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The Effect of Thoracoscopic Sympathicotomy at the Fourth Rib (R4) for the Treatment of Palmar and Axillary Hyperhidrosis

Jae-Bum Kim, M.D.*, Chang-Kwon Park, M.D.*, Dong-Yoon Kum, M.D.*

Background: Video-assisted thoracic sympathicotomy plays an important for the treatment of essential hyperhidrosis. Patients are usually satisfied with the surgical outcome at the early post-operative period, but suffer recurrence and compensatory sweating in the late post-operative period. There are many sympathicotomy methods to minimize recurrence and compensatory sweating. We compared the outcome of sympathicotomy methods above the third rib (R3) and the fourth rib (R4) with regards to symptoms, satisfaction, recurrence, and compensatory palmar and axillary hyperhydrosis. ***Materials and Methods:*** From January 1999 to April 2009, 39 cases of thoracoscopic sympathicotomy at the third rib (R3), and 94 cases of thoracoscopic sympathicotomy at the fourth rib (R4) for palmar and axillary hyperhidrosis were compared for early and late post-operative satisfaction, compensatory sweating and recurrence. ***Results:*** There was no sex or age difference between groups. Early satisfaction was 94.9% and 98.9% in the R3 group and R4 group, respectively. There was no difference in early satisfaction (94.9% in R3 and 98.9% in R4), late satisfaction (84.6% in R3 and 89.4% in R4), or recurrence (17.9% in R3 and 17.0% in R4) between groups. There was significant difference in compensatory sweating (71.8% in R3 and 33% in R4, p=0.002). ***Conclusion:*** R4 sympathicotomy demonstrated superior efficacy in the treatment of compensatory sweating compared to R3 in palmar and/or axillary hyperhidrosis.

Key words: 1. Hyperhidrosis
2. Thoracoscopic surgery
3. Sympathicotomy

INTRODUCTION

Hyperhidrosis may adversely affect patients' daily activities. Little is understood about this condition's mechanism, exacerbating factor, and definite treatment. Hyperhidrosis is frequently exacerbated by emotional stress, psychological factors and increased body weight. Hyperhidrosis generally occurs in the axillae, the palms, plantar surface of the feet, and the face. It is estimated to affect 0.6 to 1.0% of the population, generally young adults [1]. There is a positive family history in 30 to 50% of cases. The principal characteristics of this condition include intense discomfort experienced by the patients, affecting their social, affective, and professional lives. Primary hyperhidrosis generally manifests in childhood and early adolescence, does not occur during sleep, and can be exacerbated by emotional stress. There is evidence that primary palmar hyperhidrosis is a hereditary disorder [2].

Axillary hyperhidrosis is a common and distressing condition. Excessive sweating of the palms and axillae can

*Department of Thoracic and Cardiovascular Surgery, Dongsan Medical Center, College of Medicine, Keimyung University
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Corresponding author: Chang-Kwon Park, Department of Thoracic and Cardiovascular Surgery, College of Medicine, Keimyung University, 194, Dongsan-dong, Jung-gu, Daegu 700-712, Korea
(Tel) 82-53-250-7342 (Fax) 82-53-250-7307 (E-mail) ckpark80@dsmc.or.kr

cause utmost embarrassment in professional and social interaction. The fact that such sweating is not socially accepted, and the discomfort, odor, and stained clothes caused by constant wetness significantly decrease quality of life (QoL) [3].

Prompt and optimal care is needed to prevent hyperhidrosis from negatively impacting QoL. Although various treatment options are available, including topical and systemic therapies, iontophoresis, regional nerve block, and botulinum toxin injection, have their limitations. Surgical intervention is often associated with unacceptable side effects [4,5].

Video-assisted thoracoscopic sympathetic surgery has been accepted globally as a form of treatment for primary palmar hyperhidrosis. In the literature, different methods, including resection (sympathectomy), transection (sympathicotomy), and clipping have been discussed [6]. The most common and serious side effect is compensatory hyperhidrosis [7]. Much effort to reduce compensatory hyperhidrosis and determine its contributory factors has been attempted during surgical procedures [8]. Video-assisted thoracoscopic sympathicotomy is targeted and can minimize adverse effects. It has been used to reduce severe compensatory hyperhidrosis related to the procedural level of the sympathetic chain. Procedures that involve R3 or/and R4 sympathetic ganglions are widely accepted in many treatment centers, and the results have been favorable. However, some patients still present with postoperative compensatory sweating or overly dry hands [6,7].

