IMPACT OF COMPENSATORY HYPERHIDROSIS ON PATIENT SATISFACTION AFTER ENDOSCOPIC THORACIC SYMPATHECTOMY

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OBJECTIVE: Endoscopic thoracic sympathectomy (ETS) remains the definitive treatment for primary focal hyperhidrosis. Compensatory hyperhidrosis (CH) is a significant drawback of ETS. We sought to identify the predictors for the development of severe CH after ETS, its anatomic locations, and its frequency of occurrence, and we analyzed the impact of CH on patient satisfaction with ETS.

METHODS: Bilateral ETS for primary focal hyperhidrosis was performed in 220 patients, and a retrospective chart review was conducted. Follow-up evaluation was conducted using a telephone questionnaire, and 73% of all patients were contacted. Patients' responses regarding CH and their level of satisfaction after ETS were analyzed. Statistical analysis was performed using SPSS software (Version 14.0; SPSS, Inc., Chicago, IL). A P value of <0.05 was considered statistically significant.

RESULTS: Some degree of CH developed in 94% of patients. The number of levels treated was not related to the occurrence of severe CH. Isolated T3 ganglionectomy led to a significantly lower incidence of severe CH, when compared with all other levels ($P < 0.03$). Ninety percent of patients were satisfied with the procedure. The development of severe CH, as opposed to mild or moderate CH, significantly correlated with a lower satisfaction rate ($P = 0.003$).

CONCLUSION: CH is common after ETS procedures, and the occurrence of severe, but not mild or moderate, CH is a major source of dissatisfaction after ETS. The overall occurrence of severe CH is reduced after T3 ganglionectomy as opposed to ganglionectomies performed at all other levels. The level of satisfaction with ETS is high.

KEY WORDS: Compensatory hyperhidrosis, Endoscopic thoracic sympathectomy, Hyperhidrosis

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Primary focal hyperhidrosis (PFH) is a condition in which excessive sweating occurs in areas of the body that are not related to thermoregulation. PFH is bilateral and typically appears during the second or third decade of life; it can cause significant occupational, emotional, and physical impairment, as well as social embarrassment. About 7.8 million individuals in the United States (2.8% of the population) have PFH (26). Common conservative treatments have included antiperspirants (24), anticholinergics (27), iontophoresis (18, 20), and therapies based on biofeedback (6). All of these treatments produce only temporary effects, and they are effective only in mild cases. More recently, botulinum toxin has been approved for the treatment of PFH (7). The beneficial effects are usually expected to last 4 to 6 months. Repeated injections of botulinum toxin in palmar PFH are less appealing because of pain, muscle weakness, and possible atrophy, and they are not recommended by our group.

Endoscopic thoracic sympathectomy (ETS), a minimally invasive surgical approach for the treatment of palmar, axillary, and facial PFH, is a more definitive treatment with low morbidity rates and excellent outcomes (16, 21). This procedure is appropriate for those patients in whom initial conservative measures have failed.

ABBREVIATIONS: BMI, body mass index; **CH**, compensatory hyperhidrosis; **ETS**, endoscopic thoracic sympathectomy; **HH**, hyperhidrosis; **PFH**, primary focal hyperhidrosis

Compensatory hyperhidrosis (CH), the development of increased sweating after ETS in parts of the body not previously affected, has been reported to occur at an average rate of about 60% (range, 35–98%) (4, 10, 25). The relationship between the development of CH and patient satisfaction with the ETS procedure has not been clearly elucidated. In this study, we evaluated the outcomes after ETS with regard to the incidence and severity of CH and its impact on patient satisfaction.

PATIENTS AND METHODS

We conducted a retrospective review of all ETS procedures performed in our departments between February 1997 and February 2006. Two hundred twenty patients underwent the ETS procedure for a total of 440 sympathectomies, and 161 patients (73%) were available for follow-up. The majority of the cases were performed in the last 3 years of the review period. All operations were performed by 2 of the authors (NIP and CPC). There were 2 surgical techniques used: 1) ganglionectomy, and 2) sympathicotomy. Sympathicotomy entailed cutting the sympathetic trunk just proximal to the ganglion at the head of the appropriate rib and separating the cut ends, in addition to dividing any accessory branches noted at that level. Ganglionectomy involved cutting or clipping proximally and distally to the ganglion, at 2 adjacent ribs, thus effectively isolating the ganglion selected.

This retrospective study was approved by the Institutional Review Board of Roosevelt Hospital. To collect the required data, we reviewed all patient charts for the preoperative, operative, and early postoperative data. Addititional data was collected by asking patients to complete a telephone questionnaire. The questionnaire was designed to evaluate presenting symptoms, hospital complications, recovery after surgery, resolution of preoperative symptoms, development of CH, and patient satisfaction with the ETS. Telephone surveys were a planned part of our follow-up.

