

## Thoracic sympathectomy at the level of the fourth and fifth ribs for the treatment of axillary hyperhidrosis\*

Simpatectomia torácica ao nível de 4ª e 5ª costelas  
para o tratamento de hiper-hidrose axilar

Paulo César Buffara Boscardim, Ramon Antunes de Oliveira,  
Allan Augusto Ferrari Ramos de Oliveira, Juliano Mendes de Souza,  
Roberto Gomes de Carvalho

### Abstract

**Objective:** To describe the clinical results and the degree of satisfaction of patients submitted to thoracic sympathectomy at the level of the fourth and fifth ribs (R4-R5) for the treatment of axillary hyperhidrosis.

**Methods:** We included 118 patients diagnosed with axillary hyperhidrosis and having undergone axillary sympathectomy at the R4-R5 level between March of 2003 and December of 2007 at the Paraná Federal University *Hospital de Clínicas*, located in the city of Curitiba, Brazil. All procedures were carried out by the same surgeon. Data regarding the resolution of axillary hyperhidrosis and the degree of patient satisfaction with the surgical outcome, as well as compensatory hyperhidrosis in the early and late postoperative periods (after 7 days and after 12 months, respectively), were collected. **Results:** Of the 118 patients evaluated, 99 (83.9%) and 81 (68.6%) showed complete resolution of the symptoms in the early and late postoperative periods, respectively. Compensatory hyperhidrosis occurred in 49 patients (41.5%) in the early postoperative period and in 77 (65.2%) in the late postoperative period. Of those 77, 55 (71.4%) categorized the compensatory hyperhidrosis as mild. In the early postoperative period, 110 patients (93.2%) were satisfied with the surgical results, and 104 (88.1%) remained so in the late postoperative period. **Conclusions:** Sympathectomy at the R4-R5 level is efficient in the resolution of primary axillary hyperhidrosis. The degree of patient satisfaction with the long-term surgical results is high. Mild compensatory hyperhidrosis is the main side effect associated with this technique.

**Keywords:** Hyperhidrosis; Axilla; Sympathectomy; Thoracic surgery, video-assisted.

### Resumo

**Objetivo:** Descrever os resultados clínicos e o grau de satisfação de pacientes submetidos à simpatectomia torácica ao nível de 4ª e 5ª costelas (R4-R5) para o tratamento da hiper-hidrose axilar. **Métodos:** Foram incluídos 118 pacientes com diagnóstico de hiper-hidrose axilar e submetidos à simpatectomia torácica ao nível de R4-R5, realizada por um único cirurgião, no Hospital de Clínicas da Universidade Federal do Paraná, Curitiba (PR), entre março de 2003 e dezembro de 2007. Dados relativos à resolução da sudorese axilar, ao grau de satisfação com o resultado da cirurgia e ao efeito compensatório no pós-operatório precoce (7 dias) e tardio (1 ano) foram coletados. **Resultados:** Dos 118 pacientes do estudo, 99 (83,9%) e 81 (68,6%) apresentaram resolução total dos sintomas no pós-operatório precoce e tardio, respectivamente. Houve efeito compensatório em 49 pacientes (41,5%) no pós-operatório precoce e em 77 (65,2%) no pós-operatório tardio. Desses 77, 55 (71,4%) consideraram esses efeitos como leves. No pós-operatório precoce, 110 pacientes (93,2%) estavam satisfeitos com os resultados da cirurgia, enquanto 104 pacientes (88,1%) mantinham-se satisfeitos no pós-operatório tardio. **Conclusões:** A simpatectomia ao nível R4-R5 é eficaz na resolução da hiper-hidrose axilar primária. O grau de satisfação dos pacientes com os resultados em longo prazo é alto. O efeito compensatório leve é o principal efeito colateral relacionada a essa técnica.

**Descritores:** Hiperidrose; Axila; Simpatectomia; Cirurgia torácica vídeo-assistida.

\* Study carried out at the Federal University of Paraná *Hospital de Clínicas*, Curitiba, Brazil.

Correspondence to: Roberto Gomes de Carvalho. Disciplina de Cirurgia Torácica e Cardiovascular, Hospital de Clínicas da Universidade Federal do Paraná, Rua General Carneiro, 181, 7º andar, CEP 80060-900, Curitiba, PR, Brasil.

Tel 55 41 3360-7895. E-mail: ctev@hc.ufpr.br

Financial support: None.

Submitted: 7 October 2010. Accepted, after review: 5 November 2010.

