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Effectiveness of Ultrasound Versus Transcutaneous Electrical Nerve Stimulation on Postnatal Breast Engorgement

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Abstract:

Background: Breast engorgement is a common concern among breast-feeding mothers, and it can lead to serious complications such as clogged milk ducts or mastitis, as well as a reduction in the lactating mother's quality of life. It affects between 72 and 85 percent of women.

Objective: This study was conducted to compare the effect of ultrasound versus transcutaneous electrical nerve stimulation on postnatal breast engorgement.

Methods: Forty postnatal women diagnosed with breast engorgement; they were randomized into 2 equal groups. Group (A) received ultrasound with conventional therapy in the form of moist heat and massage. Group (B) received transcutaneous electrical nerve stimulation with conventional therapy as group(A). The treatments lasted a week, with one session per day. The outcome measures were subjective, including a VAS scale for measuring pain and a 6-point self-rated breast engorgement scale for determining the severity of breast engorgement.

Results: Comparison between groups (A&B) in VAS showed statistically no significant difference (t value = 0.67) and (p value = 0.5) post treatment. Also, Comparison between groups (A&B) in 6-point self- rated breast engorgement scale showed statistically no significant difference (t value = 0.95) and (p value = 0.34) post treatment.

Conclusion: It could be concluded that both TENS and ultrasound are useful for painful breast engorgement. In addition, results supported that there is no significant difference between ultrasound and TENS along with conventional treatment in postnatal painful breast engorgement.

Keywords: Breast engorgement, ultrasound, transcutaneous electrical nerve stimulation, hot moist packs, therapeutic massage.

1.Introduction

Breast engorgement is a painful overfilling of the breasts with milk caused by a milk supply and baby demand mismatch. Swelling and distension of the breasts, which normally occurs on the third or fourth day postpartum due to vascular dilation and the arrival of the milk, subsides within 12 to 48 hours if handled properly **(1).**

Breast engorgement affects 72 percent to 82 percent of lactating mothers, and it is most prevalent within the first week of motherhood, but it can also occur later. The breasts become swollen, stiff,

throbbing, aching, tender, and painful, with the pain spreading up to the armpit **(2).**

Engorgement can occur in the areola and/or body of the breast, in one or both breasts, build to a high level and then subside, or remain at the same level for a long time or peak many times **(3).**

Engorgement, if left untreated, places pressure on the milk ducts, resulting in a clogged duct. A breast infection may result from a clogged duct, and both breasts are normally affected **(4).**

Breast engorgement may occur if a child has difficulty breastfeeding or nurses less frequently than normal, whether due to sickness, the introduction of solid foods, or the abrupt cessation of breastfeeding **(5).** Another possible cause of early breast engorgement is dehydration and intravenous fluids that were administered during delivery can lead to fluid retention, making it harder for the lymphatic system to work efficiently **(5).**

There are two types of treatment for breast engorgement: medical and nonmedical. Proteolytic enzymes including serrapeptase, protease, ibuprofen, and subcutaneous oxytocin are used as medications **(6).**

Ice pads, an uplift support bra to relieve oedema, breast massage, gel pad, breast binding, application of warmth, cool compress, use of breast pump or hand expression, and cold cabbage leaves are all nonmedical approaches for treating breast engorgement. Laser and acupuncture are also used in the treatment of breast engorgement **(7).**

It has been documented that combining ultrasound therapy with traditional therapy reduces pain in non-tender breasts, allowing post-partum mothers to recover from the discomforts of engorged breasts. This, in turn, will make it easier to breastfeed. Moreover, TENS unit was used to decrease post-partum pain resulting from breast engorgement and there was no study reported which of them was more effective **(8).**

Due to the many issues associated with breast engorgement, it is now more important than ever to investigate the effects of ultrasound and TENS, as well as traditional treatments such as moist heat packs and therapeutic massage, on pain and tenderness in painful breast engorgement **(9).**

The aim of this study was to compare the therapeutic efficacy of ultrasound (US) versus transcutaneous electrical nerve stimulation (TENS) in the treatment of postpartum painful breast engorgement.