Patients were asked questions related to the occurrence of sweating in areas of the body not affected before the surgery, or an increase of sweating in areas not thought to be problematic before surgery. We asked whether the sweating interfered with normal activities, which body areas were affected, and how long after the operation this sweating started. We inquired whether the CH was noted only during hot weather and/or during exercise, or at all times, and throughout the year.

CH was graded according to the severity of symptoms: Grade 1, no symptoms of CH; Grade 2 (mild CH), CH is seldom noticeable and never interferes with daily activities; Grade 3 (moderate CH), CH is noticeable but tolerable and rarely interferes with daily activities; and Grade 4 (severe CH), CH is intolerable and always interferes with daily activities. We explained and adhered to the grading system in the telephone questionnaire to ensure that both the patient and the interviewer were in agreement as to the severity of symptoms of CH and the corresponding CH grade.

We looked at age, sex, and body mass index (BMI), as well as the location of presenting symptoms as possible variables that might independently predict the incidence and severity of CH. We sought to identify a relationship between the level and the number of levels of the sympathetic trunk isolated and the incidence and severity of CH. Specifically, we sought to detect a difference in the incidence of severe CH with sympathectomies involving the T3 ganglion versus sympathectomies performed at other levels. We examined the impact of CH on patient satisfaction with the ETS procedure.

Statistical analysis was performed using SPSS software (Version 14.0; SPSS, Inc., Chicago, IL). Student's *t* test, Fisher's exact test, a χ^2 test, and regression analysis were used as appropriate. A *P* value of less than 0.05 was considered statistically significant.

RESULTS

Two hundred twenty patients underwent bilateral ETS for the symptoms of PFH. The mean follow-up time was 17.6 months (median, 16.0 months; range, 3–60 months). Of the 161 patients available for follow-up, 96 patients (60%) were females and 65 patients (40%) were males. Their ages ranged from 13 to 67 years (mean, 28 years; standard deviation, 8.9 years). The location of sweating on initial presentation was as follows: palmar, 49 patients (30%); axillary, 16 patients (10%); palmar and axillary, 92 patients (57%); facial, 3 patients (2%); and solitary plantar, 1 patient (0.6%). In the whole group, 122 patients (76%) experienced some degree of plantar sweating, and 34 patients (21%) had some degree of facial sweating.

Bilateral ETS procedures were performed to isolate: 1) the T2 ganglion in 96 patients (60%), 2) the T3 ganglion in 24 patients (15%), 3) the T2 and T3 ganglia in 16 patients (10%), and 4) the T3 and T4 ganglia in 2 patients (1.2%). Early in our series, T2 sympathicotomy was performed in 24 patients (15%) (for isolated palmar hyperhidrosis [HH] in 18 patients, isolated facial HH in 3 patients, and combined palmar and axillary HH in 3 patients). The number and levels of procedures performed for different presenting symptoms are listed in Table 1.

Complications within 24 hours after surgery included 1 case of hemopneumothorax (0.45%) and 2 cases of pneumothorax (0.9%); all 3 patients had chest tubes placed and recovered well. Two patients (0.9%) experienced unilateral Horner's syndrome with T2 ganglionectomies, followed by partial recovery. One patient was brought back for removal of clips applied at T2, T3, and T4 (T2 and T3 ganglionectomies) for facial flushing and palmar and axillary HH; this patient had severe CH. The CH did not change significantly after the removal of the clips. There were no conversions to thoracotomy, and no instances of segmental atelectasis or persistent intercostal neuralgia. Our complication rates fell below the generally accepted reported rates for Horner's syndrome (0.7–3.0%), pneumothorax (1.4–2.5%), and hemothorax (0.5–1.0%) (2, 4, 10).

Postoperatively, almost all patients (152 of 161; 94%) reported experiencing sweating in an area of their body not affected before the surgery. Grade 4 CH was reported in 39 patients (24%), Grade 3 CH in 82 patients (51%), Grade 2 in 31 patients (19%), and Grade 1 in 9 patients (5%) (Fig. 1). Overall, 126 patients experienced the symptoms of CH only during the summer months and during exercise; 26 patients (20.6%) reported having the symptoms throughout the year. Only 12 (30.7%) of the 39 patients with Grade 4 CH reported having symptoms throughout the year. Only 8 (10%) of the 82 patients reporting Grade 3 CH experienced compensatory sweating throughout the year, and only 6 (19.3%) of the 31 patients with Grade 2 CH reported having symptoms throughout the year.

