ORIGINAL ARTICLES

Results of High Bilateral Endoscopic Thoracic Sympathectomy and Sympatholysis in the Treatment of Primary Hyperhidrosis: a Study of 1016 Procedures

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OBJECTIVE: Thoracic sympatholysis and sympathectomy are the current standard treatments for primary hyperhidrosis. In this study, we evaluated the incidence of peri- and postoperative complications associated with these procedures.

PATIENTS AND METHODS: From 1996 to 2004, 520 consecutive patients (364 women), with a mean age of 26.8 years, were treated for primary hyperhidrosis at our hospital. The procedure was bilateral in all but 24 cases. The 484 patients in the sympatholysis group underwent a single intervention while the 36 patients in the sympathectomy group underwent 2 separate interventions.

RESULTS: No deaths occurred. Anhidrosis of the target area was achieved in 97.6% of patients while 2.2% experienced hypohidrosis. In 0.2% of the cases, the procedure was initially unsuccessful and a second intervention was required. The mean duration of hospital stay was 72 hours for patients in the sympathectomy group and 17 hours for the sympatholysis group. Serious intraoperative complications requiring conversion to thoracotomy were recorded in 0.2% of patients. Postoperative complications—of which pneumothorax was the most common—occurred in 5.2% of the cases (in 22.5% of the sympathectomy group and 3.55% of the sympatholysis group). Compensatory hyperhidrosis occurred in 48.4% of the patients, excessive dryness of the hands and palpebral ptosis in 0.38%, and gustatory sweating in 0.9%. The degree of patient satisfaction was quite high (88.5%) and only 2.3% were very unsatisfied.

CONCLUSIONS: Given the results obtained, we can conclude that both sympatholysis and sympathectomy are appropriate treatments for hyperhidrosis. Nonetheless, because sympatholysis is both easier to perform and less aggressive, we consider it the treatment of choice for primary hyperhidrosis.

Key words: *Endoscopic thoracic sympathectomy. Hyperhidrosis. Hemothorax. Compensatory hyperhidrosis.*

Resultados de la simpaticólisis y la simpatectomía torácica superior bilateral endoscópica en el tratamiento de la hiperhidrosis primaria. Estudio de 1.016 procedimientos

OBJETIVO: La simpaticolisis y la simpatectomía torácica son actualmente los tratamientos habituales de la hiperhidrosis primaria. En este estudio evaluamos la incidencia cuantitativa y cualitativa de las complicaciones peri y postoperatorias.

PACIENTES Y MÉTODOS: Desde 1996 a 2004 se intervino consecutivamente a 520 pacientes (364 mujeres) con hiperhidrosis primaria, con una edad media de 26,8 años. En todos, excepto en 24 casos, el procedimiento fue bilateral. La intervención se realizó en un tiempo en 484 pacientes (simpaticólisis) y en 2 tiempos en 36 (simpatectomía).

RESULTADOS: No hubo mortalidad. La anhidrosis del territorio deseado fue del 97,6%, se apreció hipohidrosis en el 2,2% y hubo un 0,2% de fallos que requirieron reintervención. La estancia media fue de 72 h en el grupo de simpatectomía y de 17 h en el de simpaticólisis. Se registró un 0,2% de complicaciones intraoperatorias mayores con reconversión a toracotomía. Se produjo un 5,2% de complicaciones postoperatorias (un 22,5% en las simpatectomías y un 3,55% en la simpaticólisis), de las cuales el neumotórax fue la más frecuente. Se observó hiperhidrosis compensadora en un 48,4% de los casos, sequedad excesiva de manos y ptosis palpebral en el 0,38%, e hiperhidrosis gustativa en un 0,9% de casos. El grado de satisfacción fue muy elevado (88,5%) y sólo un 2,3% de los pacientes se manifestaron muy insatisfechos.

CONCLUSIONES: De los resultados obtenidos se deduce que tanto la simpaticolisis como la simpatectomía son tratamientos adecuados de la hiperhidrosis, si bien la mayor sencillez y menor agresividad de la primera nos llevan a considerarla el tratamiento de elección en la hiperhidrosis primaria.

