



Long-term follow-up in quality of life before and after endoscopic thoracic sympathectomy in 367 patients with palmar hyperhidrosis

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Background: Palmar hyperhidrosis (PH) hinders daily activities and deteriorates quality of life (QOL). Endoscopic thoracic sympathectomy (ETS) is safe and efficient as the gold standard treatment for PH. So far, the long-term change of QOL after surgery has not been fully characterized, which is important to evaluate clinical benefits and helped to identify the true beneficiaries. In the current study, we aimed to investigate the long-term outcome of ETS by comparing their preoperative QOL with a follow-up QOL.

Methods: This study enrolled 367 patients with PH who underwent ETS between March 2018 and March 2019. All patients were surveyed by a web-based questionnaire adapted from de Campos Quality-of-life Questionnaire for Evaluation of Hyperhidrosis, and compared to their preoperative results.

Results: After a median follow-up of 14 months [interquartile range (IQR), 9–21 months], improvement in QOL was reported in 90.7% of patients. Compared to preoperative QOL [median (Md) =40, IQR, 37–45], postoperative QOL was significantly improved (Md =20, IQR, 13–23; $P < 0.001$). A higher QOL score was noticed in patients with severer PH at diagnosis, whereas no significant difference was observed among postoperative QOL regarding the severity of PH. Subclinical compensatory hyperhidrosis (CH) occurred in 94.6% of post-ETS cases after long-term follow-up. The score of postoperative QOL was significantly positively correlated to the severity of CH ($r_s = 0.14$; $P = 0.009$).

Conclusions: Improvement in QOL sustained for a long-term period after receiving ETS for PH. Almost all patients developed subclinical CH on other body sites in the long run, with an impairment in QOL correlating with the severity of CH. Further investigations on the developing patterns of CH and clinical coping strategy are warranted to improve the long-term outcome of ETS.

Keywords: Palmar hyperhidrosis; quality of life; endoscopic thoracic sympathectomy; compensatory hyperhidrosis (CH)

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Introduction

Palmar hyperhidrosis (PH) is a benign functional disorder resulted from excessive secretion of exocrine glands on the palms (1). Excessive sweating might cause embarrassment especially under occupational or social stress. PH may lead to emotional difficulty and hinder daily activities, and ultimately, deterioration in quality of life (QOL).

There are many treatment options for palmar hyperhidrosis, including topical therapies, oral medications, iontophoresis, or thoracic sympathectomy (2,3). According to The Society of Thoracic Surgeons, thoracic sympathectomy is the treatment of choice for patients with primary hyperhidrosis given its safety and effectiveness (4).

Symptomatic improvement has been the primary outcome of many previous studies regarding endoscopic thoracic sympathectomy (ETS). Nowadays, the issue of QOL is receiving considerable attention (5), especially the long-term change after particular medical intervention. Besides, many previous studies assessed QOL with scales in general nature (6-8). In other words, there is a paucity of study evaluating QOL with questionnaire specified for patients with PH. Thus, we conducted a cross-sectional study, using a specific questionnaire, to evaluate QOL before and after ETS in patients with PH. We present the following article in accordance with the STROBE reporting checklist (available at <https://apm.amegroups.com/article/view/10.21037/apm-21-2860/rc>).

Methods

Study design

This study enrolled a cohort of 367 patients with PH who underwent ETS in Guangdong Provincial People's Hospital between March 2018 and March 2019. During this period, 498 patients underwent ETS for PM and were surveyed. Among them, 402 responded to the questionnaire before surgery and 35 patients were lost from follow-up. Inclusion criteria as follow: (I) age between 12 and 60 years old; (II) severe palmar sweating was the major complaint with or without sweating in other body sites; (III) patients with strong urge for surgery; (IV) patients who can literally understand and answer the questionnaire. Patients without surgical treatment or those who were not suitable for surgery because of severe pleural adhesions were excluded. Patients were excluded if they refused to participate. Preoperative assessment on QOL was collected at the admission to hospital, while the postoperative QOL was evaluated

after a median follow-up of 14 months [interquartile range (IQR), 9–21 months] after the completion of ETS. The link of questionnaire was sent to the patients via WeChat after obtaining their informed consent to participate. Completion of the questionnaire did not result in any benefit or financial compensation for respondents. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Institutional Review Board of Guangdong Provincial People's Hospital (No. 2020-268H) and informed consent was obtained from all individual participants and minors' legal guardian/next of kin.