Symptom location was not a statistically significant predictor of the incidence and severity of CH. Grade 4 CH occurred in 12 (24.5%) of 49 patients with palmar HH, 22 (24%) of 92 patients

TABLE 1. Location of sweating on presentation and level(s) of endoscopic thoracic sympathectomy performed[a]

Location of sweating and level(s) of ETS	No. of patients (n = 161)
Palmar HH	
T2 sympathicotomy	18
T2 ganglionectomy	31
Axillary HH	
T3 ganglionectomy	11
T2 + T3 ganglionectomies	3[b]
Palmar and axillary HH	
T2 ganglionectomy	64[c]
T2 sympathicotomy	3
T3 ganglionectomy	12[d]
T2 + T3 ganglionectomies	13[e]
T3 + T4 ganglionectomies	2[f]
Facial HH	
T2 sympathicotomy	3
Plantar HH	
T3 ganglionectomy	1

[a] ETS, endoscopic thoracic sympathectomy; HH, hyperhidrosis.
[b] These patients also experienced mild or moderate facial HH.
[c] Early in our series; palmar HH more severe than axillary HH, or some involvement of the face.
[d] Axillary HH more severe than palmar HH.
[e] Early in our series.
[f] Late in our series.

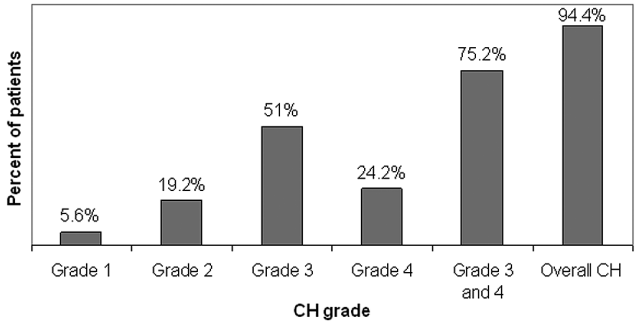

FIGURE 1. *Bar graph showing the percentage of patients who developed different grades of compensatory hyperhidrosis (CH).*

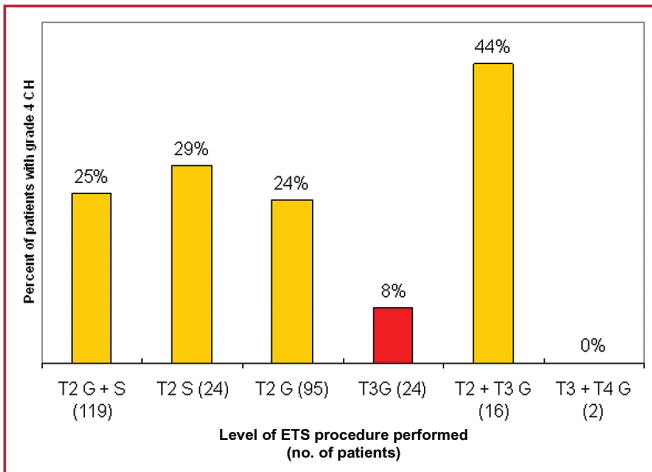

FIGURE 2. *Bar graph depicting the development of Grade 4 CH or severe CH after endoscopic thoracic sympathectomy (ETS) performed at different levels. T3 ganglionectomy alone led to fewer patients experiencing Grade 4 CH, when compared with T2 ganglionectomy (P = 0.05) and with ganglionectomies performed at all other levels combined (P = 0.03). G, ganglionectomy; S, sympathicotomy.*

with combined palmar and axillary HH, and 4 (25%) of 16 patients with solitary axillary HH.

The distribution of the CH was as follows: back, 135 patients (89%); chest, 90 patients (59.0%); abdomen, 82 patients (54%); thighs, 78 patients (51%); and head, 4 patients (2.6%). Only 16% of patients with CH experienced CH in only 1 area of the body, whereas 83% experienced CH in 2 or more areas, and 48% in 3 or more areas of the body.

The mean time to occurrence of CH after surgery was 9.2 weeks (median, 2 weeks; range, 0–100 weeks). In 70% of the cases, CH started within the first month (32% right after the procedure, 6% in the first week, and 32% at Weeks 2, 3, and 4).

There was no difference in the incidence of CH among patients who underwent sympathectomies at different levels. Thirty (21%) of 143 patients who had only 1 level of the sympathetic chain interrupted developed Grade 4 CH, compared with 7 (39%) of 18 patients with 2 levels interrupted. No statistically significant association was found between the number of levels treated and the severity of CH, although patients with more than 1 interrupted level showed a trend toward a higher incidence of Grade 4 CH ($P = 0.1$).

T3 ganglionectomy alone led to fewer patients experiencing Grade 4 CH when compared with T2 ganglionectomy ($P = 0.05$) and with ganglionectomies performed at all other levels combined ($P = 0.03$) (Fig. 2). There was no difference in the occurrence of Grade 4 CH after T2 ganglionectomy versus T2 sympathicotomy. Because only 24 ganglionectomies at the T3 level were performed as compared with 137 sympathectomies at other levels, and only 2 patients had Grade 4 CH, Fisher's test was used to detect a possible difference in CH severity after T3 ganglionectomy.

