# Satisfaction and compensatory hyperhidrosis rates 5 years and longer after video-assisted thoracoscopic sympathotomy for hyperhidrosis

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**Objective:** The objective of the present study was to determine the long-term fate and factors of compensatory hyperhidrosis (CH) in patients who have undergone video-assisted thoracoscopic sympathotomy for focal hyperhidrosis.

**Methods:** The same quality-of-life survey was administered 6 months postoperatively and then annually to all patients who underwent video-assisted thoracoscopic sympathotomy for hyperhidrosis. A second rib (R2)/R3 sympathotomy was most commonly performed until September 2007 and then R4/R5 sympathotomy was used.

**Results:** From January 1999 until December 2012, 193 patients underwent video-assisted thoracoscopic sympathotomy for hyperhidrosis, of whom, 173 had provided ≥1 year of postoperative survey information. No operative mortalities occurred. Of the 173 patients, 133 (77%) reported ''clinically bothersome'' CH. This rate had decreased to an average of 35% at 5 and 12 years postoperatively. Univariate analysis showed the CH incidence was significantly greater for the patients who had undergone R2/R3 versus R4/R5 sympathotomy ($P < .001$), had had multiple sites of sweating at presentation ($P < .001$), had used oral medication to control hyperhidrosis preoperatively ($P = .022$), or were female ($P = .002$). On multivariate analysis, only R2/R3 versus R4/R5 sympathotomy ($P < .021$) and multiple sites of sweating at presentation ($P < .037$) remained statistically significant. Twelve patients (6.2%) regretted having the operation for CH.

**Conclusions:** Patients who undergo sympathotomy for hyperhidrosis will commonly report ''clinically bothersome'' compensatory hyperhidrosis. CH will more likely if R2/R3 sympathetic interruption has been performed instead of R4/R5 and in patients who present with multiple areas of sweating. The severity of clinically bothersome CH decreased during the first 3 years postoperatively. (J Thorac Cardiovasc Surg 2014;147:1160-3)

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Video-assisted thoracoscopic (VATS) sympathotomy is the treatment of choice for focal hyperhidrosis because of outstanding and permanent results compared with other treatment options.[1,2] However, the long-term patient satisfaction, quality of life, and fate of compensatory hyperhidrosis several years after surgery is not well known. The primary objective of the present study was to determine the long-term effects and temporal trends on the quality of life, degree of compensatory hyperhidrosis (CH), and factors predicting CH in patients who have undergone VATS sympathotomy for focal hyperhidrosis.

## METHODS

The present study was a prospective cohort study of patients who had undergone VATS sympathotomy for hyperhidrosis. The indications for surgery were as previously described.[3] Patients with hyperthyroidism, obesity, and/or generalized full body sweating were not offered surgery.

### Operative Technique

General anesthesia was used for all patients. The patient is positioned in the operating room and prepped and draped only 1 time so we have access to both areas near each breast without having to reprep and drape. From 1999 to 2007, in general, we used the single 5-mm incision per side technique that features the interruption of the sympathetic chain on top of the second (R2) and third (R3) rib using cautery. No chest tube was used, but the patients were admitted overnight for observation until 2005. Starting in January 2006, the procedure was commonly performed as an outpatient operation. Starting in October 2007, we changed our operative technique and commonly used an R4/R5 interruption of the sympathetic chain for most patients. The impetus for this change was based on our involvement in an expert consensus report.[3] In general, we then performed the interruption according to the patient's complaint of hyperhidrosis. An R4 sympathotomy was used for palmar only and R4/R5 for those with palmar and axilla, palmar, axillar, and pedal, and axillary only. R3 sympathotomy was used for craniofacial hyperhidrosis.

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**Abbreviations and Acronyms**

CH = compensatory hyperhidrosis
IRB = institutional review board
R# = rib number
UAB = University of Alabama at Birmingham
VATS = video-assisted thoracoscopy

### Quality-of-Life Assessment Postoperatively

The patients were seen in our clinic 3 weeks postoperatively. At that visit, their satisfaction with the operation and their level of CH was assessed; however, no formal survey was given. The patients were subsequently asked to participate in a written survey at 6 and 12 months postoperatively and then annually (Appendix E1). The follow-up data were obtained through surveys and, if applicable, through office visits and telephone calls. The patients were contacted through mail and/or e-mail primarily. The percentage of patients who reported their CH rate was tabulated for each year.

