



## Effectiveness, success rates, and complications of different thoracoscopic sympathectomy techniques in patients with palmar hyperhidrosis

*Palmar hiperhidrozisli hastalarda farklı torakoskopik sempatektomi tekniklerinin etkinliği, başarı oranları ve komplikasyonları*

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### ABSTRACT

**Background:** This study aims to investigate the effectiveness, success and complication rates of three different video-assisted thoracoscopic sympathectomy procedures performed for the treatment of primary focal hyperhidrosis; excision, cauterization and clipping.

**Methods:** We retrospectively evaluated the records of 60 patients (33 males, 27 females; mean age 25.1±6.4 years; range 16 to 43 years) with primary focal hyperhidrosis and treated with video-assisted thoracoscopic sympathectomy between January 2010 and December 2013. The patients were treated bilaterally at the same session: the sympathetic chain and ganglia were excised from the spinal cord segments of T<sub>2</sub>-T<sub>4</sub> in 20 patients (group 1), cauterized in 20 patients (group 2), and clipped in 20 patients (group 3). The procedural success and complication rates were compared among the groups.

**Results:** Sympathectomy was successfully performed in all patients. The mean operation time was found to be significantly shorter in group 2 (42.5±7.1 min) and group 3 (36.9±7.8 min), compared to group 1 (51.1±8.4 min) (p<0.05). Compensatory hyperhidrosis developed in 17 patients (28.3%) and was comparable among all groups (p<0.05).

**Conclusion:** Our study results suggest that excision, cauterization, and clipping are effective and reliable in the treatment of primary focal hyperhidrosis. Based on our experience, we believe that sympathectomy with video-assisted excision may be preferable for the treatment of primary focal hyperhidrosis.

**Keywords:** Hyperhidrosis; sympathectomy; video-assisted thoracoscopic sympathectomy.

### ÖZ

**Amaç:** Bu çalışmada primer fokal hiperhidrozis tedavisinde kullanılan üç farklı video yardımcı torakoskopik sempatektomi işlemlerinden eksizyon, koterizasyon ve kliplenmenin etkinliği, başarıları ve komplikasyon oranları incelendi.

**Çalışma planı:** Ocak 2010 - Aralık 2013 tarihleri arasında primer fokal hiperhidrozis nedeniyle video yardımcı torakoskopik sempatektomi uygulanan toplam 60 hastanın (33 erkek, 27 kadın; ort. yaş 25.1±6.4 yıl; dağılım 16-43 yıl) kayıtları retrospektif olarak değerlendirildi. Tüm hastalar aynı seansta iki taraflı tedavi edildi: 20 hastada (grup 1) sempatik zincir ve gangliyonlar T<sub>2</sub>-T<sub>4</sub> spinal kord segmentinden eksize edildi, 20 hastada (grup 2) koterize edildi ve 20 hastada da (grup 3) kliplendi. Gruplar arasında işlem başarıları ve komplikasyon oranları karşılaştırıldı.

**Bulgular:** Sempatektomi tüm hastalarda başarılı bir şekilde uygulandı. Ortalama ameliyat süresi grup 1'e kıyasla (51.1±8.4 dk.), grup 2 (42.5±7.1 dk.) ve grup 3'te (36.9±7.8 dk.) anlamlı düzeyde daha kısa bulundu (p<0.05). Kompansatuvar hiperhidrozis 17 hastada (%28.3) gelişti ve gruplar arasında kıyaslanabilir düzeydeydi (p<0.05).

**Sonuç:** Çalışma sonuçlarımız primer fokal hiperhidrozis tedavisinde eksizyon, koterizasyon ve kliplenmenin etkili ve güvenilir olduğunu göstermektedir. Deneyimlerimiz doğrultusunda, video yardımcı eksizyonun primer fokal hiperhidrozis tedavisinde tercih edilebileceği kanısındayız.

