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## The outcome of ganglion clipping in hyperhidrosis and blushing

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■ **Abstract** A total of 114 patients with various sympathetic disorders underwent endoscopic sympathetic block over different thoracic ganglions by the clipping method. The advantages of this method include the recognition of the clipped level, changeability, and reversibility. However, 4.4% of patients were unilaterally clipped at the wrong level.

■ **Key words** sympathetic block · ganglion clipping · hyperhidrosis · sweating · autonomic nervous system

### Introduction

In 1998, we reported on the use of the T<sub>2</sub> sympathetic block (ESB<sub>2</sub>) by the clipping method for 326 cases of hyperhidrosis palmaris (HP) [1].

Recently, indications of sympathetic surgery expanded to include hyperhidrosis craniofacialis (HCF) and facial blushing (FB) [2–4]. In 2001, we set up the Lin–Telaranta classification (Table 1) for sympathetic surgery [3] in order to reduce the rate of reflex sweating, which is the most troublesome side effect of this procedure [1, 5, 6].

In this series, we report the best level of blockade for HP, the advantages of the clipping method, and the possibility of unilaterally clipping the wrong ganglion. We also explain why we believe “reflex sweating” rather than “compensatory hyperhidrosis” is a more appropriate term.

### Materials and methods

Between June 2001 and June 2003 data from 114 patients who underwent surgery for various sympathetic disorders were collected. In total, 73 patients had a history of HP, 27 HCF, and 14

FB. They all underwent sympathetic block by the clipping method using the principles of the Lin–Telaranta classification (Table 1).

The surgical procedures used were the endoscopic sympathetic block (ESB) and the reverse procedure (removal of clips). These two procedures have been previously described [1].

### Results

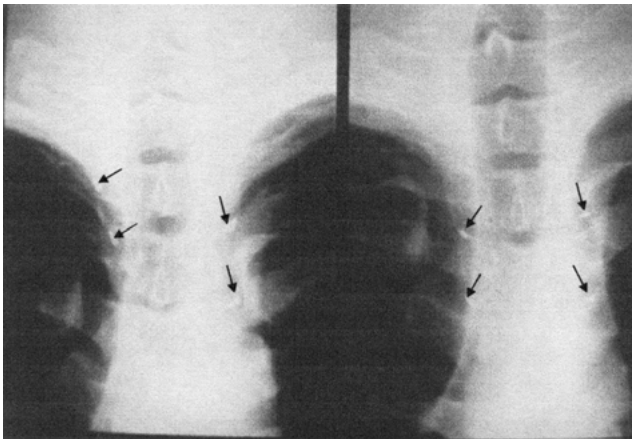
ESB<sub>4</sub> gave the best results (i.e., normal facial and hand sweating without reflex sweating) in patients with HP. After ESB<sub>4</sub>, normal physiological sweating, during hot environment exposure, occurred in the popliteal area and lower back. All FB subsided after ESB<sub>2</sub>. One patient experiencing intolerable reflex sweating, and clipping was reversed. ESB<sub>3</sub> produced satisfactory results in all patients with HCF, none reported intolerable side effects.

During the follow-up period, we surprisingly discovered that five patients (4.4%) were unilaterally clipped at the wrong level (Fig. 1). Three patients underwent ESB<sub>3</sub> for HCF. Post-operatively, they experienced hemi-facial anhidrosis. By reviewing the chest roentgenograph, one side was ESB<sub>2</sub> while the

**Table 1** Lin–Telaranta Classification (2004)

	Disorders	Procedure
Group 1	Facial blushing	ESB <sub>2</sub>
Group 2	Facial sweating, facial sweating with blushing	ESB <sub>3</sub>
Group 3	Palmar sweating	ESB <sub>4</sub>
Group 4	Axillary sweating (Bromidrosis)	ESB <sub>5</sub>

Abbreviations: ESB<sub>2</sub>, endoscopic sympathetic block of T<sub>2</sub>; ESB<sub>3</sub>, endoscopic sympathetic block of T<sub>3</sub>; ESB<sub>4</sub>, endoscopic sympathetic block of T<sub>4</sub>; ESB<sub>5</sub>, endoscopic sympathetic block of T<sub>5</sub>

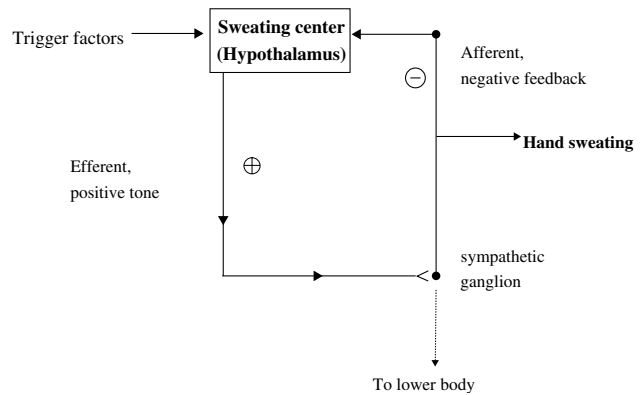


**Fig. 1** Chest roentgenographs during sympathetic blockade using the clipping method. Chest roentgenographs taken from a 20-year-old man undergoing T<sub>3</sub> sympathetic block for HCF. Arrows indicate the location of clips. The initial sympathetic block (left film) was clipped at the wrong (T<sub>2</sub>) ganglion. Post-operatively the patient experienced right face anhidrosis. The clip was corrected (right film) and all side effects were resolved

other side was ESB<sub>3</sub>. Another two patients underwent ESB<sub>4</sub> for HP. Post-operatively, one side had normal hand sweating while the other side was “too dry”. Again, on chest X-ray, one side was EB<sub>4</sub> and the other side was ESB<sub>3</sub>. They received a second operation in which the clip was re-applied to the appropriate ganglion, and achieved satisfactory results. All of the patients had no recurrence after an average follow-up period of  $28 \pm 10.5$  months.

