Finding the Optimal Level and Method for Thoracoscopic Treatment of Primary Palmar Hyperhidrosis

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Abstract

Background: The standard treatment of primary palmar hyperhidrosis had been thoracoscopic R2 sympathectomy, yet this sympathectomy level has been associated with serious unwanted side effects. Therefore, some recent experiences have recommended R2-sparing R3 or R4 thoracoscopic sympathectomy with less side effects, particularly compensatory hyperhidrosis (CH). The aim of this study is to compare the effect of R2-sparing thoracoscopic sympathectomy at R3 *vs* R4 levels in the treatment of palmar hyperhidrosis.

Materials and Methods: Medical records of all patients were retrospectively reviewed between January 2010 and January 2017. Patients were assessed at 1 week, 1 month, and 6 months or more for success of the procedure, side effects, such as compensatory hyperhidrosis (CH), pneumothorax, Horner's syndrome, and brachial plexus injuries were recorded. Patient satisfaction was assessed.

Results: Seventy-nine patients were operated on for palmar hyperhidrosis. At 6 months follow up, all patients reported complete disappearance of the symptoms with dry hands after surgery except three patients in R4 group who have a mild sweating. No failure or worsening of the symptoms developed. Any immediate post-operative complications disappeared within 4 weeks. Ten patients in the R3 group developed some degree of CH (48%) compared to11 patients in the R4 group (19%) (p =0.014). At a follow up period of R3 (78±7.6) and R4 (37±15), a telephone interview was conducted using a questionnaire and revealed that the rate of CH and palmar over dryness was significantly lower in the R4 group than in the R3 group (pP =0 .001, 0.004, respectively). No patient developed recurrence.

Conclusion: Both R3 and R4 thoracoscopic sympathectomies are effective with a high success rate and minimally invasive methods for the treatment of palmar hyperhidrosis. R4 appeared to be a better technique with significantly less compensatory hyperhidrosis and over dryness of the palms. With the removal of a segment of the sympathetic chain, there were no recurrences in either group.

Keywords: Primary Palmar hyperhidrosis, Sympathecotomy, Compensatory Hyperhidrosis, Video-assisted thoracoscopic surgery.

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Introduction

Primary hyperhidrosis (PH) is a pathological over secretion of eccrine sweat that regularly brings about genuine disturbance of a patient's physical, functional and psychosocial aspects of

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his life. It is a state of obscure etiology that starts in early life, becomes apparent in the adolescence, and without particular treatment persists throughout the patient's life. The most common sites affected by hyperhidrosis are face, palms, axillae, and feet. The palms are affected in about 80% of the cases, either isolated or in combination with the axillae or the soles of the feet[1].

The treatment options for this condition consist of many systemic medication, local medication, psychotherapy, iontophoresis, intradermal injections of botulinum toxin, cryotherapy, fractionated microneedle radiofrequency, percutaneous thoracic phenol sympathicolysis, in addition to what is considered the most durable and effective treatment, i.e. thoracoscopic sympathectomy[1].

The various medical treatments of primary palmar hyperhidrosis (PPH) are often unsuccessful, causing patients to try the myriad of different unsuccessful treatment modalities[2]. Many then choose surgery given its success rate. Surgeons are faced with more than 30 different thoracoscopic surgical approaches in the literature. They vary between resection, ablation, transection, or clipping of various levels of the sympathetic trunk[3]. Yet, there is no clear agreement as to which surgical procedure is better and which level(s) of the sympathetic chain ought to be focused on for either palmar, axillary, or facial hyperhidrosis[3].

Sympathectomy can be associated with unwanted adverse effects. Often, the most bothersome side effect is CH. To decrease the occurrence and intensity of CH, lower levels of the thoracic ganglia are being resected. Increasingly, R3 sympathectomy or even R4 sympathectomy have been employed based on the assumption of the Lin-Telaranta classification[4]. The authors proposed that R4 sympathectomy procedures for palmar hyperhidrosis spare most of the reflex sweating circuitry to the brain, thus, excluding the resultant reflex CH.

Additionally, there are reports of sympathicotomy which have recurrence rates of 5-17%[5,6,7] for R4 interruption. There are no articles comparing R4 sympathicotomy *vs*. sympathectomy. However, our experience has shown sympathectomy to be superior with respect to recurrence rates. There was one comparison between R3 sympathicotomy and sympathectomy which showed no recurrences in either group[8]. The vast majority of the descriptive studies, however, report recurrences in patients treated with sympathicotomy.