**Anahtar sözcükler:** Aşırı terleme; sempatektomi, video yardımcı torakoskopik sempatektomi.

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Hyperhidrosis adversely affects the quality of life, leading to serious emotional and social problems. Hyperhidrosis is the disorder of excessive sweating that is more than the amount of sweat required for thermoregulation of the body.<sup>[1]</sup> The incidence of hyperhidrosis in the general population is reported to be between 1 and 3%.<sup>[1-3]</sup> In general, no underlying serious pathology is present in the etiology of the hyperhidrosis; however, its incidence among the first-degree of relatives of individuals suffering from hyperhidrosis is shown to be higher.<sup>[4]</sup> Furthermore, sweat glands and their functions are normal in most of the patients; however, these patients produce abnormal or excessive amount of sweat in response to normal emotional stress. Primary focal hyperhidrosis is characterized with idiopathic hyperhidrosis localized to certain areas of the body and commonly affects the axillae, palms, and soles. The diagnosis of primary focal hyperhidrosis is based on the following features: (i) It should start before the age of 25 years and continue for at least six months; (ii) It should present bilateral involvement and the intensity that disrupts daily activities; and (iii) It should increase with emotional stress, but cease during sleeping.<sup>[1,2]</sup>

Surgical treatment of primary focal hyperhidrosis is carried out through blocking the part of the sympathetic nerve chain innervating the area subject to the hyperhidrosis. For the surgical treatment of the primary focal hyperhidrosis, video-assisted thoracoscopic sympathectomy (VATS) procedures are currently used including excision, cauterization, and clipping of the sympathetic nerve chain.<sup>[5-7]</sup>

In this study, we aimed examine the success and complication rates of VATS in the treatment of primary focal hyperhidrosis.

## PATIENTS AND METHODS

We retrospectively evaluated the records of 60 patients (33 males, 27 females; mean age 25.1±6.4 years; range 16 to 43 years) with primary focal hyperhidrosis and treated with VATS between January 2010 and December 2013. We informed the patients with primary focal hyperhidrosis prior to the operation regarding the hyperhidrosis, nature of surgery, the way the surgery would be done and potential complications of it. Particularly, the patients were informed concerning the development of potential compensatory hyperhidrosis (CH) after surgery. A written informed consent was obtained from each patient. The study protocol was approved by the Ethical Committee of the Medical School of Eskişehir Osmangazi University. The study was

conducted in accordance with the principles of the Declaration of Helsinki.

All patients were treated with VATS procedures in which T<sub>2</sub>-T<sub>4</sub> sympathetic chain and ganglia were resected in 20 patients (group 1), cauterized in 20 patients (group 2), and clipped in 20 patients (group 3). The patients were evaluated at one, six, and 12 months postoperatively.

### Surgical technique

All patients were operated under general anesthesia using a single-lumen intubation tube. The patients were placed in the lateral decubitus position to perform the procedure. A puncture needle was used to access the pleural space, and the CO<sub>2</sub> was insufflated into the thoracic cavity to inflate the cavity to obtain more working space through collapsing the lung on the side of the operation. Mediastinal shift associated with artificially increased intrapleural pressure during the operation was carefully monitored and the mean mediastinal pressure was kept constant at 10 to 12 mmHg. In addition, the heart rate, blood pressure, and arterial oxygen parameters were intraoperatively kept under constant monitoring. Consequently, a 10 mm-cut to all patients was made on the midaxillary line at the fifth intercostal space to place the trocar and used for the camera. The location and number of the cuts used for the placement of the trocars were as follows for the groups: the patients in group 1 (excision group) in which the sympathetic chain was resected and removed received two 5-mm cuts, one at the anterior and one at the posterior axillary lines at the third intercostal space, and two trocars were placed in these cuts. The patients in group 2 (cauterization group) and group 3 (clipping group) in which the sympathetic chain was cauterized or clipped received one 5-mm cut on the midaxillary line at the third intercostal space and one trocar was placed in the cut. The trocars were used to insert cameras and other devices into the thoracic cavity. After dissecting the parietal pleura in patients of group 1, the sympathetic chain was released, and the chain and the ganglia of T<sub>2</sub>-T<sub>4</sub> were excised and removed. The excised ganglia were sent to the pathology lab and they were confirmed to be pathologically sympathetic ganglia. In group 2, the sympathetic chain and ganglia of T<sub>2</sub>-T<sub>4</sub> were cauterized. The sympathetic chain in group 3 was freed at T<sub>2</sub>-T<sub>4</sub> level in group 3. A total of four clips (5-mm in length) were used. T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub> ganglia were clipped at the second, third, fourth, and fifth rib beds. Furthermore, the Kuntz nerve, if present, was also cauterized in all patients. Ultimately, bleeding after sympathectomy was controlled. After