The aim of this study was to compare two simplified methods for the treatment of palmar and axillary hyperhidrosis, in which the sympathetic chain was transected in merely one segment at the level of either the third or fourth rib, respectively referred to as R3 or R4 sympathicotomy. Emphasis was placed on comparing the impact of sympathicotomy at R3 and R4, and to evaluate the efficacy and adverse effects of palmar and axillary hyperhidrosis by surgery.

MATERIALS AND METHODS

Between January of 1999 and April of 2009, 133 patients with primary hyperhidrosis underwent video-assisted thoracic sympathicotomy. There were 62 males and 71 females, with a mean age of 22.5±6.5 years. The most common clinical manifestation of hyperhidrosis was palmer and axillary sweating (in 39.9%), followed by palmer sweating alone (in 33.8%), and axillary sweating alone (in 26.3%). The severity of palmar sweating, sweating in other parts of the body, other concomitant symptoms and past medical history were recorded. Chest radiography, electrocardiogram (ECG) and routine blood examination were performed before surgery. Severe primary palmar hyperhidrosis that significantly interfered with daily life, including work, was the common primary indication for surgery. Secondary hyperhidrosis caused by hyperthyroidism or neurotic anxiety, and patients with bradycardia (heart rate $<$60/min) were excluded from surgery. Patients were randomized into two therapeutic groups (Table 1).

Table 1. Patients characteristics (mean±SD)

	T3	T4	p-value
Number	39	94	
Sex (F : M)	22 : 17	49 : 45	0.38
Age (yr)	21.0±4.08	23.1±8.46	0.19
Hyperhidrosis site			
Palms	14 (35.9%)	31 (33.0%)	0.67
Axilla	10 (25.6%)	25 (26.6%)	0.55
Combined	15 (38.5%)	38 (40.4%)	0.42
Family Hx	8 (20.5%)	24 (25.5%)	0.22

There were no significant differences between the 2 groups for all of the above variables.

Patients were placed under single lumen intubation general anesthesia in the semi-Fowler's position (dorsal decubitus position with back lifted 45 degrees from horizontal, and abduction of both arms). A 2 mm trocar was introduced into the pleural cavity through the fourth intercostals space of the mid-axillary line. The lung was collapsed by CO_2 gas continuous instillation through the trocar. After thoracoscope insertion, an initial panoramic view of the upper pleural cavity and mediastinal structures was obtained. Another operating channel (2 mm) was made through the fourth intercostal space of the anterior axillary line. After identification of the thoracic sympathetic ganglion, the T3 or T4 sympathetic chains were then destroyed by electric cautery. The anesthesiologist re-inflated the lung. Following lung re-expansion by positive inflation with a 6 Fr feeding catheter, the trocar was

then removed. Sympathicotomy was always achieved bilaterally. Sympathicotomy was also performed with a similar method on the contralateral side. No chest drain was used.

Each patient's progress was evaluated through outpatient monitoring. The patients were asked simple questions related to symptom resolution, surgical outcome satisfaction , and occurrence/intensity of reflex sweating.

Compensatory sweating in the other regions of the body was graded as "none" when compensatory sweating was not noticeable and did not interfere with daily activities, "mild" when it was tolerable but sometimes interfered with daily activities, "moderate" when it was barely tolerable and frequently interfered with daily activities, and "severe" when it was intolerable and always interfered with daily activities. The degree of satisfaction in each patient was recorded as "satisfied" or "dissatisfied". Self-reported satisfaction, recurrence, and improvement of sweating after intervention constituted the three recorded aspects of the patients' subjective experience with sweat-triggering situations. Recurrence was defined as severe discomfort experienced by patients similar to that experienced before surgery, despite improvement in sweating.

Statistical analysis of comparisons between the 2 groups was conducted using the Student's unpaired t test and chi-square test with SPSS 13.0 (SPSS, Inc, Chicago, IL). Analyzed data were shown as mean±SD. A p-value <0.05 was considered statistically significant.

RESULTS

All operations were successfully performed using video-assisted thoracoscopy without associated severe morbidity and mortality. No life-threatening event or death occurred and no procedures were converted to open thoracotomy. Other complications, such as Horner syndrome, hemothorax, intercostal neuralgia, pulmonary edema and atelectasis were not observed. Mild subcutaneous emphysema and residual pneumothorax on follow-up chest radiograph resolved spontaneously, and no further therapy was required.

There was no significant difference between the 2 groups in terms of age, sex, and positive family history (Table 1). In addition, there was no significant difference between the 2 groups in the rate of satisfaction and recurrence. The frequency of compensatory sweating was significantly different between the 2 groups. The incidence of "moderate" to "severe" compensatory sweating was higher in the R3 (71.8%) group than R4 (33%, p=0.02)(Table 2). No patient requested reoperation in either group, and no patient expressed regret after surgery.

