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Original Article

Ultrasound guided versus fluroscopic guided pulsed radiofrequency therapy of the stellate ganglion in neuropathic pain: A prospective controlled comparative study

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ABSTRACT

Objective: To assess the efficacy and safety of fluoroscopic–guided versus ultrasound (US)-guided techniques for pulsed radiofrequency (RF) therapy of stellate ganglion for refractory neuropathic pain syndromes.
Methods: 40 patients with severe chronic neuropathic pain syndromes, Visual Analogue Scale (VAS) score > 7, with poor response to medical treatment were randomly integrated into 2 groups: Group (F): (20 patients) in whom pulsed R.F. therapy is done under fluoroscopy, group (U): (20 patients) in whom pulsed R.F. therapy is done under US guidance.
Results: The current study revealed that there is significant reduction of VAS, and of the medical treatment consumption after the block as compared with pre block values, there is no statistically significant difference between the guidance techniques of RF treatment in pain relief. However, the procedure time was significantly lower in U group.
Conclusion: Pulsed R.F. blockade of the stellate ganglion in patients with refractory neuropathic pain syndromes can be done safely and efficiently under the guidance of either ultrasound or fluoroscopy. Both radiological techniques provide similar satisfactory guidance without significant complications.

1. Introduction

The stellate (cervico-thoracic) ganglion is the result of fusion of the inferior cervical sympathetic ganglion with the first thoracic one and this fusion occurs in 80% of population. It is star shaped and measures 2.5 cm long, 1 cm wide and 0.5 cm thick and lies in front of C7 transverse process and the head of first rib [1]. Stellate ganglion blockade is utilized as diagnostic, prognostic or therapeutic intervention for sympathetic-mediated (maintained) pain, neuropathic pain syndromes and a lot of clinical implications [2].

Stellate ganglion blockade has been proven to be of value in vascular insufficiency of the upper limb such as Raynaud's disease, vasospasm, embolic vascular disease, Paget's disease, scleroderma, palmar hyperhydrosis, and in many pain syndromes like phantom limb pain, complex regional pain syndrome (CRPS), post-herpetic neuralgia, diabetic neuropathy, vascular headache, atypical facial pain and tic douloureux [3,4]. Other indications of left-stellate block are prinzemetal angina, prolonged Q-T syndrome and massive pulmonary embolism (bilateral block) [4].

On the other hand, stellate ganglion blockade is not a risk-free technique due to close proximity of a variety of vital structures. The vertebral artery originates from subclavian artery and lies anterior to the stellate ganglion at C7 level, then passing over the ganglion to enter the vertebral foramen. It lies posterior to C6-anterior tubercle. The ganglion is bounded medially by longus colli muscles, laterally by scalene muscles, anteriorly by subclavian artery, posteriorly by prevertebral fascia and transverse process, inferiorly by the pleura. Other important nervous structures related to the ganglion include the phrenic nerve (lateral), the recurrent laryngeal nerve (antero-medial) and the C8-T1 anterior divisions (posterior) [3,5].

Different modalities have been tried to block the stellate ganglion including local anesthetics, steroids, neurolytic agents

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(phenol in saline 3%) [6] and radiofrequency therapy (pulsed or thermal) [7].

Radiofrequency neurolysis is an extension of continuous regional sympathetic blockade [8] or chemical neurolysis with long-term efficacy and more safety together with less morbidity than open surgical techniques [9]. Multiple imaging guidance are in use to perform stellate block whether ultrasound (which provide clear visualization of vascular and soft tissues structures) [10], MRI, CT and plain fluoroscopy [2]. Fluoroscopic approaches to block the stellate are either anterior (C6–C7), oblique or posterior [1,3,6].

In this prospective controlled study, we tried to compare the efficacy and safety of fluoroscopic–guided versus U/S-guided techniques for pulsed radiofrequency therapy of stellate ganglion aiming that the resulting sympathectomy may help to alleviate refractory neuropathic pain syndromes.

2. Patients and methods

After approval of local ethical committee and obtaining informed consent, 40 patients were randomly selected from the pain clinic of National Cancer Institute (NCI) Cairo University between August 2011 and February 2014. All patients had chronic neuropathic pain syndromes in the upper limb with severe pain (VAS score > 7) refractory to strong opioids (morphine sulfate tablets) and adjuvant therapy (pre-gabalin Capsules) or experiencing intolerable side effects. Patients with local and systemic sepsis, coagulopathy, local anatomical distortion (post-operative or post-radiotherapy) making the procedure difficult or hazardous are excluded from the study. Also patients with history of contralateral chest disease or pneumonectomy, glaucoma, recent M.I. or severe bradyarrythmias or heart block and allergy to the used medications, were excluded from the study.