### Definitions

We have reported the failure and recurrence rates for the hands, axilla, and feet. A "failure" was defined as a patient who had never achieved satisfactory dryness of a specific part of their body that was initially hyperhidrotic preoperatively. "Recurrence" was defined as a body part that had been initially wet that had been rendered dry after surgery and then at some point had become hyperhidrotic again. We separated CH into several different categories according to the patients' response to "Do you have any new areas of sweating on your body, and, if so, where is it located, and rate it on a scale of 1 to 10."

1. No CH: if patients responded "no"
2. CH: if patients responded "yes"

The patients responding "yes" were asked to list the areas of sweating and to grade each area on a scale of 1 (minimal, infrequent sweating) to 10 (maximal sweating). "Clinically bothersome" CH was defined as a rating of $\geq$5.

The institutional review board (IRB) of the University of Alabama at Birmingham (UAB) approved the present protocol and the prospective database used to collect the information for our study. Patient consent was waived for inclusion in the study; however it was required and obtained to enter the patient data into the prospective database. The UAB IRB approved our prospective database (UAB-IRB no. X021104003) and the hyperhidrosis survey (UAB-IRB no. X021104003). Permission was also obtained to include patients <18 years old.

Data analysis was performed using Statistical Analysis Systems, version 9.1 (SAS Institute, Cary, NC). Descriptive statistics were used to provide the frequency and median values of the study variables. Fisher's exact test or Pearson's chi-square test was used to assess the categorical data and the Wilcoxon test to evaluate the continuous variables. Variables with $P \leq .1$ in the univariate model were considered to be possible independent variables and were subsequently entered into a stepwise multivariate regression analysis. The $P$ values were all 2-sided.

## RESULTS

From January 1999 until December 2012, 193 patients underwent VATS sympathotomy. The patient characteristics are listed in Table 1. Only 173 patients had undergone surgery $\geq$1 years earlier and responded to the survey. Three patients who had undergone R2-only interruption were considered to have undergone R2/R3 for statistical purposes, and 8 patients who had undergone R4-only interruption were considered to have undergone R4/R5. After October 10, 2007, only 3 patients underwent an R2/R3 interruption, and they had all had palmar and cranial facial sweating only. No patients experienced symptomatic bradycardia or Horner syndrome or complained of an inability to exercise. A radiographic pneumothorax was observed in 67% of the patients immediately postoperatively; however, only 1 patient required a chest tube for the pneumothorax. The median length of hospital stay was 2 days for the first 83 patients. It was 1 day (hospitalized for the day of surgery only) for the last 110 patients, all of whom had had it performed as an outpatient procedure.

The median follow-up period was 6.9 years (range, 6 months to 12 years). The failure and recurrence rates were the greatest for patients who complained of axillary and pedal hyperhidrosis (Table 2). Ninety-six patients described their quality of life as "very poor" or "poor" before the sympathotomy. Of these patients, we obtained surveys at 5 years for 61 of these patients, and 79% reported an improvement in their quality of life (described as "excellent," "very good," or "good") 1 year after surgery, 85% at 3 years after surgery, and 89% at 5 years after surgery.

### Compensatory Hyperhidrosis

At 6 months to 5 years postoperatively, clinically bothersome CH was reported in a median of 52% of patients. At 1 year postoperatively, clinically bothersome CH was reported by 77% of the patients surveyed (Figure 1). At $\geq$5 years after surgery, CH was reported by a median of 37% of patients. The rate of bothersome CH decreased most significantly from 1 to 2 years postoperatively. After 3 years, the rate of bothersome CH had also decreased, but this difference was not significantly different. The most common sites of "new" (compensatory sweating) reported were on the back, lower abdomen, and/or groin. Finally, 12 patients (6.2%) regretted having undergone the operation (secondary to clinically bothersome CH for all 12).

