



Study of the Vascularity of Uterine Septum Using Three Dimensional Power Doppler Ultrasound

Thesis

*Submitted for Partial Fulfillment of Master Degree in
Obstetrics and Gynecology*

Submitted by

Hesham Mohamed Mohamed Elnaggar

M.B.B.Ch

Faculty of Medicine

Mansoura University (2011)

Resident of obstetrics & Gynecology

Mahalla General Hospital

Supervised by

Prof. Dr. Mohamed Ibrahim Mohamed Amer

Professor of Obstetrics & Gynecology

Faculty of Medicine – Ain Shams University

Dr. Nashwa El-Saied Hassan

Assistant Professor of Obstetrics & Gynecology

Faculty of Medicine – Ain Shams University

Dr. Mortada El-Sayed Ahmed

Lecturer in Obstetrics & Gynecology

Faculty of Medicine – Ain Shams University

Faculty of Medicine

Ain Sham University

2019

Acknowledgment

*First and foremost, I feel always indebted to **ALLAH**, the Most Kind and Most Merciful.*

*I'd like to express my respectful thanks and profound gratitude to **Prof. Dr. Mohamed Ibrahim Mohamed Amer**, Professor of Obstetrics & Gynecology Faculty of Medicine – Ain Shams University for his keen guidance, kind supervision, valuable advice and continuous encouragement, which made possible the completion of this work.*

*I wish to introduce my respect and thanks to **Prof. Dr. Mohamed Hassan Nasr Eldin**, Head of Department of Ultrasound Special Care Unit for the Fetus, Ain Shams Maternity Hospital, for his kindness, supervision and cooperation in this work.*

*I am also delighted to express my deepest gratitude and thanks to **Dr. Mashwa El-Saied Hassan**, Assistant Professor of Obstetrics & Gynecology Faculty of Medicine – Ain Shams University, for her kind care, continuous supervision, valuable instructions, constant help and great assistance throughout this work.*

*I am deeply thankful to **Dr. Mortada El-Sayed Ahmed**, Lecturer in Obstetrics & Gynecology Faculty of Medicine – Ain Shams University, for his great help, active participation and guidance.*

Hesham Mohamed Mohamed Elnaggar

List of Contents

Title	Page No.
List of Tables	4
List of Figures	5
List of Abbreviations	10
Protocol	
Introduction	1
Aim of the Work.....	14
Review of Literature	
▪ Congenital Uterine Anomalies	15
▪ Impact of congenital uterine anomalies on pregnancy rates	43
▪ Three-Dimensional Ultrasound	62
Patients and Methods	84
Results	104
Discussion	120
Summary	127
Conclusion.....	130
Recommendations	131
References	132
Arabic Summary	—

List of Tables

Table No.	Title	Page No.
Table (1):	Basic clinical data among 30 septate uterus patients.....	104
Table (2):	Comparison between the 2 groups as regards clinical data.	105
Table (3):	Measurments of uterine septum and 3D power Doppler U/S data among 30 septate uterus patients.....	106
Table (4):	Comparison between the 2 groups as regards 3D power Doppler U/S data.	107
Table (5):	Pearson's correlation analysis for baseline clinical/ radiological Factors associated with number of abortions.....	109
Table (6):	Logistic regression model for the Factors affecting abortion occurrence using Forward method.	113
Table (7):	Logistic regression model for the Factors affecting infertility occurrence using Forward method.	113
Table (8):	Roc-curve of some radiological Factors to predict patients with abortion event from patients without.	114
Table (9):	Roc-curve of some radiological Factors to predict patients with infertility event from patients without.	117

List of Figures

Fig. No.	Title	Page No.
Fig. (1):	Urogenital sinus of female human embryo of eight weeks old	16
Fig. (2):	Urogenital sinus of female human embryo of eight weeks old	17
Fig. (3):	Schematic drawings illustrating development of the female reproductive systems from the genital ducts and urogenital sinus.....	17
Fig. (4):	Arcuate uterus	18
Fig. (5):	Uterine septum.....	19
Fig. (6):	Bicornuate uterus	20
Fig. (7):	Unicornuate uterus	21
Fig. (8):	Uterus didelphys	22
Fig. (9):	ESHRE/ESGE classification of uterine anomalies	25
Fig. (10):	Scheme for the classification of female genital tract anomalies according to the new ESHRE/ESGE classification system	26
Fig. (11):	Class U0	27
Fig. (12):	Class U1 or Dysmorphic uterus.....	28
Fig. (13):	Class U2 or septate uterus	29
Fig. (14):	Class U3 or bicorporeal uterus	31
Fig. (15):	Class U4 or hemi-uterus	32
Fig. (16):	Class U5 or aplastic uterus	34
Fig. (17):	Septate cervix	36
Fig. (18):	Double cervix.....	37
Fig. (19):	Unilateral cervical aplasia.....	38

List of Figures Cont...