The mean BMI for all patients experiencing CH was 24 cm/kg^2. The mean BMI in patients with Grade 4 CH (25 cm/kg^2) was higher by 2.0 cm/kg^2 than the mean BMI in patients with Grade 2 CH (23 cm/kg^2); however, no statistically significant association was found between the mean BMI and the severity of CH. In univariate logistic regression analysis, as well as multivariate analysis that included age and sex, BMI was not a significant predictor of the incidence or severity of

TABLE 2. Significance of the association between evaluated factors and the incidence and severity of postoperative compensatory hyperhidrosis[a,b]

Evaluated factors	*P* value	
	Lower incidence	Less severity[c]
Sex	NS	NS
Body mass index	NS	NS
Location of sweating on presentation	NS	NS
Level(s) of ETS performed		
2 levels versus 1 level	NS	NS
T2 G versus T2 S	NS	NS
T3 G versus T2 G and S	NS	0.05[d]
T3 G versus G at all other levels	NS	0.03[d]

[a] CH, compensatory hyperhidrosis; NS, not significant; ETS, endoscopic thoracic sympathectomy; G, ganglionecomy; S, sympathicotomy.
[b] The mean age of patients who developed CH was 28.5 years, as opposed to the mean age of those who did not develop CH (23.5 years). Only 9 patients did not develop CH.
[c] Grades 2 + 3 CH versus Grade 4 CH.
[d] Patients who underwent T3 ganglionectomy had significantly lower rates of Grade 4 CH (severe) when compared with patients who underwent ETS at other levels.

CH. The evaluated factors and the significance of the association between the evaluated factors and the incidence and severity of postoperative CH are listed in Table 2.

Satisfaction after the ETS procedure was quantified in the responders through the use of the telephone questionnaire. Of a total of 161 patients, 104 patients (65%) stated they were very satisfied, 40 patients (25%) stated they were somewhat satisfied, 12 patients (7%) stated they were somewhat unsatisfied, and 5 patients (3%) stated they regretted having had the surgery. Ninety-two percent (148 of 161 patients) said they would recommend the surgery to a friend or family member; this percentage was only slightly changed (91%) 1 year after the surgery (Fig. 3).

Among patients who experienced CH in 3 or 4 body areas (37 patients), 10 were unsatisfied with ETS, as opposed to 7 of 124 patients who experienced CH in 1 or 2 body areas. Ten (58%) of 17 patients who were not satisfied with the outcome had 3 or 4 areas of their body affected with some degree of CH, as compared with 27 (19%) of 144 patients who were satisfied with the outcome (very or somewhat satisfied). Patients who developed CH in 3 or 4 areas of the body were significantly less satisfied with the ETS procedure than patients experiencing CH in 1 or 2 areas of the body ($P = 0.008$).

Of the 39 patients who experienced Grade 4 CH, 14 (36%) expressed the highest degree of satisfaction with ETS, as opposed to 83 (73%) of 113 patients with Grade 2 and 3 CH (Fig. 4). Among the 144 patients who were satisfied with the ETS procedure (combining the very and somewhat satisfied groups), 28 (19.4%) experienced Grade 4 CH as compared with the unsatisfied group (combining the somewhat unsatisfied and regret-surgery groups),

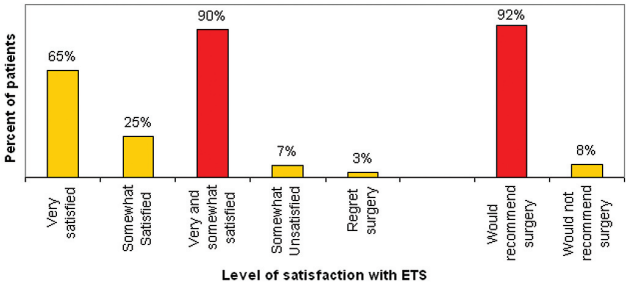

FIGURE 3. *Bar graph showing the percentages of patients expressing different levels of satisfaction with ETS: 92% of patients would recommend surgery to family members or friends.*

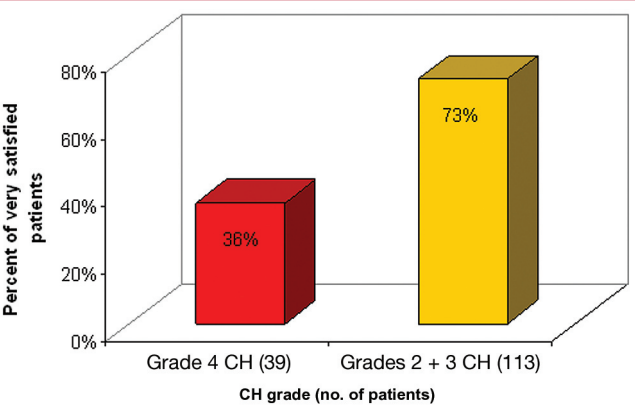

FIGURE 4. *Bar graph showing the percentage of patients who expressed the highest level of satisfaction with ETS: 14 (36%) of 36 patients with Grade 4 CH, as opposed to 83 (73%) of 113 patients with Grade 2 or 3 CH were very satisfied with ETS. Grade 4 CH significantly lowered patient satisfaction with ETS (P = 0.003). No correlation was found between Grades 2 and 3 CH and the degree of patient satisfaction.*

in which 11 (65%) of 17 patients experienced Grade 4 CH. Patients with Grade 4 CH were significantly less satisfied with the outcome than patients with Grade 2 and 3 CH ($P = 0.004$).

