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Technical Note & Surgical Technique

Cosmetic procedure for vagus nerve stimulation

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1. Introduction

Recently, the markedly increased numbers of vagal nerve stimulation (VNS) have reflected the efficacy for medically intractable epilepsy since VNS therapy was approved for coverage under health insurance in Japan in 2010 [1,2].

Since its approval, VNS implantation has been widely performed as palliative surgery for the patients with intractable epilepsy.

Generally, the VNS device is implanted according to the guide of textbook of VNS therapy physician's manual produced by Cyberonics, Co. Ltd. (Houston, TX). According to this physician's manual, the VNS cable is routinely anchored to the front side of the sternocleidomastoid muscle to provide an adequate strain relief loop. The surgical wound surface is roughened by the tie-down, which may result in an undesirable cosmetic outcome, with a high possibility of scar damage postoperatively. This procedure is particularly unsuitable for cases in which the patient has difficultly avoiding scratching the wound. Especially in patients with cognitive delay, the wound is frequently rubbed and scratched. Therefore, placing the pulse generator at a site other than the usual position at the anterior subcutaneous chest wall has been reported [3].

To avoid skin and device damage, presented here is a cosmetic approach used for the VNS device tie-downs.

2. Material and methods

2.1. Standard surgical procedure

The procedure is performed under general anesthesia. A rolled-up towel is placed under patient's left shoulder to slightly extend the neck. The head is rotated slightly to the right. A tunneler is inserted to the chest side from caudal side for tunneling of cable connecting to lead and pulse generator. A transverse incision about 3–4 cm is made on the left side of 2 cm above supraclavicle area in the neck. An incision of the platysma is made with monopolar cutting. The left carotid sheath as it extends along the anterior border of the sternocleidmastoid muscle is then exposed. The sternocleidmastoid muscle is usually dissected and retracted laterally to expose the carotid sheath. Then, the omohyoid muscle, which runs transversely over the carotid sheath, is observed. This muscle is dissected and retracted medially by a retractor. The carotid sheath and its surrounding tissue are dissected gently to expose the carotid artery and jugular vein. The area between the carotid artery and jugular vein is then dissected. Wide exposure of the carotid artery and jugular vein is obtained by opening with a retractor. The retractor is placed with the surrounding tissue of the carotid sheath to avoid direct injury to the vessel. Under a surgical microscope, approximately 3 cm of the vagus nerve is identified. The approximate length of the vagus nerve can be confirmed ensured by changing the direction of view with microscope. With adequate strength applied to the retractor, space to wrap the VNS electrode around the vagus nerve is created. The helical electrode and anchor tether are coiled around the vagus nerve according to the textbook of VNS therapy physician's manual (Cyberonics, Co. Ltd., Houston). To relieve strain on the VNS cable, the cable should be attached to the anterior oblique muscle and front of sternocleidmastoid muscle using three silicones tie-downs.

According to the VNS manual, after these anchoring tie-downs, the next step is to form the strain relief loop. One loop is also invested between the omohyoid muscle and sternocleidomastoid muscle. Then other loop of cable is finely formed on the anterior of the sternocleidomastoid muscle (Fig. 1). The skin surfaces of these three anchoring tie-downs are rough in the neck (Fig. 2).

2.2. Our cosmetic procedure

On the other hand, our procedure is an improvement in which two tie-downs are placed on the back side of omohyoid muscle and one is located inside sternocleidmastoid muscle (Fig. 3). Then a placing of the strain relief loop is different to one of the standard surgical procedure. One loop is placed on the back side of omohyoid muscle, and other loop of cable is finely formed on the inside of the sternocleidomastoid

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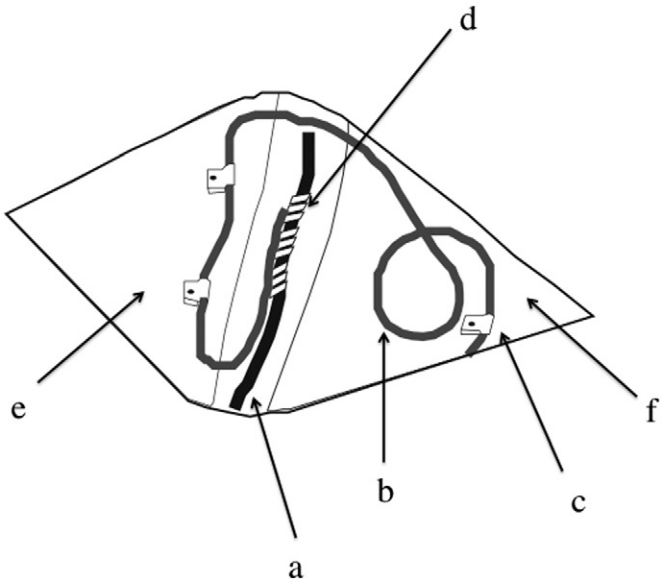

