Subsuperficial Pectoralis Fascial Placement of Implantable Pulse Generators in Deep Brain Stimulation Surgery: Technical Note

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BACKGROUND AND IMPORTANCE: The second stage of deep brain stimulation requires the placement of an implantable pulse generator (IPG). Although the current placement technique achieves acceptable outcomes, device erosion has been reported. We describe a simple surgical option aimed at increasing device longevity by placing the hardware under the superficial pectoralis fascia.

CLINICAL PRESENTATION: We describe and illustrate the technique of placing the IPG in the subfascial space in a patient undergoing deep brain stimulation. In addition, we provide pearls and pitfalls to be mindful of when implementing this method.

CONCLUSION: In this technical report, we have outlined a simple alternative approach to the traditional subcutaneous IPG placement by placing the IPG under the superficial pectoralis fascia. This subfascial approach can potentially reduce complications and preserve device longevity.

KEY WORDS: Case report, Deep brain stimulation, Implantable pulse generator, Movement disorder, Parkinson disease

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Deep brain stimulation (DBS) requires placement of an implantable pulse generator (IPG) to drive stimulation. Patient factors, such as body mass index (BMI), are considered when implanting hardware wherein preservation of device longevity is paramount to reduce morbidity.

Incidences of IPG device erosion have been reported.[1] Low BMI patients have minimal adipose tissue in the subcutaneous tissue of the chest and present a unique challenge in the avoidance of hardware-related complications. Infection is one of the most common types of hardware failure given current IPG placement technique,[1] with reports of up to 3.9% experiencing IPG erosion.[2,3]

In this technical report, we describe a surgical option meant to increase device longevity while illustrating the anatomy and operative technique for placement of DBS IPG under the superficial pectoralis fascia ("subfascial space").

ABBREVIATION: IPG, implantable pulse generator.

CLINICAL PRESENTATION

Statements and Consent

The participants consented to publication of their photograph imaging for the purposes of this study. The patient provided informed consent to the procedure discussed in this study. Ethical approval was not required for this technical report. The authors declare no conflict of interest or funding sources. Further enquiries can be directed to the corresponding author.

Description of Technique

The chest incision for IPG placement is typically a 6-cm line at the midpoint between the sternal notch and acromioclavicular joint, approximately 1 to 2 cm below the clavicle (Figure 1). This is carried deeper toward the superficial pectoralis fascia at which point the fascia is incised with monopolar cautery to mirror the skin incision.

Surgical drape positioning can be used to aid this dissection, wherein the inferior drapes may be positioned below the inferior extent of the intended IPG pocket (Figure 2). This allows the operative lighting to illuminate the soft tissue superficial to the

FIGURE 1. *A 6-cm chest incision is made at the midway point between the sternal notch and acromioclavicular joint, approximately 1 to 2 cm below the clavicle.*

pocket (Figure 3) and helps prevent transgression of more superficial tissue layers while avoiding the need for adjunct illumination.

Forceps are then used to elevate the fascia and separate this layer from the underlying muscle (Figure 4). This can be accomplished with monopolar electrocautery or standard soft tissue dissection. As a pocket is created, a handheld retractor is used to increase visualization of the more inferior tissue dissection (Figure 5).

The IPG is placed into the pocket with the incision line not overlying the hardware to reduce erosion risk. A 2-0 silk suture is then placed into the muscle layer and routed through the eyelet of the IPG to discourage device migration (Figure 6).

The wound is closed in layers, ensuring closure of the fascial layer, followed by dermal and epidermal closure (Figure 7).

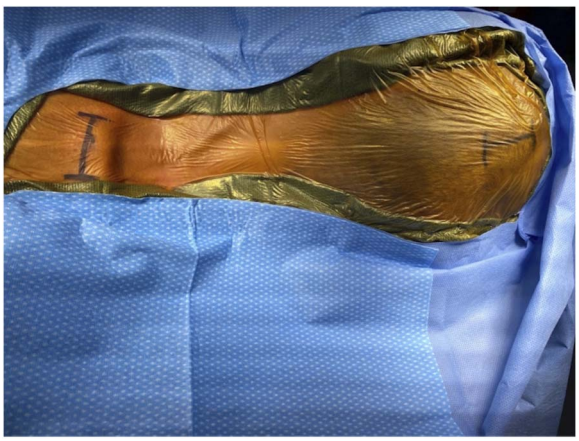

FIGURE 2. *Inferior surgical drapes are positioned below the inferior extent of the intended implantable pulse generator pocket.*

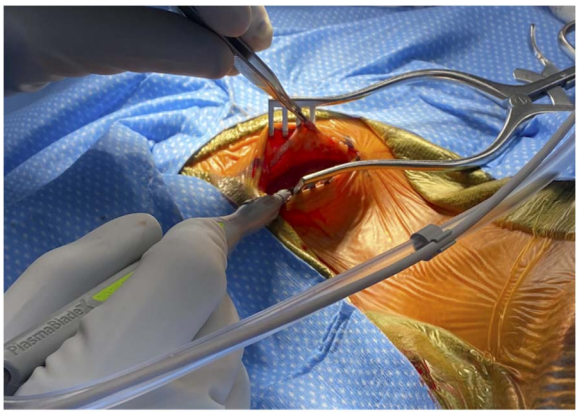

FIGURE 3. *The described surgical draping and lighting allow for optimal illumination of tissue layers.*

Pearls and Pitfalls

Positioning can aid in creation of the IPG pocket wherein the surgeons position themselves at the head of the operative table so that direct visualization can occur (Figure 8).