In the group of patients who reported regret at having the surgery (5 patients), 2 had combined axillary and palmar HH of similar severity, 2 had solitary axillary HH, and 1 had solitary facial HH; the dissatisfaction in the patient with facial HH was in the nonimprovement of the facial HH, and not the development of CH. The other 4 patients developed Grade 4 CH with good resolution of palmar symptoms but incomplete resolution of the axillary sweating in 2 patients and recurrence of the axillary sweating in 3 patients. Patients with predominantly axillary sweating at presentation were significantly less satisfied with the ETS procedure, as compared with patients presenting with palmar or combined symptoms ($P = 0.04$)

Only one patient stated that her hands being too dry was the cause of her dissatisfaction with ETS; all other patients with dry

hands after the ETS procedure were either very satisfied (5 patients), or somewhat satisfied (2 patients). All would recommend the procedure to others. In summary, low levels of satisfaction with ETS were associated with the following: axillary sweating on initial presentation, the development of Grade 4 CH, and CH in 3 or more body areas. Overall incidence of CH and the development of palmar anhidrosis were found to have no effect on patient satisfaction with ETS.

DISCUSSION

The incidence of CH as reported in the literature varies from 35 to 98% (3, 23). The wide variability may be attributable to heterogeneous patient populations, different surgical procedures, and differences in the definition of CH.

The extent of sympathectomy was not associated with reduced occurrence or severity of CH in 1 report (11), and T2 sympathicotomy reduced the severity of CH in another study (2). In yet another group of patients, T4 sympathetic block (clipping) effectively reduced the occurrence of CH in contrast to T2–T4 cauterization (19), and the rate and severity of CH were significantly lower in the clamping group than in the cauterized group (21). The incidence of CH declined from 70 to 30% after T4–T5 ganglionectomy, when compared with ganglionectomies at T3–T4 and T4 alone (8). There was no difference in the occurrence of CH between bilateral and unilateral procedures (29). Percutaneous upper thoracic phenol sympathicolysis produced CH in 38% of patients (28), and no study has reported the incidence of CH after percutaneous radiofrequency sympathicolysis.

The occurrence of CH and the relationship to the type (sympathicotomy versus ganglionectomy) and level of surgery has been studied. Atkinson and Fealey (2), in a prospective study of 10 patients, analyzed the occurrence of CH after T2 sympathicotomy. They concluded that this technique produces excellent results with a low incidence of CH, although the rate of resolution of symptoms was significantly lower compared with a standard T2 sympathectomy. Recently, Yoon et al. (31) documented a lower incidence of CH after T3 as opposed to T2–T3 sympathicotomy. Several variations on the type of surgery and the levels to be treated have been proposed (8, 15, 22). Riet et al. (22) proposed limiting the sympathectomy to the third ganglion (sectioning of the trunk at the third and fourth ribs) and reported that CH was nonexistent. Hsu et al. (8), in a retrospective study, showed the incidence of CH to decline from 70% in patients who had T3 and T4 sympathectomies to 29% in patients undergoing T4 and T5 sympathectomies. In 2007, Yang et al. (30) showed that the overall incidence of CH and the rate of moderate CH were significantly reduced after T4 sympathicotomy when compared with T3 sympathicotomy. No severe CH occurred in their cohort. Clipping of the sympathetic chain at T4 resulted in significantly less CH than clipping of the chain at higher levels (19). The severity of CH was related to the severity of the primary complaint in patients who underwent thoracic sympathicotomies (2, 9). The incidence of CH increased with the number of sympathetic ganglia divided, and there was a direct correlation between the extent of CH and the patient's quality of life (9). Preservation of the T2 ganglion may reduce the severity and incidence of CH, perhaps owing to decreased negative feedback relaying into the thalamus after preservation of the upper sympathetic ganglia.

In our series of patients, T3 ganglionectomy led to a significantly lower incidence of Grade 4 (severe) CH. Further investigation of this finding is warranted, as the number of T3 ganglionectomies performed in our cohort of patients was relatively small (24 procedures), compared with the number of sympathectomies at all other levels (137 procedures). We intend to reanalyze the correlation between T3 ganglionectomy and less severe CH in the future, as more patients undergo this procedure.

