Analgesic efficacy of pulsed radiofrequency in non-cyclic mastalgia: A randomized controlled trial

Nevert A. Abdel Ghaffar1*, Ghada F. Amer1, Mahmoud A. Abdel Ghaffar2, Adel El-Badrawy3
Lecturer of Anaesthesia1*, Intensive Care and pain management, Consultant2, General Surgery in Oncology Center, Professor3, Radiology, Faculty of Medicine, Mansoura University, Egypt.

Background: Non cyclic-mastalgia is a challenge among women. We aimed to study the effects of adding pulsed radiofrequency to tamoxifen 10mg daily in treatment of non-cyclic mastalgia.

Methods: We conducted a randomized prospective open blinded endpoint, level IV trial in the outpatient pain clinic of Mansoura University Oncology Center during the period from 2018 till 2019. Patients were randomly allocated into two groups. Group A (n=13) received tamoxifen 10mg tablet once daily and group B (n=13) received tamoxifen 10mg tablet once daily and pulsed radiofrequency of the 2nd, 3rd and 4th thoracic dorsal root ganglia. We monitored numerical rating scale (NRS) and quality of life (QOL) before and at intervals of 2 weeks, 1, 2 and 3 months after treatment; complications; side effects of tamoxifen; and number of patients who needed analgesia.

Results: Numerical rating scale significantly decreased in group B compared to group A at 2 weeks (P = 0.002) and 1, 2 and 3 months (P<0.001). Group B showed marked improvement in QOL at 2 weeks, 1, 2 and 3 months(P<0.001). No complications were reported in both groups. Patients who needed analgesia were more in group B than group A (P=0.018).

Conclusions: Combined usage of pulsed radiofrequency and tamoxifen 10mg daily is a safe line of treatment of non-cyclic mastalgia and markedly improves QOL.

Keywords: Pulsed radiofrequency; non-cyclic mastalgia; tamoxifen

Introduction
Mastalgia or breast pain is a common medical problem among women.1 Its intensity is variable ranging from mild to severe and disturbs quality of life (QOL) through affecting sexual, physical, and social activities.2

Mastalgia is classified into three main categories: cyclic, non-cyclic and extra-mammary mastalgia. As regards non-cyclic mastalgia, most cases have unknown aetiology while a minority of cases are due to mastitis, pregnancy, trauma, macrocysts, thrombophlebitis, psychological disturbance and cancers.

Typically, it presents in the fourth decade of life. Many women are postmenopausal at onset of symptoms. Unfortunately, the course of non-cyclic mastalgia may be long and persist for many years.3

Mastalgia may be bilateral or unilateral. In unilateral cases, pain may be located in only one part of the affected breast. It can be referred from the breast to the axilla and down to the medial aspect of the upper arm. The affected breast is often extremely tender and may show swellings and congestion.4 A variety of medical therapies have been recommended for treatment of mastalgia. These traditional lines of treatment include non-steroidal anti-inflammatory drugs (NSAIDs), vitamins, progesterone, diuretics, thyroxin, bromocriptine, danazol, tamoxifen and plant extracts as evening primrose oil (EPO).5

For few decades, tamoxifen is routinely used in mastalgia treatment. However, several side effects have been observed in form of weight gain, nausea, hot flushing, bloating, menstrual irregularity, amenorrhoea, vaginal dryness and
thromboembolism. Moreover, its value in alleviating non-cyclic mastalgia is doubtful when compared to cyclic mastalgia. From this point, searching for an ideal safe line of treatment for non-cyclic mastalgia is mandatory.

Pulsed radiofrequency (PRF) has recently been developed as an alternative therapeutic technique for relief of chronic breast pain. To our knowledge, it is the first trial to study the effects of adding pulsed radiofrequency of 2nd, 3rd and 4th thoracic dorsal root ganglia (DRG) in treatment of non-cyclic mastalgia through assessing both pain intensity and QOL.

