
EFFECT OF ULTRASOUND THERAPY ON ALLEVIATING PAIN AND ADHESIONS IN ENDOMETRIOSIS

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ABSTRACT

objective: This study is conducted to determine the effect of ultrasonic therapy on alleviating pain as well as adhesions in women having endometriosis.

Study design: prospective study

Setting: At Bab El-Sharia University Hospital.

Subjects and methods: Twenty women suffering from severe pelvic pain and diagnosed as having mild or moderate endometriosis participated in this study. They were treated with ultrasonic therapy for 24 sessions; 3 sessions per week. All patients were evaluated before and after 12 as well as after 24 sessions of ultrasonic treatment using present pain intensity (PPI) scale as well as McGill Pain Questionnaire (MPQ) and pain relief (PR) scale which was evaluated after 12 as well as 24 sessions and laparoscopy before and after the end of the study.

Results: The results of this study showed a statistically highly significant decrease ($P < 0.001$) in the intensity of pain, sites of pain and degree of adhesions after the end of ultrasonic therapy treatment. Conclusion: The results of this study concluded that ultrasound therapy had an excellent effect in the management of chronic pelvic pain as a result of endometriosis as well as reducing adhesions and can be considered as an alternative method for treating such cases.

Key words: Endometriosis, Pain, Laparoscopy, Adhesions, Therapeutic Ultrasound.

INTRODUCTION

Endometriosis is defined as the presence of endometrial glands and stroma in extra-uterine location. It occurs in about 8% to 10% of women and found more frequently among infertile women⁽¹⁾.

Endometriosis is a common gynecological disease that cause marked physical and emotional distress of

the women s life, resulting in pain, dysmenorrhea or both throughout the menstrual cycle in over 96% of cases⁽²⁾. Laparoscopy currently remains the only effective tool for the diagnosis and evaluation of endometriosis⁽³⁾.

Endometriosis most often affects the dependent portions of the pelvis. It is, visually identified by clear, red or black vesicles or by the presence of

adhesion. Chocolate cysts are typical with ovarian endometriosis. Diagnosis can be surmised on the basis of typical symptoms, but the gold standard of diagnosis is analysis of biopsy specimens⁽⁴⁾.

Endometriosis has been found in 4.1 % of asymptomatic women undergoing laparoscopy for sterilization; however, evidence of the disease is present in 20 % (range: 2 to 78%) of women undergoing laparoscopic investigation for infertility. Approximately 24 % (range: 4 to 82 %) of women who complain of pelvic pain are subsequently found to have endometriosis. The overall prevalence, including symptomatic and asymptomatic women, is estimated to be 5 to 10 %⁽⁵⁾.

Adhesions distort the anatomy and cause decreased mobility as well as function of the involved organs or muscles. In addition, being a common outcome of pelvic surgery, the formation of pelvic adhesions is known to accompany related conditions such as endometriosis, pelvic inflammatory disease (PID), tubal obstruction, pelvic spasms, bowel obstruction, and chronic abdominopelvic pain. It is presumed that some of these dysfunctions cause, or are caused by, adhesions⁽⁶⁾.

Medical therapy provides symptom relief in 72–93% of endometriotic patients, although recurrence is common following treatment discontinuation. Surgical therapy has had varying results for long-term pain relief; adequacy of the initial surgical treatment appears to be a critical factor. Important adjunctive measures include presacral neurectomy and excisional techniques to remove deep fibrotic and retroperitoneal lesions. The quality of life for women with endometriosis will improve with greater focus on achieving the long-term relief of pelvic pain. Limitation of pain recurrence would benefit the patient greatly, by providing symptom relief and preventing the reflection of its probable adverse effects on physical activity, work productivity, sexual fulfillment and mood⁽⁷⁾.

Ultrasonic therapy refers to mechanical vibrations which are essentially the same as sun waves but of higher frequency. Such waves are beyond the range of human hearing. Ultrasonic energy described as any vibrations at a frequency above the sound range but frequencies of few mega hertz (MHz) are typically used in physiotherapy. Several different frequencies are employed in the range from 0.5 to 5 MHz⁽⁸⁾

It has been proven that therapeutic ultrasonic accelerate the healing process during the early phases of inflammation and repair, the use of ultrasound may assist in pain relief or in the alleviation of other symptoms of inflammation, such as edema. In addition, ultrasound increases the extensibility of collagen bands, thus facilitating the stretching of scars or adhesions. Therefore, it aids resorption of adhesions⁽⁹⁾.