In the published literature, there are few reports comparing the outcomes of R2-sparing R3 *vs* R4 thoracoscopic sympathectomy[7,9,10,11,12,13,14,15,16,17,18]. The aim of this study is to retrospectively compare R2-sparing R3 *vs* R4 thoracoscopic sympathectomy in terms of success rate, satisfaction, recurrence rates, and adverse effects.

Materials and Methods

After institutional review board approval was obtained, we retrospectively reviewed 79 consecutive patients who were treated by a single surgeon in the thoracic surgery clinic from January 2010 to January 2017 for primary palmar hyperhidrosis. If the patient presented with more than one type of hyperhidrosis but our surgical goals were simply to treat the palmar hyperhidrosis, they were included as well. However, our outcomes were focused

only on the palmar aspect of their condition.

We reviewed preoperative, intraoperative, and postoperative characteristics. Patients typically returned to clinic at 1 week, 1 month, and 6 months. We elected to report the 6-month visit, because of reports of transience and degradation of some occurrences of CH and to capture any later recurrences[19]. A standardized telephone questionnaire was also performed on all patients to capture any patients who had symptoms after the typical 6-month follow up visit. Patients were asked to answer specific questions, evaluating the results of sweating, compensatory hyperhidrosis, their satisfaction, complications, and symptoms of recurrence.

We considered dry hands a success, while if there was some sweating but not as before surgery it was considered partial improvement and a failed procedure if the patient did not experience any change in sweating at all.

Consistent with the literature, we classified the severity of postoperative CH as slight, moderate, or severe. It was considered to be slight if it was visible sometimes. Moderate CH describes visible and embarrassing but not enough to change the clothes. When CH was visible, embarrassing, and necessitating more than one change of clothes during the day it was considered to be severe[10].

In scoring the satisfaction of the patient, patients were offered the options of completely satisfied, satisfied, unsatisfied, and regret of the surgery. If the patient developed excessive sweating after initial improvement, it was considered a recurrence. Degree of improvement in the plantar as well as axillary hyperhidrosis were also reviewed and recorded though they were secondary endpoints.

The initial patients, R3 resections, were performed by transecting the sympathetic chain at the middle of the 3rd intercostal space, and dissection was carried out cranially over the 3rd rib to just at the top of the 3rd rib with the removal of approximately 1cm of nerve tissue. The R4 was carried out in a similar manner but one rib space lower. The resection was performed using the cutting mode of the electrocautery hook to minimize the risk of heat injury to the remaining sympathetic trunk. The medial borders of the R3 and R4 were cauterized to ablate the possible presence of nerve of Kuntz.

Chest tubes were not routinely utilized. The same procedure was performed on the contralateral side during the same anesthetic. Postoperative chest x-ray was not done, except if a chest tube is inserted or if there are clinical signs and symptoms suggestive of pleural or parenchymal pathology.

Statistical analysis of comparisons between the two groups was performed by Fisher's exact test, chi-square test and *t*-test for continuous variables using JMP®13 software and p values <0.05 were considered statistically significant.

Results

From January 2010 to January 2017, 79 patients (Male: Female 40:39) were identified. All patients fulfilled the diagnostic criteria for primary focal idiopathic hyperhidrosis[20].

The patient demographics are summarized in Table 1. There were no significant differences between the 2 groups in terms of age, sex, marital status, duration of sweating, BMI, and positive family history. The mean age at the operation of hyperhidrosis was 22.9±5.4 years and mean body mass index (BMI) was 23.2±3.0 kg/m². Most of the patients (92%) had

grade IV disease according to Hyperhidrosis Disease Severity Scale[21].

Between January 2010 and July 2012, 21 patients (42 procedures) were treated by thoracoscopic R3 sympathectomy and between August 2012 and January 2017, 58 patients (114 procedures) by thoracoscopic R4 sympathectomy. All but two patients underwent bilateral procedures. Those two patients were referred from outside hospitals for unilateral recurrences, while most patients had isolated PPH, there were others with multiple sites of hyperhidrosis. The most common combination was palmar and plantar (Table 2). Three patients (14%) in R3 group and 16 patients (26%) in R4 group had tried local antiperspirants, botulinum toxin, and Iontophoresis or even thoracoscopic sympathectomy (5 patients) in another hospital as treatment, but those had resulted in unsatisfactory outcome.