**Table 1. Baseline characteristics of patients**

	Total (n=60)		Group 1 (n=20) (Excision)		Group 2 (n=20) (Cauterization)		Group 3 (n=20) (Clipping)		p
	n	%	n	%	n	%	n	%	
Age (year)			25.1±6.4		23.3±5.5		26.6±7.2		>0.05
Gender									>0.05
Male	33	55	8	40	14	70	11	55	
Female	27	45	12	60	6	30	9	45	
Family history	15	25	5	25	4	20	6	30	>0.05
Plantar hyperhidrosis	59	98.3	20	100	19	95	20	100	>0.05
Axillar hyperhidrosis	45	75	16	80	14	70	15	75	>0.05
Association with anxiety	46	76.7	15	75	16	80	15	75	>0.05

SD: Standard deviation.

**Table 2. The surgical features of patients**

	Total (n=60)		Group 1 (n=20) (Excision)		Group 2 (n=20) (Cauterization)		Group 3 (n=20) (Clipping)		p
	n	%	n	%	n	%	n	%	
Operation time (min.)			43.4±9.6		51.1±8.4		42.5±7.1		<0.05
Hospitalization time (day)			2.3±0.5		2.4±0.7		2.2±0.4		>0.05
Procedure success	60	100	20	100	20	100	20	100	>0.05
Patients' satisfaction									>0.05
Satisfied	55	91.7	17	85	19	95	19	95	
Partially satisfied	5	8.3	3	15	1	5	1	5	
Unsatisfied	0	0	0	0	0	0	0	0	

SD: Standard deviation.

**Table 3. Early and late complications of patients**

	Total (n=60)		Group 1 (n=20) (Excision)		Group 2 (n=20) (Cauterization)		Group 3 (n=20) (Clipping)		p
	n	%	n	%	n	%	n	%	
Pneumothorax/emphysema	1	1.7	0	0	0	0	1	5	>0.05
Bleeding	3	5	2	10	1	5	0	0	>0.05
Horner syndrome	1	1.7	0	0	1	5	0	0	>0.05
Neuritis	2	3.4	1	5	0	0	1	5	>0.05
Surgical site infection	0	0	0	0	0	0	0	0	-
Postoperative pain									>0.05
Early period (0-48 hours)	60	100	20	100	20	100	20	100	
Late period (>48 hours)	4	6.7	3	15	0	0	1	5	
Recurrent hyperhidrosis	3	5	0	0	1	5	2	10	>0.05
Bradycardia	3	5	1	5	0	0	2	10	>0.05
Respiratory failure requiring rehospitalization	0		0		0		0		-
Compensatory hyperhidrosis	17		6	30	5	25	6	30	>0.05
Dry hands	5		2	10	1	5	2	10	>0.05

the completion of the procedures, the hole made in the fifth intercostal space was placed using a 20F-chest tube, and the lung was inflated.

The success of the procedures was defined based on the effective treatment of the hyperhidrosis and patients' satisfaction. Complications of VATS procedures included pneumothorax, emphysema, hemorrhage, hemothorax, respiratory failure, chylothorax, Horner's syndrome, injury to the adjacent organs, bradycardia, dry hands, recurrent hyperhidrosis, wound infections at the site of the cuts, and CH. The rates of the procedural success and complications between the groups were compared.

### Statistical analysis

Statistical analysis was performed using the SPSS for Windows version 16.0 software (SPSS Inc., Chicago, IL, USA). Continuous variables were expressed in mean  $\pm$  standard deviation (SD). The Student's t-test was used to compare normally distributed continuous variables, while the Mann-Whitney U test was used to compare abnormally distributed continuous variables. A *p* value of <0.05 was considered statistically significant.