## Discussion

We use the term “reflex sweating” instead of “compensatory hyperhidrosis” because the latter has been misused as a medical term and several observations have been noted in actual practice. First, there is no increased sweating over the face and upper body after lumbar sympathectomy for plantar sweating. Second, different degrees of post-operative sweating were found after different levels of sympathetic block. Lastly, there has been abnormal sweating induced after sympathetic procedures for a non-sweating sympathetic disorder (e.g., FB). Hence, post-operative sweating is

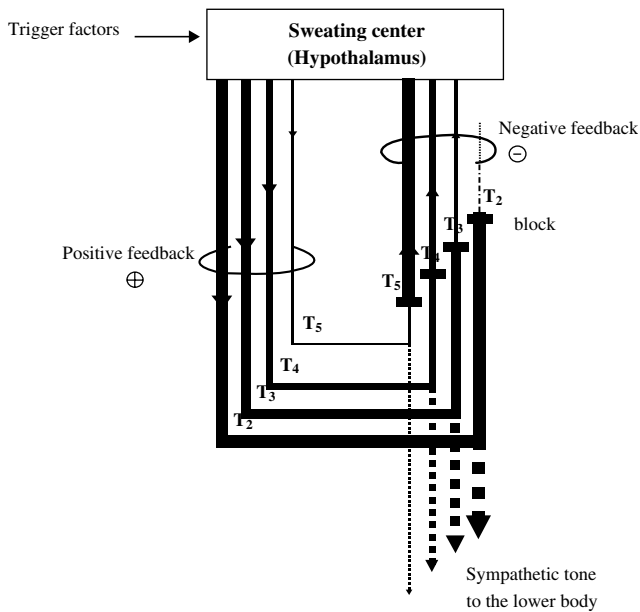


**Fig. 2** The possible mechanisms of emotional sweating as a negative feedback loop. Triggering factors (e.g., anxiety) activate “the sweating” area of the hypothalamus. This increases in efferent sympathetic activity to the target organs (e.g., to the hands) result in an increase in sweat production. Afferent signals from the target organs return back to the hypothalamus, and feedback to inhibit subsequent efferent output, creating a negative feedback loop

not a sort of compensation but due to the feedback mechanism of the autonomic nervous system [5].

The triggering factors of hyperhidrosis are emotion and anxiety, rather than a hot environment [7, 8]. These factors stimulate the sweating center located in the hypothalamus, releasing efferent signals that are positive sympathetic tones to the target organs (e.g., the hands and feet). From the target organs, some afferent signals, which serve as negative feedback tones, return to the hypothalamus for the control of sweating (Fig. 2).

If the afferent negative feedback signals are mostly blocked, such as in T<sub>2</sub> sympathectomy, the efferent positive signals from the hypothalamus will not be inhibited, thereby causing severe sweating in the lower body. This never happens in the upper body since the nerves to the upper body no longer exist (T<sub>2</sub> was blocked). Consequently, if the negative feedback signals are only partially blocked, such as in T<sub>3</sub> or T<sub>4</sub> sympathectomy, positive feedback signals are also partially inhibited, causing less post-operative sweating over the lower body (Fig. 3). This is why “reflex sweating” is a more precise term. As in hyperhidrosis, reflex sweating is emotion- and not climate-related.



**Fig. 3** The proposed effect of the level of blocking on emotional sweating control. The magnitude of nerve activity is proportional to the width of the lines. If we consider the regulation of emotional sweating as a negative feedback loop (see Fig. 2): if the inhibitory afferent signals are blocked (e.g.,  $T_2$  block), then the hypothalamic (excitatory) efferent signals will not be inhibited. This will result in increased sweating in the lower body. Increased sweating in the upper body cannot occur as the nerves (e.g.,  $T_2$ ) have been blocked. However, if the inhibitory afferent signals are only partially blocked (e.g.,  $T_3$  or  $T_4$  block), there is some negative feedback control to the hypothalamus, and inhibition of the excitatory efferent activity, therefore less inappropriate post-operative sweating in the lower body

Many specialists still treat HP with a  $T_2$  and  $T_3$  level surgery [9]. As experience has shown, this

causes serious reflex sweating [10–12]. In our previous study, 1.6% experienced regret towards the operation due to intolerable reflex sweating after ESB2 for HP [1]. Although the number does not seem great, a lot more patients actually experienced abnormally excessive sweating over the lower body. Ramicotomy [11, 13], which includes division of the  $T_2$  and  $T_3$  rami only, theoretically reduces reflex sweating. However, the recurrence was high. In this study, we verified  $T_4$  as the target ganglion for HP. Nonetheless, further studies have to be done in order to understand the actual etiology of reflex sweating.

Although the authors of this study have the experience of over 1,000 cases, 4.4% were unilaterally clipped at the wrong level. If sympathotomomy is the procedure of choice, it is difficult to evaluate the error. As a result, the blame is often laid on temperamental nature of the patient. The endoclip has become a good marker indicating whether the sympathetic procedure performed at the same location as in the pre-operative plan. As such, if the clipping was erroneously located, it can be re-applied.

## Conclusion

The advantages of clipping are the immediate recognition of location, its changeability, and its reversibility. It serves as a good marker for post-operative assessment and as an excellent pre-operative information for repeat operations.

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