3. Patients were randomly integrated into 2 equal groups

Group (F): (20 patients) in whom pulsed R.F. therapy is done under fluoroscopy.
Group (U): (20 patients) in whom pulsed R.F. therapy is done under US guidance.

ASA-standard monitors (ECG, non-invasive blood pressure and pulse oxymitery) were connected to all patients. I.V. line (G-20) and O2 (3 L/min) through nasal pronge were used. Midazolam 0.02 mg/kg and fentanyl 1 Ug/kg (conscious sedation) were used. The patient was asked to lie supine over radiolucent table with the neck extended and a small pillow under shoulders. The field was sterilized with 10% betadine (povidone-iodine) and draped. The patient was foretold to communicate by moving the contralateral hand and not to speak or swallow during needling.

4. Fluoroscopic-technique (anterior approach)

Visualization of C6-C7 level was attained through PA after good alignment was obtained by caudocephalic orientation (C7 level is identified by the nearby T1-transverse process ballooning). Then, the C-arm was turned 5-10o ipsilateral to open the vertebro-transverse junction at C7. At this point of entry, 1% lidocaine was infliterated S.C. using 22 G needle. Then R.F. needle (curved, sharp, 22 G, 50 or 100 ml length with 10 mm active tip) was advanced using tunnel technique until bony contact was made at the antero-lateral side of C7 vertebra (Fig. 1A). After negative aspiration (For blood, CSF or air), 3 ml of contrast medium (iohexol, omnipaque) was injected. It should outline the retropharyngeal space, longitudinal, huking the lateral vertebral margin, within the vertebral shadow (on lateral view), not taking vascular, epidural, intrathecal or muscular pattern (Fig. 1B). Then the suitable R.F. electrode was inserted and connected to Bailys generator. Impedance should be 250–350 and no paresthesia is felt with sensory stimulation (50 Hz to 1.0–1.5 V) particularly in the upper limb and motor stimulation should be negative (while the patient saying E-E) at 2 Hz and 3 V. 3 ml lidocaine 2% plus 1 ml diprofos (5mg betamethosone) was injected. After 30–60 s, we used pulsed RF protocol with time = 8 min, temperature = 42 °C and pulse width = 10 m s.

5. Ultrasound technique [10]

The patient was prepared as before. High-resolution ultrasound imaging for identification of small nerves and the interface between bone and soft tissues, with Doppler for the nearby vessels (vertebral, superior and inferior thyroid vessels). Siemens Acuson × 700 U/S machine with high frequency linear transducer was used for superficial targets. Anterolateral margin of C6 body with the transverse process was identified. The target point is identified by the 4–12 MHz linear-array probe and check the R.F. needle orientation (looking at thyroid anteriorly and esophagus posteriorly) we used out of plane technique.

Then the needle was withdrawn and reinserted obliquely so that the needle tip lie anterior to longus coli muscle (anterior to C6 transverse process). After negative aspiration, 1 ml of normal saline was injected which should spread adequately up and down without vascular uptake (Fig. 2). Then pulsed R.F. was done as previously after sensory and motor stimulation then 3 ml of lidocaine 2% plus 1 ml diprofos was injected.

After stellate ganglion block was performed, to confirm stellate ganglion block, touch temperature thermometer was used to compare between both sides, then the site of procedure was draped with sterile pad and ice pack is applied to reduce hematoma. The patient is monitored for 2 h vitally and all patients of both groups are screened 2 h after the procedure by plain radiography to exclude pneumothorax and by neck ultrasound for hidden hematoma possibility .The patients were instructed before discharge to call the physician urgently if severe chest pain, dyspnea, CVS collapse, dysphonia, severe pain and motor deficit develop.

6. Patient evaluation

The patients were assessed for pain relief (VAS score), opioid and pregabalin consumption prior to block and at 1 day 1, 4, 12 weeks afterwards. Both morphine and pregabalin were stopped and the patient had free access to immediate release morphine (Sevradol 10 mg) and reassessed after 2 and 7 days to estimate the new escalating dose. Complications including Horner's, nerve palsies (recurrent laryngeal, phrenic and lower brachial plexus), vascular (vertebral and carotid arteries) and pleural injuries, epidural or subarachnoid injection, esophageal puncture, hematoma and osteomyelitis all were reported.

7. Statistical analysis

Descriptive tables and statistical analysis were made by software SPSS (Statistical package for social science) version11.0 statistical program. Parametric data were represented as mean and standard deviation; meanwhile, nonparametric data were represented as median and interquartile range. Within group comparison for the difference of VAS score, morphine consumption, and pregabalin consumption was done using paired *t* test. Meanwhile, comparison between the groups at specific time intervals was made by Mann-Whitney U test. A significant difference was accepted at $P < .05$.