

Effect of Therapeutic Ultrasound Versus Low-Level Laser Therapy on Post-Operative Pain after Cesarean Section

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Abstract

Background: Cesarean section births are a lot more painful than vaginal births. It is normal to have extreme pain after C.S. A C-section is a major abdominal surgery, and it will take a long time to heal. Post-surgical incisional pain remains a major clinical problem because it may be associated with impaired activities of daily life. Most of the women experience severe incisional pain after C.S. that prevents them from sleeping at night and it makes it difficult to move or hold their babies. Sometimes this pain may cause post-natal depression and also it is a predisposing factor for puerperium morbidity. The doctors may need to prescribe strong pain medications, but in most cases, a little of this medication passes through breast milk to the baby. So, it is necessary to find another way to relieve post-operative pain after C.S.

Aim of Study: To compare between the effect of therapeutic Ultrasound and Low-level laser therapy on postoperative pain after cesarean section.

Material and Methods: This study was carried out on forty women suffering from postoperative incisional pain after a cesarean section. They were selected randomly from the maternity ward at El-Sinbellawen General Hospital in Al Dakahlia Governorate. They were divided randomly into two groups equal in number group (A) & group (B). Group (A) was consisted of 20 patients. Each patient in this group had received Low-level LASER therapy on 6 points para-incisional (90 seconds on each point), twice daily for 7 days. Also, each patient was asked to perform Abdominal, posterior pelvic tilting, and postural correction exercises for 60 minutes, twice daily for 7 days. Additionally, each patient was encouraged to walk for 10 minutes, twice daily for 7 days. Group (B) was consisted of 20 patients. Each patient in this group had received therapeutic ultrasound around stitches for 10 minutes twice daily for 7 days. Also, each patient was asked to perform Abdominal, Posterior pelvic tilting, and postural correction exercises for 60 minutes, twice

daily for 7 days. Additionally, each patient was encouraged to walk for 10 minutes, twice daily for 7 days. All patients in both groups (A&B) were evaluated by Visual Analogue Scale (VAS) and measuring serum cortisol level in blood plasma before and after the end of the treatment program.

Results: Both groups showed a statistically significant decrease in both the visual analogue scale and serum cortisol level after treatment. Group (A) achieved percentage of decrease in the visual analogue scale by 81.08% and achieved percentage of decrease in serum cortisol level by 65.30% while group (B) achieved percentage of decrease in visual analogue scale by 34.72% and achieved percentage of decrease in serum cortisol level by 20.48%. By comparing the 2 groups (A&B) it was found that the percentage of decrease in VAS and serum cortisol level in group (A) was more pronounced and more noticeable than in group (B). This means that Low-level laser therapy was more effective than therapeutic Ultrasound in decreasing post-operative pain after cesarean section.

Conclusion: Low-level laser therapy was more effective than therapeutic Ultrasound in relieving post-operative pain after cesarean section.

Key Words: Post cesarean pain – Therapeutic Ultrasound – Lowlevel laser therapy – Visual analogue scale (VAS) – Cortisol level in the blood plasma.

Introduction

THE Cesarean section is also called C-section or Cesarean birth or Cesarean delivery. The cesarean section is a surgical procedure in which the doctor delivers the baby through an incision (cut) made in the mother's abdomen and uterus. Healthcare providers use it when they believe it is safer for the mother, the baby, or both. The mother might need a C-section if she cannot deliver vaginally. C-section allows the Fetus to be delivered surgically [1].

Cesarean section births are more painful than vaginal births. It is normal to have extreme pain after a cesarean section. A C-section is a major

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abdominal surgery, and it will take a long time to heal. Post-surgical incisional pain remains a major clinical problem because it may be associated with impaired activities of daily life. Most of the women experience severe incisional pain after a C-section that prevents them from sleeping at night and it makes it difficult to move or hold their babies. Their doctors may need to prescribe strong pain medications [2].

It has been reported that postoperative incisional pain after cesarean section is severe enough to interfere with the mother's ability to care for her baby or perform activities of daily living and the presence of this pain during the puerperium makes it difficult for women to perform the daily activities required during this period such as self-care, neo born care, mobility and rest and this pain may be reflected on physical, psychological and emotional issues of the mother so this pain should be addressed and we should give importance to this pain complains of puerperal women since the incisional area of C-delivery is a predisposing factor to puerperium morbidity [3].