Surgical technique

Bilateral and sequential sympathectomy were performed in all cases in the same setting. Single lumen endotracheal intubation with general anesthesia was the standard technique. All patients were in a semi-supine position at 30°–45° to the operating table with the abduction of both upper limbs. One 5 mm incision was made in each hemithorax in the third intercostal space along anterior axillary line. Carbon dioxide was inflated through 5 mm Trocar to create artificial pneumothorax. After exclusion of severe pleural adhesions by the thoracoscope, electrocoagulation hook was introduced through the same incision. Sympathectomy at level R4 was performed using electrocoagulation hook and extended 2 cm laterally at levels R3 and R4 to include Kuntz's nerve. Aspirator was connected to the Trocar, which was removed after endoscopic confirmation of full lung re-expansion. Incisions were sutured or adhered by medical glue. Then, the patient was shifted to the recovery room and a postoperative chest X-ray was done routinely before their discharge from hospital.

Construction of QOL questionnaire for PH

QOL is defined as the subjective perception of an individual's general well-being, including functional, personal, emotional, and special circumstances parameters. In the current study, QOL questionnaire for PH were adapted from de Campos Questionnaire (9) to evaluate the QOL before and after surgery in all participants (detailed in [supplementary material](#)). Eleven Likert five-scale questions fell into five different domains, including general rating (Question 1), functional/social domain (Question 2-6), personal domain (Question 7-8), emotional domain (Question 9-10), and special circumstances (Question 11).

Table 1 Patient characteristics

Variables	Patients [n=367 (%)]
Age (y, mean ± SD)	25.14±4.50
Sex	
Male	187 (51.0)
Female	180 (49.0)
Age of onset	
0–7 years old	192 (52.3)
8–15 years old	175 (47.7)
Hyperhidrosis distribution	
Palmar	367 (100.0)
Axillary	187 (51.0)
Craniofacial	59 (16.1)
Plantar	349 (95.1)
Chest and back	56 (15.3)
Buttocks	47 (12.8)
Preoperative clinical severity of sweating	
Barely tolerable	190 (51.8)
Intolerable	177 (48.2)
Previous treatment	
Oral medication	68 (18.5)
Traditional Chinese medicine	126 (34.3)
Iontophoresis	39 (10.6)
Botulinum toxin	0 (0)
Others	11 (3.0)
None	189 (51.5)
Dermatologic complication	
Pompholyx	70 (19.1)
Eczema	53 (14.4)
Rhagade of palms	42 (11.4)
Peeling of palms	121 (33.0)
Bromhidrosis	51 (13.9)
Others	18 (4.9)
None	166 (45.2)
Family history	
Yes	113 (30.8)
No	179 (48.8)
Unknown	75 (20.4)
Recurrent rate	17 (4.6)
Transient compensatory hyperhidrosis [†]	347 (94.6)

[†], transient compensatory hyperhidrosis is defined as a postoperatively increased sweating beyond palm, such as chest, abdomen, back, buttocks, thigh, and calf.

The answers to Likert scale Question 2-11 were then used to construct a total score of QOL for every individual patients. The total score of QOL ranged from 10–50, where “excellent”, “good”, “moderate”, “poor”, “very poor” were designated as 1 to 5 points, respectively. A lower total score indicated a higher level of QOL. The pilot study was conducted enrolling 50 patients underwent ETS in March 2018. We found a Cronbach’s alpha of 0.909 for the questionnaire. Goodness-of-fit indices for the questionnaire indicated an acceptable model fit (Chi squared/degrees of freedom ratio =2.163, comparative fit index =0.913).