2.Materials and Methods

This study was a randomized control study, the ethical committee for this research was P.T.REC/012/002817 at Cairo University's Faculty of Physical Therapy. Forty females diagnosed with breast engorgement participated in this study. They were selected from outpatient clinic of gynecology at Fakous Hospital, Sharquia. The study's aim is to compare the effectiveness of ultrasound versus transcutaneous electrical nerve stimulation (TENS) in treating postnatal painful breast engorgement. The research lasted six months, starting in April 2020 and ending in September 2020.Their age ranged from 18 to 35 yrs. Their BMI was ≤ 30≥25 kg/m². The participants were excluded if they were with BMI higher than 30 kg/m², lactating mothers with soft breast, nonlactating mothers, suffering from breast cancer, using of cardiac pacemaker or having any skin condition.

Design of this study was two groups pre and post experimental design. They were divided into two equal groups: Group (A) were treated by ultrasound therapy with conventional therapy on the affected breast from the third day after delivery, The parameters were used at frequancy1MHZ and intensity 0.5W/cm² for 10-15 minutes per session, for one sessions per day for a week and conventional therapy as moist heat for10 minute per session, for on sessions per day, for a week and breast massage for 30 minute per session, for one sessions per day for a week; Group (B) were treated by Transcutaneous electrical never stimulation (TENS) on the affected breast at both side of nipple from the third day after delivery.

The parameters were used at frequency 80-120HZ with pulse width 150 microsecond and intensity according to the patient sensitivity usually starts with minimal intensity for 30 minutes per session, for one session per day, for a week. and conventional therapy as group (A). Each woman in both groups (A&B) was assessed through assessing pain intensity using visual analogue scale, and breast engorgement severity using 6-point self-rating breast engorgement scale.

2.1. Evaluative procedures

Evaluations were carried out in both groups (A&B) before and after the interventions (1 weeks). The assessor was blind about the group's assignment and wasn't involved within the treatment application.

2.1.1. Weight and height: It had been measured while the patient wearing a thin layer of clothing in order to determine the BMI according with the equation: BMI= $\frac{weight(kg)}{height(m^2)} kg/m^2$ for both groups(A&B).

2.1.2. The severity of pain level:

Pain severity was measured using a visual analogue scale (VAS) for each woman in both groups

(A&B) before and after the treatment program, with 0 indicating no pain, 1-3 indicating mild pain, 3-5 indicating moderate pain, 5-7 indicating extreme pain, 7-9 indicating very severe pain, and 9-10 indicating the worst possible pain **(10).**

2.1.3. The severity of breast engorgement:

Every woman in both groups (A&B) was assessed by using a 6-point self-rated breast engorgement scale before and after treatment, with 1=soft no difference, 2=slight difference, 3=firm and non-tender, 4=firm and beginning tenderness, 5=firm tender, 6=very firm and very tender **(12).**

2.2. Treatment procedures

The two groups (A&B) received their treatments once per day for 1 weeks.

2.2.1. Conventional therapy

Each woman in both groups (A&B) received conventional thermal therapy in form of moist warm towel for 10 minutes per session, 7 sessions per week for 1week.Also each woman in both groups (A&B) were received a conventional therapy in the form of massage for 30 minutes per session, 7 sessions per week for 1week. Massage was applied just after application of thermal therapy to gain maximum benefit.

2.2.2. Ultrasound (digisonic device 614 woolim lions vally)

Each woman in group (A) was received ultrasound therapy for 10-15 minute per session, for 7 session per week for1 week. The parameters were used at frequency1MHZ, intensity 0.5 W/cm^2. Soon after treatment to gain maximum benefit, they were received conventional therapy as moist heat and massage.

2.2.3. Transcutaneous electrical nerve stimulation (TENS) (chatanoga mobile stimulator device)

Each woman in group (B) was received TENS therapy for30 minute per session, 7 session per week for 1 week. The parameters were used at frequency 80-120HZ with pulse width 150 microsecond and intensity according to the patient sensitivity usually starts with minimal intensity. Soon after treatment to gain maximum benefit, they were received conventional therapy as moist heat and massage the same as group (A).