The relationship between the number of levels of the sympathetic chain interrupted and the severity of CH has also been examined, and reports have been inconclusive (9, 11, 12, 22). In our cohort, we found no statistical difference in the incidence of CH when comparing patients with 1- versus 2-level sympathectomies, although a trend was observed toward an increase in the incidence of Grade 4 (severe) CH with 2 levels of the sympathetic chain interrupted. Unlike Jeganathan et al. (9), we did not find a correlation between the severity of PFH and CH. It is difficult to draw conclusions from these opposing findings, because 2 different procedures were performed in these studies (sympathectomies versus sympathicotomies).

The variability in the reported incidence of CH may also be attributable to different methods used to quantify CH. Licht and Pilegaard (12) evaluated the severity of CH in 158 patients. To assess the severity of the CH, they asked their patients whether they had to change their clothes sometime during the day because of soaking. They found that 89% of their patients had severe CH and had to change their clothing at least once in an average day. However, when questioned regarding the severity of the CH, only 35% of the patients claimed it was severe. Andrews and Rennie (1), in a study of 42 patients undergoing ETS, used a visual analog scale (0–10) to quantify the amount of sweating before and after the operation. The visual analog scale has not been commonly used in CH grading. We elected to quantify CH as Grade 1 (no CH), Grade 2 (mild CH), Grade 3 (moderate CH), and Grade 4 (severe CH) on the basis of descriptions of postoperative sweating given by patients during the telephone questionnaire. There is no standardized questionnaire to better evaluate the frequency and degree of postoperative CH, normalize reporting, and compare results. No such standardized questionnaire has been recommended by the International Society of Sympathetic Surgery, but the need for such a vehicle is clearly apparent.

The time onset of postoperative sweating varies greatly among patients, and the reasons for this are uncertain. The latency period observed in some patients in our cohort may likely be attributable to the fact that they had the procedure performed during the winter, and the compensatory sweating began later, during the summer months. T3 sympathectomy led to a lower incidence of severe CH in our cohort. Even though only 24 procedures were performed at that level, and

the follow-up was relatively short (average, 14 months in this subgroup), it is unlikely that the incidence of severe CH will increase in these patients. Of all 152 patients who experienced compensatory sweating, none reported worsening of the symptom over time, and some showed improvement (11 of 152 patients; 7.2%). In addition, compensatory sweating started 12 months or more after ETS in only 5 of 152 patients.

The issue of BMI and its possible correlation with the incidence and severity of CH has been raised at past meetings of the International Society of Sympathetic Surgery. We wanted to investigate whether higher BMI predicts higher incidence and severity of CH. Although there was a clear trend toward both higher incidence and greater severity of CH in patients with a higher BMI, we did not detect a direct correlation between the variables. An investigation including more patients may be necessary to fully explore this issue.

There is no general agreement as to whether compensatory sweating is purely a compensation for lost surface area for sweating, as reported by Guttmann (5) or a reflex response. The occurrence of decreased sweating in the feet, an area of the body not directly innervated by the ganglia isolated by the ETS procedure, suggests that the response to ETS is somewhat more complex. It has been reported that T3–T4 ganglionectomy can reduce palmar and axillary HH with a lower incidence of CH, compared with T2 ganglionectomy. However, the reduction of the sweating in the hands may be somewhat smaller, with a slightly higher recurrence rate than that after a T2 ganglionectomy (14). Lin and Telaranta (14) described the compromise accepted by the patients to reduce CH with less than complete reduction in the hand sweating and a slightly higher recurrence rate. Based on their experience with 248 sympathectomies, they proposed a complete positive and negative sympathetic sweating circle between the hypothalamus and the sweat glands. Thus, in patients undergoing a T2 ganglionectomy, an amplified efferent sympathetic tone is said to be induced. The authors claim this side effect should be called "reflex" instead of "compensatory" HH.

CH after ETS for the treatment of intractable HH is 1 of the main causes of postoperative dissatisfaction after the surgery. Other factors leading to dissatisfaction are recurrence of symptoms (13), excessive hand dryness (3, 4), and intercostal neuralgia corresponding to the incision sites (10).

Satisfaction rates after ETS reported in the literature are high, ranging from 72 to 98%, despite high rates of CH (4, 17, 29). For a majority of patients seeking surgical cure, PFH is a disabling disease that severely affects their personal and professional life. ETS is highly effective in eliminating the disabling sweating, and in the majority of patients, CH is much more tolerable than the original presenting symptoms, including in patients with moderate or severe CH. Reports in the literature indicate that patients experiencing severe CH are still satisfied with ETS. Although most of these patients have cessation of their primary symptom, the satisfaction rates in this group are generally lower. In our study, of 36 patients with severe CH, 27 expressed some degree of satisfaction with the procedure, 5 were not satisfied, and 4 regretted the surgery. Two patients in this group cited the recurrence of palmar and axillary sweating, and not the severe CH, as the reason for regret. Even severe CH was more acceptable than the initial symptoms.

