Impact of transthoracic endoscopic sympathectomy on plantar hyperhidrosis



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Impact of transthoracic endoscopic sympathectomy on plantar hyperidosis.

INTRODUCTION: The aim of this study is to evaluate the impact of transthoracic endoscopic sympathectomy on plantar hyperhidrosis in patients operated on for upper limb hyperhidrosis.

MATERIALS AND METHODS: From 2003 to 2011, 41 consecutive patients underwent videothoracoscopic T3-T4 sympathicotomy or T3-T4 ganglion block at our Unit for upper limb hyperhidrosis. Twenty-one (51%) were affected by palmar hyperhidrosis and 20 (49%) by palmar and axillary hyperhidrosis combined. The patients affected by the plantar form were 26 (63%). Clinical follow-up was performed at 3, 6 and 12 months after surgery. Phone interviews and/or clinical assessment were made after a variable period of time (range 6 months to 8 years) to asses long term results. RESULTS: Plantar hyperhidrosis improved in 14 patients, which represents the 54% of the sufferers and the 34% of all

RESULTS: Plantar hyperhidrosis improved in 14 patients, which represents the 54% of the sufferers and the 34% of all patients. It was partially regressed in 11 patients (79%) and resolved in 3 cases (21%). There were not significant differences between patients treated with sympathicotomy and those treated with ganglion block.

CONCLUSIONS: Transthoracic endoscopic sympathectomy performed through T3-T4 sympathicotomy or ganglion block improves plantar hyperhidrosis in approximately 54% of the affected patients, with a partial and complete resolution rate of 79% and 21% respectively.

KEY WORDS: Hyperhidrosis, Sympathetic chain, Sympathectomy, Sympathicotomy, TES

Introduction

Hyperhidrosis (HH) is an excessive perspiration beyond physiological needs. Hyperhidrosis can be primitive (essential, idiopathic) or secondary to drugs, toxins, substance abuse, cardiovascular disorders, respiratory failure, infections, malignancies (Hodgkin disease, myeloproliferative disorders) and endocrine – metabolic disorders (thyreotossicosis, pheocromocytoma, acromegaly).

Hyperhidrosis can involve different areas of the human body, being focal, regional or diffuse. It can also be symmetric or asymmetric, unilateral or bilateral. The most common forms in relation to the human district involved are palmar, axillary, facial, dorsal and plantar HH, even if frequently there are more than one district involved (combined HH). The diffuse form is usually secondary to other conditions, whereas localized HH is generally primitive.

Hyperhidrosis is a benign condition but causes important physical, psychological, professional and social dis-

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comfort and it cannot be considered only a cosmetic disorder ¹. Several therapies are available for the treatment of HH. Conservative treatment includes medical, physical and psychological therapies. Medical therapies consist prevalently in application of topic medications containing aluminium chloride or tanning agents, use of systemic anticholinergic drugs and injection of botulin toxin in the affected area. Physical therapies include methods as iontophoresis and biofeedback. Conservative therapies provide partial and transitory relief and have to be repeated, often becoming frustrating, time spending and expensive ²⁻⁴.

Transthoracic Endoscopic Sympathectomy (TES) is currently considered the most acceptable treatment for HH of the face, axilla and palms. The first report on endoscopic sympathectomy appeared more than a half century ago but the procedure did not achieve rapid general acceptance and it was only performed sporadically. It was only in the last three decades that the technique had a wide diffusion, thanks to progressive technological improvements and excellent results obtained. Long term success rates of TES for palmar HH ranges between 90 – 98% in several reports, while results for axillary HH seem to be slightly lower but absolutely satisfactory 5^{-8} . In some studies it was observed, as a collateral finding,

that TES has a positive impact on plantar HH in patients who underwent surgery for upper limb HH and were also affected by plantar HH ^{2,9}. The aim of this study is to evaluate such impact in a series of 41 patients operated on for palmar and axillary excessive sweating and to investigate the pathophysiological mechanisms involved.

Material and Methods

From October 1993 to September 2011, 108 consecutive patients underwent TES for palmar and axillary hyperhidrosis at our institution. The mean age was 28 years (range: 18-48) and the male-female ratio approximately 1:4. This period can be divided on the basis of the surgical technique adopted into two sub-periods, one from 1993 to 2003 and one other from 2003 to 2011. In the first period all patients (67) had bilateral T2-T4 sympathectomy, while from 2003 we started perform either sectioning or clipping of the ganglionic tract. Using one of these latest variants, called respectively T3-T4 sympathicotomy and T3-T4 ganglion block, we treated 41 patients (35 sympathicotomies and 6 ganglion blocks).