## RESULTS

All patients were successfully applied VATS. Baseline clinical and demographic features of the groups are shown in Table 1. The mean operation time was significantly shorter in group 2 (42.5 $\pm$ 7.1 min) and group 3 (36.9 $\pm$ 7.8 min), compared to group 1 (51.1 $\pm$ 8.4 min) (*p*<0.05). The mean hospitalization time for the all population was 2.3 $\pm$ 0.5 days and there was no

significant difference in the hospitalization time among the groups (*p*>0.05). As for the satisfaction of the patients, 91.7% of the patients were fully and 8.3% were partially satisfied with the procedure; however, none of the patients were unsatisfied with the procedure. There was no significant difference between the groups in terms of the patients' satisfaction (*p*>0.05).

Furthermore, the influential factors for the success of VATS procedures are presented in Table 2. The following complications associated with the procedures were noted in the patients. Following sympathectomy, one patient developed pneumothorax six hours after removing the chest tube, three patients had hemorrhage, one patient suffered from Horner syndrome, three patients had distress with recurrent hyperhidrosis, three patients had bradycardia, and five patients developed dryness in their hand. The most frequent complication of the VATS procedures is CH characterized by excessive sweating at untreated areas, most frequently the lower back and trunk, but can be spread over the total body surface below the level of the cut after sympathectomy.<sup>[5]</sup> In our study, 17 patients developed CH. While complaining of postoperative early-pain over the chest and back was common in all the patients, postoperative late-pain (>48 hours) over the chest and back was reported only in four patients. These complications were comparable among the groups (*p*>0.05). Postoperative early and late complications pertaining to the patients are shown in Table 3.

## DISCUSSION

In the present study, we compared the effect of VATS procedures (excision, cauterization, and clipping) using VATS on the success and complication rates of the treatment of the patients with palmar hyperhidrosis. Sympathectomy procedures in the current study were successful and complete recovery from hyperhidrosis was achieved in all patients.

Obtaining complete recovery from hyperhidrosis requires not only isolation of the sympathetic chain, but also elimination of alternative neural pathways, if available.<sup>[5,8]</sup> One of the most well-known alternative pathways is the Kuntz nerve, which is shown to be an alternative connection route linking T<sub>1</sub> to T<sub>2</sub> segment of spinal cord.<sup>[9]</sup> The Kuntz nerve plays a substantial role in the development of recurrent hyperhidrosis, if left undiagnosed and unremoved.<sup>[9]</sup> In the present study, we found the Kuntz nerve in seven of 60 patients, and all of them were intraoperatively excised or cauterized. We, therefore, can conclude that full recovery of our patients is related to the effective accomplishment of sympathectomy and careful removal of the Kuntz nerve.

Pneumothorax due to residual gases is one of the most frequent intraoperative complications in primary focal hyperhidrosis patients treated with sympathectomy.<sup>[5]</sup> Although the majority of the primary focal hyperhidrosis patients recovered with sympathectomy are shown to suffer from enduring pneumothorax, only 1 to 2% of them require chest tube drainage. In addition, subcutaneous emphysema is another common complication and it is encountered approximately in 2 to 7% of cases.<sup>[10-12]</sup> In the present study, the rate of pneumothorax and subcutaneous emphysema development (n=1) was relatively low, compared to the literature. We routinely used thoracic tubes after VATS in all patients. However, the literature review showed that most of the studies did not use routinely these tubes after thoracoscopic sympathectomy.<sup>[10,11]</sup> Therefore, we consider that the routine use of thoracic tubes after VATS would be a helpful precaution to reduce the risk of complication development, such as pneumothorax, subcutaneous emphysema, and hemothorax.

Although postoperative bleeding is among the common complications of sympathectomy, it is not serious and life-threatening in most cases. Intercostal arteries and veins may bleed during the operation, but bleeding can be effectively controlled with the help of the clips.<sup>[14-16]</sup> In the current study, bleeding arising from the intercostal arteries and veins were noted in three patients, and it was controlled through

cauterization in one patient and with the help of clips in the other patient.