Palabras clave: *Simpatectomía torácica endoscópica. Hiperhidrosis. Hemotórax. Hiperhidrosis compensadora.*

Introduction

Primary hyperhidrosis, which can affect up to 1% of the population, is a disorder of unknown etiology characterized by excessive sweating, typically of the palms, axillas, and the soles of the feet.

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Emotional stimuli, temperature, or high levels of anxiety cause the sweat glands to overrespond. The main symptom of primary hyperhidrosis is excessive sweating, although other indicators of sympathetic hyperactivity —such as facial blushing, palpitations, trembling, headaches, and high levels of anxiety—may also be present. However, whether these signs and symptoms are the cause or the consequence of the illness is difficult to determine. In any case, the symptoms produce a general state of discomfort that can affect the everyday social and work life of those who suffer from the disorder.[1,2] High bilateral endoscopic thoracic sympatholysis is currently the standard treatment for primary hyperhidrosis.[3-6]

The aim of this study was to analyze the overall results obtained from 520 patients who underwent either high bilateral endoscopic thoracic sympathectomy or sympatholysis for primary hyperhidrosis.

Patients and Methods

From 1996 to 2004, 520 consecutive patients (364 women, 70%; 156 men, 30%), with a mean age of 26.8 years (range, 14-52 years), were treated for primary hyperhidrosis at our hospital. All patients underwent the same preoperative evaluation, which included: clinical history, simple chest x-ray, electrocardiogram, complete hemogram with biochemistry and coagulation study, thyroid function tests, and simple spirometry. Patients with a history of asthma or bronchial hyperresponsiveness were given a methacholine challenge test to identify variations in bronchial tone; if the test was positive, the patient was treated with inhaled corticosteroids for 2 months before surgery.

The sample consisted of 2 groups, according to the surgical technique used: ganglionectomy or sympathectomy in group A, and sympatholysis in group B.

Group A

From January 1996 through September 1998, 71 procedures (7%) were performed on 36 patients; in all but 1 case the procedure was bilateral. The bilateral intervention consisted of 2 separate procedures (sequential bilateral), with a mean interval of 3 months between operations. The surgical technique was as follows: *a)* general anesthesia and selective bronchial intubation with the patient positioned in lateral decubitus; *b)* entry port to insert 10 mm Wolf® thoracoscope (Richard Wolf, Knittlingen, Germany) with either 1 (51 procedures) or 2 (20 procedures) additional 5 mm ports for the surgical instruments; *c)* dissection of the sympathetic chain by ganglionectomy of the second and third thoracic (T2-T3) ganglia (to treat palmar hyperhidrosis) or a T2-T4 ganglionectomy (for axillary hyperhidrosis); and *d)* insertion of a 20F chest tube for 24 hours after surgery and, assuming a normal postoperative x-ray, discharge from hospital 48 hours after the intervention.

Group B

From October 1998 through October 2004, 945 procedures (93%)—all but 23 of which were bilateral—were performed on 484 patients. The surgical protocol was as follows: *a)* general anesthesia, selective bronchial intubation with the patient positioned in dorsal decubitus and the trunk inclined forward 25º, abduction of the upper extremities with the forearms partially extended; *b)* table turned 10º laterally towards the nonintervention side with a single entry port for the 5/10 mm Wolf thoracoscope at the third intercostal space (midaxillary line); *c)* identification of the upper thoracic sympathetic chain followed by sympatholysis of the T2-T3 ganglia (to treat palmar hyperhidrosis) or T2-T4 ganglia (for axillary hyperhidrosis) by 25 W monopolar electrocoagulation (5 to 10 brief electric discharges); *d)* hemostasis and evacuation of the pneumothorax by air aspiration through the thoracoscopic port without insertion of a chest tube; and *e)* assuming a normal postoperative x-ray, discharge 17 hours after surgery.

Data Collection

All patients completed a preoperative questionnaire 8 weeks before surgery. The independent variables studied were as follows: family history of primary hyperhidrosis, location of the hyperhidrosis, associated symptoms and negative consequences of the primary hyperhidrosis on family, friends, partner, and work. Patients completed another questionnaire 12 weeks after surgery to evaluate the following: postoperative pain requiring the use of analgesics for less than 1 month, between 1 and 2 months, or more than 2 months; slight drooping of the eyelid; gustatory hyperhidrosis; degree of hand dryness; and degree of palmar and/or axillary hypohidrosis

Patients who completed at least 18 and 24 months, respectively, of postoperative follow-up were selected to complete a second postoperative questionnaire designed to assess the degree of compensatory hyperhidrosis and the overall level of satisfaction. This second questionnaire was used to assess any changes in the degree of subjective sweating, evaluated according to the following parameters: increase, no change, or decrease in sweating. Degree of satisfaction was measured according to the following scale: very satisfied, unsatisfied, very unsatisfied.