Fig. No.	Title	Page No.
Fig. (20):	(A) The fundus of the uterus is noted without a cervix. (B) The cervical body is intact with obstruction of the cervical os. (C, D) Fragmentation of the cervix in which portions of the cervix are noted with no connection of the uterine body	39
Fig. (21):	Longitudinal non-obstructing vaginal septum.....	40
Fig. (22):	Longitudinal obstructing vaginal septum.....	41
Fig. (23):	Transverse vaginal septum	42
Fig. (24):	Hysterosalpinographic (HSG) images from three patients with recurrent early pregnancy loss.....	52
Fig. (25):	Three-dimensional transvaginal sonohysterogram of a septate uterus.....	54
Fig. (26):	Three-dimensional ultrasound showing the formula proposed.....	55
Fig. (27):	Unicornuate uterus with rudimentary horn: axial T2-weighted image	57
Fig. (28):	Bicornuate uterus: axial T2-weighted images showing a bicornuate unicollis uterus.....	57
Fig. (29):	Septate uterus: axial T2-weighted images showing a septate uterus	58
Fig. (30):	Arcuate uterus: axial T2-weighted images showing an arcuate uterus	58
Fig. (31):	Arcuate uterus	59
Fig. (32):	Septate uterus	59
Fig. (33):	Bicornuate uterus	60
Fig. (34):	Basic processes in 3DUS	63
Fig. (35):	Construction of 3D data set.....	64

List of Figures Cont...

Fig. No.	Title	Page No.
Fig. (36):	Reconstruction of a section from a 3D data set.....	65
Fig. (37):	A three-orthogonal-plane image.....	66
Fig. (38):	Relations of a 3D probe, initial three sections, a three-orthogonal-plane image and a 3D data set	66
Fig. (39):	Volume rendering	67
Fig. (40):	Surface rendering	68
Fig. (41):	(A to C) Surface rendering and measurement of the volume of an ovarian cyst. (D) A 3D image by surface rendering is displayed; (E) The 3D image is based on a set of small polygons and the volume is calculated automatically with the polygon data.....	69
Fig. (42):	Calculation of uterine septum volume through the VOCAL method	74
Fig. (43):	Three-dimensional surface rendered ultrasound image (coronal view) showing arcuate uterus.....	78
Fig. (44):	Three-dimensional surface rendered ultrasound image (coronal view) showing bicornuate uterus	78
Fig. (45):	Three-dimensional surface rendered ultrasound image (coronal view) showing complete septate uterus.....	79
Fig. (46):	Three-dimensional surface rendered ultrasound image (coronal view) showing unicornuate uterus.....	79
Fig. (47):	Three-dimensional surface rendered ultrasound image (coronal view) showing uterus didelphys with double cervix	80
Fig. (48):	3D ultrasound of fibroid	81

List of Figures Cont...

Fig. No.	Title	Page No.
Fig. (49):	Coronal reconstructive view of submucosal fibroid.....	81
Fig. (50):	Coronal view of the uterus, showing a large endometrial polyp	83
Fig. (51):	Endomet infusion.....	86
Fig. (52):	Light source.....	86
Fig. (53):	Inner sheath with working element.	86
Fig. (54):	Telescope.....	86
Fig. (55):	Outer sheath.	87
Fig. (56):	Lens.....	87
Fig. (57):	Camera.	87
Fig. (58):	TVCR Goldstar.	87
Fig. (59):	Dorsal lithotomy position.....	89
Fig. (60):	Samsung H60 ultrasound machine.	90
Fig. (61):	Measurement of myometrial VI, FI and VFI using histogram facility.....	91
Fig. (62):	Patient informed consent.....	95
Fig. (63):	3D transvaginal ultrasound report.....	101
Fig. (64):	Hysteroscopy report.	103
Fig. (65):	Obstetric outcomes among 30 septate uterus patients.	105
Fig. (66):	Comparison between the 2 groups as regards septal VI, FI and VFI.	108
Fig. (67):	Correlation between number of abortions and gravidity.....	110
Fig. (68):	Correlation between number of abortions and septal VI.....	111
Fig. (69):	Correlation between number of abortions and septal FI.	111

List of Figures Cont...

Fig. No.	Title	Page No.
Fig. (70):	Correlation between number of abortions and septal VFI.	112
Fig. (71):	Correlation between number of abortions and myometrial VI.....	112
Fig. (72):	ROC curves of septal VI, FI, and VFI.	116
Fig. (73):	ROC curves of septal VI, FI, and VFI.	119

