

ULTRASOUND GUIDED RADIOFREQUENCY ABLATION OF UTERINE MYOMA

Essay

Submitted for Fulfillment of Master Degree in

Radiodiagnosis

BY

WAFAA MOHAMMED ABDULLA AL AIASHY

MB, B.CH, Cairo University

Supervisors

DR. SOHA TALAAT HAMED

Assistant Professor of Radiodiagnosis
Faculty of Medicine,
Cairo University

DR. MOHAMMED HAMED

Lecturer of Radiodiagnosis
Faculty of Medicine,
Cairo University.

**Faculty of Medicine,
Cairo University
2010**

Abstract

Uterine fibroid are the most common pelvic tumor in woman of reproductive age, represented about 20-25 %.

So the woman health care center has been interested to find the good treatment for symptomatic uterine fibroid which has effecting on fertility status of woman.

Radiofrequency ablation performed to treat fibroid uterus in 2004. Radiofrequency ablation is consider as effective day care alternative to conventional surgery.

Key Word: uterine fibroid. Radiofrequency ablation in fibroid uterus

ACKNOWLEDGEMENT

I would like to express my gratefulness and sincere gratitude to Prof. Ahmad Sami, Head of Radiodiagnostic Department, Faculty of Medicine, Cairo University, for his keen supervision, guidance and for the trust he put in me. He is always pushing me to achieve good work.

I owe too much to Dr. Soha Talaat Hamed, Assistant Professor of Radiodiagnosis, Faculty of Medicine, Cairo University, and Dr, Mohammed Hamed, Lecturer of Radiodiagnosis, Faculty of Medicine, Cairo University who helped and supported me throughout this work and encouraged me a lot.

Lastly and not least, I send my deepest love and sincere gratitude to my father, big brother, my family and friends for their love, care and ever-lasting support.

LIST OF ABBREVIATIONS

Ant	: Anterior
C.T	: Computed Tomography.
D	: Douglas pouch
2D	: Two dimension
3D	: Three dimension
DSA	: Digital subtraction angiography
E2	: Estrogen 2
ER	: Estrogen Receptor
FDA	: Food and Drug Administration
Fig	: Figure.
FUS	: Focused Ultrasound Surgery
G	: Gauge
GnRHa	: Gonadotropin releasing hormone agonist.
HIFU	: High Intensity Focused Ultrasound.
HPf	: highest power frequency
IV	: Intravenous
KHz	: Kilo Hertz
LM	: Laparoscopic Myomectomy
mA	: milliampers
MPR	: Multiplanar Reconstruction
MRgFUS	: Magnetic Resonant Guided Focused Ultrasound Surgery.
MRI	: Magnetic Resonance imaging.

NaCl	: Sodium chloride
NO	: Number
NPV	: Non perfused volume.
Post	: Posterior
PR	: Progesterone Receptor
Pt.	: Patient
PVA	: Polyvinyl Alcohol.
QOF	: Quality of life
RF	: Radiofrequency Ablation.
RFA	: Radiofrequency ablation
RITA	: Radiofrequency interstitial thermal ablation
Temp	: Temperature
UAE	: Uterine Artery Embolization.
UFS	: Uterine fibroid symptom.
US	: US
V.R	: Volume reduction
VU	: Vesicouterine fold
W	: Watt
Y	: Year