2.2.1.1. Moist heat

Each woman in both groups (A&B) received conventional thermal therapy in form of moist warm towel for 10 minutes per session, 7 sessions per week for 1week. Firstly, she was instructed to assume a comfortable relaxed half lying position. Her back was supported by cushions and pillows. She was covered by sheet. The skin of the affected breast was exposed. Moist warm towels were applied on the affected breast, and they were handled by the patient **Fig.(1).**

Fig. (1): Conventional therapy (Moist heat)

2.2.1.2. Breast massage

Each woman in both groups (A&B) received breast massage for 30 minutes per session, 7 sessions per week for 1week. Massage was applied just after application of thermal therapy to gain maximum benefit. Firstly, she was instructed to assume a comfortable half lying position. Her back was supported by cushions and pillows. She was covered by sheet. The skin of the affected breast was exposed, then applying some extra virgin olive oil to the breast to decrease the friction between the therapist's hand and the skin of the breast. Then gently massage with small circular movement all around the breast. The massage was often in a rhythmic motion by applying four fingers of one hand on the top of the breast and four fingers of the other hand on the bottom, then massage in a circular pattern.

Alternatively, both hands were placed together around the areola and then slid toward the base of the breast with or without a gentle rotation of the breasts: to the right and back, and then repeated to the left and back. Therapist hands were warm to gain best benefit. In between massage use hand expression at frequency of massage to 1-2 minutes for every 3-4 times of hand expression. Hand expression was applied by position index finger behind the base of the nipple. Bring fingers together while gentle pressure was applied to the breast, pushing the milk toward the nipple, removing the breast milk and squeezing the nipple rhythmically **Fig. (2).**

2.2.2. Ultrasound therapy

Each woman in group (A) received ultrasound therapy for 10-15 minute per session, for 7 sessions per week for1 week. Ultrasound device (digisonic) was used on the affected breast from a comfortable half lying position. Firstly, ultrasound head was cleaned by disinfectant solution, the pillows and cushions were used to support the patient body parts.

She was covered by sheet. the affected breast was exposed and cleaned by disinfectant solution and cotton, then the KY gel was applied to the ultrasound head as a coupling medium to insure maximum transmission of the waves.

Fig. (2): Conventional therapy (Massage).

The head of ultrasound was applied firmly over the breast from periphery towards the areola, lightly back to the chest and firmly down again to the areola in a slow, deep and circular movement. Then the ultrasound was switched off and any observable response to the treatment was documented. The parameters were used at frequency1MHZ, intensity 0.5 W/cm^2. Soon after US treatment to gain maximum benefit, they received conventional therapy (moist heat and breast massage) **Fig.(3).**

Fig. (3): US application for group (A)

2.2.3.Transcutaneous electrical nerve stimulation (TENS) therapy:

Each woman in group (B) received TENS therapy for 30 minute per session, 7 sessions per week for 1 week. Firstly, the adhesive electrodes were cleaned by cotton and disinfectant. The skin of the affected breast was exposed. The skin of affected breast was cleaned by disinfectant solution and cotton.

The woman was instructed to assume a comfortable half lying position. The pillows were used to support the patient body parts. Sheets were used to cover rest of the body which did not need exposure. Then the adhesive electrodes were applied on both side of nipple of the affected breast. The parameters were used at frequency 80-120HZ with pulse width 150 microsecond and intensity according to the patient sensitivity usually starts with minimal intensity. Then the TENS was switched off and any observable response to the treatment was documented. Soon after treatment to gain maximum benefit, they received conventional therapy (moist heat and breast massage) the same as group (A) **Fig.(4).**

Fig. (4): TENS application for group (B).

Statistical analysis:

Statistical analysis was conducted using SPSS for windows, version 22 (SPSS, INT., Chikagho, IL). Descriptive statistics and unpaired t-test were conducted for comparison of the mean age, weight, height and BMI of both groups. Unpaired t-test was conducted for comparison of VAS and 6-point self-rated breast engorgement scale between both groups. Paired t test was conducted for comparison between pre- and post- treatment mean values of VAS and 6-point self-rated breast engorgement scale in each group. The level of significance for all statistical tests was set at $p < 0.05$.

3.Results

3.1.Subject characteristics:

The current study was conducted on 40 participants. They were assigned into two equal groups. Group (A) consisted of 20 participants with mean age and BMI values of 25.9±3.32 years and 26.03±1.81 kg/m^2 respectively. Group (B) consisted of 20 participants with mean age and BMI of 26.85±2.5 years and 26.31±1.83 Kg/m^2 respectively.

As indicated by the independent t test, there were no significant differences ($p>0.05$) in the mean values of age and BMI between both tested groups **(Table 1).**

Table 1. Baseline characteristics of women in both groups.