Table 1. Patient characteristics

	R3 group (n = 21)	**R4 group (n = 58)**	***P* value**
Age (y)	23.3 ± 4.4	22.8 ± 5.7	0.73[1]
Gender (M:F)	21 (14:7)	58 (26:32)	0.08[2]
Marital status(M:S)	21 (2:19)	58 (7:51)	0.75[2]
Age of onset of sweating (y)	7 ± 3.3	8.3 ± 5.3	0.10[1]
BMI (kg/m2)	23.3 ± 3.1	23.3 ± 3.0	0.95[1]
Severity of the Disease	All patient has grade 4	52 patients grade 4 6 patients grade 3	0.58[3]
Positive family history	2/21 (10%)	9/58 (15%)	0.48[3]
History of previous treatment Local: Botox: Iontophoresis Sympathectomy	3/21(14%) 2/21(10%) 3/21 (14%) 0/21 (0%) 0/21 (0%)	16/58 (26%) 7/58 (12%) 6/58 (10%) 3/58 (5%) 5/58 (9%)	

1= t-test, 2 = chi square, 3= fisher

Regarding the short-term outcomes, all patients in both groups underwent thoracoscopic sympathectomy with no conversion into open or any perioperative mortality. In the R3 group, one of the patients developed a transient left sided partial Horner's syndrome (ptosis and miosis) that resolved completely within 4 weeks, 6 patients (8%) received chest tube insertion at the discretion of the operating surgeon. Five of them were due to adhesiolysis and one due to accidental cautery injury to the parenchyma. Postoperative rebound sweating was observed in one patient on the 3rd post-operative day and lasted for 24 hours. Other complications included facial anhydrosis in one patient and brachial plexus neuropraxia due to over abduction in another. Both of those complications resolved without treatment in less than a month. None of the patients had developed bradyarrhythmia. The vast majority (93%) were discharged early in the first postoperative day. All patients were

satisfied with complete disappearance of their symptoms in the early postoperative period.

Table 2. Site presentation

Presentation	R3 group 21	R4 group 58	Total 79
Isolated palmar hyperhidrosis	1/21(5%)	4/58 (7%)	5/79 (6%)
Combined palmar and axillary only	0/21 (0%)	3/58 (5%)	3/79 (4%)
Combined palmar and plantar only	16/21 (76%)	34/58 (60%)	50/79 (64%)
Combined palmar, axillary and plantar	4/21 (19%)	13/58 (23%)	17/79 (22%)
Combined facial, palmar and plantar	0/21 (0%)	3/58 (5%)	3/79 (4%)

The outcome and effect of thoracoscopic R3 and R4 sympathectomy respectively at 6 months follow up is shown in Table 3. Completely dry hands were achieved in all procedures of the R3 group and in 108 of 114 procedures (95%) of the R4 group (p=0.19). The remaining 5% of the R4 group experienced incomplete but marked improvement. As expected, the satisfaction mirrors the improvement. Ten patients in the R3 group developed a degree of CH (48%) compared to 11 patients in the R4 group (19%), which was statistically significant (*p* =0.014). The occurrence of moderate to severe CH was higher in the R3 group than R4 (15% *vs* 2%). No patient developed severe CH in R4 group.

Over-dryness of the hands was noted in 3 patients (14%) in the R3 group, while none of the R4 group had developed this complaint (*P*=0.02). In both groups, none of the patients developed gustatory sweating. The associated axillary and plantar sweating was improved in both groups with no statistically significant difference between R3 and R4 levels (*P*=0.17 and *P*=0.50, respectively). The subjective feeling of improvement for axillary and plantar sweating was 40-100% and 20-100%, respectively. There were no recurrences in either group and no patient regretted having the surgery.