Statistical analysis

Demographic and clinical data except for age were summarized as frequency and percentage. Results were given as median (Md) with IQR. Differences of QOL before and after ETS were compared by Wilcoxon rank-sum test. Differences of the score of preoperative QOL (QOL_{pre}) or postoperative QOL (QOL_{post}) according to PH severity were examined by Kruskal-Wallis rank sum test. Correlation between compensatory hyperhidrosis (CH) and QOL was examined by Spearman rank correlation test. A P value of less than 0.05 was considered to indicate a statistically significant difference. All data analysis was performed using SPSS version 21 (IBM Corp, Armonk, NY, USA).

Results

Patients characteristics

A total of 367 patients underwent ETS between March 2018 and March 2019 were included in this analysis. Median follow-up time was 14 months (IQR, 9–21 months) after surgery. The mean age was 25.1±4.5 years (range, 14 to 47 years old); and 180 (49%) patients were females. The self-reported preoperative severity of hyperhidrosis was intolerable in 48.2% patients and barely tolerable in 51.8% patients. Almost half of the patients (178/367, 48.5%) had previously received conservative treatment elsewhere, however, with no obvious improvement. The detail breakdown of the distribution of hyperhidrosis and some of other main characteristics were shown in *Table 1*. After receiving ETS, the palmar sweating was disappeared in 60.22% patients and alleviated in 36.51% patients (*Figure 1*). However, what stood out in *Figure 1* was the high rate of exacerbation of sweating on the back, thigh, buttocks, and chest.

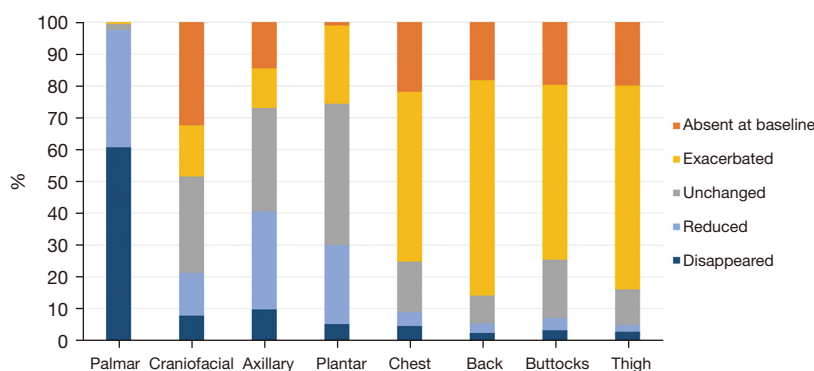


Figure 1 Evolution of hyperhidrosis of each location after surgery.

Table 2 QOL before and after ETS

Domains	Preoperative (Md, IQR)	Postoperative (Md, IQR)	P value
General	4 [3–4]	2 [2–3]	<0.001
Functional/social	20 [18–23]	10 [6–11]	<0.001
Personal	8 [8–10]	4 [2–4]	<0.001
Emotional	7 [6–8]	4 [2–5]	<0.001
Special circumstances	4 [4–5]	2 [1–3]	<0.001
Total	40 [37–45]	20 [13–23]	<0.001

QOL, quality of life; ETS, endoscopic thoracic sympathectomy; Md, median; IQR, interquartile range.

Table 3 Satisfaction with the surgical results

Satisfaction	Patients [n (%)]
Very dissatisfied	6 (1.6)
Dissatisfied	12 (3.3)
Basically satisfied	96 (26.2)
Satisfied	163 (44.4)
Very satisfied	90 (24.5)

Long-term change in quality of life

QOL was examined by QOL questionnaire for PH. Significant reduction of general QOL score was found after surgery (Md =2.0, IQR, 2.0–3.0) in comparison with the score prior to surgery (Md =4.0, IQR, 3.0–4.0; $P<0.001$). The median of QOL_{post} was 20.0 (IQR, 13.0–23.0), and it was significantly lower when compared with QOL_{pre} (Md =40.0, IQR, 37.0–45.0; $P<0.001$). After thoracic sympathectomy, the greatest reduction of QOL score was observed in personal domain (52.6%); however, it was also

noticeable in other domains (Table 2). In summary, 90.7% of the patients achieved a better QOL after the surgery.