These 41 patients represent our study group. A written consent was obtained from the patients in all cases. The indication to surgery was palmar HH in 21 (51%) cases and combined palmar and axillary HH in 20 (49%) patients. Among these 41 patients, 26 (63%) were also affected by plantar hyperhidrosis. Approximately 75% of the patients (30) had tried other forms of non-surgical treat-

TABLE I - Demographic and clinical data of the patients.

Number of patients	41
Sex (male – female)	25 - 16
Mean age (years)	30 (18 - 48)
Palmar HH	21
Palmar + Axillary HH	20
Plantar HH	26

ment such as topical therapies, homeopathy and acupuncture with no lasting benefits. The demographic and clinical data of our patients are summarized in Table I.

All patients were treated bilaterally in a single stage under general anaesthesia and in supine anti-Trendelemburg position with both arms abducted to 90 degrees. The operation was carried out through two mini-incisions for trocar placement, one on the IV intercostal space at the anterior axillary line and another one at the II intercostal space on the mid-axillary line. In patients treated with sympathicotomy we placed a 5 mm trocar for the 0 degrees thoracoscope and a mini-trocar of 2 mm for the dissector and the hook. In case of ganglion block we used a 5mm trocar for the clip-applicator instead of the 2mm mini-trocar.

For both methods, after lung collapse and sympathetic chain identification through the parietal pleura, the 3^{rd} thoracic ganglion was detected, just below the 3^{rd} rib. Afterwards a small pleural window was created and the pleural strip was lifted by a diathermic hook exposing the interganglionic T3-T4 tract, which was subsequently underpassed using the same hook. At this point the sympathicotomy was done by activating diathermy, leading within 1-2 seconds to the full section of the nervous chain.

For the ganglion block instead, we used a clip-applicator. For a proper interruption it was necessary that one of the two branches of the clip-applicator was placed behind the thoracic chain. Finally the lung was reexpanded under direct vision and a drain tube was placed when necessary.

Clinical follow-up was performed at 3, 6 and 12 months after surgery. Phone interviews and/or clinical assessment were made after a variable period (range 6 months to 8 years) to asses long term results.

Results

In all cases the operation was completed with thoracoscopic approach, without conversions to thoracotomy and major intra- or post-operative complications.

Our results concerning palmar and axillary hyperhidrosis were extremely satisfactory, as we reported in a previous publication ⁴. Immediate remission of HH was observed in 100% of cases. The most relevant adverse

TABLE II - Results

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Patients (%	Parameter		
41 (100%)	Immediate hyperhidrosis remission		
4 (10%)	Palmar anhidrosis		
8 (20%)	Transitory intercostal pain		
6 (15%)	Compensatory hyperhidrosis		
2 (5%)	Recurrences		
11 (79%)	Plantar HH partially regressed		
3 (21%)	Plantar HH completely regressed		
14 (54%)	Plantar HH overall improvement		
	Plantar HH overall improvement		

events observed were palmar anhidrosis and intercostal pain (Table II). Anhidrosis was generally transitory, except in three cases which were well-managed with moisturizing creams. Intercostal pain was also temporary. It regressed in all cases within 6 months from surgery and it was managed generally with common NSAIDs. We had two recurrences representing an overall recurrence rate of 5%.

Plantar hyperhidrosis was present in 26 patients, which represents the 63% of the overall study group. After TES it was resolved in three (21%) of them and improved in further eleven (79%) patients. A benefit of TES on plantar HH was registered totally in 14 patients, which represents the 54% of the sufferers and the 34% of the overall study group. There were not significantly different results between patients treated with sympathicotomy and those treated with ganglionic block.

Discussion

Transthoracic Endoscopic Sympathectomy (TES) was described in 1942 by Hughes and represents currently the most acceptable treatment for HH of the face, axilla and palms¹⁰. The technique consists on the interruption of the thoracic sympathetic chain, which causes the decrease of the autonomic nervous stimulation of the sweat glands and, consequently, the reduction or cessa-tion of excessive perspiration. The interruption of the sympathetic trunk can be performed in different ways: 1) by removing or ablating part of it (sympathectomy); 2) by sectioning on the desirable level (sympathicotomy or sympathotomy); 3) by clipping the chain (ganglion block). Great part of the authors in literature believe that the intervention of choice is sympathectomy. Others prefer the sympathicotomy or the ganglion block. That is because the first is simpler to perform and the latter is reversible if necessary. Several authors do not distinguish these techniques and use the term "sympathectomy" for all of them, creating a certain terminological confusion. For this reason the Society of Thoracic Surgeons published recently an expert consensus statement aiming to standardize the performance and reporting of results of sympathetic surgery for HH¹¹.

