J Minim Invasive Surg Sci. 2014 November; 3(4): e20543.

Published online 2014 September 20. **Research Article**

Comparison Between R2-R4 and R3-R5 Sympathicotomy for Primary Hyperhidrosis

Hassan Ali Mohebbi [1,2]; Shaban Mehrvarz [1]; Saba Emami [2]; Shahram Manoochehry [1,*]; Mahdieh Mohebbi [2]

[1]Surgical Department, Faculty of Medicine, Baqiyatallah University of Medical Sciences, Tehran, IR Iran
[2]Trauma Research Center, Baqiyatallah University of Medical Sciences, Tehran, IR Iran

*Corresponding author: Shahram Manoochehry, Surgical Department, Faculty of Medicine, Baqiyatallah University of Medical Sciences, Tehran, IR Iran. Tel: +98-9122014196, Fax: +98-2181263550, E-mail: shahram.manoochehry@yahoo.com

Received: May 21, 2014; **Revised:** July 9, 2014; **Accepted:** July 15, 2014

Background: Primary hyperhidrosis (PHH) is characterized by sweating more than physiologic need for thermoregulation in certain parts of body without a known cause, for a period of at least six months. Surgical methods such as sympathicotomy are efficient and permanent treatments for PHH.

Objectives: This study was planned to evaluate and compare complications and patients' satisfaction of thoracoscopic sympathicotomy in levels of R2-R4 versus R3-R5 for PHH treatment.

Patients and Method: From March 2010 to January 2013, a prospective single-blinded randomized study was performed on 94 patients with PHH in two groups, which were treated by thoracoscopic R2-R4 (group A) and R3-R5 (group B) sympathicotomies. The patients were evaluated at the first week and at least after six months postoperatively for outcomes, complications and satisfactions. Collected data were analyzed by SPSS version 18 using Student T test and Chi-square test.

Results: In a total of 94 patients, 73 (77.7%) were men and 21 (22.3%) were women. Their mean age was 26.5 ± 6.5 years. Thoracoscopic R2-R4 sympathicotomy was done in 47 patients (group A) and thoracoscopic R3-R5 sympathicotomy was also done in 47 patients (group B). Early compensatory sweating (CS) were 78.7% and 66.0% in groups A and B (P = 0.167). The rates of late compensatory sweating were 74.4% (group A) and 70.7% (group B) (P = 0.241). Early and late postoperative satisfactions were 98.6% and 98.2% in group A and 97.9% and 97.3% in group B, respectively (P > 0.05). There were no statistical significant differences between two groups in early and late CS and postoperative satisfactions. The Rates of other early and late complications, such as pneumothorax, hemorrhage, hemothorax, and infection, were lower in group B. (P = 0.006 and P = 0.005)

Conclusions: Thoracoscopic sympathicotomy shows proper results in treatment of PHH. Thoracoscopic R3-R5 sympathicotomy compared with R2-R4 sympathicotomy is a preferable method, because of similar results and fewer complications.

Keywords: Hyperhidrosis; Satisfaction; Complications; Sympathicotomy

1. Background

Essential or primary hyperhidrosis (PHH) is characterized by sweating more than physiologic need for thermoregulation (1). This excessive sweating is usually focal and prominent in palms, axillae, feet and face. The number and histology of sweat glands in these patients are normal and the main effective factor is excessive stimulation that causes hyperhidrosis (2). Diagnosis is based on excessive focal visible sweating without a known secondary cause for a period of at least six months, and it should have at least two of the following criteria: bilateral and symmetrical hyperhidrosis, frequency of at least once a week, adverse effects on daily activities, onset age before 25, positive family history of PHH, and interruption of excessive sweating during sleep (1, 2). Some articles have reported that PHH is an autosomal dominant disorder with variable penetration in chromosome 5, 14 or both, so in some cases congenital factors are effective (3, 4). In the past, PHH prevalence was reported lower; as in 1979 it was 0.6%, but recently it has been reported as high as 4.6% (5-7). The prevalence is reported also up to 6.1% in different societies and populations; in Asia it is about 3% (8). It affects men and women equally and is more prevalent in mid-twenties and early thirties (1). Proper treatment reduces unsatisfactory effects on quality of life in these patients. Medical treatments are local or systemic and don't have good results. Iontophoresis and botolinum toxin injection are accepted as local treatments although they have transient and temporary results. Surgical methods are efficient and permanent in treatment of PHH (1,9,10). Its success rate and patients' satisfaction are reported to range from 71% to 100% and 93% to 95% respectively (1,11,12). Nomenclature for sympathetic surgery is changed and is