	Group (A)	Group (B)	MD	t-value	p-value
	x̄ ± SD	x̄ ± SD			
Age (years)	25.9 ± 3.32	26.85 ± 2.5	-0.95	-1.02	0.31
Weight (kg)	72.9 ± 7.01	73.75 ± 8.48	-0.85	-0.34	0.73
Height (cm)	167.25 ± 5.5	166.75 ± 6.7	0.5	0.25	0.79
BMI (kg/m²)	26.03 ± 1.81	26.31 ± 1.83	-0.28	-0.49	0.62

x̄, mean; SD, standard deviation; p value, probability value

3.2. Within group comparison:

In group A and B, there was a substantial reduction in VAS and the 6-point self-rated breast engorgement scale after treatment relative to pretreatment ($p > 0.001$). The VAS and 6-point self-rated breast engorgement scale decreased by 65.93 and 51.09 percent in group A respectively, while they decreased by 68.61 and 53.93 percent in group B respectively **(figure 1, table 2).**

3.3. Between groups comparison:

In both variables, there was no substantial difference between the two groups before treatment ($p > 0.05$). After therapy, there was no substantial difference in VAS or the 6-point self-rated breast engorgement scale between group A and group B ($p > 0.05$) **(figure 1, table 2).**

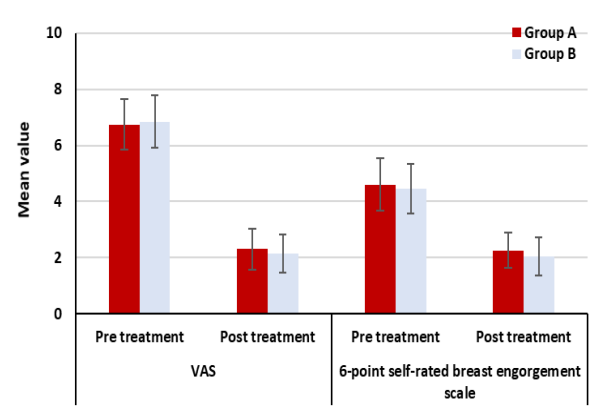

Figure 1. Mean VAS and 6-point self-rated breast engorgement scale pre and post treatment of the group A and B.

Table 2: Mean VAS and 6-point self-rated breast engorgement scale pre and post treatment of the group A and B

	Group A	Group B	MD	t-value	p value
	x̄ ± SD	x̄ ± SD			
VAS					
Pre treatment	6.75 ± 0.91	6.85 ± 0.93	-0.1	-0.34	**0.73**
Post treatment	2.3 ± 0.73	2.15 ± 0.67	0.15	0.67	**0.5**
MD	4.45	4.7			
% of change	65.93	68.61			
t- value	28.99	44.7			
	p = 0.001	***p = 0.001***			
6-point self-rated breast engorgement scale					
Pre treatment	4.6 ± 0.94	4.45 ± 0.88	0.15	0.51	**0.6**
Post treatment	2.25 ± 0.63	2.05 ± 0.68	0.2	0.95	**0.34**
MD	2.35	2.4			
% of change	51.09	53.93			
t- value	17.89	21.35			
	p = 0.001	***p = 0.001***			

x̄, mean; SD, standard deviation; MD, mean difference; p-value, probability value

4.Discussion

Breast engorgement is a common issue that affects both the start and continuation of breastfeeding. There are just a few options for relieving the discomfort of breast engorgement. As a result, further research into strategies for achieving real symptom relief is vital to promoting breastfeeding success. Pain will make it difficult for a woman to care for herself and her child. Untreated pain has been linked to increased opioid usage, postpartum depression, and the emergence of chronic pain **(13).**

The present study was conducted to compare the therapeutic efficacy of ultrasound (US) versus transcutaneous electrical nerve stimulation (TENS) on postpartum painful breast engorgement. The present study was carried on forty women suffering from postnatal breast engorgement, who were distributed randomly into two equal groups Group A and Group B. Evaluation for both groups (A&B) was done by evaluating pain level through visual analogue scale as well as evaluating severity of breast engorgement

through 6 point self -rated breast engorgement scale before and after the treatment.

Forty females diagnosed with breast engorgement shared in this study. They were choosen from the outpatient clinic of gynecology at Fakous Hospital, Sharquia. Their age ranged from 18 to 35 yrs. Their BMI was ≤ 30≥25 kg/m². The participants were excluded if they were with BMI higher than 30 kg/m², lactating mothers with soft breast, nonlactating mothers, suffering from breast cancer, using of cardiac pacemaker or having any skin condition.