LIST OF FIGURES

Figure No	Title	Page No.
1.	Sagital section of the female pelvis	7
2.	Pelvic viscera of female (superior view) A & b	7-8
3.	Posterior half of uterus and upper part of vagina	8
4.	Sagital section through the pelvis of a newly born female child	9
5.	Uterine changes with age	10
6.	Uterus and adnexa (frontal section)	11
7.	Uterus and adnexa (posterior view)	11
8.	Arterial blood supply of the internal genital organs of the female	12
9.	Digital subtraction angiogram of uterine artery	14
10.	Arterial and venous system of uterus and its appendages	15
11.	Hysterosalpingography shows normal uterine cavity and fallopian tube.	17
12.	Ultrasound, shows the endometrial thickening and echopattern in different menstrual cycle	21
13.	Normal 3D Ultrasound	21
14.	Normal 2D &3D Sonohysterography	22
15.	Axial CT section in a patient with free fluid shows normal uterus and ovary	23
16.	MRI T1, T2 Sagital and axial section, shows normal female	25
17.	Types of fibroid. Pathology.	27
18.	Plain films Calcified fibroid	36
19.	2D Ultrasound shows different type of fibroid uterus	37
20.	3D Ultrasound show intramural fibroid	38
21.	3D Ultrasound show submucosal fibroid	38
22.	2D Sonohysterogram with colour Doppler interrogation showed a submucosal fibroid	40
23.	2D &3D Sonohysterogram show submucosal fibroid	40
24.	Inversion Modal sonohysterography, submucosal fibroid	41
25.	Hysterosalpingography show submucosal fibroid	42
26.	Hysterosalpingography show intramural fibroid	42
27.	CT pelvis show calcified fibroid	43
28.	Contrast-enhanced CT of the pelvis show different types of fibroid	44

29.	Multi-detector CT pelvis show degenerated fibroid	44
30.	MRI, T2 Sagital image shows a different type of fibroid uterus	46
31.	DSA. Non selective angiography of uterine artery	46
32.	Schematic drawing of the technique of UAE	59
33.	Schematic drawing of a catheter within the uterine artery	59
34.	Non selective pelvic angiogram demonstrating arteries supplying uterine fibroid	59
35.	Case treated by UAE	64
36.	Cryoprobe	67
37.	Sequence of cryomyolysis guided by US	67
38.	MRI guided Cryoablation procedure	69
39.	The procedure of MR-guided focus ultrasound	71
40.	Case1: MR-guided focus ultrasound	72
41.	Case 2: MR-guided focus ultrasound	72
42.	Ionic agitation during RFA	76
43.	Schematic illustrates heat efficacy	84
44.	Equipment of radiofrequency ablation	85
45.	The original needle design in monopolar system	90
46.	Various radiofrequency (RF) electrodes	91
47.	Cooled radiofrequency (RF) electrodes	91
48.	Valley Lab Radionics switcher control RF 3000 Boston Scientific	93
49.	Rita 1500 generator with 7 cm needle application facility	93
50.	Specimen of Laparoscopic RFA uterine fibroid after hysterectomy	100
51.	MRI after Laparoscopic RFA	100
52.	RITA System	104
53.	3000 Boston System	110
54.	Case (1): Suprapubic sonogram during percutaneous approach of RFA	111
55.	Case (2): Suprapubic sonogram during Percutaneous approach of RFA	111
56.	Percutaneous RFA guided by ultrasound after UAE	116
57.	Percutaneous RFA guided by CT after UAE	116
58.	MRI & MRI diffusion post Percutaneous RFA after UAE	120
59.	MRI post Percutaneous RFA after UAE	120
60.	A-C. Histopathology of uterine fibroid	129

LIST OF TABLES

Figure No	Title	Page No.
1.	Characteristics of patients undergoing RFA for treatment of symptomatic fibroid (<i>Milic et al, 2006</i>)	99
2.	Myoma volume and volume reduction in follow-up(<i>Ghezzi F et al, 2007</i>).	106
3.	Ablation setting	130
4.	Patient and tumour characteristics and outcome in five studies on RFA for uterine fibroid	132

TABLE OF CONTENTS

Topics	Page
Introduction and the aim of work	1
Anatomy of uterus	3
Pathology of fibroid uterus	26
Diagnosis of fibroid uterus	30
Management of fibroid uterus	47
Physics of Radiofrequency ablation (RFA)	74
Review of RFA fibroid uterus	94
Discussion	133
Summary and conclusion	138
References	143
Arabic Summary	162

INTRODUCTION

Uterine fibroids are the most common pelvic tumours in women of reproductive age (**Chavez et al, 2001**). Over the past decade an increasing demand for uterine-sparing treatment to manage symptomatic uterine myoma has become apparent in woman's health care (**Ghezz et al., 2007**).