There was no incidence of persistent intercostal neuralgia in our cohort. Eight patients experienced excessive hand dryness, and only 1 patient in this group was unsatisfied with the procedure; his dissatisfaction was secondary to his severe CH, and not the hand dryness. All patients with excessive hand dryness would recommend the surgery to others. In 1 patient who had undergone bilateral ETS, palmar symptoms failed to improve on 1 side. The patient did not consent to revision of the affected side. Axillary HH symptoms failed to improve in 14 of 108 patients; all of them had predominantly palmar HH, and their hand sweating improved after ETS. In this group, the surgery was targeted toward treatment of the hand sweating. Only 1 patient in this group was unsatisfied with the procedure; the source of dissatisfaction was his severe CH.

Recurrence rates were low in our cohort; hand sweating recurred in 11 (7.8%) of 141 patients, and 2 patients in this group were unsatisfied with the procedure, and they would not recommend it to others. It was difficult to asses the true recurrence rate among patients who experienced axillary sweating, as some patients reported the reappearance of slightly humid armpits after total initial cure, but it was significantly less intense than before surgery. Of those patients (26 of 108 patients; 24%), only 4 reported the recurrence of severe axillary symptoms. In this group, 3 patients regretted having the surgery done, and 1 patient was very unsatisfied; none would recommend the procedure to others.

The lower levels of satisfaction with ETS among patients with axillary sweating may be attributable to the fact that they underwent T2 or T3 ganglionectomies for this symptom during the earlier phase of our series. Isolating the T4 ganglion, as opposed to the higher ganglia, is presently recommended for axillary HH, and it is the procedure we currently offer. It is possible that "undertreatment" of the axillary sweating might have been the cause of dissatisfaction with ETS in patients with combined palmar and axillary sweating. T3 ganglionectomy has been reported not to relieve hand symptoms as effectively as T2 ganglionectomy and to have a higher recurrence rate (19, 22). This has not been our experience to date.

One key measurement of satisfaction is the number of patients who said they would recommend the procedure to a friend or relative. In our series, this number was 92% overall and 91% 1 year after the ETS procedure. This is in keeping with results for satisfaction after ETS surgery in the literature (29). Loscertales et al. (17), in a study of 226 patients, found that 97% of their patients said they would undergo the operation again. Reisfeld et al. (21), in a study of 1312 patients aimed at reviewing the results for clamping versus cauterization of the sympathetic chain, found a satisfaction rate of 98% in the clamping group and 94 and 95%, respectively, in the 2 cauterization groups. We currently analyze factors that may potentially affect improvement and recurrence rates after ETS in our patient population and their impact on patient satisfaction.

Our techniques have evolved over the years from offering a T2 sympathicotomy for palmar HH and T2–T3 ganglionectomies for palmar and axillary HH to presently performing a T3 ganglionectomy for palmar HH, T3–T4 ganglionectomies for palmar and axillary HH, and T4–T5 ganglionectomies for predominantly severe axillary HH. We perform a T2 ganglionectomy for HH of the head and face. The shift toward performing ETS at lower segments occurred in the past 2 years, and the case series we present does not reflect this change. We adopted the new techniques on the basis of the recommendations endorsed at the past 2 meetings of the International Society of Sympathetic Surgery and recent literature. We are currently in the process of collecting data from the new cohort of patients who have had sympathectomies performed at the lower segments. We plan to investigate the efficacy of the new technique, the incidence and severity of CH, and satisfaction with ETS, and we will present our results in the near future.

Rates of follow-up reported in the literature range from 32 (4) to 100% (2), with most studies reporting 70 to 90% follow-up rates. In our study, we reached 73% of patients. Our patient population included a significant number of business persons, college and other students, and patients who traveled to us just to have the procedure done. In addition, the population of New York City and its vicinity is extraordinarily mobile. We believe that, under those circumstances, our 73% follow-up rate is satisfactory.

We acknowledge that our current study is retrospective in nature and carries associated flaws; however, prospective studies have been performed, and they serve as a reference and guide for this type of surgery. Treatment strategies have been modified over time and are still evolving. In the past 10 years, other than the ETS level offered, we did not introduce any significant change in our surgical and postsurgical patient management. For instance, we have always used a harmonic scalpel, minimized manipulation of the sympathetic trunk, and kept all patients after surgery in a monitored setting overnight. It is highly unlikely that an inadvertent factor is responsible for the decrease in CH severity after T3 ganglionectomies. We believe that a thorough explanation of the benefits and risks of the procedure, weighed against patients' expectations, can help to decide on an approach tailored to each patient.