It has been reported that most women experience intense abdominal pain after C.S., also there is redness and swelling around the incision due to inflammation. Additionally, the mother may have some tingling and numbness of nerves that are cut during the surgical procedure. This can take up to six months for all the nerves in the abdominal area to heal completely [4].

In another study the authors demonstrated that some women feel pain three months after Cesarean section. This is normally due to the build-up of scar tissue which can stick to muscles or even organs. Some women feel pain or numbness or both at their Cesarean section scar for months or even years after surgery [5].

A C-section is a major surgery, the mother may be tired for the first few days or weeks after a C-section because she lost a lot of blood during surgery. The incisional (cut) on the mother's belly may be sore. If this post-operative incisional pain persists for at least 3 months after cesarean section, it is considered chronic pain. This chronic post-operative pain may be the result of unresolved inflammation or neuropathy due to nerve injury induced by the surgery due to the build-up of scar tissues or due to infection. No matter the reason, this Chronic Post-operative Pain has a bad impact on patients and their overall quality of Life [6].

A surgical wound infection can happen at any time after surgery until the wound is healed. Most surgical wound infections are skin infections. But, if the uterine incision is infected, the abdominal pain is extremely increased, also there will be fever over 100°F, fatigue, and body aches. For this reason, healthcare providers usually prescribe antibiotics

besides pain medications to avoid infection which has a negative effect on the patient's health as well as a negative impact on her quality of Life [7].

It is important to support physical therapy procedures aimed at preventing and managing women's complaints of pain during the post-operative period [8].

Several physical therapy modalities can be used to relieve acute postoperative pain after cesarean section such as TENS, Laser Therapy, Therapeutic Ultrasound, Phonophoresis, Iontophoresis, Electro-acupuncture, Acupuncture Like TENS, Interferential current, Daidynamic Current, Russian Current, Extracorporeal Shock Wave Therapy, Pulsed Electromagnetic Field, Short Wave Diathermy, Radiofrequency Current, Neuromuscular Electrical Nerve Stimulation, Infra-red Radiation, Heat & Cold Therapy and Kinesiotaping [9].

Low-level laser therapy is a physical therapy modality that is commonly used to relieve pain, reduce inflammation, and accelerate wound healing in soft tissue injuries. So, it is used to treat post-operative pain after Cesarean section, Symphyseal pain, L.B.P. carpal tunnel syndrome, Coccydynia, acute perineal pain after episiotomy, myofascial pain, sacroiliac joint pain, Dequervain's tenosynovitis, osteoarthritis, ligament sprains, muscle strains, bursitis, rheumatoid arthritis, plantar fasciitis, and so many other cases of musculoskeletal disorders [10].

Low-level laser therapy [LLL] is a non-invasive light source treatment that uses red and near-infrared monochromatic light to relieve pain and treat soft tissue injuries without increasing skin temperature. It has a low energy output (between 1 and 1000mW) and generates a single wavelength of light (between 600 and 1100nm). Lasers have been used for photo biomodulation. LLLT is an effective procedure to manage acute post-operative pain after cesarean section and it usually gives good outcomes. Additionally, it has no side effects like other medications [11].

LLL has been used as a non-pharmacological alternative to treat painful musculoskeletal conditions for three decades and laboratory researchers have confirmed that Low energy irradiations from lasers change cellular processes, producing among others anti-inflammatory effects and increasing Collagen turnover [12].

Several researchers reported that LLLT had anti-inflammatory and anti-edematous actions due to its reduction effect in prostaglandin synthesis. Its inhibition effect on prostacyclin has been approved to provide pain and inflammation regression [13].

In another studies, the researchers had suggested that an inhibition of neuronal activity might be responsible for the therapeutic effect of LLLT, and

the laser irradiation selectively inhibits nociceptive signals at peripheral nerves [14].