The reason for requesting conservative procedures include the desire to maintain childbearing potential, the wish to avoid major surgery, and, for some, the belief that the uterus plays a role in perceived sexual satisfaction or is the essence of their womanhood (**Nevadunsky et al 2007**).

A variety of minimally invasive approaches aimed at preserving the uterus in the face of symptomatic fibroids have been introduced in the clinical arena (**Ghezz et al 2007**). Myolysis- an alternative to the conservative surgical treatment of uterine fibroid- was introduced in the late 1980s in Europe (**Donnez J, et al 2000**).

A variety of energy sources have been used in myolysis, including the neodymium: yttrium aluminum garnet (Nd: YAG) laser, bipolar electrode, diathermy, cryoprobe, etc. These conventional myolysis methods are performed under general anesthesia by laparoscopy (**Nisolle et al 2001**).

Radiofrequency myolysis has been performed since 2004. **Hyan Hee CHO** in 2008 suggested that radiofrequency ablation may represent a safe, well-tolerated, and effective day-care alternative to conventional surgery for the treatment of uterine myomas (**CHO et al 2008**).

Luo and his colleagues explored the mechanism by which radiofrequency ablation treats uterine leiomyoma by observing the features of lesion caused by RFA to leiomyoma tissue. They concluded that radiofrequency ablation might treat uterine leiomyomas by inducing coagulative necrosis and depressing Estrogen and Progesterone receptors expression (**Luo, et al 2007**).

Percutaneous image-guided RFA as adjunctive to uterine artery embolization (UAE) under moderate sedation is feasible .It appears safe without significant morbidity in the treatment of large uterine leiomyomata. Radiofrequency ablation of symptomatic fibroids seems a valuable alternative to major surgery, with durable symptom relief for most patients and a low chance of recurrence one to three years after treatment. A larger data set of long- term efficacy will be awaited with interest (**Ghezz et al 2007**).

AIM OF WORK

To assess the feasibility and efficacy of Ultrasound guided radiofrequency ablation for symptomatic uterine myoma and to evaluate its outcomes in terms of durability of symptom control and level of health-related quality of life

BASIC ANATOMY OF THE UTERUS

The uterus is a hollow, thick-walled, muscular organ situated deeply in the pelvic cavity between the bladder and rectum. The uterine tubes open into its upper part, one on either side, while below, its cavity communicates with that of the vagina (*fig.1*) (**Williams et al., 1995**).

The uterus measures about 7.5 cm in length, 5 cm in breadth at its upper part, and nearly 2.5 cm in thickness, it weighs from 30 to 40 gm (**David and Nayna, 2001**).

On the surface, about midway between the apex and base, is a slight constriction; known as the isthmus, and corresponding to this in the interior is the internal orifice of the uterus. The portion above the isthmus is termed the body and that below, the cervix. The part of the body that lies above a plane passing through the points of entrance of the uterine tubes is known as the fundus (*fig.3*) (**Williams et al., 1995**).

The vesical or anterior surface is covered by peritoneum, which is reflected on to the bladder to form the vesicouterine excavation. The intestinal or posterior surface is covered by peritoneum, which is continued down on to the cervix and vagina. It is in relation with the sigmoid colon, from which some coils of small intestine usually separate it (Douglas pouch) (*Fig.2a-b*) (**William et al, 1995**).

The fundus is convex in all directions, and covered by peritoneum continuous with that on the vesical and intestinal surfaces. The lateral margins are slightly convex. The uterine tube pierces the uterine wall at the upper end of each wall. The round ligament of the uterus is fixed

below and in front of this point, while behind it is the attachment of the ligament of the ovary. These three structures lie within a fold of peritoneum, which is reflected from the margin of the uterus to the wall of the pelvis, and is named the broad ligament (Fig.2a) **(Clare, 1995)**.