based on rib-oriented description with using the number of rib (R) instead of using the number of sympathetic ganglion (T). The type of interruption is also required denoting whether the chain is clipped, cut or cauterized (sympathicotomy), or a segment removed (sympathectomy) (1,2,13). In the beginning, sympathectomy was performed via open thoracotomy (1,2,5,10,14,15) but after the introduction of videoscopic surgery, this minimally invasive approach has become the current method of choice. The first videoscopic or endoscopic thoracic sympathectomy (ETS) was performed in 1951 and it has much developed till now (11,12). Recently it has been suggested that sympathicotomy is better than sympathectomy (1,2). There is controversy in the levels that sympathicotomy should be done, for palmar, plantar and axillary hyperhidrosis sympathicotomy is performed at R2 and R3, R3 and R4, R4 and R5 or a combination of these (1,2,10,16) although sympathicotomy on R2-R4 and R3-R5 are the accepted options.

2. Objectives

The aim of this study is evaluating and comparing the complications and patients' satisfaction of thoracic sympathicotomy in these two different levels.

3. Patients and Method

In this clinical trial, patients with severe PHH in palms, axillae and feet were admitted for surgery after history taking and clinical examination. An informed consent sheet about the trial was signed by all patients. The inclusion criteria were the patients with severe PHH who had undergone medical treatments without desired outcome. For data collection we used a questionnaire which was made based on previous studies (1,2,4,5). The severity of PHH was evaluated based on a 5 grades scale: 1 (near normal), 2 (mild), 3 (moderate), 4 (severe), 5 (very severe: dripping sweating). Severity of compensatory sweating after surgery was evaluated as mild, moderate and severe according to the patients' opinions. Patients' satisfaction was expressed on percentile scale from 0% to 100%. All operations were performed via thoracoscopy under general anesthesia with single lumen tracheal intubation. Thoracoscopies were done through either a 10 mm port or two 5mm ports at each axilla. CO_2 gas was insufflated into plural cavity to collapse the lung during operation. Procedures were done from March 2010 to January 2013 in two hospitals by the same thoracic surgeon. After admission of patients, they were randomly placed in two groups: A and B. Group A underwent sympathicotomy at the levels of R2-R4 and group B underwent R3-R5 sympathicotomy. The study was performed single blinded and patients did not know in which group they were. Patients were discharged at the day after surgery with prescribed oral analgesics. All patients were visited and evaluated for early postoperative complications and satisfaction, about one week after surgery in clinic. Patients were also evaluated for the late postoperative complications and satisfaction after at least six months after surgery by a visit in clinic or telephone inquiry. Quantitative variables were compared using student T test and qualitative variables were compared by means of chi-square test. Normal scatter variables were evaluated with independent sample test and variables with abnormal scatter were evaluated by Mann-Whitney test. The statistical significance level was set at $P < 0.05$. For the analysis, the statistical software package SPSS version 18 for windows was used.

4. Results

Ninety-four patients were included in the study, 73 ones (77.7%) were men and 21 (22.3%) were women. Their mean age was 26.5 ± 6.5 years and the patients were from 11 to 53 years old (Table 1). There were severe and very severe hyperhidrosis in palms of 81 (86.1%) of patients, in feet of 70 (74.1%) and in axillae of 49 (52.1%) of patients (Table 2). Thoracoscopic R2-R4 sympathicotomies were done in 47 patients (group A) and thoracoscopic R3-R5 sympathicotomies were also done in 47 patients (group B). There were no statistical significant differences between two groups in sex, age and severity of hyperhidrosis before surgery ($P = 0.216$, $P = 0.730$, $P = 0.132$) (Tables 2 and 3). Because of some air leakage at the end of surgery and probability of lung injury, small thoracic drainage tubes were inserted for two patients in group A and six patients in group B. There were no statistical significant differences in this regard. Mean follow-up time was 14.6±7.0 months and there were no statistical significant difference between two groups in this regard ($P=0.573$) (Table 1).