Therapeutic ultrasound is a marvelous intervention that is commonly used in the physical therapy field to treat so many cases of musculoskeletal disorders and soft tissue injuries to relieve pain, reduce inflammation and accelerate wound healing such as low back pain, Carpal tunnel syndrome, coccydynia, acute perineal pain after episiotomy, myofascial pain, Dequervain's tenosynovitis, sacroiliac joint pain, symphyseal pain, osteoarthritis, ligament sprains, muscle strains, bursitis, rheumatoid arthritis, planter fasciitis, metatarsalgia, facet irritations, fibromyalgia and tennis elbow [15].

Also, therapeutic ultrasound is used to accelerate wound healing, increase range of motion, and decrease muscle spasms [16].

Several studies confirmed that therapeutic ultrasound has great efficacy in relieving acute post-operative pain, reducing inflammation, and swelling, and accelerating wound healing after cesarean section [17].

Therapeutic ultrasound has great efficacy in reducing pain, reduce inflammation, and accelerate wound healing in soft tissue injuries. It has no side effects like other medications and always gives marvelous outcomes [18].

Therapeutic ultrasound is mechanical waves that can penetrate skin layers to reach the target tissues. Ultrasonic waves can be delivered in two modes: Continuous mode and pulsed mode. The physiotherapist usually uses ultrasound with continuous mode for its thermal effect. It can produce physiological heat that heat subcutaneous tissues of the target area. So, blood circulation is increased in the treated area which in turn accelerates the inflammatory process, and removes all waste products of the inflammatory phase, the resulting edema & swelling are reduced and pain is relieved [19].

Additionally, the micro-massage effect of therapeutic ultrasound assists in closing pain-gait releasing opiate substances (natural pain Killer substances), so pain is relieved. The continuous mode of ultrasound with frequency 1 MHZ and intensity 1.5W/cm² can penetrate the deep tissues at a depth ranging from 5-6cm, therefore it is a highly effective procedure to relieve post-operative Pain after Cesarean section [20].

Material and Methods

This study was carried out on forty women suffering from postoperative incisional pain after a cesarean section. They were selected randomly from the maternity ward at El-Sinbellawen General Hos-

pital in Al Dakahlia Governorate. This study had Lasted 12 months From June 2023 to June 2024. Their ages ranged from (25-35) years²old, their body mass index did not exceed 30kg/m² and their parity ranged from (0-3) children.

Table (1): Demographic characteristics of all the patients in both groups (A&B).

	Group A (n=20)	Group B (n=20)	t- value	p- value
Age (yrs.)	31.05±2.24	30.60±2.54	0.594	0.556 (NS)
Weight (kg.)	82.90±5.20	80.52±5.15	1.451	0.155 (NS)
Height (cm)	168.90±4.94	167.30±4.39	1.083	0.286 (NS)
BMI (kg/m ²)	29.23±0.70	28.82±1.13	1.379	0.176 (NS)

Data are expressed as mean ± SD.

NS = $p > 0.05$ = Not significant.

Material:

Informed consent form: Each patient in both groups (A&B) was asked to sign a consent form before participating in this study.

Recording data sheet: It was used to record all data of each patient in both groups (A&B) before starting the treatment course. It included name, age, address, weight, height, occupation, date & type of labor, number of parities, chief complaint, diagnosis, past, present, and family history.

Weight-Height Scale: It was used to measure the weight & height of each patient in both groups (A&B) to calculate body mass index (BMI) before participating in this study through this equation: $BMI (kg/m^2) = (Body\ weight\ (kg)) / (square\ of\ body\ height\ (m^2)) = kg/m^2$.

Visual Analogue Scale (VAS): It is a graphic rating scale with numerical values ranging from (0-4), placed equidistantly on a line of 10cm long drawn horizontally. The description and numbers help the patient to describe her level of pain.

- Represents no pain.
- Represents mild pain.
- Represents moderate pain.
- Represents severe pain.
- Represents intolerable pain.

Syringes: They were used to withdraw blood samples from each patient in both groups (A&B) before and after the treatment course in the early morning to measure cortisol level in blood plasma. About 3cm of blood was withdrawn from the ante-cubital vein in the early morning from each patient in groups (A&B) before and after treatment and they were sent immediately to the laboratory center for analysis.

Low-level LASER device (model: EME LASER LIS 1050 Italy): It was used to apply low-level LASER therapy treatment to all patients in group (A).