CONCLUSION

ETS for PFH is a safe procedure with generally low complication rates. CH is common after ETS. In our study, there was no association between symptom location, BMI, and the number of levels treated and the development or severity of CH. T3 ganglionectomy alone resulted in significantly less severe CH than sympathectomies performed at all other levels.

The level of satisfaction with the ETS procedure is high. Patients presenting with axillary sweating were significantly less satisfied with ETS. The occurrence of severe, as opposed to mild or moderate, CH, and the development of CH affecting 3 or more body areas significantly reduced patient satisfaction with the ETS procedure. In our cohort, hand anhidrosis was not the cause of patient dissatisfaction.

Disclosure

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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COMMENTS

Chwajol et al. evaluated 220 patients who underwent bilateral endoscopic thoracic sympathectomy (ETS) in a single institution. A retrospective chart review was conducted, and a follow-up telephone questionnaire was administered. The response rate was 73%. Various responses of patients regarding compensatory hyperhydrosis (CH) were evaluated by the questionnaire, and the patients' level of satisfaction was tabulated and analyzed using several statistical tests.

The findings of the study included the fact that virtually all patients had at least a minimal amount of CH after ETS. Despite this, the majority (90%) of patients were satisfied with the procedure. Grade 4 (severe) CH, defined as being intolerable and always interfering with daily activities, was self-reported in 39 patients (24% of the patients available for follow-up). Not surprisingly, the development of severe CH significantly correlated with a lower satisfaction rate from surgery. With regard to all factors analyzed, the only technical issue that led to a significantly lower incidence of severe CH was an isolated T3 ganglionectomy.

This study, being retrospective in nature, has all of the attendant problems. A prospective study most likely would have resulted in better data collection. Moreover, loss to follow-up of more than 25% of the patients is a matter of significant concern. As with many studies with this degree of loss, I would be concerned that a disproportionate number of the patients who were lost to follow-up would have had poorer outcomes and/or severe CH.

The span of the reported patient study is 10 years (February 1997 to February 2006). As the authors describe, their surgical techniques have changed over this time period, with the evolution of practice seeming to target a more caudal level. The authors performed T3 ganglionectomy alone in only the most recent set of their patients. This concurs with recent literature, which the authors cite and discuss nicely, in which the trend is toward a T3 and/or T4 ganglionectomy (and preservation of the T2 ganglion). It will be interesting to see, in further prospective studies, from this group and others, whether this surgical approach indeed results in a lower incidence of disabling severe CH.

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The rates of CH were quite high in this series, with 94% of patients reporting CH and 24% having severe, intolerable CH that affected their daily activities. Other published series have reported significantly lower rates of CH. Is this inconsistency secondary to a difference in technique, the definition of CH, the timing of postoperative evaluation, or simply the thoroughness with which the patients are questioned for signs of CH? The answers will probably await a prospective study that documents the prevalence of CH, as well as other issues (e.g., efficacy), using uniform operative techniques and outcome assessment measures. I presume that the International Society of Sympathetic Surgeons would take part in designing such a study.

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In this retrospective clinical chart review, the authors attempt to identify the factors that predict the development, incidence, and location of severe CH after ETS for primary focal hyperhidrosis. Their primary hypothesis, however, is that the degree of CH is directly correlated with patient satisfaction. As expected, they demonstrate that patients with the most severe CH are the least satisfied with surgery, but they are unable to establish a statistically significant relationship between CH and patient age, sex, body mass index, or surgical level. The authors conclude that, although CH is a common side effect of ETS for primary focal hyperhidrosis (94% by their measure), patient satisfaction with this procedure remains very high.

Essentially, Chwajol et al. illustrate the fact that the surgical treatment of this unusual but socially debilitating condition is hampered by a common, untoward side effect. They show that, in spite of the very high incidence of postoperative CH, most patients would repeat the surgery or recommend it to a friend. They arrive at this conclusion by measuring patient responses to a telephone questionnaire developed to qualitatively and quantitatively characterize CH and to establish support for the influence of numerous patient variables on the occurrence and severity of CH. Unfortunately, this study does not demonstrate a predictive relationship between any of these factors and the development, incidence, or location of severe CH, which seems to have been the more important goal here.

Ultimately, Chwajol et al. have shown, in a relatively short-term, retrospective review, that, although CH is common after ETS and may be severe, the vast majority of patients are very satisfied with the outcome of this surgery. The degree of CH is correlated with patient satisfaction, and it appears that a connection may exist between the isolated T3 ganglionectomy and reduced CH, at least in patients treated for palmar and/or axillary primary focal hyperhidrosis. The authors also appropriately conclude that a larger study looking specifically at patients who undergo the isolated T3 approach may demonstrate a statistically significant relationship with better outcomes. Longer follow-up will also allow evaluation of the question of whether a more limited lesion will result in a higher rate of symptom recurrence. We are confident that the authors will continue to gather data as they apply this promising technique to more patients in the future.

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