Statistical Analysis

Statistical analysis of the data was performed with the SPSS 11.0 statistical software package (SPSS; Chicago, IL, USA). The McNemar test was used to analyze the matched paired data collected before and after the intervention. A *P* value less than .05 was considered significant.

Results

Epidemiological Results

A family history of primary hyperhidrosis was reported by 49% of patients. The distribution of body areas affected by hyperhidrosis in our patients was as follows: 150 patients (28.8%) had palmar hyperhidrosis, 83 (16%) had both palmar and axillary hyperhidrosis, 156 (30%) had palmar, axillary, and plantar hyperhidrosis, and 102 (19.6%) had palmar and plantar hyperhidrosis; the reported incidence of hyperhidrosis in other locations was relatively minor. Table 1 shows the distribution of sweating in the different areas of the body according to the preoperative questionnaire. In terms of accompanying signs, facial blushing was reported by 313 patients (60.2%), palpitations by 272 (52.3%), hand trembling by 163 (31.3%), and headaches by 157 (30.2%).

As Table 2 shows, patients felt they were most negatively affected by the primary hyperhidrosis in their relationships with friends (73.4% of patients) and at work (88.1%).

Effectiveness of the Procedure

Anhidrosis of the target areas was achieved in 97.6% of patients while 2.2% experienced hypohidrosis (the result was visibly noticeable, although the palms retained

TABLE 1
Location of Hyperhidrosis Before Intervention

Anatomical Region	N	%
Palms	150	28.8
Palms and axillas	83	16
Palms, axillas, and soles	156	30
Palms and soles	102	19.6
Palms and face	2	0.4
Axillas	16	3.1
Face	5	0.9
Face, palms, axillas, and soles	6	1.1

TABLE 2
Areas of Patients' Lives Affected Negatively by Primary Hyperhidrosis

	N	%
Family	110	21.1
Partner	240	46.1
Friends	382	73.4
Workplace	458	88.1

some moisture). In 2 patients (0.2%)—1 from each group—the procedure was initially unsuccessful and a second intervention was required to achieve complete anhidrosis. The mean duration of hospital stay was 72 hours for patients in group A and 17 hours for group B.

Intraoperative Complications

No deaths were recorded in either group. The overall intraoperative morbidity rate was 0.2% (2 of 1016 patients). No intraoperative complications were observed in group B. However, in group A, conversion to thoracotomy was necessary in 2.8% of the procedures (2 of 71 procedures): 1 patient had abundant pleural adhesions requiring 2 accessory ports and a utility incision; the other patient required an axillary thoracotomy to treat severe hemorrhaging caused by a ruptured superior intercostal vein.

Postoperative Complications

Postoperative complications developed in 5.2% of the cases (53 of 1016 procedures), distributed by group as follows:

– Group A. Complications were recorded in 22.5% of the cases (16 of 71 procedures), as follows: pneumothorax in 12.6% (9 of 71 procedures; of these, 1 required chest tube drainage for 48 hours), subcutaneous emphysema in 4.2% (3 of 71 procedures), and pleural effusion in 5.6% (4 of 71 procedures). All of these complications were resolved with respiratory physiotherapy.

– Group B. Complications were recorded in 37 of the 945 procedures (3.9%), as follows: 1 case of hemopericardium of unknown etiology at 4 hours postintervention and 1 case of hemothorax with hemodynamic instability 24 hours after surgery—both of these cases required an emergency thoracotomy; 19 cases (2%) of pneumothorax of which 5 (0.2%) required a chest tube; 2 cases (0.2%) of pleural effusion; 2 prolonged air leaks (0.2%) treated by thoracoscopy and talc pleurodesis 10 days after the intervention; 1 case (0.1%) of hemothorax secondary to pseudoaneurysm of the intercostal artery developed 15 days after surgery and was resolved by embolization and respiratory physiotherapy without need of a chest tube; 10 cases (1.05%) of localized radiologic subcutaneous emphysema; and 1 case (0.1%) of atelectasis.