Considering the final surgical results, 90 patients (24.5%) were very satisfied with the outcome of the operation; 163 patients (44.4%) were satisfied; 96 patients (26.2%) were basically satisfied. Only 4.9% of the patients were not satisfied after the procedure attributing to CH, surgical cost, or pain (Table 3). In addition, 335 participants (91.3%) were willing to recommend the surgical treatment for other patients with PH.

Quality of life and severity of palmar hyperhidrosis

According to the severity scale of PH (10), the proportions of patients who had severe (defined as ‘sweat was in the shape of drops when palms sweated’), moderate (defined as ‘palmar sweat was profuse enough to drench a handkerchief’) and mild (defined as ‘palms were frequently moist’) PH were 65.4%, 32.2% and 2.5%, respectively. Table 4 revealed that QOL_{pre} is higher in patients with more severe PH before ETS. Moreover, there was a significant difference

Table 4 Preoperative QOL score compared with initial PH severity

Severity of PH	Frequency (%)	QOLpre [Md (IQR)]	P value
Mild	9 (2.5)	39.0 (24.5–45.0)	Mild versus moderate 1.000
Moderate	118 (32.2)	38.5 (34.8–42.0)	Moderate versus severe <0.001***
Severe	240 (65.4)	42.0 (38.0–46.0)	Mild versus severe 0.523

***, P value <0.001. QOL, quality of life; PH, palmar hyperhidrosis; QOLpre, the score of preoperative quality of life; Md, median; IQR, interquartile range.

Table 5 Distribution of CH

Distribution	Patients [n (%)]
Craniofacial	72 (20.8)
Chest	248 (71.5)
Back	295 (85.0)
Abdomen	171 (49.3)
Buttocks	201 (57.9)
Thigh	246 (70.9)
Calf	145 (41.8)
Plantar	151 (43.5)

CH, compensatory hyperhidrosis.

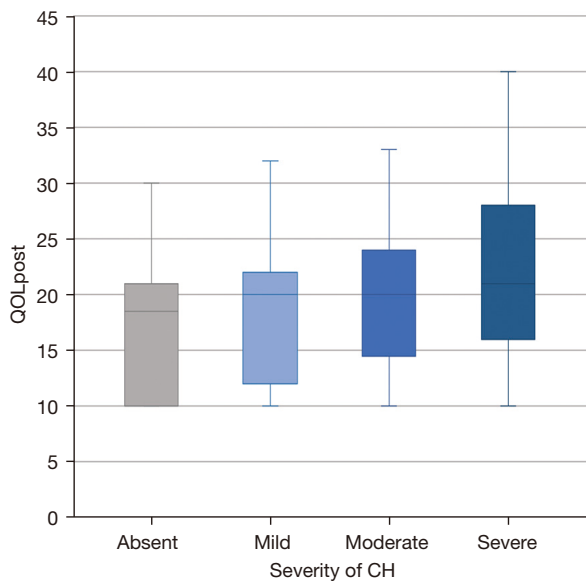


Figure 2 Postoperative QOL score compared with severity of CH. Examined by the Spearman correlation analysis ($r_s=0.14$; $P=0.009$). QOL, quality of life; CH, compensatory hyperhidrosis; QOLpost, the score of postoperative quality of life.

of QOLpre between moderate group (Md =38.5, IQR, 34.8–42.0) and severe group (Md =42.0, IQR, 38.0–46.0; $P<0.001$). However, there was no significant difference among QOLpost regardless of the severity of PH ($P=0.946$).

Postoperative quality of life and compensatory hyperhidrosis

CH was present in 94.6% cases after ETS. The most common location was the back (85.0%), but CH also emerged on the chest, thigh, buttocks, or other regions (Table 5). Among the patients who presented with CH, only 9.5% considered it was severe. Moreover, there was a weak but significant positive correlation between postoperative QOL score and the severity of CH (Figure 2), which was examined using the Spearman correlation analysis ($r_s=0.14$; $P=0.009$).

Discussion

Patients with excessive sweat production were often restricted in both their private and professional lives, and QOL was affected. Surgical treatment does bring a long-term resolution to the difficulties. In this study, the QOL questionnaire for PH was applied among 367 patients. The present study elicited three main findings. First, it was found that the deteriorated QOL improved significantly in personal, functional/social, special circumstances, and emotional domains. Second, this study revealed that, postoperative QOL was not affected by preoperative severity of PH. Finally, CH may be an important factor affecting the QOL of PH patients after ETS, as QOL after surgery was negatively correlated to the severity of CH.