At a follow up period of 78±7.6 months for R3 and 37±15 months for R4, a telephone interview was conducted using a questionnaire containing the parameters listed in Table 3. Seventy-six of the 79 patients replied and answered our questions. Three patients were international students who left the country after they graduated and were unavailable to follow up. None of the 3 patients unavailable to follow up had CH at their 6-month outpatient visit. The success rate of the procedure, satisfaction, gustatory sweating, and improvement of axillary and plantar sweating have kept the same percentages as at 6 months follow up. One of the patients with mild hyperhidrosis has progressed into moderate and a new patient has started to develop mild CH in the back, while the symptoms of 2 of the patients in R4 group with mild CH disappeared (Table 4). Accordingly, the R4 group had a lower percentage of CH 16% *vs* 55% in R3 group (*P*=0.001). One patient in the R3 group developed palmar over-dryness, while none of the R4 group experienced over-dryness.

Table 3. Results of intervention at 6 months of follow up

6 Months follow-up time	R3 group (n = 21)	R4 group (n = 58)	*P* value
Success of the procedure			
Completely dry hands	42 (100%)	108 (95%)	0.19[1]
Partial improvement	00 (0.0%)	6 (5%)	0.56[1]
No change	00 (0.0%)	00 (0.0%)	
Worsening of the symptoms	00 (0.0%)	00 (0.0%)	
Compensatory hyperhidrosis			
Total	10/21 (48%)	11/58 (19%)	0.01[2]
Mild	7/21 (33%)	10/58 (17%)	0.14[2]
Moderate	2/21 (10%)	1/58 (2%)	0.17[1]
Severe	1/21 (5%)	0/58 (0%)	0.26[1]
Gustatory sweating	0	0	
Over dryness of the palms	3	0	0.02[1]
Satisfaction			
Completely satisfied	42 (100%)	108 (95%)	0.19[1]
Satisfied	00 (0%)	6 (5%)	0.56[1]
Unsatisfied	00 (0%)	00 (0%)	
Regret Surgery	00 (0%)	00 (0%)	
Recurrence	00 (0%)	00 (0%)	
Improvement of axillary sweating	4/4 (100%)	11/16 (68%)	0.17[1]
Improvement of plantar sweating	11/20 (55%)	30/50 (60%)	0.50[2]

1= Fisher test, 2= Chi-square test

Table 4. Results of the long term follow up

	R3 group (n=20)	R4 group (n=56)	*P* value
Follow up period (months)	78±7.6	37±15	0.01[1]
Compensatory hyperhidrosis			
Total	11/20 (55%)	9/56 (16%)	0.001[2]
Mild	7/20 (35%)	8/56 (14%)	0.04[2]
Moderate	3/20 (15%)	1/58 (2%)	0.05[3]
Severe	1/20 (5%)	0/58 (0%)	0.26[3]
Over dryness of the palms	4(25%)	0	0.004[3]

1= t-test, 2= Chi square test, 3=Fisher test

Discussion

Success without recurrence and minimizing CH are the two factors directly related to the satisfaction and feelings of regret after surgery. The development of CH is unpredictable and so surgeons seek to find the best procedure and the best level of sympathetic trunk interruption.

Our series is consistent with previous reports showing higher rates of CH with 20% having moderate or severe symptoms in the R3 group but with 100% of patients with dry hands. Three patients in the R3 group complained of

overdryness, which is often more bothersome than incomplete improvement. The R4 group had a more than acceptable rate of 95% completely dry hands, 5% had partial improvement, only 2% had moderate CH, and 0% had severe. None of the R4 patients had any overdryness. The R4 level interruption also provides distance from the more cranial portion of the sympathetic chain which, if injured, could result in Horner's syndrome. Our only patient with transient Horner's syndrome was an R3 sympathectomy. None of the R4 group developed a Horner's syndrome.

Prevailing opinion is moving towards doing R4 interruption; however, several reports have reported recurrences. We prefer a sympathectomy versus a sympathicotomy. Removal of a portion of the sympathetic chain provides less recurrence (in our hands) when compared to the published reports of simple interruption with cutting or clipping. Given the paucity of data comparing removal *vs*. simple interruption, it follows that a more sophisticated prospective multicenter trial is in order. We contend that our series, in combination with previous reports, satisfactorily answers the question of R3 *vs* R4, but the literature is much more scarce when it comes to the method of interruption of the sympathetic chain. Given our zero percent recurrence and much higher rates in sympathicotomy papers, we recommend sympathectomy at the R4 level.