The duration of postoperative pain was less than 1 month in 79.6% of cases (414 of 520 procedures), between 1 and 2 months in 13.1% (68 of 520 procedures), and longer than 2 months in only 7.3% (38 of 520 procedures). In 12.5% (n=65) of cases, the postsurgical pain was such that a 2-week medical leave from work was required; of the patients requiring a medical leave, 91.6% (33 of 36 patients) belonged to group A and 6.6% (32 of 484 patients) to group B.

Unwanted Effects: Compensatory Hyperhidrosis, Hypohidrosis, Excessive Dryness, Palpebral Ptosis, and Gustatory Hyperhidrosis

A total of 285 patients who had completed at least 18 months of follow-up were surveyed to assess compensatory hyperhidrosis (reflex sweating). Of these, 244 (85.6%) reported the sensation of compensatory hyperhidrosis. However, when the reported degree of sweating in different areas of the body from the preoperative questionnaire was compared to information from the postoperative questionnaire, only 138 (48.4%) were found to have actually changed. The areas of the body with statistically significant changes in sweating were the trunk (increased sweating) and the feet (decreased sweating).

At 12 weeks postintervention, hypohidrosis of the denervated area was found in 22 cases (2.16%; 2 from group A and 20 from group B); of these, the hypohidrosis involved the palms in 14 cases (1.37%) and the axillas in 8 (0.78%). Two patients (0.38%) reported excessive sweating of both hands, with a negative repercussion. Palpebral ptosis was recorded in 4 patients (0.39%; 1 in group A and 3 in group B); of these, 3 recovered spontaneously 12 months after the intervention. Only 5 patients (0.9%; 1 in group A and 4 in group B) reported gustatory hyperhidrosis of the chest, back, and neck.

Degree of Satisfaction

To evaluate the patient degree of satisfaction, 350 of those who had completed at least 24 months of follow-up were surveyed. Of these, 310 (88.5%) were very satisfied, 32 (9.1%) were unsatisfied, and 8 (2.3%) were very dissatisfied after the intervention and even expressed regret about having undergone the operation.

Discussion

Because of the lack of effective medical treatments to manage primary hyperhidrosis over the long term, most published specialists in the field consider sympathectomy and sympatholysis to be the best treatments.[3-8]

TABLE 3
Comparative Results Between High Bilateral Endoscopic Thoracic Sympatholysis and Sympathectomy*

Author, Year	N	G	Complication, %	CH	GH	Horner's Syndrome, %	Recurrence, %	Complete or Partial Satisfaction, %
Herbst et al,[14] 1994	270/480	T1-T4	2.6	67	51	2.5	1.5	93.4
Zacherl et al,[15] 1998	352/630	T1-T4	3.4	67	47	3.8	1.36	68
Drott et al,[8] 1995	850/1700	T2	1	55	36	1	2	98
Lin y Fang,[12] 1999	1360/2715	T2	0.88	84	(?)	0	2.1	95
Gossot et al,[16,7] 2001, 2003	467/940	T2-T4	2.9	50	7.2	0.4	8.8†	93†
Present series, 2005	520/1016	T2-T3	5.2	48	0.9	0.1	0.19	88

*N indicates number of patients/procedures; G, sympathetic ganglia eliminated; GH, gustatory hyperhidrosis; and CH, compensatory hyperhidrosis.
†All data provided for this author refer to the 2001 study except for recurrence and patient satisfaction, both of which are from the 2003 study of 125 patients/250 procedures.

No deaths occurred in our surgical series of 1016 procedures. Nevertheless, cases in which death occurred secondary to cerebral edema have been described[9]; the emergence of brain swelling may be related to insufflation of carbon dioxide into the pleural cavity, a technique that is normally performed in laparoscopic surgery to induce and maintain pneumoperitoneum during the operation. In our study, we induced pneumothorax through selective bronchial intubation and the passive admission of air through the instrument port.

