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A Retrospective, Single-Center Study Investigating the Effects of a Novel Miniature Wireless Spinal Cord Stimulation System for the Treatment of Chronic Back and Leg Pain

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Background: Tietze syndrome is believed to be a result of recurrent microtrauma and characterized by painful localized inflammation and swelling of the chest wall. Chronic inflammatory changes may infiltrate surrounding tissues, leading to nerve root irritation and subsequent neuralgia. Resultant chronic neuropathy has been historically treated with conservative therapies and local nerve blocks, but the role of implantable neurostimulators have not been well described.

Case Report: A 73-year-old woman presented with chronic pain in the left paracentral chest area with episodes of burning and tingling, which radiated to the left shoulder, left arm, and left upper side of the jaw and face. Following the implantation of a permanent neurostimulator, the patient reported a near complete resolution of her pain symptoms.

Conclusion: The role of implantable neurostimulators in the treatment of chronic neuropathy in the setting of Tietze syndrome is promising and their use may become a mainstay option in the future.

Key words: Tietze Syndrome, neuromodulation, spinal cord nerve stimulation, pain management, neuralgia, implantable spinal cord stimulator

BACKGROUND

Chest pain accounts for nearly 1% of all outpatient physician office visits (1) and is the second most common reason to visit the emergency department (2); however, only about 1.5- percent of outpatient visits culminate in a diagnosis of unstable coronary artery disease or myocardial infarction, (3) and as few as 10-percent of emergency department patients are confirmed to have acute coronary syndrome (4). Moreover, nearly 50-percent of chest pain presentations are due to a noncardiac or nonpulmonary etiologies. More specifically, musculoskeletal etiologies are the most common diagnoses made for chest pain presentations to primary care settings in the United States and Europe (5-7). The main causes of musculoskeletal chest pain in adults span a number of categories (8) and are often misunderstood and confounded.

Tietze syndrome (TS) is a rare musculoskeletal pathology that is believed to be a result of recurrent microtrauma, usually self-limiting, and characterized by painful localized inflammation and swelling of the costochondral, costosternal, manubriosternal, xiphisternal, or sternoclavicular joints (9, 10). First described in 1921 by Alexander Tietze (11), Tietze syndrome is

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monoarticular in most cases but may affect multiple anterior chest wall joints; the most common sites of pain and swelling are the second and third ribs (12). Histological findings include cartilaginous hypervascularity, degeneration, and mucoid debris formation which may undergo calcification and result in peripheral hypertrophic changes (13). Investigative magnetic resonance imaging has revealed localized cartilage thickening, bone marrow edema, and increased gadolinium uptake in areas of thickened cartilage, subchondral bone marrow, joint capsule, and related ligamentous structures (14). Imaging studies support the presence of chronic inflammatory changes (9) which may lead to chronic pain and swelling that can mimic tumors, atypical chest pain, acute coronary syndrome, pneumonia, and other severe disease processes (10,15-18). Finally, chronic inflammatory changes may infiltrate surrounding tissues, leading to nerve root irritation and subsequent neuralgia, which may progress to radiculopathy affecting the neck, shoulders, and arms (12). Resultant chronic neuropathy has been treated with nonsteroidal anti-inflammatory drugs, antidepressants, anticonvulsants, opioid analgesics, and local nerve blocks (16, 17); however, the role of implantable neurostimulators in TS has not been well described yet.

CASE PRESENTATION

A 73-year-old woman with a reported history of back problems, eye disorder, gastroesophageal reflux, and former smoking status presented to the outpatient pain clinic with pain in the left paracentral chest area. She described the pain as debilitating and reported the pain to be an 8/10 on the visual analog scale (VAS). There were associated paroxysmal episodes of swelling and edema superimposed on the painful area. She also reported that at times a burning and tingling pain radiated to the left shoulder, left arm, and left upper side of the jaw and face. There were no reported other neurological deficits or neck pain. Finally, conservative treatment was not able to control her pain.

She denied any recent travel or trauma but did admit to experiencing multiple bouts of severe pneumonia for which she was intubated, underwent 4 thoracotomies, and treated in the intensive care unit for a period of 8 weeks. She denied fatigue, fever, and change in weight, but did admit to experiencing headaches. She also denied any cough, dyspnea, and pleurisy. The patient did endorse an allergy to penicillin.

Musculoskeletal exam of the thorax revealed the following: inspection and palpation of the thoracic spine was within normal limits anatomically but there was tenderness noted on the spinous processes (T8-T10). There was also notable tenderness upon palpation of the front parasternal area near the sternocostal joints (T8-T10) with evidence of swelling and edema measuring 12 inches. There was no evidence of discoloration, erythema, or ecchymosis present on the overlying skin. Spinal alignment on lateral view revealed an increase in thoracic kyphosis. Range of motion of the thoracic spine in flexion was restricted and approximately 15°. Range of motion of the thoracic spine in extension was restricted and approximately 15°. Strength testing of the major muscles innervated by the thoracic spine was graded at 5/5. T1 nerve root strength testing of the interosseous muscles was graded at 5/5, bilaterally. Lower thoracic nerve roots: Beevor sign for asymmetric loss of thoracic root motor function was negative.

All other physical exam findings were unremarkable.

The working diagnosis at this point was TS. The diagnosis and treatment options were explained to the patient and discussed in detail. Topical lidocaine 1.8% patches were prescribed to be applied at the site of pain in the left parasternal area for 24 hours daily to start conservative treatment. Over the course of the following 8 months, the patient had a total of 3 procedures including one where a mixture of dexamethasone 20 mg, ketorolac 30 mg, triamcinolone 40 mg and lidocaine 1% were injected under fluoroscopic guidance into costochondral joints T8-T10 and 2 where autologous platelet rich plasma was introduced under fluoroscopic guidance into costochondral joints T8-T10. These procedures provided temporary relief, but the patient redeveloped the same symptoms. Following the last procedure, the decision was then made to attempt a peripheral nerve stimulator trial for the treatment of this intractable chest pain and left-sided intercostal neuralgia.