Two Goggle glasses: They were used by each patient and the physiotherapist to protect their eyes from laser beams during laser treatment sessions that were used to treat patients in group (A) only.

Therapeutic Ultrasound device (model: PhysioGo 200A-Astar): It was used to apply ultrasound waves with continuous mode for each patient in group (B).

Ultrasound Sono gel: It was used as a coupling media for ultrasound waves.

Stopwatch: It was used to determine the time of each treatment session.

Mirror: It was used during the posture correction exercises.

Plinth: It was used by each patient in both groups (A&B) to receive the treatment sessions and to perform the abdominal and postural correction exercises on it.

White sheets: For covering the patients during the treatment sessions.

Cotton and alcohol: They were used to clean the skin before applying ultrasonic waves.

Evaluating procedures:

All data of each patient in both groups (A&B) were recorded in a recording data sheet before starting the treatment course (7 days).

The weight and height of each patient in both groups (A&B) were taken before the treatment course and BMI was calculated.

Each patient was asked to sit on an armchair. The antecubital area was cleaned with alcohol. A blood sample of 3cm was withdrawn from the antecubital vein from each patient in both groups (A&B) by disposable sterile syringe before and after the treatment course and it was sent to the laboratory center to determine the plasma cortisol level in the blood.

Each patient in both groups (A&B) was asked to put a mark on VAS to estimate the intensity of her pain. This was done before and after the treatment course (7 days).

Treatment procedure:

Group (A):

Each patient in this group was asked to lie on the plinth, in a supine lying position and she was covered by a white sheet except for the treated area (abdominal region around the cesarean incision). Then,

the physiotherapist cleaned the skin around the incision with a piece of cotton immersed in alcohol to decrease the skin resistance. Then the low-level LASER device was adjusted on the following parameters: Wavelength: 830nm, Energy density: 20J/cm², Power: 30-40mw, Continuous output of 100%, Beam diameter: 4mm, Irradiation rate (time of treatment session): 90 seconds for each painful para incisional point.

Protective goggles had been worn by the patient and the physiotherapist to protect their eyes from the laser beam. After that, the therapist held the low-level laser therapy from its handle perpendicular to the skin to deliver the laser beam for 90 seconds on each painful para-incisional point. After finishing the session, the LLLT device was switched off, and the patient was asked to perform Abdominal, posterior pelvic tilting, and postural correction exercises for 60 minutes, twice daily for 7 days. Additionally, each patient was encouraged to walk for 10 minutes, twice daily for 7 days.

Group (B):

Each patient in this group was asked to lie on the plinth, in a supine lying position and she was covered by a white sheet except for the treated area (abdominal region around the cesarean incision). Then, the ultrasound device was adjusted on the following parameters: Frequency: 1MHZ, Intensity: 1.5w/cm², Mode: Continuous mode, Duration: 10 minutes.

After adjusting the parameters of the device, the skin of the treated area was cleaned with a piece of cotton immersed in alcohol and a sufficient amount of Sono gel was placed on it, while the transducer head of the ultrasound device was covered by a condom to avoid transferring infection.

After that, the physiotherapist held the transducer head (treatment head) from its hand and put it in contact with the skin of the treated area, then the physiotherapist switched on the ultrasound device and started to move the transducer head over the treated area of the skin around the incision in a circular movement for 10 minutes, then the ultrasound device was switched off, the condom was removed and the treated area was cleaned with a piece of cotton.

After the session of therapeutic ultrasound, the patient was asked to perform Abdominal, posterior pelvic tilting, and postural correction exercises for 60 minutes, twice daily for 7 days. Additionally, each patient was encouraged to walk for 10 minutes, twice daily for 7 days.

Results

By comparing the two groups (A & B) after treatment regarding VAS scores, it was found that both groups showed a decrease in pain score after

treatment, group (A) achieved 81.08% while group (B) achieved 34.72% but the percentage of decrease in VAS was more pronounced and more notable in group (A) when compared with group (B), this means that low-level laser therapy was more effective than therapeutic ultrasound in decreasing pain.

Table (2) & Figs. (1-3): Illustrate mean ± SD for VAS scores before and after treatment for both groups (A & B).