Fig. 1. Schematic diagram of vagus nerve stimulation electrode placement and a routine anchoring of Tie-down on the left vagus nerve above sternomastoidcleid muscle and omohyoid muscle. Referring to the VNS therapy system physician's manual (Cyberonics, Co. Ltd., Houston), a cable of electrode should be routinely formed loop to prevent the lead breakdown. a. Vagus nerve (black line). b. Cable of vagus nerve stimulation (gray line). c. Tie-down of anchoring. d. Electrode of vagus nerve stimulation. e. Omohyoid muscle. f. Sternocleidomastoid muscle.

muscle (Fig. 3,4). Therefore, the skin surfaces of these three anchoring tie-downs are invisible in the neck (Fig. 5).

2.3. Placement of pulse generator

A cosmetic incision is made just on the junction of the left anterior chest and axilla according to Langer line. The distal ends of the lead are conventionally connected to the pulse generator. The connecting cable runs subcutaneously over the left clavicle. The pulse generator is usually inserted subcutaneously into the anterior chest above the pectoral major muscle.

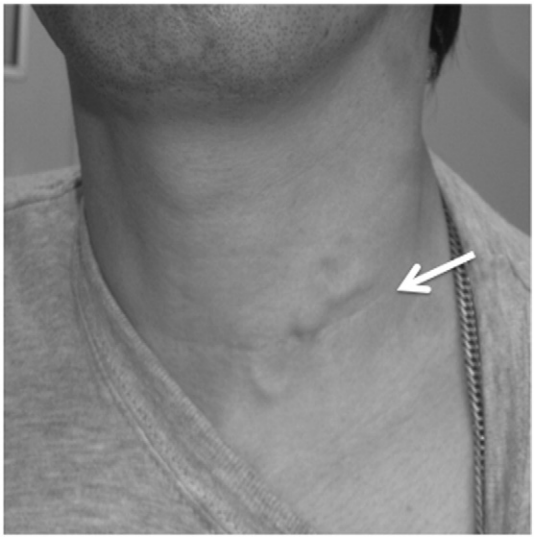

Fig. 2. Cosmetic procedure of VNS shows the appearance of incision after 2 months postoperatively (arrow).

3. Results

The authors have implanted 40 VNS devices using this technique since October 2010. All patients were satisfied with the postoperative appearance and healing of cervical incision (Fig. 5). No obvious complications were seen in these cases.

4. Discussion

Implantation of a VNS is one of the functional neurosurgical approaches for intractable epilepsy. Therefore, this procedure must cause no disability on postoperative periods. The appearance of the area surrounding the implanted device should be clear and cosmetic to prevent infection.

Unfortunately, if the VNS patient develops an abscess involving the pulse generator and cable of lead, the VNS device must be completely removed and, thus, cannot be effective for intractable epilepsy. In addition, VNS hardware may be quite difficult to remove totally, because its removal may be complicated by the need of additional manipulation of fragile vagus nerve and re-implantation of a VNS device may be quite difficult.

Implanted VNS might be used a mechanical devices, thus various hardware problem can occur in some cases with VNS [4].

Therefore, our cosmetic approach to VNS implantation is one of the surgical techniques that can prevent a complication such as infection.

Patill et al. reported that single incision techniques provide potential benefits in the postoperative period [5].

Our technique includes the inside of sternocleidmastoid and back side of omohyoid muscle anchoring of cable tie-downs as a cosmetic procedure for vagus nerve stimulation device. This cosmetic surgery technique provides several potential benefits to prevent complications.

Kahlow et al. report 12 cases with infection among a total 143 patients that underwent VNS device implantation in a single center with normal technique for VNS implantation [6].

While the number of VNS patients has been few, there have been no obvious complications, especially infection.