Our experience began in 1993 with T2-T4 sympathectomy and we convert in T3-T4 sympathicotomy or ganglion block in 2003. The reasons of such conversion were the lower invasiveness, the greater simplicity and the rapidity of the latter techniques, the possibility to reverse ganglion blocks and the maintenance of excellent results. The reversion of ganglion blocks is performed through the removal of the clip in cases of Claude -Bernard – Horner syndrome or excessive compensatory HH 12,13. The removal has to be done within the first 2 weeks after surgery, before nerve compressive damage can happen. We recently decided to abandon this procedure because we have never had Claude - Bernard -Horner or severe compensatory HH in our experience, as in T3-T4 sympathicotomy these complications are rare.

Sympathicotomy or ganglion block are generally performed under general anesthesia, even if De Campos et al refer ten procedures performed under epidural anesthesia and sedation with success ². In our experience all the procedures were performed under general anesthesia with the patient positioned supine with the arms abducted to 90°. In the past TES was carried out in two stages, one for every side, with an interval of 2 to 6 weeks between the two operations. Anti – Trendeleburg position was used to move the lungs downwards, leaving free the fields of the upper sympathetic chain.

In the past, when the TES was at an initial stage, it was preferred the use of three different ports. Generally these were of 10mm diameter to permit the use of traditional thoracoscopic instruments. To date, some surgeons continue to use three accesses but the ports are of inferior diameter (miniature ports) thanks to the technological evolution of surgical instrumentation (Needlescopic TES). The greater part of the surgeons uses a double access with a vast variability of options regarding instrumentation. One port is generally dedicated to the telescope and the remaining one to the instruments employed for dissection, coagulation and cutting. Some authors use a single 10 mm access with a telescope disposing a work channel for the introduction of the operative instruments ^{14,15}. The use of abdominal trocars is not recommended, especially when used CO² insufflation to collapse the lung, because they don't permit the CO₂ to abandon the pleural cavity and this may be the cause of cerebral oedema and death as reported by Cameron ¹⁶.

In literature there is a great variability regarding the choice of the area to introduce the ports. We prefer to insert the first trocar on the IV intercostal space at the anterior axillary line (submammary sulcus in women) and the other one at the II intercostal space on the midaxillary line where the scar is substantially invisible.

The first operative step was the identification of the sympathetic chain under the parietal pleura. The identification of the ribs is useful to estimate the right level to perform the interruption of the sympathetic trunk. Generally the first rib is hidden beneath fat tissue and

Report	Technique	Number plantar HH	Complete regression	Partial regression	Overall improvement
Lin 1999	T2 sympathectomy	1251	_	_	64%
De Campos 2003	T2-T4 sympathicotomy or sympathectomy	312	_	_	58%
Gossot 2003	T2-T4 sympathectomy and selective	115	_	_	15%
Neumayer 2005	T3-T4 ganglion block	66	4.5%	37.9%	42.4%
Atkinson 2011	T1-T2 sympathicotomy	155	_	_	39.8%
Current study	T3-T4 sympathicotomy or ganglion block	26	21%	79%	54%

TABLE III - Effect of TES on plantar HH as depicted in current literature.

it is not possible to visualize it. Thus the first visible rib from the top corresponds to the second rib and so on. Once identified the right level of the sympathetic trunk, the surgeon opened the parietal pleura and isolated the nervous chain. Ganglion blocks without opening the pleura and placing the clip directly on the chain covered by the pleural sheath are described. Once isolated the sympathetic trunk, the section can be made in different ways: by electrocautery, by ultrasonic scalpel or it can be clipped.

The data in literature agree that TES can reduce or abolish hyperhidrosis in more than 90% of the patients treated 5-8. Drott reported a success rate of 98.6% on 850 patients treated and Lin published the results of TES performed on 2200 patients, reporting a success rate of 99% ^{5,7}. The possibility to guarantee proper results even after a long time is confirmed by numerous reports in literature ¹⁷. Also in our experience short and long term results were extremely satisfactory, as we reported in the past ⁴. Considering T2-T4 sympathicotomy or ganglionic block we observed a 100% of immediate HH remission, while the recurrence rate was extremely low (5%). Side effects and complications, such as palmar anhidrosis, compensatory HH and intercostal pain, were observed with relatively low frequencies and they did not compromise the global satisfaction of the patients (Table II). Patients with axillary and/or palmar HH additionally are often affected by plantar HH. Plantar HH is frequently associated with dermatologic diseases, such as bromhidrosis, keratolysis, trench foot, eczema, plantar warts and several mycotic, bacterial and viral infections. The treatment of these conditions is generally demanding and the persistence of HH causes frequent recurrences. This leaded to the necessity to treat the cause rather than its complications. Conservative treatments described for HH of the upper limb are available also for the plants, but their benefit is transitory. Open or endoscopic lumbar sympathectomy (L2-L4 ablation) was proposed with satisfactory results, but it may cause sexual dysfunction and orthostatic hypotension and it is not diffusely used as TES.