Therapeutic ultrasound has been shown to increase the extensibility of collagen bands on the surface of the scars and adhesions. Also, it aids resorption of adhesions by depolymerisation of mucopolysaccharides, mucoproteins and glycoproteins. Adhesions and intracellular substances converted from gel to the soluble state responding to ultrasonic treatment so, resorption of adhesions occurs by both heating and micro massaging effects⁽¹⁰⁾.

AIM OF THE WORK

This study was conducted to estimate the effect of ultrasonic therapy on alleviating pain as well as adhesions in women having endometriosis.

MATERIALS & METHODS

This study was carried out on 24 women suffering from severe pelvic pain and diagnosed by laparoscope as having mild or moderate endometriosis (according to the revised classification of endometriosis of the American Society of Reproductive Medicine, 1997) at Bab El-Sharia University Hospital. Their age ranged

from 25 to 35 years old and their body mass index (BMI) didn't exceed $29\text{kg}/\text{m}^2$ and waist to hip ratio not exceeding 0.85.

All patients were free from diabetes, gynecological hemorrhage, impaired sensation and tubo-ovarian abscess. In addition, all patients had a course of therapeutic ultrasonic therapy for 24 sessions (one every other day i.e. three sessions per week) and received the same regimen of hormonal treatment (Medroxyprogesterone acetate 150mg every two weeks for one month then once monthly for 6 months intramuscular) as well as they didn't take any analgesic drugs all through the study period (8 weeks).

Informed consent forms were assigned by each patient before starting the study. The duration of this study was 14 months starting from 10/2006 till 12/2007.

Evaluating instruments in the form of Weight-height scale to measure the body weight and height for each patient before starting the study were prepared in order to determine the body mass index (BMI) for each patient, Ultrasonographic machine as a diagnostic procedure to detect endometriotic cyst to exclude other causes of severe pelvic pain before the application of laparoscopy was available, and laparoscopy was performed by the same Gynecologist to confirm the diagnosis of endometriosis which was suspected firstly by ultrasonography before the application of ultrasonic therapy and in order to determine the degree and sites of adhesions according to the American Society for Reproductive Medicine. It was repeated again after 8 weeks of the treatment by therapeutic ultrasound in order to determine the efficacy of ultrasonic treatment, Pain scales in the form of Present pain intensity (PPI) scale, Pain relief (PR) scale, McGill Pain Questionnaire (MPQ) to determine degree of pain and sites of pain. Treatment Instrument in the form of Ultrasonic machine used for the application of ultrasonic therapy for all patients in this study with the following parameters: Frequency

of 1MHz, Mode: continuous wave, Intensity: $1.5\text{W}/\text{cm}^2$, Duration of treatment: 15 minutes for each treatment site.

The results were expressed as means \pm SD. The data were statistically analyzed with Student t-test for comparison of means between before and after 12 as well as after 24 sessions of treatment, Chi-square test for comparison of the qualitative variables between before and after 12 as well as after 24 sessions of treatment.

Probability values of less than 0.05 were considered to be statistically significant.

RESULTS

This study was conducted on a sample of twenty women diagnosed as mild or moderate endometriosis (according to the revised classification of endometriosis of the American Society for Reproductive Medicine, 1997) confirmed by laparoscope at Bab El-Shehria University Hospital. They were suffering from pelvic pain and free from any conditions which are contraindicated for the usage of ultrasound therapy. They had been enrolled in a course of ultrasonic therapy one every other day, 3 sessions per week, for 24 sessions.

Table I presents the mean and (SD) of the physical characteristics of the patients. The age of patients with endometriosis ranged from 25 to 35 years with a mean value of (29.10 ± 1.71) yrs. Their weight ranged from 65 to 75 kgs with a mean value of (70.93 ± 3.36) kgs, height ranged from 155 to 170 cm with a mean value of (160.65 ± 3.63) cm and their body mass index (BMI) ranged from 24.9 to 29.9 kg/m^2 with a mean value of (27.45 ± 1.21) kg/m^2

Table II presents the intensity of pain assessed by PPI scale as experienced by each patient before starting the study and after the end of 12 as well as 24 sessions of ultrasonic treatment.

Before the application of ultrasound treatment, the pain was felt as severe pain in 8 cases (40%) and unbearable pain in 12 cases (60%)

After the end of 12 sessions of ultrasound treatment, the menstrual pain completely disappeared in one case (5%), mild pain in 9 cases (45%),

moderate pain in 5 cases (25%) and remained severe pain in 5 cases (25%).

After the end of 24 sessions of ultrasound treatment, the pain completely disappeared in 7 cases (35%), mild pain in 9 cases (45%) and remained moderate in 4 cases (20%).

Table (I): Statistical summary of the physical characteristics of the patients.