4.1. Compensatory Sweating (CS)

In early surveillance, there were 37 patients in group A (78.7%) affected by CS in abdomen, back, thighs or other sites. In group B there were 31 patients affected by CS in these sites (66%) ($P = 0.167$). There were only 8 cases (8.5%) of severe early CS in all patients, and there was no statistical significant difference between these groups in this regard ($P = 0.714$) (Table 3). In late follow-up period, 74.4% of patients in group A and 70.7% of patients in group B were affected by CS ($P = 0.716$). There were only three cases of severe late CS in patients and there was no statistical significant difference between two groups about late CS ($P = 0.241$) (Table 3).

Table 1. Patients' Demographic Data [a]

Variables	Group A	Group B	All	P Value
Age, y				0.730
Mean ± SD	26.36 ± 6.77	26.66 ± 6.33	26.51 ± 6.52	
Min-Max	16-53	11-42	11-53	
Gender				0.216
Male	39 (83)	34 (72.3)	73 (77.7)	
Female	8 (17)	13 (27.7)	21 (22.3)	
Follow up, mo	14.41 ± 6.86	14.85 ± 7.22	7.00 ± 14.63	0.573

[a] Data are presented as Mean ± SD or No. (%).

4.2. Other Complications

Pnomothorax, hemorrhage, hemothorax, infection, eyelids ptosis, severe dryness, pompholyx and gustatory sweating (GS) are complications of thoracoscopic sympathicotomy (Table 4), although occurrence of these complications were low but both early and late complications were lower in group B with statistically significant differences (P = 0.006 and P = 0.005).

4.3. Patients' Satisfaction

Patients' postoperative satisfaction was good, especially for palms (Table 5). Early postoperative satisfactions were 98.6% in group A and 97.9% in group B. Late postoperative satisfactions were 98.2% and 97.3% in groups A and B, respectively. There were no significant statistical differences in early and late satisfactions between groups (P = 0.980, P = 0.582) (Table 5).

Table 2. Severity of Primary Hyperhidrosis in Patients of Two Groups [a]

Severity	Group A (R2-R4)	Group B (R3-R5)	All	P Value
Palmar Hyperhidrosis				0.132
Normal (1)	1 (2.1)	2 (4.3)	3	
Mild (2)	2 (4.3)	1 (2.1)	3	
Moderate (3)	6 (12.8)	1 (2.1)	7	
Severe (4)	19 (40.4)	14 (29.8)	33	
Very Severe (5)	19 (40.4)	29 (61.7)	48	
Axillary Hyperhidrosis				0.503
Normal (1)	8 (17.0)	13 (27.7)	21	
Mild (2)	5 (10.6)	4 (8.5)	9	
Moderate (3)	8 (17.0)	7 (14.9)	15	
Severe (4)	12 (25.5)	15 (31.9)	27	
Very Severe (5)	14 (29.8)	8 (17.0)	22	
Plantar Hyperhidrosis				0.094
Normal (1)	1 (2.1)	4 (8.5)	5	
Mild (2)	4 (8.5)	0 (0)	4	
Moderate(3)	7 (14.9)	8 (17.0)	15	
Severe (4)	13 (27.7)	19 (40.4)	32	
Very Severe (5)	22 (46.8)	16 (34.0)	38	

[a] Data are Presented as No. (%).

Table 3. Severity of Compensatory Sweating in Patients of Two Groups [a]

CS	Group A (R2-R4)	Group B (R3-R5)	P Value
Early			0.332
non	10	16	
mild	24	16	
mod	10	10	
severe	3	5	
late			0.178
missed	8	6	
non	10	12	
mild	21	13	
mod	8	13	
severe	0	3	

[a] Abbreviation: CS, compensatory sweating.