Table 2. Intervention results at follow-up

	T3 (n=39)	T4 (n=94)	p-value
Satisfaction rate			
Early (<1 month)	37 (94.9%)	93 (98.9%)	0.46
Late (>1 month)	33 (84.6%)	84 (89.4%)	0.37
Compensatory sweating			
None	4 (10.3%)	27 (28.7%)	0.11
Mild	7 (17.9%)	36 (38.3%)	0.07
Moderate	19 (48.7%)	24 (25.5%)	0.02
Severe	9 (23.1%)	7 (7.5%)	
Recurrence	7 (17.9%)	16 (17.0%)	0.44

There was no significant difference between the 2 groups in the follow-up period regarding satisfaction or recurrence of hyperhidrosis.

DISCUSSION

The dominating indication for sympathetic surgery is hyperhidrosis of the upper limb [9]. When conservative and medical treatment fails, endoscopic thoracic surgery is performed [9,10]. The first sympathectomy for the treatment of hyperhidrosis was performed in 1920 [11], in which anterior cervical access was used. In 1942, great advance in surgical technique was made, which rendered it unnecessary to sacrifice the stellate ganglion in order to denervate the upper limb [12]. As such, one of the most feared complications in thoracic sympathectomy - Claude Bernard-Horner syndrome - was eliminated.

In this study, patients were informed about the possible side effects of sympathicotomy, including compensatory sweating, prior to the procedure. Many attempts have been made to avoid compensatory sweating and explain its underlying mechanism. However, the mechanism that causes compensatory sweating following sympathicotomy remains unclear. Chou et al. asserted that reflex response in the

sweating center of the hypothalamus could cause the underlying mechanism of compensatory sweating [13]. According to previous studies, various factors, such as the location of hyperhidrosis, sympathicotomy level, and surgical procedures including clamp, cut and resect can induce compensatory sweating [14,15]. Also, the severity of compensatory sweating is influenced by patient condition, such as obesity, primary complaint severity and T2 sympathetic ganglion resection [15]. Therefore, more selective sympathicotomy was proposed to minimize side effects, by lowering the level to preserve sympathetic tone in place of upper T2 sympathicotomy or multilevel sympathicotomy [13].

Selective sympathicotomy is an effective surgical method to eliminate compensatory sweating in the treatment of hyperhidrosis. Although compensatory sweating remains the main secondary effect, numerous studies have reported that sympathicotomy is a safe and effective procedure for the management of hyperhidrosis and reduction of compensatory sweating [16,17]. Our data support the findings of previous studies of sympathicotomy on compensatory sweating [16,17]. The frequency and severity of compensatory sweating were reduced, with less interruption of sympathetic trunk in group T4 compared to group T3 (Table 2). This explains the differences at the other levels in sympathicotomy at palmar sweating and compensatory sweating are still controversial topic. Lin et al. suggested that postoperative results including compensatory sweating is influenced by changes in the sympathetic tone and disturbance of the reflex arc in the hypothalamus secondary to the procedures of the upper thoracic sympathetic system [18]. Furthermore, anatomical variation, a mistake at the level of interruption, and incomplete resection of the sympathetic trunk may also cause compensatory sweating. The high personal expectations of patients could be the reason of dissatisfaction despite the development of minor complications.

Compensatory sweating is the most common side effect of thoracic sympathetic surgery for hyperhidrosis. The reported incidence of this complication ranges between 69% and 90% [19,20]. Difference in surgical technique, such as sympathicotomy level and surgical procedure (clamp, cut and resect), and classification of the extent of compensatory sweating could impact on the complication rate. Many authors felt that the more sympathetic segments excised, particularly including T2, the greater the incidence of severe compensatory symptoms.

Dewey et al. [21] limited the extent of resection for hyperhidrosis to a single level, and found reduction in the incidence of severe compensatory symptoms. However, until now, no prospective study has been performed to compare R3 and R4 single level sympathicotomy for the treatment of palmar and axillary hyperhidrosis. In this study, patients did not experience discomfort in their daily activities. Relatively severe compensatory sweating occurred more often in group R3 than in group R4. These results suggest that, compared to R3 sympathicotomy, R4 sympathicotomy decreases the extent of side effects but does not compromise efficacy. As such, it should be the method of choice for the treatment of palmar and axillary hyperhidrosis.

CONCLUSION

R3 and R4 have similar success rates in the treatment of palmar and axillary hyperhidrosis. The major side effects of compensatory sweating were effectively reduced by R4 sympathicotomy. In addition, R4 results in remarkable patient satisfaction and quality of life improvement.

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