Our study was retrospective in nature and therefore is subject to all the limitations inherent to that study design. While there was no randomization to our cohort, there was no selection bias as both groups included consecutive patients and the switch to R4 was not based on patient characteristics but rather on a change in practice. In spite of these weaknesses, we believe this adds more evidence to the superiority of R4 level interruption and sympathectomy as the preferred method of interruption.

Conclusion

We conclude that PPH is treated effectively by thoracoscopic R3 or R4 sympathectomy, which is a safe and highly successful procedure. R4 thoracoscopic sympathectomy results in less CH than R3 thoracoscopic sympathectomy at long-term follow-up, while R3 is associated with more over-dryness than R4. Usually, patients tolerate mild moisture in the hands better than over-dryness. Accordingly, R4 sympathectomy can be a more useful and viable treatment for the reduction of palmar sweating than R3.

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إيجاد الطريقة والمستوى الأمثل لعلاج فرط التعرق الراحي الأولي بالتنظير الجراحي الصدري

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الملخص

خلفية البحث: كان قطع الودي الصدري على مستوى الضلع الثاني R2 بواسطة المنظار الجراحي هو العلاج الجراحي الرئيسي لفرط التعرق الراحي الأولي، ولكن هذا المستوى من القطع ارتبط مع آثار جانبية خطيرة غير مرغوب فيها. لذلك أوصت الدراسات العلمية مؤخرا بتجنب قطع الودي الصدري على مستوى الضلع الثاني وان يكون القطع على مستوى الضلع الثالث R3 او الرابع R4 وذلك لقلة الآثار الجانبية وخصوصاً التعرق التعويضي. الهدف من هذه الدراسة هو مقارنة بين تأثير القطع على مستوى الضلع الثالث R3 او الرابع R4 على فرط التعرق الراحي الاولي.

الخطوات والأساليب: تم مراجعة الملفات الطبية لجميع المرضى بأثر رجعي بين شهري كانون الثاني 2010 وكانون الثاني 2017. وتم تقييم المرضى بعد أسبوع، شهر، و6 أشهر أو أكثر من اجراء العملية لبيان وتسجيل نجاح الإجراء، والآثار الجانبية مثل التعرق التعويضي، استرواح الصدر، متلازمة هورنر، وإصابات الضفيرة العضدية. بالإضافة إلى تقييم رضا المرضى.

النتائج: تم إجراء العملية لتسعة وسبعين مريضا يعانون من فرط التعرق الراحي. أظهر التقييم في الشهر السادس بعد الإجراء الجراحي اختفاء كامل الأعراض في جميع المرضى مع الجفاف التام لليدين باستثناء ثلاثة مرضى ظهر لديهم تعرق راحي خفيف جدا في المجموعة التي تم بها القطع على مستوى الضلع الرابع R4. لم يحدث أي فشل للإجراء أو تفاقم في الأعراض. جميع المضاعفات والآثار الجانبية المباشرة بعد العملية اختفت في غضون 4 أسابيع. عشرة مرضى (48%) في المجموعة التي تم القطع فيها على مستوى الضلع الثالث R3 عانوا من احدى درجات التعرق التعويضي مقارنة بأحد عشر مريضا (19%) في المجموعة التي تم بها القطع على مستوى الضلع الرابع R4 (P =0.014). بعد فترة متابعة R3 (78 ± 7.6) وR4 (37 ± 15) أجريت مقابلة هاتفية لتعبئة استبانة تبين من خلالها أن معدل التعرق التعويضي والجفاف الزائد كان أقل بكثير في مجموعة R4 من مجموعة R3 (P =0.001, 0.004) على التوالي). لم يعانِ أي مريض من رجوع الأعراض.

الاستنتاج: يعتبر قطع أي من المستويين R3 أو R4 طريقة فعالة وبنسبة نجاح عالية جداً لعلاج فرط التعرق الراحي الأولي. يبدو أن قطع الودي الصدري على مستوى R4 تقنية أفضل لمصاحبتها لنسب أقل من التعرق التعويضي والجفاف الزائد. مع إزالة جزء من العصب الودي لم نلاحظ أي رجوع للأعراض في كلتا المجموعتين.

الكلمات الدالة: فرط التعرق الراحي الأولي، قطع الودي الصدري، التعرق التعويضي، جراحات المناظير الصدرية بمساعدة الفيديو.