Materials and methods
Study design and participants
Our research was a randomized prospective open blinded endpoint, level IV study, carried out in the outpatient pain clinics of Mansoura University Oncology Center during the period from October 2018 till February 2019. We enrolled 26 patients suffering from non-cyclic mastalgia that did not respond to traditional treatment for one month (well-fitting bra, reduction in dietary fat intake, EPO, oral or topical NSAIDs). Patients aged from 20 to 60 years with numerical rating scale (NRS) ≥ 4 were enrolled. Written informed consents were obtained from all participants.

Sample size
It was calculated using G Power 3.0.10 program. Assuming α (type I error) = 0.05 and β (type II error) = 0.2 (power = 80 %) and effect size (δ) = 0.6 yielded a total sample size of 26.

Randomization
Each patient was randomly allocated into one of two groups (Group A and B) using variable sized blocks (3, 3, 3 and 4). Opaque sealed envelopes technique was used for allocation concealment. Group A (n=13) received tamoxifen 10mg tablet once daily, while group B (n=13) received tamoxifen 10mg tablet once daily and PRF of the 2nd, 3rd and 4th thoracic DRG.

Exclusion criteria
Cyclical mastalgia (abnormal oestrogen, progesterone and prolactin hormones levels), extra-mammary mastalgia (cervical MRI, chest examination and ECG), patients refusal to participate, suspicion of malignancy (mammogram was done for all participants), acute inflammatory breast conditions; presence of polycystic ovarian diseases, cervical hyperplasia, pregnant patients, lactating women, coagulopathy disorder, sepsis at the site of injection, history of thromboembolic disease, mental disorder and disturbed anatomy (congenital, traumatic, and postsurgical) which increase the intervention difficulty.

Technique
We inserted an intravenous cannula. All required resuscitation drugs and equipment were available. All participants were monitored for vital signs and oxygen saturation throughout the procedure and up to one hour after performance of block.

Resuscitation equipment were available including endotracheal tubes of different sizes, self-inflating bag and mask, a ventilator, chest tubes and drugs as atropine and adrenaline.

We performed the procedures on a 64 MDCT scanner (Brilliance 64-Philips). The acquisition parameters of CT were 200mAs, 120kVp, 512 × 512 matrix, 1.172 pitches; 4mm slice thickness and 64 × 0.625mm section collimation.

Patients were positioned prone, then 2nd, 3rd and 4th thoracic disc levels were detected in the sagittal plan, then the target corresponding thoracic nerve roots were identified in the axial plan. After marking the entry points, povidone iodine was used for skin sterilization, and then the skin was anaesthetized by 2ml lidocaine 2% at each entry point. The Baileys radio frequency 22G, 10cm needles with 10mm active tip were introduced to face the 2nd, 3rd and 4th thoracic nerve roots (Figures 1a and b).

![Figure 1a: Sagittal view of the needles at the 2nd, 3rd and 4th thoracic nerves roots.](image-url)
Figure 1b: 3-Dimensional view of the needles at the 2nd, 3rd and 4th thoracic nerves roots.

If the pleura or the lung were within the pathway of the needle, saline injection was done to push them away from the field (Figure 1c).

Figure 1c: Axial view of the needle at the 2nd thoracic nerve root.

Once we confirmed the place of the needles tips, the sensory and motor stimulations was done by the RF generator to get sensory paraesthesia along T2, T3 and T4 dermatomes at 0.4–0.8V (Figures 1c, d and e, respectively), and intercostal fasciculation were obtained at double the sensory amplitude.

Figure 1d: Axial view of the needle at the 3rd thoracic nerve root.

Figure 1e: Axial view of the needle at the 4th thoracic nerve root.

The PRF course was carried out at 42°C for 120s twice at each level followed by injection of 1 ml lidocaine 2% and 1 ml dexamethasone 4mg at each level.