Table 4. Other Complications in Two Groups

Complication	Group A (R2-R4)	Group B (R3-R5)	P Value
Early			0.006
non	34	46	
Pompholyx	1	0	
pneumothorax	7	1	
Gustatory sweating	5	0	
Ptosis	0	0	
Late			0.005
Missed	8	6	
non	33	41	
pneumothorax	0	0	
Pompholyx	2	0	
Gustatory sweating	4	0	
ptosis	0	0	

Table 5. Satisfaction rate in Patients of Two Groups [a]

Sites	Group A (R2-R4)	Group B (R3-R5)	P Value
Early			
Hands	98.65% ± 4.09	97.91% ± 9.03	0.980
Axillae	85.85% ± 22.37	87.30% ± 20.40	0.247
Feet	55.54% ± 29.93	55.58% ± 26.12	0.995
Late			
Hands	98.20% ± 4.05	97.37% ± 8.08	0.582
Axillae	76.51% ± 22.92	74.24% ± 29.63	0.742
Feet	38.94% ± 22.54	35.38% ± 35.52	0.600

[a] Data are presented as Mean ± SD.

5. Discussion

Nowadays, many patients with PHH are referred to surgeons for definite treatment. These patients are mostly young and are looking for the best cure with the least complications. In our study the mean age of patients was 26.5±6.5 years. In other studies the patients were also mostly young, for example the mean age of the patients in two other studies were 24.7±9.0 and 27±9 years (17, 18). In most studies the prevalence of PHH was rather equal in men and women (17, 19), but in our study the prevalence were three times more in men than women. The reason is unknown to us. CS in different sites of the body, such as abdomen, back and thighs is one of the most important complications of sympathectomy or sympathicotomy. The mechanism of CS is unknown. Chou and collogues say that reflexive responses to sweat center in hypothalamus is responsible for CS (20). Drott expresses that interruption of sweating in hands and face is the main stimulatory factor for creation of CS (21). In our study the rate of late CS in group A (R2-R4) and group B (R3-R5) were 74.4% and 70.7%, respectively. The prevalence of postoperative CS varies among different studies, for example Zacherl reported the prevalence of postsympathectomy CS in 352 of patients about 69% (22). In Iran a study was conducted on 33 patients undergoing T2-T3 sympathectomies, in which the frequency of CS was 60% (23) but in another study on 60 PHH patients, CS was reported up to 90% (16). The rate of CS after sympathicotomy in our study is rather higher, although the supporters of this method believe that the rate of CS in sympathicotomy is lower comparing with sympathectomy (1, 2). One study reported 62.7% CS in 630 patients undergoing sympathicotomy for PHH (24), but other studies reported the CS at 27%, 70.9% and 62.1% (1, 17). There is an emphasis that in most patients, severity of CS is low and they tolerate it simply. Only a small number of patients complain of severe CS. There was 3.7% severe CS in our study, which is comparable to other studies; for example in a study the prevalence of severe CS was reported as low as 3.4% (25). There is controversy about the levels and number of sympathicotomies. Some believed that lower number and level of sympathicotomies causes lower rate of CS (1, 2). Schmidt and collogues reported that simpathicotomy away from T2 may decrease the rate of CS (26). In some literatures only R4 and R5 are recommended (2). The patients' postoperative satisfaction, especially in palms, is an important factor for the patients and improvement in their quality of life and this data actually encourage other patients with PHH to accept surgery and its risks. In this study postoperative satisfaction rate in groups A and B were 98% and 97%, which seems high. The level of sympathicotomies did not show any effect on the satisfaction rate in our study. In a study on 335 patients with PHH who had undergone T2- T3 sympathectomies, the primary satisfaction rate was 93% (27). In an another study on patients who had undergone T3 sympathicotomy in one group and T4 sympathicotomy in another group, late satisfaction rates were 84% and 89% (28). In many other studies the postoperative satisfaction rates were also reported high. (1,2,29). In this study there was no recurrence of hyperhidrosis. A study on 141 palmar HH also reported no postoperative recurrence (13), although another study reported 5% recurrence during 2 years after surgery (30). Although other postoperative complications - except CS - in our study were low, both early and late occurrences of these complications were lower in group B (R3-R5) which is similar to other experiences (1,2,17,28). Thoracoscopic sympathicotomy shows proper results in treatment of PHH. Thoracoscopic R3-R5 sympathicotomy compared with R2-R4 sympathicotomy is a preferable method, because of similar results and fewer complications.