Variable	Group A		Group B	
	Before treatment	After treatment	Before treatment	After treatment
Mean ± SD	3.70±0.47	0.70±0.92	3.60±0.50	2.35±1.18
MD				
# value		3.0		1.25
p-value		14.620		4.626
		0.001		0.001
% of in VAS		81.08%		34.72%
Significance		Highly significant		Highly significant

MD = Mean difference.

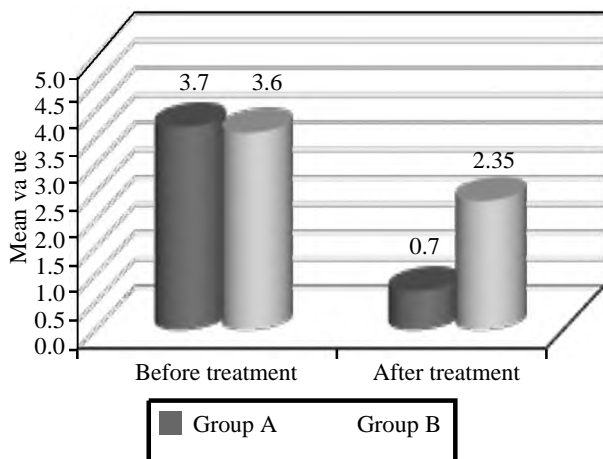


Fig. (1): Illustrates mean values of VAS measured before and after treatment in the two studied groups (A & B).

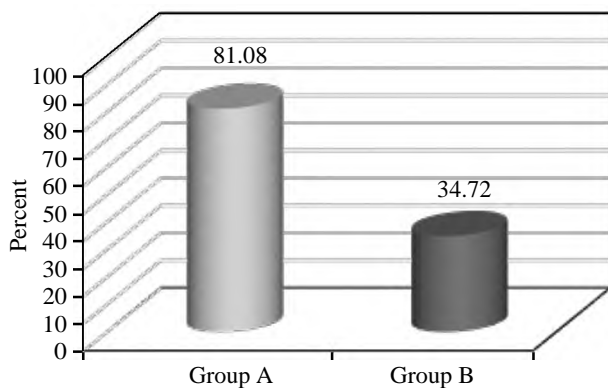


Fig. (2): Illustrates the percent of the decrease in VAS scores in both groups (A & B) after treatment.

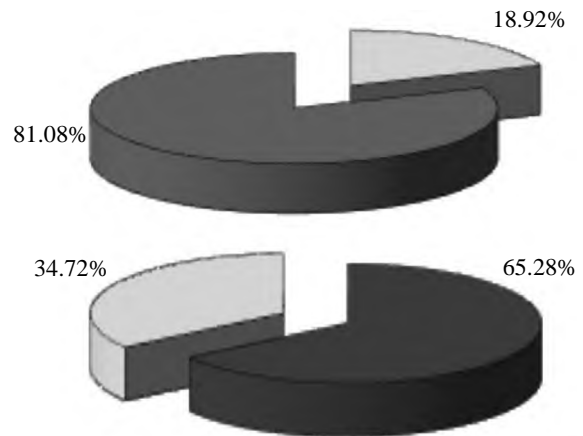


Fig. (3): Illustrates the percent of decrease in VAS scores after treatment in both groups (A & B).

By comparing the two groups (A & B) after treatment regarding serum cortisol level, it was found that both groups showed a decrease in serum cortisol level after treatment, group (A) achieved 65.30% while group (B) achieved 20.48% but the percentage of decrease in serum cortisol level was more pronounced and more notable in group (A) when compared with group (B), this means that low-level laser therapy was more effective than therapeutic ultrasound in decreasing serum cortisol level.

Table (3) and Figs. (4-6) illustrate mean ± SD for serum cortisol before and after treatment for both groups (A&B).

Variable	Group A		Group B	
	Before treatment	After treatment	Before treatment	After treatment
Mean ± SD	19.51±2.12	6.77±1.57	19.82±2.31	15.76±5.12
MD		12.74		4.06
# value		22.937		4.272
p-value		0.001		0.001
% of in cortisol		65.30%		20.48%
Significance		Highly significant		Highly significant

MD = Mean difference.