## Introduction

Axillary hyperhidrosis is a disease characterized by excessive production of sweat and commonly affects youth, causing harm to the patient in the psychological and social aspects. Population-based studies indicate that 1% of the Western population is affected by axillary hyperhidrosis, without any of the other forms of hyperhidrosis.<sup>(1)</sup>

Conventional clinical treatments include antiperspirants, iontophoresis, botulinum toxin type A injections, and the use of systemic drugs, such as anticholinergics. However, these treatment options have produced frustrating or temporary results.<sup>(1)</sup> The treatment with botulinum toxin is effective but produces a transient response, which lasts less than 6 months, and it is costly. Excision/resection of the eccrine glands shows low efficacy and a high recurrence rate when compared with surgical sympathectomy. In general, these techniques provide temporary symptom relief, and the adverse effects are significant.<sup>(2)</sup>

Video-assisted thoracic sympathectomy is safe and effective, which has contributed to its consolidation as the gold standard in the treatment of this disease.<sup>(3)</sup> The International Society of Sympathetic Surgery classifies the levels of resection based on the anatomic relationship between the sympathetic chain and the ribs. Therefore, simple interruption of the sympathetic chain at the level of the fourth and fifth ribs is designated sympathicotomy at the R4-R5 level ("R" being derived from "rib"). Excision of the segment of the sympathetic chain between the fourth and fifth ribs is designated sympathectomy at the R4-R5 level.<sup>(4)</sup>

The major side effect of sympathectomy is the so-called compensatory hyperhidrosis, which is the occurrence of episodes of hyperhidrosis in other parts of the body that were not affected prior to surgery.<sup>(5)</sup> Typically, compensatory hyperhidrosis occurs in the torso, abdomen, thighs, groins, feet, and buttocks.<sup>(2,6)</sup> Compensatory hyperhidrosis is of great relevance, since its degree of severity directly influences the quality of life of patients.

Other postoperative complications described in the literature include Horner's syndrome and facial vasodilation. In addition, it is possible to observe a reduction in heart rate in some patients who underwent sympathectomy.<sup>(6)</sup> It has also

been demonstrated that, for the treatment of axillary hyperhidrosis, thoracic sympathectomy with resection at the R4-R5 level alone has lower rates of complications than does thoracic sympathectomy with resection at the R3-R4 level alone or at the R3-R4 and R4-R5 levels.<sup>(2)</sup>

The objective of the present study was to describe the clinical outcomes and the degree of satisfaction of patients submitted to thoracic sympathectomy, with resection of the segment of the sympathetic chain at the R4-R5 level, for the treatment of axillary hyperhidrosis.

## Methods

This was a retrospective, descriptive observational study. The study population comprised all patients diagnosed with axillary hyperhidrosis and having undergone thoracic sympathectomy at the R4-R5 level between March of 2003 and December of 2007 at the *Hospital de Clínicas da Universidade Federal do Paraná* (HC-UFPR, Paraná Federal University *Hospital de Clínicas*), located in the city of Curitiba, Brazil. All procedures were carried out by the same surgeon. The study was approved by the HC-UFPR Human Research Ethics Committee. All patients gave written informed consent for surgery.

Patient data were collected from the medical records containing information on postoperative visits, and incomplete records were excluded. We analyzed data regarding the resolution of axillary hyperhidrosis, compensatory hyperhidrosis (occurrence and quantification), and the degree of patient satisfaction with the surgical outcome in the early postoperative period (first seven days after the procedure) and in the late postoperative period (12 months after the procedure).

The preoperative evaluation included blood workup, determination of the coagulation profile, measurement of serum creatinine levels, measurement of glucose levels, electrocardiogram, and chest X-ray, as well as cardiac evaluation for ruling out rhythm and conduction disturbances. Surgery was contraindicated for patients with a history of pleural disease or chest trauma.

Patients with a BMI > 30 kg/m<sup>2</sup> were not considered surgical candidates. Those with a BMI of 25-30 kg/m<sup>2</sup> were encouraged to lose weight prior to the day of the operation, without any objective goals.

Prior to surgery, the patients received general anesthesia and underwent orotracheal intubation with a simple cannula and were placed in a semi-upright position with abduction of the upper limbs. Two 0.5-cm incisions were made in the anterior axillary and midaxillary lines in the third or fourth intercostal spaces for the insertion of two 5-mm trocars. Pneumothorax was induced by the flow of air through the trocars due to transient apnea, after which the anatomical landmarks were identified. The costal arches were numbered based on the identification of the insertion of the posterior scalene muscle, on the outer surface of the second rib. The sympathetic chain was sectioned by electrocautery at the R4-R5 level, and the segment located between the sections was then resected. Subsequently, the lung was re-expanded, and the procedure was repeated on the contralateral side.