ETS is a safe and effective treatment for PH (4,11). It is able to locate the sympathetic chain accurately, provide cosmetic result, shorter length of hospital stay, and less bodily pain. To achieve the optimal therapeutic effect, in addition to the reduction of palmar sweating, patients'

satisfaction and QOL should also be comprehensively evaluated. Divisi and colleagues described an overall 93.3% satisfactory rate after ETS (12). Similarly, 95.1% of the participants reported satisfaction in the present study. As regards the remaining 18 patients who dissatisfied, 77.8% reported moderate to severe CH.

Several researches applied modified questionnaires to evaluate QOL of patients with PH (2,6,13). Such questionnaires include Functional Assessment of Chronic Illness Therapy Scale (FACIT), Medical Outcomes Study Short Form 36 (SF-36), Spielberger State Trait Anxiety Inventory (STAI). They were widely used, easy to apply, and reliable. However, these questionnaires were not designed specifically for PH. It is believed that de Campos Questionnaire is a specific scale to accurately assess QOL in patients with PH. Publications by Horslen (14) and de Campos (9) revealed that 86% and 86.4% of the patients achieved a significant better QOL after the operation, respectively. As we found in our study, about 90% reported a better QOL. Significant improvement was found postoperatively in all evaluated domains of QOL. These findings are in agreement with those obtained by earlier studies (9,15). The greatest improvement was observed in the personal domain, which indicated patients found less PH-related difficulty in common interaction or intimate touching with other people. It was valuable that the improvement in QOL sustained for a long-term period after receiving ETS.

It is particularly important to recognize the factors determining the QOL of patients with PH, which may be applied to specify certain actions to be taken to provide them with an adequate comfort of life. de Campos *et al.* suggested that the major factors affecting patients' QOL were the type of hyperhidrosis and side effects (9). However, preoperative severity of PH did not make a difference to postoperative QOL. Although poorer QOL was reported by patients with more severe PH before surgery, all patients reported better QOL at a similar level.

CH is one of the most common (11.0–96.2%) side effects after sympathectomy (16,17). CH was embarrassing and bothering, and it can be so severe that patients may require several changes of clothes during the day (17). CH emerged on the back, chest, thigh, buttocks, and other sites. As is well-known, there are a variety of methods to evaluate CH. Some objective methods were proposed, such as VapoMeter or Doppler scanning of skin perfusion (18,19). However, most studies used subjective methods to evaluate CH via questionnaires, which leading to an inconsistent and a very wide range of prevalence across studies (16,20). Therefore,

it is essential to recommend a consolidated appraising method, which can be easily and internationally applied.

Still, it is controversial as to what extent CH influences patients' QOL (6). It was stated that CH did not significantly alter QOL (21,22), whereas results presented here are different. Significantly positive correlation between CH and postoperative QOL score was tested by the Spearman correlation analysis ($r_s=0.14$; $P=0.009$) (Figure 2). This result may be explained by the fact that, CH was one of the factors negatively influencing postoperative QOL. Surgical success can be reflected from the QOL improvements after surgery (20). Even after a 10-year follow-up, a sustained and stable improvement was seen regarding quality of life in patient after surgery (5). Despite the correlation between CH and QOL, satisfaction and significant improvement of QOL was reported by patients after sympathectomy. Substantial cases of CH were subclinical, since they require no specific treatment. Although CH could be an underlying cause for discontent postoperatively, it is still preferred over the distress experienced from PH.