Recurrent hyperhidrosis is another potential side effect of hyperhidrosis surgery and it is described as the repeated excessive sweating in the same areas after sympathectomy. The incidence of recurrent hyperhidrosis vary greatly and shown to be between 1 and 27% among the patients.<sup>[10]</sup> Although recurrent hyperhidrosis can occur within three years after surgery, it most commonly develops within the first six months after surgery.<sup>[17]</sup> Among the most important underlying factors triggering the development of the recurrent hyperhidrosis are the discrepancies among the techniques used, inadequate sympathetic blockade, and sympathetic regeneration. Several studies have shown that incidences of the recurrent hyperhidrosis are higher in the sympathetic blockade including T<sub>2</sub> level than the sympathetic blockade applied inferiorly to the T<sub>2</sub> level.<sup>[17,18]</sup> In the present study, three patients developed recurrent hyperhidrosis at six months of follow-up: one of them was in the cauterization group and two of them were in the clipping group. The occurrence of the recurrent hyperhidrosis in the cauterization and clipping groups, but not in the incision group, suggests that excision of the sympathetic chain and its ganglia is not only more effective, but also hinder the development of recurrent hyperhidrosis. The symptoms in the patients presented with recurrent hyperhidrosis were mild and they were followed with conservative approaches.

Furthermore, CH is the most common complication of hyperhidrosis surgery and it adversely affects satisfaction of the patients. It can be defined as the relief of excessive sweating in palms and axillary regions, but excessive sweating starts in different parts of the body, such as back, groin, and waist after sympathectomy.<sup>[5]</sup> The occurrence rate of CH significantly varies ranging from 35 to 67%.<sup>[5,19]</sup> There are also several studies indicating a causal relationship between the development of CH and the level of the sympathectomy. Schmidt et al.<sup>[19]</sup> reported that sympathectomy applied inferiorly to the T<sub>2</sub> level of the vertebral column was likely to reduce the risk of CH development. Likewise, Dewey et al.<sup>[20]</sup> suggested that sympathectomy including T<sub>2</sub> level of the vertebral column increased the frequency of CH. In general, the majority of the studies have demonstrated that sympathectomy operations at the levels of T<sub>2</sub>, compared to the inferior to the T<sub>2</sub> level of the vertebral column, increased the risk of CH development.<sup>[21,22]</sup> Recent studies regarding VATS have also shown the fact that surgeons should avoid from carrying out extensive resection of sympathetic chain, and particularly T<sub>2</sub> ganglion should be spared during

sympathectomy to prevent the development of the postoperative CH.<sup>[23]</sup> In our study, 28.3% of the patients developed postoperative CH, consistent with the reports in the literature on the level of the sympathectomy, further supporting the concept that the inclusion of T<sub>2</sub> ganglion increases the risk of postoperative CH development. In addition, we performed the segmental chain and ganglion sympathectomy at T<sub>2</sub>-T<sub>4</sub> levels; and accordingly, we believe that higher incidence of CH in the present study might be owing to interfering with T<sub>2</sub> ganglion. Three of 17 patients who developed CH were particularly very disruptive due to CH and they were followed with conservative treatment. Sympathectomy of two of these three patients was performed with the clipping procedure. Although there are other studies suggesting that the removal of clips may regress CH,<sup>[24]</sup> other studies have shown that the removal of clips fail to retreat CH.<sup>[25]</sup> Therefore, we believe that the patient should be informed that the removal of clips may not be effective all the time in the treatment of CH.

In conclusion, our study results demonstrate that all three VATS procedures (excision, cauterization, and clipping of the sympathetic chain and its ganglia) are effective and useful in the full recovery of primary focal hyperhidrosis. Nevertheless, considering reduced frequency of recurrent hyperhidrosis in cases of primary focal hyperhidrosis treated with excision, we suggest that sympathectomy using video-assisted excision is desirable for the treatment of primary focal hyperhidrosis, although further large-scale studies are needed to establish a conclusion.

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