5. Conclusion

A cosmetic procedure such as the inside of sternocleidmastoid and back side of omohyoid muscle anchoring of cable tie-down is an alternative to the conventional procedure. This procedure can be performed safely without high technique and special devices. We believe that this cosmetic procedure provides excellent outcomes.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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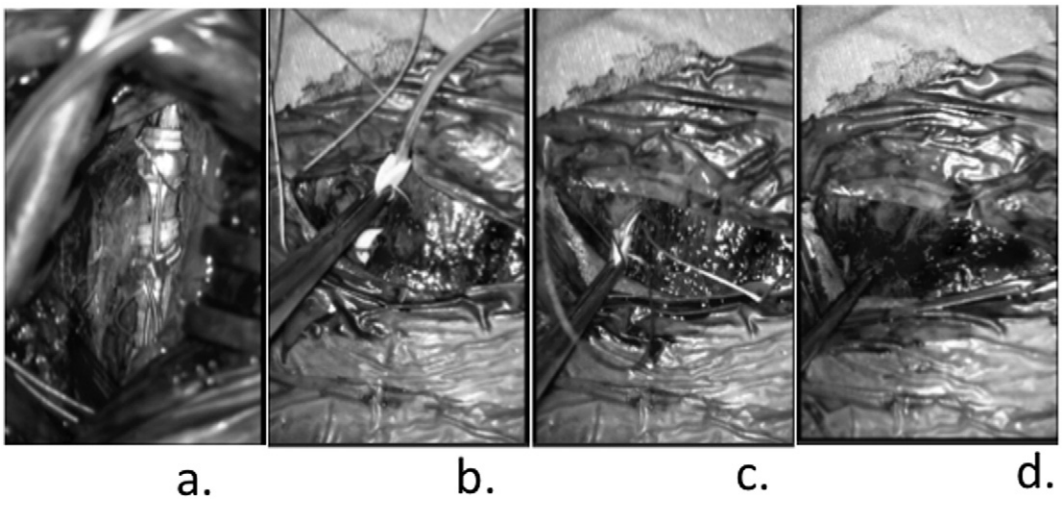

Fig. 3. Intraoperative photograph. a. Exposure of the left vagus nerve and the electrodes wrapped around the vagus nerve. b. Anchoring of Tie-down (white device) is important to strain relief of the cable of VNS. Two points of anchoring of Tie-down are substitute located subomohyoid muscle. Intraoperative photograph. c. Anchoring of Tie-down (white device) is important to strain relief of the cable of VNS. One point of anchoring of Tie-down is substitute located substernocleidmastoid muscle. d. Final step. Spontaneous disclosure of the placement of VNS and anchoring of Tie-down.

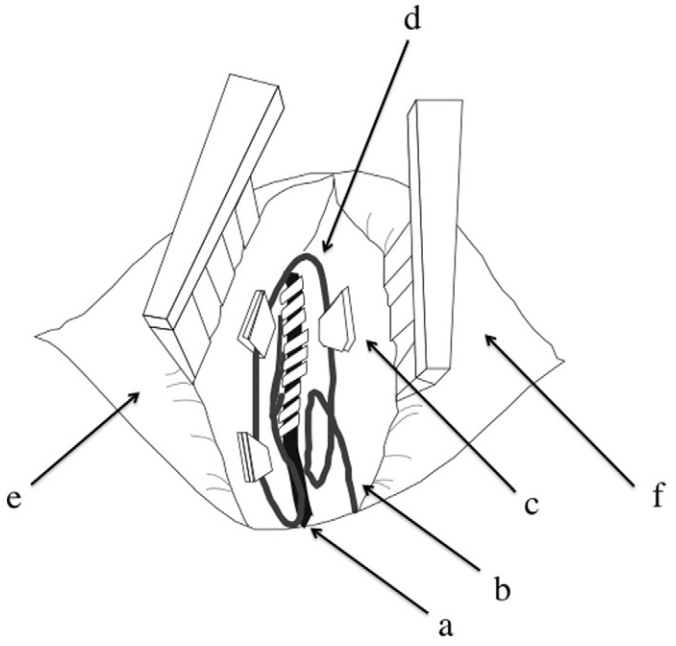

Fig. 4. Schematic diagram of vagus nerve stimulation electrode placement and technique of anchoring of Tie-down on the left vagus nerve inside sternomastoidcleid muscle and backside omohyoid muscle. a. Vagus nerve (black line). b. Cable of vagus nerve stimulation (gray line). c. Tie-down of anchoring. d. Electrode of vagus nerve stimulation. e. Omohyoid muscle. f. Sternocleidomastoid muscle.

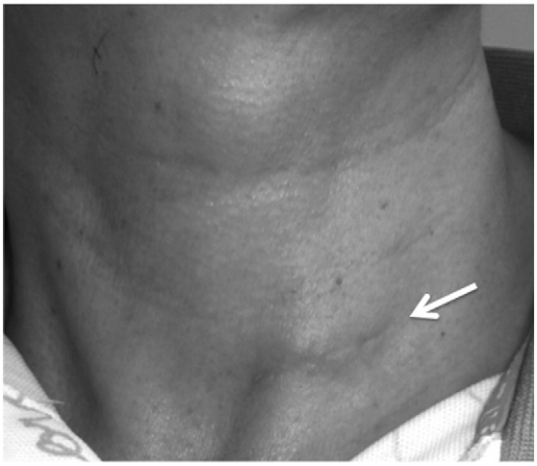

Fig. 5. Cosmetic procedure of VNS shows the appearance of incision after 6 months postoperatively (arrow).