After intervention, all patients were transferred to a recovery room for observation and followed for any complication. If NRS was ≥ 4, we gave NSAIDs in form of oral piroxicam 20mg once daily with or after food.

Primary outcome: NRS was recorded before and at intervals of 2 weeks, 1, 2 and 3 months after starting treatment.
Secondary outcomes:
1. QOL (The American Chronic Pain Association’s QOL scale): It measured the daily activities of patients with chronic pain ranging from 0 = stay in bed all day and feel hopeless and helpless about life to 10 = normal daily activities each day and have a social life outside of work. We assessed QOL before treatment and after two weeks, 1, 2 and 3 months;
2. Complications during and after intervention as haematoma, neurological deficits, infection or respiratory insufficiency (dyspnoea or pneumothorax);
3. Number of patients who needed analgesia;
4. Side effects of tamoxifen as nausea, vomiting, hot flushes and dizziness.

Statistical analysis
SPSS (version 25) was used for statistical analysis. For continuous variables, data normality was checked by Shapiro-Wilk test. Continuous variables were presented as mean ± SD, ordinal variables shown as median and inter-quartile range while categorical data were presented as number (percentage). Independent samples t-test and Mann Whitney test were used to compare normally and abnormally distributed continuous variables with no follow-up readings respectively. A linear mixed model with unstructured co-variance was conducted using the maximum likelihood method and 95% confidence interval to compare basal and follow-up readings of the NRS score and QOL after the procedure in all patients and both study groups. P value < 0.05 was considered statistically significant.

Results
Both groups were matched as regards demographic data, duration of pain and the affected breast. However, the number of patients who needed NSAID after intervention was significantly higher in group B than group A (P=0.018, Table 1).

Table 1: Differences in demographic data, duration of pain, analgesia need and affected breast between the studied groups.

|                          | Group A (n=13) | Group B (n=13) | P value |
|--------------------------|----------------|----------------|---------|
| Age (years)*             | 30.6±5.65      | 30.6±5.12      | 0.84    |
| Height (cm)*             | 162±6.65       | 163.9±5.6      | 0.43    |
| Weight (kg)*             | 76.6±10.18     | 75±8.94        | 0.67    |
| Duration of pain (months)*| 8.32±1.88     | 8±2.04         | 0.77    |
| NSAIDS needs†            | 4 (30.7)       | 10 (76.9)      | 0.018   |
| Affected breast†         |                |                |         |
| Left side                | 7(53.8)        | 5(38.5)        |         |
| Right side               | 5(38.5)        | 8(61.5)        |         |
| Bilateral                | 2(15.4)        | 2(15.4)        | 0.39    |

Data are shown as *mean (SD); † numbers (percentage).

NRS was significantly lower in group B than group A at 2 weeks (P =0.002) and became much lower after 1, 2 and 3 months (P<0.001, Table 2).

Table 2: Differences in numerical rating scale (NRS) between the studied groups

| NRS       | Group A (n=13) | Group B (n=13) | P values |
|-----------|----------------|----------------|----------|
| Basal     | 8 (7.5-8.5)    | 8 (7-9)        | 0.62     |
| Two weeks | 5 (4-5)        | 3 (2.5-4)      | 0.002    |
| One month | 4 (4-5)        | 2 (1.5-2.5)    | < 0.001  |
| Two months| 4 (3.5-4)      | 1 (1-2)        | < 0.001  |
| Three months | 3 (3-4) | 1 (1-2)        | < 0.001  |

NRS; numerical rating scale; Data are shown as median (IQR).