Authors' Contributions

Study concept and design: Hasan Ali Mohebi, Mehrvarz and Saba Emami. Acquisition of data and Statistical analysis: Saba Emami and Mohebi M. Analysis and interpretation of data: Hasan Ali Mohebi and Mehrvarz. Drafting of the manuscript: Shahram Manoochehry, Hasan Ali Mohebi and Saba Emami. Critical revision of the manuscript for important intellectual content: Hasan Ali Mohebi, Shaban Mehrvarz, Shahram Manoochehry and Saba Emami. Administrative, technical, and material support: Hasan Ali Mohebi. Study supervision: Hasan Ali Mohebi.

Funding/Support

This study was performed as a thesis under financial support of Trauma Research Center, Baqiyatallah University of Medical Sciences, Tehran, IR Iran.

References

1. Kuijpers M, Klinkenberg TJ, Bouma W, DeJongste MJ, Mariani MA. Single-port one-stage bilateral thoracoscopic sympathicotomy for severe hyperhidrosis: prospective analysis of a standardized approach. *J Cardiothorac Surg*. 2013;**8**:216.
2. Cerfolio RJ, De Campos JR, Bryant AS, Connery CP, Miller DL, DeCamp MM, et al. The Society of Thoracic Surgeons expert consensus for the surgical treatment of hyperhidrosis. *Ann Thorac Surg*. 2011;**91**(5):1642–8.