Results of the univariate analysis at 1 year of follow-up are listed in Table 3. Univariate analysis showed that clinically bothersome CH was significantly greater for patients who had undergone R2/R3 sympathotomy than for those who had undergone R4/R5 sympathotomy ($P < .001$), had had multiple sites of sweating at presentation ($P < .001$), had used an oral prescription for sweating preoperatively ($P = .022$), or were female ($P = .002$). On multivariate analysis, only the level of interruption ($P = .021$) and multiple sweating sites present preoperatively ($P = .037$) remained significantly associated with clinically bothersome CH.

## DISCUSSION

When a surgeon operates on a patient for lifestyle reasons, the operation must be extremely safe and offer outstanding short- and long-term results. Although hyperhidrosis can have severe psychological and

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**TABLE 1. Patient characteristics (n = 193)**

| Characteristic | Total patients (n = 193) | Study Population (≥1 y postoperatively; n = 173) |
|---|---|---|
| Median age at operation (y) | 25.2 | 25 |
| Gender | | |
| Female | 151 (78) | 143 (83) |
| Male | 42 (22) | 30 (17) |
| Initially reported site of HH | | |
| Single site | 56 (29) | 45 (26) |
| Hands | 29 | 26 |
| Axillary | 13 | 10 |
| Craniofacial | 6 | 4 |
| Feet | 8 | 5 |
| Multiple sites | 137 (71) | 128 (74) |
| Hands + axilla | 18 | 16 |
| Hands + feet | 49 | 45 |
| Hands + feet + axilla | 68 | 65 |
| Other combinations | 2 | 2 |
| Age at onset (y) | 12 (preadolescence) | 12 (preadolescence) |
| Median body mass index (kg/m$^2$) | 22.1 | 23.0 |
| Level of interruption | | |
| R2-R3 | 124 (64.2) | 112 (64) |
| R4-R5 | 69 (35.8) | 61 (35) |

Data presented as n (%), unless otherwise noted. *HH*, Hyperhidrosis; *R#*, rib number.

physiologic consequences (and these should not be trivialized), the operation is for lifestyle changes only. For these reasons, we must carefully assess not only the short-term results, but also the long-term results of VATS sympathotomy.

In the present report, we have shown that the long-term results of VATS sympathotomy for hyperhidrosis were quite good; however, the rate of CH was high. The published data have indicated a CH rate of 3% to 98%.[4,5] This wide variation in reported CH rates has primarily resulted from the different definitions of CH and its inherent subjectivity. In the present study, we used patient self-report of their degree of hyperhidrosis. Those who reported

**TABLE 2. Failure and recurrence rates of VATS sympathotomy stratified by patient hyperhidrosis locations**

| Hyperhidrosis location preoperatively | Failure rate (%) | Recurrence rate (%) |
|---|---|---|
| Hands only (n = 29 patients) | 3.4 (1 patient)* | 0 |
| Hands + axilla (n = 18 patients) | Hands, 0<br>Axilla, 11 (2 patients) | Hands, 5.6 (1 patient)<br>Axilla, 11 (2 patients) |
| Hands + feet (n = 49 patients) | Hands, 2 (1 patient)*<br>Feet, 4 (2 patients) | Hands, 0<br>Feet, 6.1 (3 patients) |
| Hands + feet + axilla (n = 68 patients) | Hands, 0<br>Axilla, 4.4 (3 patients)<br>Feet, 2.9 (2 patients) | Hands, 1.5 (1 patient)<br>Axilla, 8.8 (6 patients)<br>Feet, 4.4 (3 patients) |

*Treated with reoperation.