Group B showed marked improvement in QOL at 2 weeks, 1, 2 and 3 months (P<0.001, Table 3).
Table 3: Differences in quality of life (QOL) between the studied groups

| QOL          | Group A (n=13) | Group B (n=13) | P values |
|--------------|----------------|----------------|----------|
| Basal        | 2 (2-3.5)      | 2 (1.5-3.5)    | 0.85     |
| Two weeks    | 7 (7-8)        | 9 (8-9.5)      | < 0.001  |
| One month    | 8 (7-8)        | 9 (9-10)       | < 0.001  |
| Two months   | 8 (7-8)        | 10 (10-10)     | < 0.001  |
| Three months | 8 (7-8)        | 10 (10-10)     | < 0.001  |

QOL: Quality of life; Data are shown as median (IQR).

No complications were reported in both groups as regards both PRF and tamoxifen.

Discussion

Mastalgia is a painful condition affecting up to 70% of women. Indeed, it is a challenge that affects QOL in a way similar to other painful conditions such as arthritis or cancer.13

In the current study, we clarified the value of adding interventional PRF of the 2nd, 3rd and 4th thoracic dorsal root ganglia to the routine treatment, tamoxifen 10mg tablet once daily, in management of non-cyclic mastalgia.

In our study, the improvement in NRS with radiofrequency could be explained by activation of temperature-independent pathway that leads to cessation of the current pain and promptly changes pain conduction to normal.14 This goes hand in hand with Kim et al who used PRF of the 4th thoracic spinal root in a 52 years old female patient complaining of chronic mastalgia after breast reduction. They reported long-lasting pain reduction {Visual analogue score (VAS) 20-30/100 mm} for 9 months without any particular exacerbation of pain and without any side effects.15

Moreover, Fam et al found that PRF with steroid injection on the 2nd and 3rd thoracic DRG is a safe and effective method for intercostobrachial neuralgia post-mastectomy treatment. VAS decreased significantly after 1 week, 1, 3 and 6 months respectively (from 7.48±1.46 to 5.01±2.61, 3.26±2.37, 4.44±2.8 and 4.7±2.88 respectively, p<0.05).8

Interestingly, our study reported gradual improvement in NRS with time in group B to reach its full effect after one month (P< 0.001). This goes hand in hand with authors who proved that pain with PRF become progressively better and takes up to several weeks to show a maximum effect.16

An important observation was the higher need for NSAIDs within the first few days among group B. This could be due to the pain induced from needles entrance in the back. Moreover, the inflammation of the nerve roots caused by PRF and the release of interleukins, tumor necrosis factor-α, and phospholipase A2 could add a pathophysiological explanation for the initial increased need for analgesia with PFR.17

Another finding in our report was the dramatic improvement in QOL among group B. Of course, we could explain this finding by better pain relief in this group. Our results are in agreement with authors who used PRF in post-herpetic neuralgia patients and found dramatic pain relief with subsequent enhanced QOL. They used 36-Item Short Form Survey (SF-36) score to assess QOL.18

Also, our study emphasized safety and well tolerance of tamoxifen and PRF in both groups as evidenced by absence of complications. This could be explained by usage of CT that minimizes technical errors. Absence of complication with tamoxifen 10mg daily was supported by the previous report of Jain et al.11

In summary, combined usage of PRF and tamoxifen 10mg daily could be considered a safe line of treatment of non-cyclic mastalgia. Also, adding PRF to the traditional tamoxifen 10mg therapy markedly improves QOL. We recommend large scale multicenter studies with larger simple sizes to generalize our findings.

Limitations of study: A single center study with relatively small sample size.

References

1. Kataria K, Dhar A, Srivastava A, et al. A systematic review of current understanding and management of mastalgia. Indian J Surg 2014;76(3):217-22
   https://doi.org/10.1007/s12262-013-0813-8
   PMID:25177120 PMCid:PMC4141056
2. Smith RL, Pruthi S, Fitzpatrick LA. Evaluation and management of breast pain. Mayo Clinic Proceedings 2004;79(3):353-72
3. Davies EL, Gateley CA, Miers M, Mansel RE. The long-term course of mastalgia. J R Soc Med 1998;91(9):462-4
https://doi.org/10.1177/014107689809100903
PMid:9849515 PMCid:PMC1296872