List of Abbreviations

Abb.	Full term
2D US	Two-dimensional transvaginal ultrasound
3D US	Three-dimensional ultrasound
AFS	American Fertility Society's
BMI	Body mass index
DES.....	Diethyl stielbesterol
ESGE	European Society for Gynecological Endoscopy
ESHRE	European Society of Human Reproduction and Embryology
FI.....	Flow index
GnRH.....	Gonadotropin-releasing hormone
HS	Highly significant
HSG	Hysterosalpingography
IQR.....	Inter-quartile range
MRI	Magnetic resonance imaging
NS	Non-significant
PD	Power Doppler
RPL.....	Recurrent pregnancy loss
S	Significant
SD	Standard deviation
SHG	Sonohysterography
TVS	Transvaginal ultrasound
VFI.....	Vascularization flow index
VI	Vascularization index
VOCAL	Virtual Organ Computer Aided Analysis

INTRODUCTION

Congenital uterine anomalies result from abnormal formation, fusion or resorption of the Mullerian ducts during fetal life (*Moore et al., 2008*). Uterine septum is believed to develop as a result of failure of resorption of the tissue connecting the two Mullerian ducts prior to the 20th fetal week (*Valle and Ekpo, 2013*).

The degree of septal extension through the uterine cavity results in classification as a septate or sub-septate uterus (*Hassan et al., 2010*).

The prevalence of all uterine anomalies diagnosed by optimal tests was 5.5% in unselected population. Septate or sub-septate uteri had a prevalence of 2.3% in unselected population, 3% in infertile women, 5.3% in patients with recurrent miscarriage and 15.4% in infertile women with recurrent miscarriage in a systematic review of 94 studies about uterine anomalies (*Chan et al., 2011*).

The European Society of Human Reproduction and Embryology (ESHRE) and the European Society for Gynecological Endoscopy (ESGE) classified congenital uterine anomalies according to severity into 5 classes (U0-5) with U5 being the most severe and uterine septum being class U2 (*Stavrou et al., 2015*).

Congenital uterine anomalies have been implicated as a potential cause of infertility, recurrent pregnancy loss, preterm delivery and fetal mal-presentation (*Rackow and Arici, 2007*).

Reported significant ultra-structural alterations in septal endometrium compared with endometrium from the lateral uterine wall in samples obtained during the pre-ovulatory phase. The ultra-structural alterations included reduction and irregular distribution of glandular ostia, incomplete ciliogenesis, and a reduced ciliated cell ratio. These histopathologic findings prove that septal endometrium has abnormal maturation and differentiation which could play a role in the pathogenesis of primary infertility in women with septate uterus (*Fedele et al., 1996*).

Initially, uterine septa were believed to be predominantly fibrous tissue and avascularization was believed to be the main cause of recurrent abortion. However, biopsy specimens suggest that septa are composed primarily of muscle fibers and less connective tissue and also suggest that the septum is vascular but authors suggested further studying to substantiate those results (*Dabirashrafi et al., 1995*).

In a recent study conducted to evaluate uterine septum using 3D TVUS in Zagazig university, results showed that uterine septum is mainly vascular and recurrent pregnancy loss is usually associated with higher vascularization index(VI) and infertility is usually associated with lower vascularization index(VI) (*Ghada and Soha, 2013*).

Hysterosalpingography, 2D ultrasound and endoscopies were formerly mostly used for the diagnosis of female genital tract anomalies. Nowadays noninvasive imaging techniques such as 3D ultrasound and MRI are the recommended procedures for the diagnosis of Mullerian duct anomalies (*Grimbizis et al., 2016*).

Color Doppler interrogation allows precise assessment of uterine artery flow in real time. Doppler indices change according to menstrual cycle phases inducing Doppler waveforms changes in non-gravid women characterized by high resistance to blood flow (*Ben-Haroush et al., 2012*).

Hysteroscopic metroplasty is common treatment for women with uterine septa who have had recurrent spontaneous abortions (*Valle and Ekpo, 2013*).

AIM OF THE WORK

This study aims to assess the relation between the vascularity of uterine septum and obstetric performance with Transvaginal 3D Power Doppler Ultrasound.

Research hypothesis:

In women with uterine septum vascularity of the septum may affect obstetric performance.

Research question:

In women with uterine septum does vascularity of the septum affect obstetric outcome?

Chapter 1

CONGENITAL UTERINE ANOMALIES

Congenital malformations of the female genital tract are defined as deviations from normal anatomy resulting from embryological mal-development of the Müllerian or paramesonephric ducts. They represent a rather common benign condition with a prevalence of 4–7% (*Grimbizis et al., 2001*).

The most frequent symptomatic malformation is septate uterus, accounting for close to 50% of all such malformations. Septate uterus occurs in 1% to 2% of the general population, and in 3.3% of women with recurrent pregnancy loss (RPL). It is the uterine anomaly most commonly associated with obstetric complications and infertility (*Pabuuccu and Gomel 2004*).

Mullerian Development

The Müllerian ducts are part of the embryonic urogenital system. They give rise to mature structures that serve a critical function in the transport and development of the oocyte and/or embryo. Both sexes initially develop Müllerian ducts during embryogenesis, but they regress in males under the influence of testis-derived Anti-Müllerian Hormone (AMH) (*Roly et al., 2018*).