The cervix is the lowest constricted segment of the uterus. It is somewhat conical in shape, with its truncated apex directed downward and backward, but is slightly wider in the middle than either above or below. Owing to its relationships, it is less freely movable than the body, so that the latter may bend on it. The long axis of the cervix is therefore seldom in the same straight line as the long axis of the body. The long axis of the uterus as a whole presents the form of a curved line with its concavity forward, or in extreme cases may present an angular bend at the region of the isthmus (Fig.1) **(Williams et al, 1995)**.

The cervix projects through the anterior wall of the vagina, which divides it into an upper, supravaginal portion, and a lower, vaginal portion (Fig.1) **(Clare, 1995)**.

The supravaginal portion is separated in front from the bladder by fibrous tissue (parametrium), which extends also on to its sides and lateral ward between the layers of the broad ligaments. The uterine arteries reach the margins of the cervix in this fibrous tissue, while on either side the ureter runs downward and forward in it at a distance of about 2 cm from the cervix. Posteriorly, the supravaginal cervix is covered by peritoneum, which is prolonged below on to the posterior vaginal wall, when it is reflected on to the rectum, forming the recto uterine excavation **(Williams et al, 1995)**.

The vaginal portion of the cervix projects free into the anterior wall of the vagina between the anterior and posterior fornices. The cavity of the cervix communicates with that of the vagina through a small, depressed, somewhat circular aperture, the external orifice of the uterus (Fig.1) (**Williams et al, 1995**).

The Cavity of the Body (Fig.3) is a mere slit, flattened antero-posteriorly. It is triangular in shape, the base being formed by the internal surface of the fundus between the orifices of the uterine tubes, the apex by the internal orifice of the uterus (**Williams et al, 1995**).

Ligamentous support of the uterus:

The ligaments of the uterus are eight in number: one anterior; one posterior; two lateral or broad; two uterosacral; and two round ligaments.

1. The anterior ligament consists of the vesicouterine fold of peritoneum, which is reflected on to the bladder from the front of the uterus, at the junction of the cervix and body (Fig.2) (**Moore, 1998**).
2. The posterior ligament consists of the rectovaginal fold of peritoneum, which is reflected from the back of the posterior fornix of the vagina on to the front of the rectum. These folds are named the sacrogenital or recto uterine folds. They contain a considerable amount of fibrous tissue and non-striped muscular fibers which are attached to the front of the sacrum and constitute the uterosacral ligaments (Fig.2) (**Moore, 1998**).
3. The two lateral or broad ligaments pass from the sides of the uterus to the lateral walls of the pelvis. Together with the uterus they form a septum across the female pelvis, dividing that cavity into: anterior part

containing the bladder, posterior part containing the rectum, and in certain conditions some coils of the small intestine and a part of the sigmoid colon. Between the two layers of each broad ligament are contained: (1) the uterine tube superiorly; (2) the round ligament of the uterus; (3) the ovary and its ligament; (4) the epoöphoron and paroöphoron; (5) connective tissue; (6) unstriped muscular fibers; and (7) blood vessels and nerves (Fig.6-7) (**Moore, 1998**).

4. The round ligaments are two flattened bands between 10 and 12 cm in length, situated between the layers of the broad ligament in front of and below the uterine tubes. The round ligaments consist principally of muscular tissue, some fibrous and areolar tissue, besides blood vessels, lymphatics; and nerves, enclosed in a duplicature of peritoneum (Fig2a) (**Moore, 1998**).

In addition to the ligaments just described, there is a band named the ligamentum transversalis colli (*Mackenrodt*) on either side of the cervix uteri. It is attached to the sides of the cervix and to the vault and lateral fornix of the vagina, and is continuous externally with the fibrous tissue, which surrounds the pelvic blood vessels (Fig2b) (**Moore, 1998**).