4. Ader DN, Shriver CD, Browne MW. Cyclical mastalgia: premenstrual syndrome or recurrent pain disorder? J Psychosom Obstet Gynecol 1999;20(4):198-202
https://doi.org/10.3109/01674829909075596

5. Saghafi N, Rikhshandeh H, Pourmoghadam N, et al. Effectiveness of Matricaria chamomilla (chamomile) extract on pain control of cyclic mastalgia: a double-blind randomized controlled trial. J Obstet Gynaecol (Lahore) 2018;38(1):81-4
https://doi.org/10.1080/01443615.2017.1322045
PMid:29072514

6. Messinis IE, Lolis D. Treatment of premenstrual mastalgia with tamoxifen. Acta Obstet Gynecol Scand 1988;67(4):307-9
https://doi.org/10.1080/01443618800674985
PMid:29072514

7. Fentiman IS, Caleffi M, Hamed H, Chaudary MA. Dosage and duration of tamoxifen treatment for mastalgia: a controlled trial. Br J Surg 1988;75(9):845-6
https://doi.org/10.1002/bjs.1800750905
PMid:3052691

8. Fam BN, El-Sayed GGE, Reyad RM, Mansour I. Efficacy and safety of pulsed radiofrequency and steroid injection for intercostobrachial neuralgia in postmastectomy pain syndrome-A clinical trial. Saudi J Anaesth 2018;12(2):227-34
https://doi.org/10.4103/sja.SJA_576_17
PMid:29628852 PMCid:PMC5875210

9. BeLieu RM. Mastodynia. Obstet Gynecol Clin North Am 1994;21(3):461-77

10. Colak T, Ipek T, Kanik A, et al. Efficacy of topical nonsteroidal antiinflammatory drugs in mastalgia treatment. J Am Coll Surg 2003;196(4):525-30
https://doi.org/10.1016/S1072-7515(02)01893-8

11. Jain BK, Bansal A, Choudhary D, et al. Centchroman vs tamoxifen for regression of mastalgia: a randomized controlled trial. Int J Surg 2015;15:11-6
https://doi.org/10.1016/j.ijsu.2014.12.033
PMid:25619124

12. Association ACP. Quality of life scale: a measure of function for people with pain. 2003. Available at: https://www.theacpa.org/wpcontent/uploads/2017/08/Life_Scale_3.pdf

13. Koçoğlu D, Kurşun S, Akin B, Altuntug K. Mastalgia and associated factors: a cross-sectional study. Agri 2017;29(3):100-8
https://doi.org/10.5505/agri.2017.91069
PMid:29039149

14. Byrd D, Mackey S. Pulsed radiofrequency for chronic pain. Curr Pain Headache Rep 2008;12(1):37-41
https://doi.org/10.1007/s11916-008-0008-3
PMid:18417022 PMCid:PMC2913603

15. Kim HT, Kim KY, Kim YD, Moon HS. Pulsed radiofrequency lesioning for treatment of chronic breast neuropathic pain after breast reduction-A case report. Korean J Anesthesiol 2010;59:3238-41
https://doi.org/10.4097/kjae.2010.59.S.238

16. Sluijter ME. Pulsed radiofrequency. Anesthesiology 2005;103(6):1313
https://doi.org/10.1097/00000542-200512000-00029
PMid:16306748

17. Choi G, Ahn SH, Cho YW, Lee DG. Long-term effect of pulsed radiofrequency on chronic cervical radicular pain refractory to repeated transforaminal epidural steroid injections. Pain Med 2012;13(3):368-75
https://doi.org/10.1111/j.1526-4637.2011.01313.x
PMid:22296730

18. County C, Yingwei W, Jiaotong S. Efficacy of pulsed radiofrequency in the treatment of thoracic postherpetic neuralgia from the angulus costae: a randomized, double-blinded, controlled trial. Pain Physician 2013;16(1):15-25