Variables	Mean	SD
Age (yrs)	29.10	± 1.71
Weight (kgs)	70.93	± 3.36
Height (cm)	160.65	± 3.63
BMI (kg/m ²)	27.45	± 1.21

Table (II): Intensity of pain before starting the study and after the end of 12 as well as 24 sessions of ultrasonic treatment.

PPI Scale	PPI Scores of endometriotic pain					
	Before starting the study		After 12 sessions of treatment		After 24 sessions of treatment	
	No.	%	No.	%	No.	%
No pain	0	0 %	1	5 %	7	35 %
Mild pain	0	0%	9	45 %	9	45 %
Moderate pain	0	0%	5	25 %	4	20 %
Severe pain	8	40 %	5	25 %	0	0 %
Unbearable pain	12	60 %	0	0 %	0	0 %
Mean ± SD	3.6 ± 0.50		1.7 ± 0.92		0.85 ± 0.74	
Percentage of change and level of significance	Before and after 12 sessions of treatment		52.77 %		P < 0.001	
	After 12 and 24 sessions of treatment		50 %		P < 0.001	
	Before and after 24 sessions of treatment		76.38 %		P < 0.001	

Table (III): Pain relief scale after 12 and 24 sessions of ultrasonic treatment.

PR Scale	PR Scores of endometriotic pain			
	After 12 sessions		After 24 sessions	
	No.	%	No.	%
No relief	0	0 %	0	0 %
Slight relief	2	10%	0	0 %
Good relief	5	25 %	1	5 %
Excellent relief	12	60 %	12	60 %
Complete relief	1	5 %	7	35 %
Mean ± SD	2.60 ± 0.75		3.30 ± 0.57	
Percentage of change	26.92 %			
Level of significance	P < 0.001			

Table (IV): Degrees of endometriosis before and after the end of ultrasonic treatment.

Degrees of endometriosis	Before starting the study		After 24 session	
	No.	%	No.	%
Minimal endometriosis	0	0 %	6	30 %
Mild endometriosis	6	30 %	14	70 %
Moderate endometriosis	14	70 %	0	0 %
Mean ± SD	18.35 ± 7.12		8.35 ± 3.96	
Percentage of change	54.4 %			
Level of significance	P < 0.001			

Table III presents the pain relief and the mean value of PR scores as experienced by each patient after 12 and 24 sessions of ultrasonic treatment.

After the end of 12 sessions of ultrasound treatment, the pain was completely relieved in one case (5%), excellent relief in 12 cases (60%), good relief in 5 cases (25%) and slight relief in 2 cases (10%).

After the end of 24 sessions of ultrasound treatment, the pain was completely relieved in 7 cases (35%), excellent relief in 12 cases (60%) and good

relief in one case (5%).

Table IV presents the degrees of endometriosis according to American Society for Reproductive Medicine as determined by diagnostic laparoscopy before the starting of the study and at the end of the study (24 sessions).

Before starting the study, 14 cases (70%) had moderate endometriosis, 6 cases (30%) had mild endometriosis as determined by the laparoscope. While after the end of 24 sessions of ultrasonic treatment, 14 cases (70%) had mild endometriosis

and 6 patients (3 0%) had minimal endometriosis.

DISCUSSION

Endometriosis can cause local inflammation, which is a key factor in adhesions formation. Adhesions may be formed as a result of endometrial implant bleeding onto the area around them, causing inflammation, which again leads to the formation of scar tissue as -ironically- part of the healing process. Unfortunately, sometimes this injured tissue comes into contact with another inflamed area nearby and forms a band of scar tissue (adhesions between these two areas). Adhesions vary in appearance from thin, filmy and transparent to thick, dense and opaque. In some cases, adhesions have been found to such an extent throughout the pelvis to create what is known as *frozen or fixed pelvis* ⁽¹¹⁾. Just like endometriosis itself, adhesions can cause pain and subsequently affect a woman's quality of life to the extent that her day to day activities are impaired ⁽¹²⁾.

Since the problem of adhesions in endometriosis is widely recognized, there is at the moment no way of preventing them, when caused by the disease alone, nor can be prevented completely during surgery; so many companies are working on finding a product which prevent adhesions ⁽¹³⁾.

Twenty women suffering from endometriosis (mild and moderate degree) diagnosed by laparoscopy from Bab El-Shebria University Hospital, participated in this study to estimate the effect of ultrasonic therapy on alleviating pain as well as adhesions in women having endometriosis.

The results of this study showed:

A highly significant decrease in the severity of pain between before and after the end of 12 as well as 24 sessions of ultrasonic treatment and also between 12 and 24 sessions of ultrasonic treatment as measured by PPI scale.

Also, there was a highly significant decrease in

the severity of pain as measured by PR scale between after the end of 12 and 24 sessions of ultrasonic treatment.