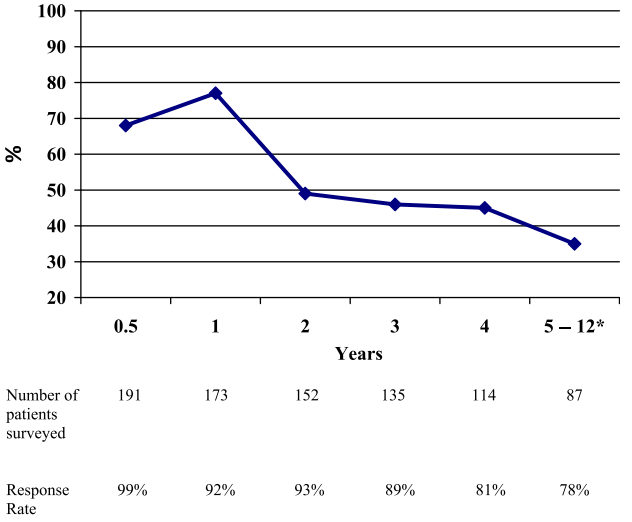


**FIGURE 1.** Percentage of patients with clinically bothersome compensatory hyperhidrosis stratified by postoperative year. *Cumulative results provided for postoperative years 5 to 12.

a ≥5 in a new area of hyperhidrosis were considered to have clinically bothersome CH. The present study is the first to show that CH will diminish over time. The reasons are unknown. However, possible explanation include that the perception of an illness changes as the person ages or perhaps a response bias was present in that patients with CH might have been likely to respond to the survey over time. We reported a disappointing patient regret rate of

**TABLE 3. Univariate analysis of 173 patients who responded to the 1-year survey**

| Variable | Patients with clinically bothersome CH (n = 133) | Patients without clinically bothersome CH (n = 40) | *P* value |
|---|---|---|---|
| Median age at surgery (y) | 23.2 | 24.6 | .595 |
| Gender | | | .002 |
| Female | 117 (88) | 26 (65) | |
| Male | 16 (12) | 14 (35) | |
| Initial reported site of HH | | | <.001 |
| Single | 24 (18) | 21 (53) | |
| Multiple | 109 (82) | 19 (47) | |
| Median BMI (kg/m$^2$) | 23.0 | 24.4 | .415 |
| Used oral medication to control sweating preoperatively | 46 (35) | 6 (15) | .030 |
| Family history of HH | 36 (21) | 10 (18) | .791 |
| Level of interruption | | | <.001 |
| R2-R3 | 98 (74) | 14 (35) | |
| R4-R5 | 34 (26) | 27 (65) | |

Data presented as n (%), unless noted otherwise. *CH*, Compensatory hyperhidrosis; *BMI*, body mass index; *HH*, hyperhidrosis; *R#*, rib number.

6.2%. Chwajol and colleagues,[6] in 2009, showed that 7% were dissatisfied with the operation, and 3% of patients regretted undergoing the operation. De Campos and colleagues,[7] in 2003, reported a 4% regret rate in their study of 378 patients.

In our study, we found that several factors predicted clinically bothersome CH on univariate analysis: patients who had undergone R2/R3 versus R4/R5 ($P < .001$), those with multiple versus single sites of sweating at presentation ($P < .001$), patients who had used oral medication to control their hyperhidrosis preoperatively ($P = .022$), and female gender ($P = .002$). On multivariate analysis, only an R2/R3 compared with an R4/R5 interruption ($P < .021$) and multiple sites of sweating at presentation ($P < .037$) remained statistically significant. Our study, just as have many previous publications, also found that the most common sites of CH were on the back, lower abdomen, and groin. We also found that patients with palmar-only hyperhidrosis had the greatest satisfaction and lowest failure and recurrence rates. Although many have favored an R2/R3 interruption for patients with palmar hyperhidrosis alone, most of the patients we had treated had also had bothersome hyperhidrosis on their axilla and feet. Thus, for the second half of the present series, we almost exclusively used an R4/R5 interruption.

The strengths of our report include that the same surveys were administered yearly, only 1 surgeon performed every operation, the response rate was high, and the median follow-up period was long (6.5 years). We used the same definitions and the same survey throughout the entire study period. However, the present study also had many limitations. Some of these included the inherent subjectivity of CH and the use of self-reported surveys, which could have led to a sampling error because of the patients who did not respond to the survey. This might have underreported the true rate of CH or clinically bothersome or severe CH. Also we changed the operative technique during the study period and performed a different operation in the latter aspect of the study period according to the location of the hyperhydrosis. Finally, the bias resulting from those who reported versus those who did not cannot be underestimated.