They were assigned randomly into two equal groups: Group (A) were treated by ultrasound therapy on the affected breast from the third day after delivery. The parameters were used at frequancy1MHZ and intensity 0.5W/cm² for10-15 minutes per session, for one session per day for a week and conventional therapy as moist heat for10 minute per session, for one session per day, for a week and breast massage for 30 minute per session, for one session per day for a week.

According to the findings of the current research, the VAS of group A decreased significantly after treatment relative to before treatment ($p = 0.0001$). In addition, the 6-point self-rated breast engorgement scale of group A post treatment was significantly lower than that of group A pretreatment ($p = 0.0001$).

The findings of this study are backed up by **Kariman,** who compared the effects of ultrasound therapy and traditional therapy in treating breast engorgement in postpartum mothers using the VAS and Six-point engorgement scale (SPES). The findings of this research supported an alternative hypothesis that Ultrasound therapy applied to traditional therapy resulted in a substantial improvement in pain relief using the VAS or Six-Point Engorgement Scale **(14).**

Angelopoulou et al. who tested the effect of therapeutic ultrasound on breast mastitis, backed up the findings of this report. Therapeutic ultrasound (n=175), education and guidance (n = 160), and massage (n = 103) were among the physiotherapy interventions obtained by mothers. In the ultrasound category, 91.1 percent of women were clinically healed or significantly changed, compared to 83.3 percent in the education and guidance group and 53.6 percent in the massage group **(15).**

These findings match those of a study of 25 women who had a breast lump caused by a blocked duct. Eight women had their ducts repeatedly blocked (5 had multiple episodes while nursing the same child while 3 women experienced episodes with more than 1 child). Women were given therapeutic ultrasound therapies, ranging from one to seven sessions, in order to relieve their donation symptoms. After therapy, the majority of patients reported improved breastfeeding and symptoms relief. No adverse reactions were found in the medical records **(16).**

Jacobs et al. indicated that thermal (continuous) ultrasound therapy could promote the removal of milk from engorged breasts by assisting milk letdown, resulting in less pain and hardness (n=109), which may explain the findings of this study. A total of ten treatments were given to the women. When opposed to pretreatment, there was a substantial reduction in VAS after treatment **(17).**

The findings of this study supported by **Wong et al.** who reported that ultrasound is as successful as cabbage leaves, hot packs, and pharmacological treatment for breast engorgement. Since the type of treatment used in this study differed, the duration of treatment in each group was different. The findings showed that all of the treatments decreased engorgement and tenderness **(18).**

In contrary to **Witt et al.** who found this in their report of breast engorgement during lactation. Three research involving cabbage leaves or cabbage leaves extract found no overall benefit. In the treatment of breast engorgement, both ultrasound treatment and placebo were equally successful **(19).**

The results of **Rothenberg et al.** who examined ultrasound and simultaneous pumping without massage and ultrasound and simultaneous pumping with massage in different receiving classes, are consistent with the findings of the current research. The results showed that ultrasound combined with breast pumping and massage is more successful **(20).**

Also, **Coca et al.** support the current research by using clinical ultrasound to treat a ductal blockage that was preventing 25 lactating women from breastfeeding. Therapeutic ultrasound appears to be a viable option for treating blocked ducts and breast engorgement in this situation. painful blockages can develop in the breast tissue which can be painful and disrupt your ability to effectively nurse the affected breast **(21).** Blocked milk ducts can be caused by a number of factors which can make the surrounding tissue to become swollen and inflamed such as breast engorgement. Blocked ducts, if not treated early, it can lead to an infection of breast tissue, or painful mastitis. Therapeutic ultrasound had proved it's efficacy for the treatment of painful mastitis **(22).**

Also**, Mangesi et al.** and **Lavigne and Gleberzon** compared ultrasound to sham ultrasound in a study where both breasts were randomised (women may have active treatment on both breasts, sham treatment on both breasts, or active treatment on one breast and sham ultrasound on the other). Based on VAS comparing the paired pretreatment and posttreatment ratings for each breast, the trial authors note that both sham and active treatment had substantial decreases in subjective ratings of pain and hardness, but there were

no discrepancies between groups at the end of treatment. Treatment had a slight and incompatible impact on pain as calculated by VAS, adding that the placebo effect was present. In addition, no differences in breastfeeding period (18 weeks) were noted for women in different treatment groups, but the real rates in each group were not reported. Warmth, massage, rest, concentration, functional, emotional, and informative support offered by the physiotherapists during care were all factors that contributed to the therapeutic impact observed in both groups **(4-23).**