3. Higashimoto I, Yoshiura K, Hirakawa N, Higashimoto K, Soejima H, Totoki T, et al. Primary palmar hyperhidrosis locus maps to 14q11.2-q13. *Am J Med Genet A.* 2006;**140**(6):567–72.
4. Ro KM, Cantor RM, Lange KL, Ahn SS. Palmar hyperhidrosis: evidence of genetic transmission. *J Vasc Surg.* 2002;**35**(2):382–6.
5. Adar R, Kurchin A, Zweig A, Mozes M. Palmar hyperhidrosis and its surgical treatment: a report of 100 cases. *Ann Surg.* 1977;**186**(1):34–41.
6. Strutton DR, Kowalski JW, Glaser DA, Stang PE. US prevalence of hyperhidrosis and impact on individuals with axillary hyperhidrosis: results from a national survey. *J Am Acad Dermatol.* 2004;**51**(2):241–8.
7. Tu YR, Li X, Lin M, Lai FC, Li YP, Chen JF, et al. Epidemiological survey of primary palmar hyperhidrosis in adolescent in Fuzhou of People's Republic of China. *Eur J Cardiothorac Surg.* 2007;**31**(4):737–9.
8. Bechara FG, Gambichler T, Bader A, Sand M, Altmeyer P, Hoffmann K. Assessment of quality of life in patients with primary axillary hyperhidrosis before and after suction-curettage. *J Am Acad Dermatol.* 2007;**57**(2):207–12.
9. Rieger R, Pedevilla S. Retroperitoneoscopic lumbar sympathectomy for the treatment of plantar hyperhidrosis: technique and preliminary findings. *Surg Endosc.* 2007;**21**(1):129–35.
10. Solish N, Bertucci V, Dansereau A, Hong HC, Lynde C, Lupin M, et al. A comprehensive approach to the recognition, diagnosis, and severity-based treatment of focal hyperhidrosis: recommendations of the Canadian Hyperhidrosis Advisory Committee. *Dermatol Surg.* 2007;**33**(8):908–23.
11. Ahn SS, Wieslander CK, Ro KM. Current developments in thoracoscopic sympathectomy. *Ann Vasc Surg.* 2000;**14**(4):415–20.
12. de Campos JR, Kauffman P, Werebe Ede C, Andrade Filho LO, Kusniek S, Wolosker N, et al. Quality of life, before and after thoracic sympathectomy: report on 378 operated patients. *Ann Thorac Surg.* 2003;**76**(3):886–91.
13. Liu Y, Yang J, Liu J, Yang F, Jiang G, Li J, et al. Surgical treatment of primary palmar hyperhidrosis: a prospective randomized study comparing T3 and T4 sympathicotomy. *Eur J Cardiothorac Surg.* 2009;**35**(3):398–402.
14. Baumgartner FJ. Surgical approaches and techniques in the management of severe hyperhidrosis. *Thorac Surg Clin.* 2008;**18**(2):167–81.
15. Dewey TM, Herbert MA, Hill SL, Prince SL, Mack MJ. One-year follow-up after thoracoscopic sympathectomy for hyperhidrosis: outcomes and consequences. *Ann Thorac Surg.* 2006;**81**(4):1227–32.
16. Mohebbi HA, Mehrvarz S, Manoochehry S. Thoracoscopic Sympathicotomy vs Sympathectomy in Primary Hyperhidrosis. *Trauma Mon.* 2012;**17**(2):291–5.
17. Hwang JJ, Kim do H, Hong YJ, Lee DY. A comparison between two types of limited sympathetic surgery for palmar hyperhidrosis. *Surg Today.* 2013;**43**(4):397–402.
18. Walles T, Somuncuoglu G, Steger V, Veit S, Friedel G. Long-term efficiency of endoscopic thoracic sympathicotomy: survey 10 years after surgery. *Interact Cardiovasc Thorac Surg.* 2009;**8**(1):54–7.
19. Yuncu G, Turk F, Ozturk G, Atinkaya C. Comparison of only T3 and T3-T4 sympathectomy for axillary hyperhidrosis regarding treatment effect and compensatory sweating. *Interact Cardiovasc Thorac Surg.* 2013;**17**(2):263–7.
20. Chou SH, Kao EL, Lin CC, Chang YT, Huang MF. The importance of classification in sympathetic surgery and a proposed mechanism for compensatory hyperhidrosis: experience with 464 cases. *Surg Endosc.* 2006;**20**(11):1749–53.
21. Drott C. Results of endoscopic thoracic sympathectomy (ETS) on hyperhidrosis, facial blushing, angina pectoris, vascular disorders and pain syndromes of the hand and arm. *Clin Auton Res.* 2003;**13 Suppl 1**:I26–30.
22. Zacherl J, Imhof M, Huber ER, Plas EG, Herbst F, Jakesz R, et al. Video assistance reduces complication rate of thoracoscopic sympathicotomy for hyperhidrosis. *Ann Thorac Surg.* 1999;**68**(4):1177–81.
23. Toolabi KRA, Salimi J, Rabani A, Meisami A. Thoracoscopic sympathectomy of T2 and T3 ganglions for palmar hyperhydrosis. *Tehran Univ Med J.* 2008;**65**:37–43.
24. Zacherl J, Huber ER, Imhof M, Plas EG, Herbst F, Fugger R. Long-term results of 630 thoracoscopic sympathicotomies for primary hyperhidrosis: the Vienna experience. *Eur J Surg Suppl.* 1998(580):43–6.
25. Prasad A, Ali M, Kaul S. Endoscopic thoracic sympathectomy for primary palmar hyperidrosis. *Surg Endosc.* 2010;**24**(8):1952–7.
26. Schmidt J, Bechara FG, Altmeyer P, Zirngibl H. Endoscopic thoracic sympathectomy for severe hyperhidrosis: impact of restrictive denervation on compensatory sweating. *Ann Thorac Surg.* 2006;**81**(3):1048–55.
27. Oncel M, Sadi Sunam G, Erdem E, Dereli Y, Tezcan B, Gurol Akyol K. Bilateral thoracoscopic sympathectomy for primary hyperhydrosis: a review of 335 cases. *Cardiovasc J Afr.* 2013;**24**(4):137–40.
28. Kim JB, Park CK, Kum DY. The effect of thoracoscopic sympathicotomy at the fourth rib (r4) for the treatment of palmar and axillary hyperhidrosis. *Korean J Thorac Cardiovasc Surg.* 2011;**44**(2):154–8.
29. Scognamillo F, Serventi F, Attene F, Torre C, Paliogiannis P, Pala C, et al. T2-T4 sympathectomy versus T3-T4 sympathicotomy for palmar and axillary hyperhidrosis. *Clin Auton Res.* 2011;**21**(2):97–102.
30. Kim WO, Kil HK, Yoon KB, Yoon DM, Lee JS. Influence of T3 or T4 sympathicotomy for palmar hyperhidrosis. *Am J Surg.* 2010;**199**(2):166–9.