The incidence of plantar HH in patients with upper limb or facial HH generally ranges from 80% to 100% in literature. De Campos et al report plantar HH in 57.4% of patients palmar HH and in 25% of those with axillary and palmar HH². Cossot et al report the presence of plantar HH variously combined with facial, palmar and axillary HH in 92% of cases ¹⁷. Similar incidences were reported also by Lin et al (92%) and Neumayer et al (90.4%) ^{9,18}. A lower incidence is reported by Moya et al (49.6%) ¹⁹. Also in our experience the incidence of plantar HH (63%) was slightly inferior to those mainly reported in literature.

As regards the effect of TES performed for facial or upper limb HH on plantar HH only few data are available, as many authors do not describe this effect. Furthermore, the existing data must be carefully analysed and interpreted as the methods and the terminology used are variable and the results differently reported. Table III summarizes the surgical techniques and results on plantar HH as depicted in the most important series reporting data on plantar HH. Most of the authors report the overall improvement of plantar HH.

This improvement varies between 15% and 64%. Neumayer et al reports more detailed results, observing an overall improvement of plantar HH in 42.4% of cases, but complete resolution was observed only in 4.5% ¹⁸. Our results are similar, as we observed a 54% overall improvement with only 21% of complete remission of plantar HH.

The pathophysiological mechanisms of these results are not clear. It was speculated that a number of nerve fibres for the lower limbs are sectioned during TES and this causes a reduction on the sweating tone of the eccrine glands of the soles. Nevertheless, this mechanism does not explain the fact that only a part of the patients experience an improvement of plantar HH, while others do not. Furthermore, cases of worsening of plantar HH after TES have been described, suggesting that the pathophysiological mechanisms involved are more complex and not yet understood.

It has been hypothetized that the autonomic nervous system functions in the same way as the neuroendocrine system, through positive and negative feed-back mechanisms ²⁰. It is well known that HH is induced centrally by mental stress or anxiety rather than by high temperature. These factors often trigger sweating centers located in the hypothalamus, releasing efferent sig-

nals, which are positive in a sympathetic tone to the target cells or organs (e.g. hands and feet). As with the neuroendocrine system, some sympathetic tones return from the target organs and then become afferent negative feed-back signals to the hypothalamus. In other words, the impulses originating from the target organs (i.e. sweat glands) are transmitted as an afferent negative feed-back signal to the central nervous system. A section of the sympathetic chain at a T3-T4 level produces an interruption of the sympathetic innervation of the upper limbs but preserves that of the lower limbs, including the negative feedback signals returning to the hypothalamus. It is possible that these negative feedback signals are enhanced, in the absence of those from the upper limbs, determinating a reduction of HH of the soles.

Conclusions

TES performed through T3-T4 sympathicotomy or T3-T4 ganglion block reduced plantar hyperhidrosis in 79% of the affected patients and resolved it in 21% of them, obtaining an overall improvement in 54% of cases. The pathophysiological mechanisms of such improvement are not completely clear. Further well-designed prospective studies are necessary to better understand pathophysiology and to interpret disaccording literature data.

Riassunto

Lo scopo di questo studio è la valutazione dell'impatto della simpaticectomia endoscopica transtoracica, effettuata per iperidrosi primitiva degli arti superiori, sull'iperidrosi plantare. Quarantuno pazienti consecutivi sono stati sottoposti a simpaticotomia o blocco gangliare T3-T4 in videotoracoscopia dal 2003 al 2011 presso la nostra Unità Operativa, per iperidrosi primitiva degli arti superiori. Ventuno pazienti (51%) erano affetti da iperidrosi palmare e 20 (49) da iperidrosi combinata palmare ed ascellare. I pazienti contemporaneamente affetti da iperidrosi plantare erano 26 (63%). I risultati a distanza sono stati valutati con intervista telefonica o valutazione clinica (intervallo di follow up 6 mesi - 8 anni). L'iperidrosi plantare è migliorata in 14 pazienti, i quali rappresentano il 54% dei pazienti affetti da questa forma di iperidrosi, regredendo parzialmente in 11 casi (79%) e totalmente in 3 casi (21%). Non sono state registrate differenze significative tra i pazienti trattati con simpaticotomia T3-T4 e quelli sottoposti a blocco gangliare T3-T4. I nostri dati suggeriscono che la simpaticectomia endoscopica transtoracica effettuata per iperidrosi primitiva degli arti superiori riduce anche l'iperidrosi plantare in più della metà dei casi ed è risolutiva in circa un quinto dei pazienti.

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