Wireless Peripheral Nerve Stimulation for the Treatment of Chronic Leg Pain due to Partial Paraplegia

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Background

Wireless neurostimulation has been used effectively for the treatment of pain syndromes of multiple etiologies (1,2). An octopolar or quadripolar Implantable Nerve Stimulator (INS), is implanted percutaneously with a Touhy needle in the required area and a small, external, rechargeable wireless pulse generator (WPG) worn by the patient, provides the stimulation parameters and energy to power the INS via radio frequency. The implantation of an implantable pulse generator (IPG) and the tunneling of the extensions required for traditional neurostimulation are not necessary.

Therefore, wireless neurostimulation therapy offers an easy to implant system in difficult anatomical areas with less potential complications that benefits both the patient and the physician.

Case Report

The patient is a 53-year old male that had a parachute accident on 2015 which resulted in paraplegia. After a slow recovery the patient was able to stand independently for a short time but is wheel-chair dependent to ambulate. The patient complained of intermittent jolting pain episodes (more than 20 per day) in the left leg starting laterally under the knee and extending to the malleolus. He described that the only way to stop the pain was applying a constant and strong pressure to a point above the knee as shown in Figure 1 corresponding to the area of the cutaneous lateral femoral nerve. Because of the painful episodes the patient often missed from work

Fig. 1: Subject applies pressure to point above knee to stop the pain

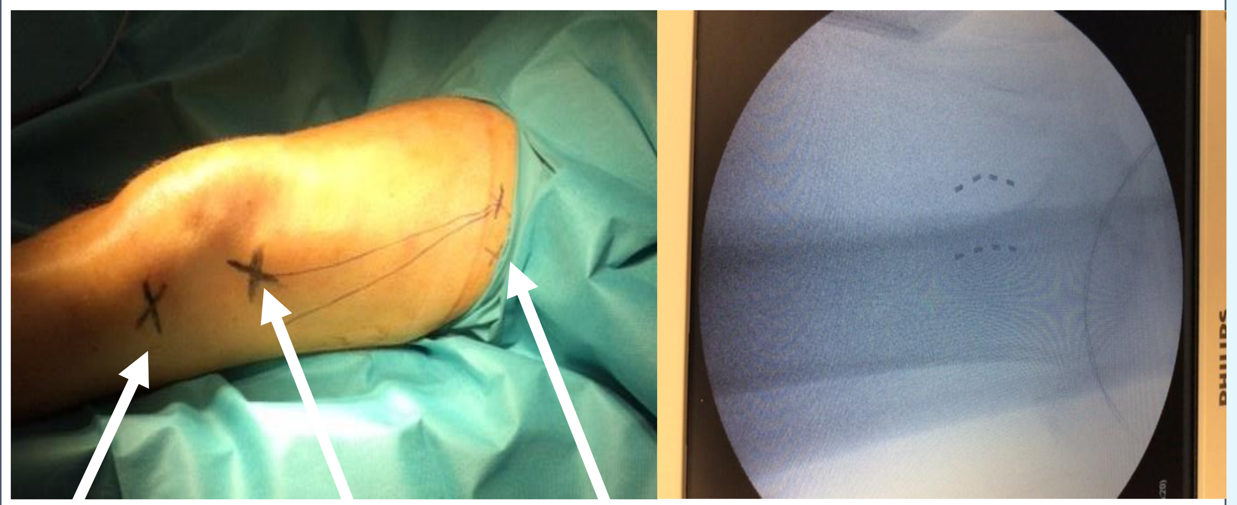
The patient had been treated with Gabapentin but experienced sides effects: at dose of 300 mg/day the patient was very sleepy and drowsy and had no pain reduction. Weight increased by approximately 10kg. These side effects resulted in discontinuation of the drug therapy. Opioids (tapentadol) were considered as a possible alternative for pain reduction, but the patient was not willing to start opioid treatment. Wireless peripheral nerve stimulation was then suggested to the patient which he accepted.

Methods

We immediately performed a permanent implant procedure under light sedation, with local anesthesia and in supine position on 30 November 2018. The entry point for the arrays was laterally above the knee, and the electrodes were placed at the condylus lateralis femoris of the left knee.

Approach was done from lateral to the poplietus nerve as in a distal ischias block (Fig. 2). The leads were then fixed with a conventional anchor on the muscle fascia. There were no complications during the procedure.

Fig. 2: Entry points of leads and final placement



Results

The devices were programmed to stimulate at 1.5 kHz and 30 Us pulse length, and an amplitude of 1 mA. Pain scores at trial stimulation were 2-4 in the VAS compared to 8 without stimulation. These pain reduced pain scores were consistent up to 6 month. All parameters indicate an immediate improvement after implant No adverse events nor side effects were reported by the patient.

Discussion

This was the first time that neurostimulation was used for this indication. The anatomical conditions of the area are such, that the implant of a conventional system with an IPG would have been literally impossible. In general, peripheral nerve stimulation is difficult with conventional devices which require not only an IPG but also extensions to the site where the IPG is implanted.

Conclusions

Wireless peripheral nerve simulation was a successful option for this patient suffering of debilitating jolting neuropathic pain due to partial paraplegia. WNS allows PNS in difficult to access sites and the procedure is much more straight forward for the physician, since he/she does not have to consider how and where the extensions connecting the stimulation lead to the IPG could be tunneled.

Wireless System Components

The Freedom SCS System (Fig. 4) utilizes wireless technology. Each electrode array contains four or eight contacts (1.3 mm in diameter with 4 mm spacing) with embedded electronics and a separate, mated receiver component. A small, externally, wearable, rechargeable transmitter attached to a transmitting antenna worn in clothing provides the energy to power the implanted device wirelessly through the skin. The device uses pulsed electrical current to create an electrical field that acts on nerves to inhibit the transmission of pain signals to the brain.

Fig. 4: Device Components

References

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