In most cases, the patient was discharged on the same day or on postoperative day 1. Postoperative analgesia was usually achieved with the use of nonsteroidal anti-inflammatory drugs and mild opioids, such as codeine.

Data regarding gender, age, BMI, and a family history of hyperhidrosis were registered, as were those regarding the presence and location of hyperhidrosis and the degree of patient satisfaction. The severity of compensatory hyperhidrosis was divided into three categories: mild—the droplets formed do not seep through the clothing and therefore do not cause a change of habits (a change of clothing) or social embarrassment; moderate—the sweat droplets formed coalesce and trickle down, being uncomfortable, but without causing embarrassment or requiring a change of clothing; and severe—sweating is triggered by mild heat or without environmental stimulus, forming droplets that coalesce and trickle down, causing social embarrassment and requiring a change of clothing.<sup>(5)</sup> For the resolution of axillary hyperhidrosis, we considered the following categories: complete—no axillary hyperhidrosis; partial—any degree of axillary hyperhidrosis lower than that of the initial profile; and absent—hyperhidrosis similar to that of the initial profile.

Regarding the degree of patient satisfaction, the following response options were given to the patients: completely dissatisfied; dissatisfied; no opinion; satisfied; and completely satisfied. For

analysis purposes, the degree of satisfaction was summarized into three classes: satisfied (completely satisfied or satisfied); no opinion; and dissatisfied (dissatisfied or completely dissatisfied).

Results

The study sample comprised 118 patients submitted to sympathectomy at the R4-R5 level in the study period.

Of the patients in the sample as a whole, 78.8% were female. The mean age for women was 29 ± 9 years (range: 14-63 years), whereas the mean age for men was 28 ± 6 years (range: 16-42 years).

A family history of hyperhidrosis symptoms in first- or second-degree relatives was reported by 47% of the patients.

The mean BMI was 21.9 ± 2.8 kg/m<sup>2</sup> (range: 16.49-30.09 kg/m<sup>2</sup>). There were 14 patients with a BMI > 25.0 kg/m<sup>2</sup>.

Complete resolution of hyperhidrosis was reported by 83.9% and 68.6% of the patients in the early and late postoperative periods, respectively. Partial resolution of hyperhidrosis was reported by 15.3% and 26.3% of the patients in the early and late postoperative periods, respectively. And, finally, 0.8% and 5.1% of the patients in the early and late postoperative periods, respectively, reported no resolution of hyperhidrosis (Table 1).

Recurrence of axillary hyperhidrosis was observed in 6 patients (5.08%), corresponding to the patients who showed complete or partial resolution of hyperhidrosis in the early postoperative period but developed it again in the late postoperative period.

One patient had no resolution on one side in the early postoperative period, requiring

**Table 1** - Resolution of axillary hyperhidrosis in the early and late postoperative periods in 118 patients submitted to sympathectomy in the study period. Federal University of Paraná *Hospital de Clínicas*, Curitiba, Brazil.

Resolution of axillary hyperhidrosis	Early postoperative period	Late postoperative period
	n (%)	n (%)
Complete	99 (83.9)	81 (68.6)
Partial	18 (15.3)	31 (26.3)
Absent	1 (0.8)	6 (5.1)

a second, unilateral, surgical procedure. In this case, there was complete resolution of hyperhidrosis in the late postoperative period.

Complete or partial resolution of hyperhidrosis was reported by 99.2% and 94.9% of the patients in the early and late postoperative periods, respectively.

Compensatory hyperhidrosis was observed in 41.5% of the patients in the early postoperative period. Among those patients, 67.3% complained of mild compensatory hyperhidrosis, 30.6% had moderate compensatory hyperhidrosis, and only 2.1% had severe compensatory hyperhidrosis. In the late postoperative period, there was an increase in the incidence of this complication, with 65.2% of the patients complaining of compensatory hyperhidrosis. Of those, 71.4% had mild symptoms, 23.4% had moderated symptoms, and 5.2% had severe symptoms. In the early postoperative period 58.5% of the patients were free of compensatory hyperhidrosis, compared with 34.8% in the late postoperative period (Table 2). Of the 4 patients who had severe compensatory hyperhidrosis in the late postoperative period, only 1 had a BMI > 25.0 kg/m<sup>2</sup>. In the sample as a whole, there were 14 patients with a BMI > 25.0 kg/m<sup>2</sup>. Among those 14 patients, the rate of severe compensatory hyperhidrosis was 7.1%.