The epidemiological data collected in our series showed that 49% of patients had a family history of primary hyperhidrosis. The most common location of hyperhidrosis for patients in our series was as follows: palms, axillas, and the soles of the feet (30% of patients), palms (28.8% of patients), and palms and axillas (16% of patients). These findings are similar to those reported for other series.[10,11] In addition to the hyperhidrosis, each patient had a mean of 1.7 accompanying signs and symptoms, with the most common being facial blushing (60.2%), palpitations (52.3%), trembling hands (31.3%), and headaches (30.2%). These results are similar to those described in other series.[11]

From a psychological standpoint, patients in our study reported that primary hyperhidrosis negatively affected the following areas of their life: work (88.1%), friendships (73.4%), and relations with partner (46.1%) and family (21.1%). Indeed, it is precisely this negative repercussion that motivates patients to undergo surgery to solve the problem, yet a review of the literature turned up very little information about patient motivation.

The systematic surgical elimination of the T2-T3 ganglia was quite effective in our series; anhidrosis of the target area was achieved in 97.6% of the patients while 2.2% experienced hypohidrosis. In 0.2% of the cases, the procedure was initially unsuccessful, although complete anhidrosis was achieved after a second intervention. These results are similar to those reported by other authors[10]; in fact, the results are comparable to other series[8,12-15] in which the T1-T4 ganglia were eliminated.

Overall intraoperative morbidity was 0.2%. Conversion to thoracotomy was necessary in 2.8% of the procedures in the sympathectomy group and 0% of the sympatholysis group; however, all incidences were completely resolved with no sequelae. One noteworthy case involved hemopericardium of unknown etiology that occurred a few hours after surgery. The complication rate reported by most case series is similar to ours[8,12,13,16,17]; however, unlike other studies, our patients did not suffer chylothorax,[16-18] nerve damage,[19,20] or pulmonary edema.[21] Table 3 compares different series in terms of complication rates, recurrences, unwanted effects, and degree of satisfaction.[7,8,14-16]

In our study, postoperative complications developed in 5% of cases, with patients from the sympathectomy group presenting a higher morbidity rate (22.5% compared to 3.7% in the sympatholysis group). Pneumothorax was the most common complication in both groups, although only 0.5% of cases required pleural drainage. Once again, we have confirmed that sympatholysis offers certain advantages—in particular, lower morbidity rates and better immediate and late postoperative well-being—when compared to sympathectomy. Given these benefits, we agree with other authors that sympatholysis is the technique of choice.[5,11,13] Postoperative pain lasting longer than 1 month was observed in 30.4% of the cases; however, of these, only 12.5% of the patients in the sympatholysis group required a 2-week medical leave from work after the intervention, compared to 91.6% of patients in the sympathectomy group.

Compensatory hyperhidrosis was the most common unwanted side effect (48.4%), regardless of the number of ganglia removed. Statistically significant changes in sweating occurred in the trunk (increase of sweating) and the feet (decrease). Some series[8,12,13] report similar rates of compensatory sweating, which tended to gradually diminish in intensity over a 5-year follow-up period.

The cause of compensatory hyperhidrosis is not known; however—unlike primary hyperhidrosis—it is generally accepted that compensatory hyperhidrosis is unrelated to anxiety or stressful situations.[1,2] Some authors believe that there is a direct link between compensatory hyperhidrosis and the number of sympathetic ganglia eliminated or the extent of sympatholysis[22-26]; however, other studies have found no such connection.[24] Some authors apply metal clips to interrupt the sympathetic chain by compression in an attempt to reduce compensatory sweating and to retain the ability to reverse the effects of sympatholysis,[25] but we do not support that technique.[26] Other authors, after eliminating only the T3 ganglion, have found no evidence of compensatory hyperhidrosis, even after 3.5 years of follow-up.[23]

In our series, 2.16% of patients had hypohidrosis, but it was well-tolerated and did not require a second

intervention. Excessive dryness of the hands, on the other hand, was observed in 0.38% of cases. We believe that these varying responses to the same procedure are not related the procedure itself, but rather to differences among individuals.

We also observed gustatory hyperhidrosis in 0.38% of cases, a similar percentage to that reported by other authors,[7,16] although this figure contrasts with the much higher rates—between 30% and 50%—described in other series.[8,12,13] This unwanted effect creates a level of anxiety high enough to warrant psychotherapy. We have found no satisfactory explanation for such an unpleasant consequence as gustatory hyperhidrosis.

