSc	27
Patients & Methods	31
Results	32
Case presentation	44
Discussion	54
Summary and Conclusion	59
Recommendations	62
References	63
Arabic Summary	

List of Abbreviations

dcSSc	Diffuse cutaneous systemic sclerosis
GI	Gastrointestinal
HRCT	High resolution computed tomography
IP	Interphalangeal
lcSSc	Limited cutaneous systemic sclerosis
MHz	Megahertz
MCP	Metacarpophalangeal
mRss	Modified rodnan skin score
PAH	Pulmonary arterial hypertension
SLEB	subepidermal low echogenic band
SNEB	subepidermal non echogenic band
SSc	Systemic sclerosis
US	Ultrasound

List of Tables

no		Page
1	The American College of Rheumatology/European League Against Rheumatism criteria for the classification of systemic sclerosis	32
2	dermis thickness in millimeters in SSc and controls	36
3	dermis thickness in millimeters in diffuse SSc and limited SSc	37
4	Dermis echogenicity in patients of SSc and controls.	38
5	hypodermis thickness in millimeters in SSc and controls	39
6	Hypodermis echogenicity in SSC patients and controls	40
7	relation between dermis thickness and disease duration	41
8	Relation between hypodermis thickness and disease duration.	42

List of Figures

no		Page
1	General overview of the pathogenesis of systemic sclerosis	6
2	X rays showing subcutaneous calcifications as radiopaque deposits in the leg of SSc patient	10
3	Telangiectasias scattered on the face of SSc patient	10
4	Raynaud's phenomenon	11
5	HRCT images of the chest in patient with SSc(axial and coronal)	14
6	modified rodnan skin score	17
7	The structure of normal skin	23
8	Normal sonographic anatomy of the skin	25
9	Ultrasound of the dermis showing the two well defined dermal layers	26
10	Imaging of the anechoic band lying beneath the epidermis (SLEB) in the dorsum of the hand	26
11	Ultrasound in scleroderma shows the variable degrees of activity	30
12	Dermis thickness in SSc and controls.	36
13	Dermis thickness in diffuse and limited SSc.	37
14	relation between dermis thickness and disease duration	41
15	relation between hypodermis thickness and disease duration	42
16	Illustrative case1: Skin ultrasound of the phalanx	44

17	Illustrative case 1: Skin ultrasound of the hand	44
18	Illustrative case 1: Skin ultrasound of the leg	44
19	Illustrative case 1: Skin ultrasound of the forehead	44
20	Illustrative case 2: Skin ultrasound of the phalanx	46
21	Illustrative case 2: Skin ultrasound of the hand	46
22	Illustrative case 2: Skin ultrasound of the forearm	46
23	Illustrative case 2: color doppler of the skin of the chest	46
24	Illustrative case 3: Skin ultrasound of the phalanx	48
25	Illustrative case 3: Skin ultrasound of the hand	48
26	Illustrative case 3: Skin ultrasound of the forearm	48
27	Illustrative case 3: Skin ultrasound of the forehead	48
28	Illustrative case 4: Skin ultrasound of the phalanx	50
29	Illustrative case4: Skin ultrasound of the forearm	50
30	Illustrative case4: Skin ultrasound of the leg	50
31	Illustrative case4: Skin ultrasound of the chest	50
32	Illustrative case5: Skin ultrasound of the hand	52
33	Illustrative case5: Skin ultrasound of the forearm	52
34	Illustrative case5: Skin ultrasound of the leg	52
35	Illustrative case 5: Skin ultrasound of the chest	52



INTRODUCTION

Systemic sclerosis (SSc, Systemic scleroderma) is a heterogenous autoimmune disorder of unknown aetiology that is characterized by musculoskeletal involvement, vascular dysfunction, and cutaneous and visceral fibrosis (**Gutierrez et al 2014**)

Skin thickening and tightness are characteristic manifestations of SSc and the only major diagnostic criterion. The pathophysiology consists of vascular damage, inflammation and excessive deposition of extracellular matrix by fibroblasts. The extent of skin involvement in early disease permits the diagnostic distinction between limited and diffuse SSc (**Leroy et al, 1988**).

Three phases of skin involvement can be identified: an early edematous phase associated with increased amounts of interstitial fluid, an indurative phase during which newly synthesized collagen is deposited in the skin and an atrophic phase in which thinning of the abnormal skin may occur (**Akesson et al, 2004**).

Recent advances in the field of ultrasound have broadened the spectrum of applications to soft tissues, adding the skin layers among the possibilities for study. There is a growing number of reports in the literature about the use of sonography to assess anatomic changes in different dermatologic entities (**Kleinerman et al 2012**).



Ultrasound (US) has been suggested for the measurement of dermal thickness in SSc as a reliable and change-sensitive methodology. It has a great potential as an outcome measure that is quantitative, valid, reproducible and responsive (**Seibold et al, 1997**).

Because tissue characteristics such as thickness, vascularity, and echogenicity vary by individual, examination of the contralateral side or an uninvolved “control” site is important in accurate assessment with ultrasound. Sensitivity, accuracy, and validity of ultrasound for these disorders of skin thickening has yet to be established (**Kleinerman et al., 2012**).

Doppler ultrasound has shown great promise in evaluation of scleroderma. It has been used to diagnose scleroderma by analyzing structural changes in tissue and vascularity. Some believe that Doppler ultrasound may further prove useful in monitoring disease activity (**Kleinerman et al., 2012**).



AIM OF THE WORK

The aim of this study is to evaluate the skin and subcutaneous tissue thickness, echogenicity and vascularity in thirty SSc patients by using high frequency ultrasound and color Doppler, and compare it with healthy control group.



SYSTEMIC SCLEROSIS

Systemic sclerosis is a heterogeneous autoimmune disorder of unknown aetiology that is characterized by musculoskeletal involvement, vascular dysfunction, and cutaneous and visceral fibrosis (**Gutierrez et al 2014**).

It is most obvious in the skin, presenting clinically by thickening and fibrosis, however, the gastrointestinal, respiratory, renal, cardiovascular and genitourinary systems, as well as numerous vascular structures are involved frequently (**Koeing and Jimenez, 2002**).

Incidence and Epidemiology:

SSc is a sporadic disease that has worldwide distribution and occurs in every ethnic group. No seasonal or geographic clustering of cases has been documented (**Varga and Denton, 2009**).

The incidence of SSc, derived from well-designed studies, is between 18 and 20 individuals per million population per year (**Steen et al, 1997**).

Similar to other connective tissue diseases, SSc is more frequent in women than men, with the most common age of disease onset in the 30 to 50 years range. The incidence of SSc is higher and disease onset occurs at earlier age among African-Americans compared with whites. African-Americans with SSc are more likely