Two benefits of using cautery include hemostatic benefits and pectoralis muscle twitching that aids in preservation of muscle body integrity and avoidance of traversing the fascia. Our institution uses the PlasmaBlade at CUT: 5 and COAG: 6, which is a monopolar device that uses lower thermal energy and lowers the risk of hardware damage.

DISCUSSION

Hardware complications in DBS procedures can lead to interruptions in treatment and significant morbidity.[4,5] Because of

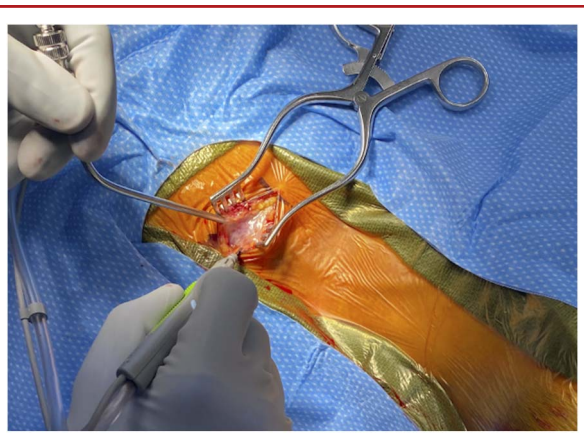

FIGURE 4. *Forceps are used to help separate the layer of fascia from the underlying muscle.*

FIGURE 5. *A handheld retractor is used to better visualize the more inferior tissue dissection.*

FIGURE 7. *Wound closure after implantable pulse generator placement.*

the risk of morbidity or interruptions in care, it is vital to explore all surgical options for the placement of IPG.

Comparison of Approaches

The DBS IPG is most commonly implanted subcutaneously in the infraclavicular region. Subcutaneous IPG placement is associated with relatively higher rates of erosion (11%) and lower cosmetic satisfaction.[6-8] Subpectoral implantation seems to have better cosmetic satisfaction and lower erosion rates (<1%) but is time-consuming and can rarely lead to hematoma formation (0.7%) and intercostobrachial nerve injury on one reported occasion.[6,9] Subfascial placement has not been well described in the literature, and, to the best of our knowledge, no study evaluating its outcomes or complications exists. The pectoralis fascia is a layer of dense connective tissue measuring approximately 0.5 mm thick.[10] It can provide extra soft tissue protection for the IPG, leading to more stability and potentially lower risk of erosion.

When considering the location of IPG placement, we recommend tailoring the approach to the patient. If there is thick subcutaneous tissue and/or the IPG is rechargeable, then a subcutaneous approach would be appropriate to maximize connectivity, especially

FIGURE 6. *A suture is placed into the muscle layer and routed through the eyelet of the implantable pulse generator for increased stability.*

FIGURE 8. *The surgeon is situated at the head of the bed to best visualize and dissect within the implantable pulse generator pocket.*

because certain IPGs must be placed within a 2-cm depth from the skin surface.[11] If the patient is thin, which is often the case for patients with Parkinson disease, then subfascial or submuscular approaches could be considered to minimize risk of complications.

Subfascial placement of implantable hardware has demonstrated benefits in patients requiring cardiac pacemakers. Historically, exposure of cardiac pacemaker hardware placed subcutaneously was a significant source of morbidity in these patients, leading to potential hardware failure.[12] It has been found that subfascial placement of hardware leads to healing while minimizing the risk of resurfacing.[12] In addition, the placement of Cardiac PacemaKEr Trial is a prospective randomized controlled trial launched in 2017, which aims to assess multiple factors in hardware placement, including patient discomfort, chronic pain, and overall cosmetic appearance.[13] Although the results of this trial have yet to be published, it is clear that other fields have recognized the potential advantage of placing these devices in the subfascial space and the importance of publishing literature describing this technique.

CONCLUSION

In this technical report, we have suggested a surgical option for DBS IPG placement that may preserve device longevity and prevent morbidity, especially in motor movement disorders correlated with low BMI. This surgical method describes placement of the IPG hardware in the subsuperficial pectoralis fascia, which may reduce device erosion.

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Disclosures

The authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

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Acknowledgments

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