It is necessary to warn all patients with PH, who consider sympathectomy, about the unpleasant effects of CH, which are difficult to control with currently available therapies. Although some researchers had been discussing the prevention of CH by modified procedures (23,24), the practical effects required confirmation by further studies. Jeong and coworkers had proposed a predictive procedure by using local anesthesia to detect compensatory hyperhidrosis before sympathectomy. This approach may be useful in guiding patients' decisions about sympathectomy (25). Although the detailed mechanism was unclear, Divisi and colleagues consider that CH as a failure of feedback mechanism of the sectioned chains and para-physiological rearrangement of sweating in other parts of the body (12). In another way, multiple hyperhidrosis distribution presented preoperatively were indicated to be associated with clinically bothersome CH (20). Reducing the negative effects of CH to patients became imperative. Preoperatively, surgeon should inform the patient of a relatively high incidence of CH, and the possibility of occurring anywhere. Patients' knowledge about the severity of CH and the permanent characteristic of surgery should be ensured. Postoperatively, proper psychological counselling is necessary for those with severe CH, since extremely disruptive psychologic state had been reported in some patients (11).

Although sympathectomy resulted in some bodily pain (the proportions of patients who had mild, moderate, and severe postoperative wound-related pain were 48.5%,

25.8%, and 10.4%, respectively in this study) and side effects like CH, these drawbacks were outweighed by the improvement in QOL of the four domains. We believed that, even though CH is unpredictable, exhaustive inform by surgeon can influence patients' satisfaction positively.

There are several limitations in the present study. First, although clearly defined in our questionnaire, the postoperative report of transient hyperhidrosis or compensatory hyperhidrosis was not formally evaluated by surgeons, which impaired the reliability of these results. Second, QOL after surgery was evaluated only once. However, several studies have suggested that the incidence and severity of CH could change over time (20,26-28). Third, our study only involved patients at a single center, which might limit the generalizability of our results. Therefore, a prospective study involved multiple centers with regular follow-up in the future is ideal.

Nevertheless, this study confirmed the benefit of ETS to patients' QOL and subjective well-being. The QOL questionnaire for PH was proved to be highly effective, easily understood and applied. It was able to dynamically evaluate QOL before and after sympathectomy.

In conclusion, ETS can significantly improve PH patients' QOL, which sustains for a long period of time. Despite different severities of PH and a correlated QOL might be observed preoperatively, patients could generally reach a similar level of improved QOL after ETS. ETS is a safe and simple procedure, yet reducing CH or the negative impact of CH is still part of our main objective in the future clinical practice.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at <https://apm.amegroups.com/article/view/10.21037/apm-21-2860/rc>

Data Sharing Statement: Available at <https://apm.amegroups.com/article/view/10.21037/apm-21-2860/dss>

Conflicts of Interest: All authors have completed the

ICMJE uniform disclosure form (available at <https://apm.amegroups.com/article/view/10.21037/apm-21-2860/coif>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Institutional Review Board of Guangdong Provincial People's Hospital (No. 2020-268H) and informed consent was obtained from all individual participants and minors' legal guardian/next of kin.

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Table S1 Quality-of-life Questionnaire for Evaluation of Hyperhidrosis adapted from de Campos

	BEFORE SURGERY	AFTER SURGERY
1. How would you rate your quality of life GENERALLY?	1 2 3 4 5	1 2 3 4 5
FUNCTIONAL/SOCIAL DOMAIN, related to the following items, how would you rate your Quality of life?		
2. Writing	1 2 3 4 5	1 2 3 4 5
3. Using electronics	1 2 3 4 5	1 2 3 4 5
4. Manual work	1 2 3 4 5	1 2 3 4 5
5. Sports	1 2 3 4 5	1 2 3 4 5
6. Hand shaking	1 2 3 4 5	1 2 3 4 5
PERSONAL DOMAIN: with partner/spouse, how would you rate your quality of life?		
7. Common interaction	1 2 3 4 5	1 2 3 4 5
8. Intimate touching	1 2 3 4 5	1 2 3 4 5
EMOTIONAL DOMAIN: how would you rate the fact that after sweating excessively?		
9. I always justified myself	1 2 3 4 5	1 2 3 4 5
10. People rejected me slightly	1 2 3 4 5	1 2 3 4 5
Under SPECIAL CIRCUMSTANCES: how would rate the quality of your life?		
11. When tense or worried	1 2 3 4 5	1 2 3 4 5
TOTAL SCORE	10 Excellent 50 Very poor	10 Excellent 50 Very poor

1: Excellent 2: Good 3: Moderate 4: Poor 5: Very poor