## CONCLUSIONS

We have shown that although VATS sympathotomy can be an effective therapy for patients with focal hyperhidrosis, CH will be common and could be clinically bothersome in $\leq 77\%$ of patients 1 year postoperatively. This rate decreased over time, especially during the next 3 years. Surgeons should carefully counsel patients, especially those with multiple areas of sweating about CH. Finally, agreed-on definitions and terminology are needed to compare series and derive the better evidence our patients deserve.

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**APPENDIX E1. HYPERHIDROSIS—YEARLY FOLLOW-UP QUESTIONNAIRE**

May we contact you again in a few months to see how you are doing? No Yes

E-mail: _____ Telephone _____

FOLLOWING SURGERY please rate your sweating on a scale of 10 (worst) – 0 (none):

Ex: (10) most bothersome/dripping sweat…(5) somewhat bothersome…(0) No sweating/not at all bothersome

_____Right hand _____Left hand

_____Right axilla (arm pit) _____Left axilla

_____Face/forehead

_____Right foot _____Left foot

Have you noticed sweating in any NEW areas of your body? No Yes

Has this changed since the last time we contacted you/your last survey? No Yes

If yes, where and how much (on a scale of 1 – 10 [worst])_____

In retrospect, are you glad you had this surgery? No Yes

If no, why not? _____

Are you satisfied with the results of the hyperhidrosis surgery overall? No Yes

If no, why not? _____

Are you satisfied with the cosmetic result (scar from surgery)? No Yes

Would you recommend this surgery to a friend who has hyperhidrosis? No Yes

On a scale of 0 (no pain) – 10 (severe pain), grade any pain you are having now related to this surgery?_____

Generally speaking, how would you rate your quality of life (since surgery)? (circle)

1 – Excellent 2 – Very good 3 – Good 4 – Poor/inferior 5 – Very poor

Using the same scale as above (1–5), how would you rate the following activities after the VATS hyperhidrosis surgery:

| | | | | | |
|---|---|---|---|---|---|
| Writing | 1 | 2 | 3 | 4 | 5 |
| Manual work | 1 | 2 | 3 | 4 | 5 |
| Leisure | 1 | 2 | 3 | 4 | 5 |
| Sports | 1 | 2 | 3 | 4 | 5 |
| Hand shaking | 1 | 2 | 3 | 4 | 5 |
| Socializing | 1 | 2 | 3 | 4 | 5 |
| Grasping objects | 1 | 2 | 3 | 4 | 5 |
| Social dancing | 1 | 2 | 3 | 4 | 5 |

Personal Domain – with partner/spouse…how would you rate your quality of life:

| | | | | | |
|---|---|---|---|---|---|
| Holding hands | 1 | 2 | 3 | 4 | 5 |
| Intimate touching | 1 | 2 | 3 | 4 | 5 |
| Intimate affairs | 1 | 2 | 3 | 4 | 5 |

Emotional – Self/Others —

I am more confident now than before surgery

Very true True Not sure Not true Not at all true

People rejected me slightly

Very true True Not sure Not true Not at all true

Under Special Circumstances – Using the 1–5 scale above, how would you rate the quality of your life:

| | | | | | |
|---|---|---|---|---|---|
| In a closed or hot environment | 1 | 2 | 3 | 4 | 5 |
| When tense or worried | 1 | 2 | 3 | 4 | 5 |
| Thinking about the problem | 1 | 2 | 3 | 4 | 5 |
| Before a test, meeting, or public speaking | 1 | 2 | 3 | 4 | 5 |
| Wearing sandals/barefoot | 1 | 2 | 3 | 4 | 5 |
| Wearing colored clothing | 1 | 2 | 3 | 4 | 5 |
| Having problems at school/work | 1 | 2 | 3 | 4 | 5 |

Have you noticed a difference in your exercise ability/capacity? No Yes