The incidence of Horner's syndrome in our series was 0.1%; in other recent series[6,8,12,13,16] the reported incidence has ranged from 0% to 3.8%. Several ideas—such as the diffusion of electric current from the monopolar scalpel, excessive force applied to the sympathetic chain[19] or abnormalities in the location of the second rib or of the distribution of the sympathetic chain[27,28]—have been suggested to explain the emergence of Horner's syndrome after this type of surgery. If sympatholysis is limited to the T2 ganglion, the incidence of Horner's syndrome is close to 0%, and eliminating this single ganglion is sufficient to achieve palmar or facial anhidrosis.

Despite the considerable incidence of compensatory hyperhidrosis (48.4%), which was consistent with reports of other series,[29] 88.5% of our patients reported a high degree of satisfaction. However, we should remember that compensatory sweating is related to changes in the surrounding air temperature, in contrast to primary hyperhidrosis, in which sweating occurs in anticipation of a future stressful situation.

In conclusion, after analyzing the overall results, it is clear that satisfactory results can be achieved with both high bilateral endoscopic thoracic sympathectomy and sympatholysis; therefore, both can be considered standard treatments for primary hyperhidrosis, even though sympatholysis is both easier to perform and less aggressive. Despite the considerable incidence of compensatory hyperhidrosis, the procedure is still valid because the sweating tends to diminish in intensity over time or the patient gradually comes to accept it. As a result, overall patient satisfaction is quite high, despite the compensatory hyperhidrosis. Given that not all patients experience compensatory hyperhidrosis, we believe that it would be interesting to study the basal sympathetic nerve activity of patients with primary hyperhidrosis to discriminate between nosologic subgroups within the clinical context[30] so that expected patient response to sympatholysis could be identified preoperatively.