As can be seen in Table 3, the sites at which compensatory hyperhidrosis were observed (some patients experiencing hyperhidrosis at more than one site) were the back (in 53.2%), abdomen (in 44.1%), feet (in 27.2%), breasts (in 26.3%), and other sites, such as the buttocks, groins, calves, anterior surface of the chest, and face (in 29.9%, collectively). No compensatory palmar hyperhidrosis was observed.

No cases of chronic pain, Horner's syndrome, conversion to open thoracotomy, postoperative hemorrhage, or death were observed in this study.

Regarding patient satisfaction with the surgical outcome in the early postoperative period, 93.2% of the patients reported being satisfied, 5% reported having no opinion, and 1.8% reported being dissatisfied. When the surgical outcome in the late postoperative period was evaluated, 88.1% of the patients reported being satisfied, 4.2% reported having no opinion, and 7.7% reported being dissatisfied

**Table 2** - Occurrence and severity of compensatory hyperhidrosis in the early and late postoperative periods in 118 patients submitted to sympathectomy in the study period. Federal University of Paraná *Hospital de Clínicas*, Curitiba, Brazil.

Occurrence of compensatory hyperhidrosis	Early postoperative period	Late postoperative period
	n (%)	n (%)
No	69 (58.5)	41 (34.8)
Yes	49 (41.5)	77 (65.2)
Mild	33 (67.3)	55 (71.4)
Moderate	15 (30.6)	18 (23.4)
Severe	1 (2.1)	4 (5.2)

(Table 4). There were no reports of dissatisfaction with the surgical scar.

Of the 9 patients who were dissatisfied in the late postoperative period, 3 had a BMI > 25.0 kg/m<sup>2</sup>. Among the 14 patients within this BMI range, the rate of dissatisfaction with the procedure was 21.4%.

## Discussion

Hyperhidrosis mainly affects the palms, feet, armpits, scalp, and face. For most patients, it is a stigmatizing condition from a social, psychological, and professional standpoint.<sup>(5,7)</sup>

The technique of video-assisted thoracoscopy has few serious postoperative complications,<sup>(8)</sup> there being, in the present study, only one episode of difficulty in re-expanding the lung in the immediate postoperative period, without much discomfort to the patient.

Axillary hyperhidrosis is believed to have a genetic component, as has been determined for palmar hyperhidrosis.<sup>(3)</sup> However, the prevalence rates vary greatly among studies. The rate of

**Table 3** - Location of occurrence of compensatory hyperhidrosis in the patients submitted to sympathectomy in the study period. Federal University of Paraná *Hospital de Clínicas*, Curitiba, Brazil.

Location of compensatory hyperhidrosis	%
Back	53.2
Abdomen	44.1
Feet	27.2
Breasts	26.3
Other <sup>a</sup>	29.9

<sup>a</sup>Buttocks, groin, calves, anterior surface of the chest, and face.

**Table 4** – Degree of satisfaction with the surgical outcome, in the early and late postoperative periods, among 118 patients submitted to sympathectomy at the Federal University of Paraná *Hospital de Clínicas*, in Curitiba, Brazil.

Patient attitude	Early postoperative period	Late postoperative period
	n (%)	n (%)
Satisfied	110 (93.2)	104 (88.1)
No opinion	6 (5.0)	5 (4.2)
Dissatisfied	2 (1.8)	9 (7.7)

patients with a family history of hyperhidrosis in first- or second-degree relatives ranges from 12.5% to 56.5%,<sup>(9)</sup> the latter value being close to the 47.0% observed in our sample.

In the present study, the rate of resolution of hyperhidrosis through sympathectomy at the R4-R5 level, including complete and partial response, was 94.9% in the late postoperative period. In another study also involving only patients with axillary hyperhidrosis, the rate of resolution reported was 96.4%; however, those patients underwent sympathectomy at the R3-R4 and R4-R5 levels, with or without resection at the R5-R6 level.<sup>(1)</sup> It is of note that there have been very few studies describing the surgical approach and how the outcomes were assessed, as we have done here.

Recurrence can be explained by possible reinnervation by local sympathetic fibers or by other nerves in the region, with consequent return of the sympathetic stimulus, since sympathectomy does not address in situ sweat or sebaceous glands (in the dermis).<sup>(10,11)</sup>

Recurrence of axillary hyperhidrosis after thoracic sympathectomy was found to occur in 5% of our sample. The recurrence rates reported in other studies have ranged from 0% to 13.7%, depending on the follow-up period and the level of resection.<sup>(1,9,12)</sup>

One of our patients showed a unilateral lack of resolution, which can be explained by deviation from the technique, such as the difficulty in delineating the thoracic levels in some patients, as well as by anatomical variations, in which ganglion 4 is not located between the fourth and fifth ribs, as is the case in some patients.