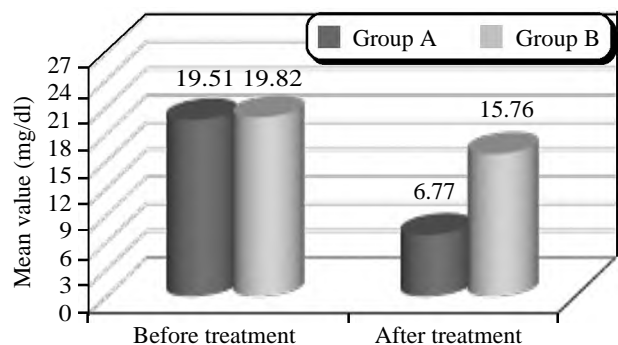


Fig. (4): Illustrates mean values of serum cortisol measured before & after treatment in the two studied groups (A&B).

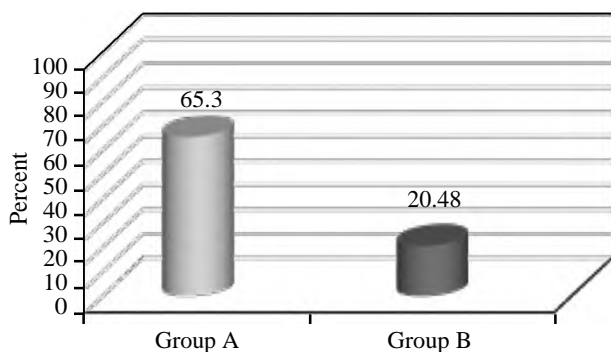


Fig. (5): Illustrates percent of the decrease in serum cortisol level in both groups (A& B) after treatment.

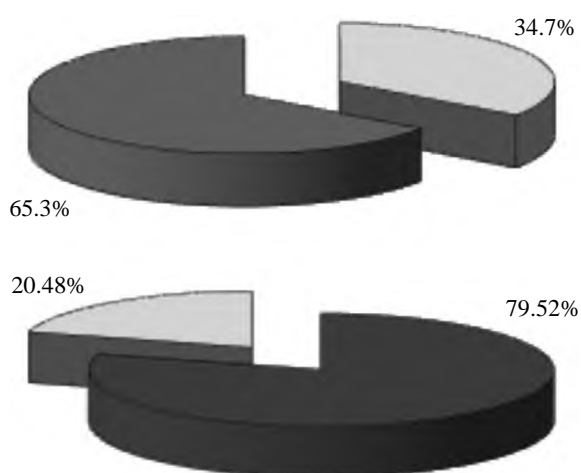


Fig. (6): Illustrates the percent of decrease in serum cortisol after treatment in both groups (A & B).

Discussion

Allen et al., [21] conducted an experimental study to compare between the effect of therapeutic ultrasound and the effect of low-level laser therapy on postoperative pain after cesarean section. The results of his study revealed that low-level laser therapy achieved a highly statistically significant decrease in pain sensation and serum cortisol level in blood plasma greater than the therapeutic ultrasound. This means that low-level laser therapy was advanced to therapeutic ultrasound in alleviating incisional pain and decreasing blood cortisol level in blood plasma after treating post-operative pain after cesarean section. Allen added, "If you are a physiotherapist, do not hesitate to choose low-level laser therapy to treat post-operative incisional pain after cesarean section. It is the best modality to relieve pain and reduce inflammation. The patients can return to their normal activities of daily living pain-free after only a few sessions. This in turn affects greatly their emotional and psychological status, making them so happy with their newborns". This came in agreement with the results of the current study.

The results of the present study agree with the results of Johnson et al., [22] who reported that, "It is approved that, LLLT has a highly beneficial effect on nerve cells which block pain transmission to the brain (close pain gate). Another pain-blocking mechanism involves the production of a high level of natural pain-killing chemicals such as endorphins and enkephalins from the brain and adrenal gland by stimulating the descending inhibitory system".