Group (B) were treated by Transcutaneous electrical never stimulation (TENS) on the affected breast at both side of nipple from the third day after delivery. The parameters were used at frequency 80-120HZ with pulse width 150 microsecond and intensity according to the patient sensitivity usually starts with minimal intensity for 30 minutes per session, for one session per day, for a week. and conventional therapy as group (A).

The results of this study revealed that there was a significant decrease in the VAS of the group B post treatment compared with that pretreatment (p = 0.0001). Also, there was a significant decrease in the 6-point self-rated breast engorgement scale of the group B post treatment compared with that pretreatment (p = 0.0001).

The results of the present study could be explained by the results of **Terkawi et al.** who reported that the effectiveness of TENS in reducing post mastectomy pain related to neo-plasm. Method: Single-blind randomized clinical trial with two groups of study. Conventional TENS was applied to one group while other group received placebo TENS during 10 sessions. They concluded that conventional TENS is an effective therapy to treat post mastectomy pain as it may reduce it as much as 79.6% **(24).**

In contrast with **Knoerl et al.; Siemens et al.** who stated that there was no difference between using of TENS and placebo in the treatment of persistant pain secondary to breast cancer with 41 participants. The improvement in the placebo group is likely related to a psychological component **(25-26).**

The findings supported **Leung's** conclusion that using TENS at the mother's breast and/or close to the mother's breast for milk expression stimulation was an effective process **(27).** These findings are in line with those of **Siemens et al.** who looked at the effects of TENS for the treatment of mastitis, blocked ducts, and engorgement and found a substantial improvement **(26).**

These findings came in accordance with **Gibson et al.** and **Altintoprak et al.** who reported that using of electrical stimulation such as TENS or faradic on acupuncture points lead to increase milk production **(28-29).** In addition, **Mann and Zhang** who demonstrated that electro acupuncture has a major impact on milk supply **(30).**

Also**, Krisana et al.** demonstrated that breast massage was an effective intervention in reducing breast engorgement in lactating mothers **(31).**

In addition, according to **Lily** hot fomentation was thought to be highly effective in reducing breast engorgement, while cold compression was found to be more effective in reducing pain severity score due to breast engorgement among postpartum women **(32).**

Also, according to **Princy et al.** there was a substantial improvement in breastfeeding strategies of postnatal mothers and their babies due to a decrease in breast engorgement after application of breast massage, which was successful in managing moderate breast engorgement, an increase in breast milk pH, and an increase in the suckling speed of postnatal neonates **(33).**

It was concluded that the use of chilled cabbage leaves and hot compression to relieve breast engorgement was found to be successful. In the clinical environment, both procedures were successfully implemented. Both treatment modalities are inexpensive and widely available. It may be used by nurses in their daily work at the hospital and at home to treat breast engorgement **(34).**

Pretreatment, there was no statistically significant difference between groups (A&B) (t value= -0.34) and (p value =0.73). There was also no significant difference between the two groups (A&B) after treatment (t value = 0.67) and (p value = 0.5).

There was no substantial difference between the two groups (A&B) after treatment, according to the comparison. **Apurva et al.** who presented evidence to support the use of both TENS and US for painful breast engorgement, backed up the findings of this report. Furthermore, the findings revealed that there was no substantial difference in the efficacy of ultrasound and TENS with conventional treatment in postnatal painful breast engorgement **(35).**

This study got several limitations. First was the inability to use objective methods such as sonography or mammogram. Also, small sample size, emotional and psychological state of subject may affect evaluation, individual and personal difference between subjects, learning and performance skill, duration of the study and environmental factor that may affect subject's response.

5.Conclusion

Accordingly, it can conclude that both ultrasound and transcutaneous nerve stimulation are effective and successful therapy in treating postnatal breast engorgement and there is no significant difference between them.

Conflict of Interest

The authors declare that this research has received no grad or fund from any agency further, the authors declare that there is no conflict of interest.

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