REFERENCES

1. Ramos R, Moya J, Pérez J, Villalonga R, Morera R, Pujol R, et al. Hiperhidrosis primaria: estudio prospectivo de 338 pacientes. Med Clin (Barc). 2003;121:201-3.
2. Ramos R, Moya J, Turón V, Pérez J, Villalonga R, Morera R, et al. Hiperhidrosis primaria y ansiedad. Estudio prospectivo y preoperatorio de 158 pacientes. Arch Bronconeumol. 2005;41:88-92.
3. Wittmoser R. Sympathectomies et vagotomies par thoracoscopie. En: Gossot D, editeur. Techniques de chirurgie endoscopique du thorax. Paris: Springer Verlag; 1994. p. 168-89.
4. Moya J, Ferrer G, Peyrí J, Pujol R, Morera R, Tarrado X, et al. Simpatectomía torácica endoscópica en el tratamiento de la hiperhidrosis palmar primaria. A propósito de 28 casos. Actas Dermosifiliogr. 2000;91:43-6.
5. Moya J, Ferrer G, Morera R, Pujol R, Ramos R, Villalonga R, et al. Estudio comparativo entre ganglectomía y la simpaticólisis torácica superior para el tratamiento quirúrgico de la hiperhidrosis palmar primaria. A propósito de 185 procedimientos en 100 pacientes. Actas Dermosifiliogr. 2001;92:369-75.
6. Doolabh N, Horswell S, Williams M, Huber L, Prince S, Meyer DM, et al. Thoracoscopic sympathectomy for hyperhidrosis: indications and results. Ann Thorac Surg. 2004;77:410-4.
7. Gossot D, Galetta D, Pascal A, Debrosse D, Caliandro R, Girard P, et al. Long-term results of endoscopic thoracic sympathectomy for upper limb hyperhidrosis. Ann Thorac Surg. 2003;75:1075-9.
8. Drott C, Göthberg G, Claes G. Endoscopic transthoracic sympathectomy: an efficient and safe method for the treatment of hyperhidrosis. J Am Acad Dermatol. 1995;33:78-81.
9. Cameron AE. Complications of endoscopic sympathectomy. Eur J Surg. 1998;580 Suppl:33-5.
10. Dumont P, Denoyer A, Robin P. Long-term results of thoracoscopic sympathectomy for hyperhidrosis. Ann Thorac Surg. 2004;78: 1801-7.
11. Hederman WP. Present and future trends in thoracoscopic sympathectomy. Eur J Surg. 1994;572 Suppl:17-9.
12. Lin TS, Fang HY. Transthoracic endoscopic sympathectomy in the treatment of palmar hyperhidrosis with emphasis on perioperative management (1360 case analyses). Surg Neurol. 1999;52:453-7.
13. Neumayer CH, Bischof G, Fugger R, et al. Efficacy and safety of thoracoscopic sympathicotomy for hyperhidrosis of the upper limb. Results of 734 sympathicotomies. Ann Chir Gynaecol. 2001;90:195-9.
14. Herbst F, Plas EG, Fugger R, Fritsch A. Endoscopic thoracic sympathectomy for primary hyperhidrosis of the upper limbs. A critical analysis and long-term results of 480 operations. Ann Surg. 1994;220:86-90.
15. 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. 1998;580 Suppl:43-6.
16. Gossot D, Kabiri H, Caliandro R, Debrosse D, Girard P, Grunenwald D. Early complications of thoracic endoscopic sympathectomy: a prospective study of 940 procedures. Ann Thorac Surg. 2001;71:1116-9.
17. Lai YT, Yang LH, Chio CC, Chen HH. Complications in patients with palmar hyperhidrosis treated with transthoracic endoscopic sympathectomy. Neurosurgery. 1997;41:110-3.
18. Cheng W, Chang C, Lin T. Chylothorax after endoscopic sympathectomy: case report. Neurosurgery. 1994;35:330-1.
19. Lange JF. Inferior brachial plexus injury during thoracoscopic sympathectomy. Surg Endosc. 1995;9:830.
20. Lardinois D, Ris HB. Minimally invasive video-endoscopic sympathectomy by use of a transaxillary single port approach. Eur J Cardiothorac Surg. 2002;21:67-70.
21. Lan CJ, Luk HN, Wu CT, Chang WK, Tsou MY, Lui PW, et al. Bilateral pulmonary edema after endoscopic sympathectomy in a patient with glucose-6-phosphate dehydrogenase deficiency. Acta Anaesthesiol Scand. 2001;45:123-6.
22. Yoon H, Ha Y, Park YG, Chang JW. Thoracoscopic limited T-3 sympathicotomy for primary hyperhidrosis: prevention for compensatory hyperhidrosis. J Neurosurg. 2003;99 Suppl 1:39-43.
23. Riet M, Smet AA, Kuiken H, Kazemier G, Bonjer HJ. Prevention of compensatory hyperhidrosis after thoracoscopic sympathectomy for hyperhidrosis. Surg Endosc. 2001;15:1159-62.
24. Lesèche G, Castier Y, Thabut G, Petit MD, Combes M, Cerceau O, et al. Endoscopic transthoracic sympathectomy for upper limb hyperhidrosis: limited sympathectomy does not reduce postoperative compensatory sweating. J Vasc Surg. 2003;37:124-8.
25. Lin CC, Mo LR, Lee SM, Ng SM, Hwang MH. Thoracoscopic T2-sympathectomy block by clipping: a better and reversible operation for treatment of hyperhidrosis palmaris. Experience in 326 cases. Eur J Surg. 1998;580 Suppl:13-6.
26. Moya J, Ramos R, Vives N, Pérez J, Morera R, Perna V, et al. Sudación compensatoria secundaria a la simpaticólisis superior. Estudio de 123 casos. Arch Bronconeumol. 2004;40:360-3.
27. Yarzebski JL, Wilkinson HA. T2 and T3 sympathetic ganglia in the adult human: a cadaver and clinical-radiographic study and its clinical application. Neurosurgery. 1987;21:339-42.
28. Ramsaroop L, Singh B, Moodley J, Partab P, Satyapal KS. Anatomical basis for a successful upper limb sympathectomy in the thoracoscopic era. Clin Anat. 2004;17:294-9.
29. Loscertales J, Arroyo Tristán A, Congregado Loscertales M, Jiménez Merchan R, Girón Arjona J, Arenas Linares C, et al. Tratamiento de la hiperhidrosis palmar por simpatectomía torácica. Resultados inmediatos y calidad de vida postoperatoria. Arch Bronconeumol. 2004;40:67-71.
30. Lefaucheur JP, Fitoussi M, Becquemin JP. Abolition of sympathetic skin responses following endoscopic thoracic sympathectomy. Muscle Nerve. 1996;19:581-6.