The results of the current study are confirmed with the results of Kuffler et al., [23] who suggest that "LLLT for tissue regeneration in postoperative surgery, periodontal treatment, pain, and inflammation control. Pain relief promoted by LLLT is related to reduced E2 prostaglandin, which prevents the onset of pain by stimulating compounds and controls the inflammation process. Analgesia is caused by the release of endogenous endorphins and hyperpolarization of nerve endings, which inhibit the transmission of painful stimuli to the central nervous system. Additionally, the biological effects produced due to the energy absorption by the tissues allow the light of the photons to interact with the cellular structure. An increase in cellular energy is observed, which alters the permeability of the cell membrane, and causes a reduction in the interstitial fluid, wound healing, muscle relaxation, modulation of the immune system, and nerve regeneration". Unlike medications, laser therapy reduces pain without undesirable side effects. LLLT is particularly effective when it is administered as soon as possible following injury. The faster the inflammation is reduced, and the healing process can begin. LLLT helps to restore normal function quickly. LLLT is the best modality to treat post-operative pain after cesarean section, it gives amazing results.

De Holanda et al., [24] demonstrated that "the LLLT can easily be routinely applied in postpartum patients to reduce pain and to help restore functionality. The study suggests that LLLT was effective in relieving surgical wound pain after cesarean section. Laser therapy seems to be a good nonpharmacological resource for pain improvement after cesarean section. LLLT has positive acceptance by patients for promoting physical improvement and emotional well-being after surgical procedures".

Conclusion:

Low level laser therapy is more effective than therapeutic ultrasound to relieve postoperative pain after cesarean section.

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تأثير العلاج بالموجات الفوق صوتية مقابل العلاج بالليزر منخفض الشدة على ألم ما بعد الجراحة بعد الولادة القيصرية

تهدف هذه الرسالة إلى مقارنة تأثير العلاج بالموجات الفوق صوتية بتأثير العلاج بالليزر منخفض الشدة على ألم ما بعد الجراحة في السيدات بعد الولادة القيصرية.

شملت هذه الرسالة أربعين امرأة مرضعة يعانون من ألم ما بعد الجراحة بعد الولادة القيصرية، تراوحت أعمارهم بين (٢٥ - ٣٥) عاماً. لم يتعد مؤشر كتلة الجسم ٣٠ كغم/م^٢ وكان عدد إنجابهم يتراوح بين (٠ - ٣) طفل، وقد تم اختيار المرضى من قسم النساء والتوليد بمستشفى السنبلولين العام وقد تم تقسيم المرضى عشوائياً إلى مجموعتين متساويتين:

المجموعة (أ): اشتملت هذه المجموعة على عشرين مريضة تلقين العلاج بالليزر منخفض الشدة العلاجي على ٦ نقاط مؤلمة حول خط الشق الجراحي لمدة ٩٠ ثانية على كل نقطه، مرتين يومياً لمدة ٧ أيام، بالإضافة إلى عمل تمارين علاجية لمدة ٦٠ دقيقة مرتين يومياً لمدة ٧ أيام.

المجموعة (ب): اشتملت هذه المجموعة على عشرين مريضة تلقين العلاج بالموجات الفوق صوتية لمدة ١٠ دقائق، مرتين يومياً لمدة ٧ أيام، بالإضافة إلى عمل تمارين علاجية لمدة ٦٠ دقيقة مرتين يومياً لمدة ٧ أيام.

طرق التقييم: أ - اختبار مقياس النظير البصرى. ب - قياس مستوى الكورتيزول فى الدم.

نتائج البحث: وقد أظهرت نتائج البحث وجود فارق ذو دلالة إحصائية فى كل من المجموعتين بعد العلاج.

وبمقارنة نتائج المجموعتين وجد التالى:

- ١- وجود نقص ذو دلالة إحصائية فى المؤشر البصرى للألم لصالح المجموعة (أ).
- ٢- وجود نقص ذو دلالة إحصائية فى مستوى الكورتيزول فى الدم لصالح المجموعة (أ).

الاستنتاج: نستنتج من هذه الدراسة أن تأثير العلاج بالليزر منخفض الشدة العلاجي أعلى من تأثير العلاج بالموجات الفوق صوتية فى تقليل شدة الألم وخفض مستوى الكورتيزول فى الدم لدى السيدات اللاتي يعانين من الام ما بعد الجراحة بعد الولادة القيصرية.