Despite the fact that patients might not be monitored over time, some authors have reported

that the early outcomes of sympathectomy remain in the long term.<sup>(1,9,13)</sup>

There is no consensus among authors as to whether compensatory hyperhidrosis is attributable to the level of resection or to the extent of sympathetic chain resection.<sup>(1)</sup> Some authors have suggested that more extensive resection translates to more severe compensatory hyperhidrosis.<sup>(14,15)</sup> Others, however, have reported that there is no relationship between the extent of resection and compensatory hyperhidrosis,<sup>(16,17)</sup> suggesting that the level of resection is implicated in compensatory hyperhidrosis.<sup>(18-21)</sup>

In the present study, compensatory hyperhidrosis occurred in 65.2% of the patients in the late postoperative period. However, most (71.4%) of those patients had mild symptoms, mainly related to heat and physical exertion. In contrast, only 5.2% of the patients reporting compensatory hyperhidrosis classified it as severe (causing social embarrassment or requiring frequent clothing changes).

A comparative study of the levels of sympathectomy for the treatment of axillary hyperhidrosis showed that, after 30 days, compensatory hyperhidrosis occurred in 90.6% of the patients submitted to resection at the R3-R4 and R4-R5 levels and in 56.7% of those submitted to resection at the R4-R5 level alone. After 6 months, all of the patients submitted to resection at the R3-R4 and R4-R5 levels reported some degree of compensatory hyperhidrosis, compared with only 43.3% of those submitted to resection at the R4-R5 level alone. Therefore, the authors of that study concluded that resection at the R4-R5 level alone had advantages over resection at the R3-R4 and R4-R5 levels for the treatment of axillary hyperhidrosis.<sup>(2)</sup>

It has been suggested that BMI can affect the degree of compensatory hyperhidrosis and the degree of patient satisfaction with the surgical outcome. One group of authors reported that a higher BMI translates to more severe compensatory hyperhidrosis, although it does not correlate with the degree of patient satisfaction.<sup>(22,23)</sup> Despite the fact that our sample comprised few patients with a BMI > 25.0 kg/m<sup>2</sup>, we found a higher prevalence of severe compensatory hyperhidrosis and a correlation with patient dissatisfaction with the surgical outcome among those within this BMI range.

In terms of compensatory hyperhidrosis, the outcomes of resection and splitting techniques (sympathectomy and sympathectomy, respectively) are similar.<sup>(24,25)</sup> Both techniques are safe and effective when performed by experienced surgeons.<sup>(1,26)</sup>

In our study, patient satisfaction was found to be positively associated with the resolution of hyperhidrosis and negatively associated the severity of compensatory hyperhidrosis. In the late postoperative period, 88.1% of the patients reported being satisfied with the surgical outcome and 4.2% reported having no opinion, although the occurrence of moderate or severe compensatory hyperhidrosis was reported in 28.6% of the cases.

Sympathectomy causes hyperhidrosis in other parts of the body in 67-85% of patients, and the question of whether it is reasonable to create one disorder in order to resolve another has been raised.<sup>(27)</sup> In our sample, we observed that resection at the R4-R5 level alone had lower rates of compensatory hyperhidrosis, considerably increasing surgical success, as measured based on patient satisfaction. Predominantly, we found mild or moderate compensatory hyperhidrosis, there being few cases of severe symptoms. Most patients remained satisfied with the long-term surgical outcome.

We conclude that thoracic sympathectomy for the resolution of axillary hyperhidrosis has a high rate of patient satisfaction, there being few postoperative complications. The occurrence of compensatory hyperhidrosis is the major disadvantage associated with this technique. Physicians should inform patients of the possible adverse effects associated with this surgical technique, especially that of compensatory hyperhidrosis.

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## About the authors

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### *Paulo César Buffara Boscardim*

Physician in Charge of the Department of Thoracic Surgery, Federal University of Paraná *Hospital de Clínicas*, Curitiba, Brazil.

### *Ramon Antunes de Oliveira*

Medical Student. Federal University of Paraná School of Medicine, Curitiba, Brazil.

### *Allan Augusto Ferrari Ramos de Oliveira*

Medical Student. Federal University of Paraná School of Medicine, Curitiba, Brazil.

### *Juliano Mendes de Souza*

Visiting Professor. Postgraduate Program in Thoracic and Cardiovascular Surgery, Federal University of Paraná School of Medicine, Curitiba, Brazil.

### *Roberto Gomes de Carvalho*

Adjunct Professor. Department of Surgery, Federal University of Paraná School of Medicine, Curitiba, Brazil.