There was a highly significant decrease in the degree of endometriosis as diagnosed by laparoscopy after the end of 24 sessions of ultrasonic treatment.

There was a highly significant decrease in the sites of pain according to the 1st part of MPQ between before and after end of 12 as well as 24 sessions of ultrasonic treatment and also between 12 and 24 sessions of ultrasonic treatment.

The results of this study were supported by the work of others ⁽¹⁴⁾ who reported a significant decrease in the perception threshold for pain after exposure to ultrasound; this effect was developed within 30- 60 seconds and was increased both with increasing intensity at constant frequency, as well as with increasing frequency at a constant intensity.

So, pain relief can be explained according to the clinical effects that may ultimately be exerted by the ultrasound in which heat generated by ultrasound is utilized to treat pain by either ablating the nociceptive nerve and nerve ending responding to the pain or by warming the target tissue. Treating pain by heating the target, the tissue, with ultrasonic energy has been proven effective. Assuming the therapeutic effect of ultrasonic administration are tied to a thermal effect, this method attempt to rise the temperature of the target tissue any where from 1 to 4 °C, deep pain and chronic pain are treated with higher temperatures 15.

Also, others ⁽¹⁶⁾ suggested that the heating effects of continuous ultrasound at 1.0 and 1.5 W/Cm² causes an increase in nerve conduction velocity as well as increase in subcutaneous tissue temperature.

In contrast, Cosentino ⁽¹⁷⁾ reported a decrease in sensory nerve conduction velocity following the application of ultrasound which may be related to the frequency component of ultrasound and not to the thermal effects.

As, the mechanical effects of ultrasound are thought to increase the activity of large nerve fibers, thereby closing the pain gate at the substantia gelatinosa and so, reintroducing normal inhibition of the smaller unmyelinated fibers⁽¹⁸⁾.

Haysmith⁽¹⁹⁾ also reported that ultrasound can accelerate the inflammatory phase through a rapid resolution of hematoma and edema that reduce the pressure on pain sensitive structures thus help to get rid of pain.

A highly significant decrease in the degree of endometriotic adhesions between before and 24 sessions of ultrasonic treatment, was also documented in the present work.

This could also be explained by the study of Dyson⁽²⁰⁾ who reported that therapeutic ultrasound is an accelerator of the inflammatory process through increasing the release of mitogenic and angiogenic growth factors from mast cells, platelets and macrophages.

Also, the thermal effect of US is beneficial for chronic inflammation is supported by the work of Low and Reed⁽⁸⁾ as they mentioned that heat increases blood flow and thereby increases microvascular hydrostatic pressure that assist in the reabsorption of late inflammatory exudates and debris.

In addition, therapeutic ultrasonic has been shown to increase the extensibility of collagen bands on the surface of the scars and adhesions. Also it aids resorption of adhesions by depolymerisation of mucopolysaccharides, mucoprotiens and glycoprotiens. Adhesions and intracellular substances converted from gel to the soluble state respond to ultrasonic waves and so, resorption of adhesions occurs by both heating and micro massage effect⁽¹⁰⁾.

It has been suggested that ultrasound interact with one or more components of inflammation and earlier resolution of inflammation, alteration of collagen fibers type distribution, with a relative

increase in type III collagen over type I collagen and in some tendon lesions, fibrovascular proliferation and focal expression of type II collagen. After injury, an increase in matrix turnover is necessary to remove damaged matrix and to remodel scar tissue. Alternatively ultrasound may be used for its thermal effects in order to relieve pain and muscle spasm and to increase tissue extensibility⁽²¹⁾.

According to this study, it was found that ultrasound therapy can be considered as one of the alternative methods in treating pain as well as adhesions in women having endometriosis in which there are no side effects like medical and surgical treatment.

CONCLUSION

There was a highly significant decrease in the severity of pain between before and after the end of 12 as well as 24 sessions of ultrasonic treatment and also between 12 and 24 sessions of ultrasonic treatment as measured by PPi scale.

There was a highly significant decrease of pain as measured by PR scale between after the end of 12 and 24 sessions of ultrasonic treatment.

There was a highly significant decrease in the degree of endometriosis diagnosed by laparoscopy between before and after the end of 24 sessions of ultrasonic treatment.

The results of this study concluded that ultrasound therapy had an excellent effect in the management of chronic pain as a result of endometriosis as well as reducing adhesions and can be considered as an alternative method for treating such cases without any side effects or complications to the patient like medical and surgical treatment for such cases.

RECOMMENDATIONS

It is recommended to assess the long term effect of therapeutic ultrasound in the management of endometriotic pain, adhesions and infertility.

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