Informed consent for the trial procedure involving percutaneous placement of 2 peripheral stimulator leads using the StimWave system (Stimwave Technologies, Pompano Beach, FL) was obtained and the patient was taken to the operating room. She was placed prone. Blood pressure, pulse oximeter, and electrocardiogram were applied and monitored continuously throughout the procedure. Oxygen was delivered through a nasal cannula at 3 liters per minute. A 22-gauge IV catheter was inserted. The targets were identified and marked using fluoroscopy. The patient received 300 mg of

clindamycin for postoperative infection prophylaxis. Full aseptic technique was used with triple povidone-iodine preparation to the areas and a sterile drape placed in the usual sterile fashion. Three mL of lidocaine 1% was injected with 25-gauge needle. The entry site was chosen, and a skin wheal was raised on the side on top of the areas. Then, a 14-gauge Coude´® needle was advanced under fluoroscopic guidance until the areas covered were identified by fluoroscopic view. We confirmed the placement of the lead with anteroposterior and lateral views. Once we were satisfied with the position of the leads, the patient was then stimulated. The painful dermatomes were covered in entirety. Once we were satisfied with the placement of the electrodes, the needles were withdrawn intact. The leads were secured with Steri-Strips™ (3M, Maplewood, MN) and covered by 2X2 sterile gauzes followed by an OPSITE dressing. The patient tolerated the procedure well, and no complications were noted. Five days later, the patient reported a decrease in her pain symptoms by approximately 90-100% in addition to improved daily function and the ability to resume normal daily activities. During this encounter, the patient reported a VAS of 2/10. Due to the highly positive response of the trial, she requested permanent implantation as soon as possible.

Surgical Technique

An informed consent was obtained for the implantation of a peripheral nerve stimulator for the treatment of left-sided chest pain and intercostal neuralgia involving T8-T10. The patient was identified and placed prone. Blood pressure, pulse oximeter, and electrocardiogram were applied and monitored continuously throughout the procedure. Oxygen was delivered through a nasal cannula at 3 liters per minute. A 22-gauge IV catheter was inserted. The targets were identified and marked using fluoroscopy.

The patient received 300 mg of clindamycin for postoperative infection prophylaxis. Full aseptic technique was used with triple povidone-iodine preparation to the areas and a sterile drape placed in the usual sterile fashion. 3mL of lidocaine 1% was injected with a 25-gauge needle. The entry site was chosen, and a skin wheal was raised on the side on top of the areas. A 15 mm incision was made with a #11 scalpel through the cutaneous and subcutaneous layers to allow insertion of the introducer. Using a 10 cm Coude´® 14-gauge needle, the introducer was advanced under fluoroscopic guidance until the areas covered were identified by fluoroscopic view. The introducer was passed through the cutaneous and subcutaneous tissues towards the left intercostal nerve targets. The introducer was advanced using a "tendon" approach to stay within the subcutaneous layer and to prevent diving into the muscular fascia. The introducer was placed and advanced at a shallow angle, no more than at 10°. The electrode array was inserted through the introducer and advanced to the left side of the eighth and ninth intercostal nerves, proximal to the sternum. We fluoroscopically confirmed the placement of the leads with anteroposterior and lateral views. Two leads were placed, as per the trial results. Once we were satisfied with the position of the leads, the patient was then stimulated. The previously painful dermatomes were covered in entirety identical to the trial done before. Once we were satisfied with the placement of the electrodes, the introducers were withdrawn intact. The leads were secured inside the previously made 0.5 cm incision.

Following the placement of the electrode array at the nerve targets, a receiver was removed from the packaging and kept in the sterile field. Local anesthetic was administered, and a receiver pocket incision site was created approximately 5 cm distally from the incision location of the electrode array. The incision made at the receiver pocket location allowed for subcutaneous placement and fixation of the receiver element. Following thorough irrigation with bacitracin solution, good hemostasis was confirmed with electrocautery. The tunneler was passed below the skin from the second incision site, made for the receiver lead, directly through the first incision site. The lead of the receiving element was inserted into the tunneling needle and was then advanced proximally towards the electrode array to establish connection.

The tubing attached to the electrode array was connected with the lead of the receiving element. The receiving element was a coiled receiver placed in the receiver pocket incision. The system was then tested intraoperatively with an external transmitter, which required the patient to obtain the pain reception threshold. Good paresthesia covering the painful areas was obtained. The receiver coil was secured in place under the skin and was fixated with suture. The pocket was closed utilizing an interrupted 3-0 Vicryl® suture (Johnson & Johnson Medical Devices, Warsaw, IN) and was dressed. The incision sites were closed with nylon suture.

The patient tolerated the procedure well. No complications were noted, and the patient was transferred to the recovery room in satisfactory condition.

CONCLUSION

TS is a rare musculoskeletal pathology which frequently presents with chronic chest pain and chest wall swelling. Accurate diagnosis of TS expedites patient treatment, pain management practices, and reduces unnecessary work-up. Historically, TS has been treated with nonsteroidal anti-inflammatory drugs, antidepressants, anticonvulsants, opioid analgesics, and local nerve blocks with varying success; however, results from this case report suggest that the role of implantable neurostimulators in the treatment of chronic neuropathy in the setting of TS is promising and their use may become a mainstay option in the future.

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