



Research Article

A Multicenter Retrospective Study of Lumbar Sympathectomy for Plantar Hyperhidrosis: Satisfaction and Postoperative Complications

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Key Summary Points

Lumbar sympathectomy for plantar hyperhidrosis remains marginal and unknown to health professionals and patients. Our study encourages practitioners to consider the surgery on patients with severe plantar hyperhidrosis for whom conservative treatments have failed. Sexual dysfunctions are rare and transient, which justifies extending the surgical indication to men.

Abstract

Primary plantar hyperhidrosis has a severe impact on quality of life and conservative treatments are only effective in the short-term. Thoracic sympathectomy has proven its effectiveness in the treatment of palmar hyperhidrosis, but lumbar sympathectomy for plantar hyperhidrosis remains poorly described. The objective of this study is to report the satisfaction of treated patients as well as the postoperative complications.

This was a multicenter retrospective observational study of sixteen patients with primary plantar hyperhidrosis, treated with mechanical lumbar sympathectomy from December 2012 to October 2022. Patients' characteristics were collected from medical records. Quality of life, postoperative satisfaction and complications were evaluated using a standardized questionnaire.

Lumbar sympathectomy was performed on 16 patients, fourteen were women and two were men with a total of thirty-one procedures. 87.5% of patients were satisfied and would recommend the surgery to other patients. Compensatory hyperhidrosis occurred in 75% of patients, recurrence of hyperhidrosis in 31.3% and sexual dysfunction in 18.8%.

Lumbar sympathectomy is a well-tolerated option and provides satisfying results for plantar hyperhidrosis, regardless of gender. Compensatory hyperhidrosis was the most frequent complication but had no impact on patient satisfaction. Data on the risk of sexual dysfunction are reassuring, with only one case of transient ejaculation disorder.

Keywords: Plantar hyperhidrosis; Lumbar sympathectomy; Compensatory hyperhidrosis; Sexual dysfunction

Introduction

Hyperhidrosis is a common disease affecting 2% of the population, and up to 4.8% in the United States [1,2]. Axillary and palmoplantar areas are the most affected. Plantar hyperhidrosis is the second most frequent localization, accounting for 15.5% of patients, and up to 50% in multiple sites of involvement [3]. The literature reports a family history of hyperhidrosis in 42% to 65% of patients, with predisposing loci identified [4-6]. Plantar hyperhidrosis is responsible for a deterioration in functional, professional and social quality of life. A higher prevalence of anxiety is reported than for certain chronic diseases. According to Brangança et al, 68% of anxious patients had a plantar localization of hyperhidrosis [7]. Maceration also promotes the development of bacteria, viral and fungal infections, or eczema [8]. There are several conservative treatments available. Local antiperspirants based on aluminum chloride hexahydrate are used in the first place. They require repeated application and may cause local irritation [9,10]. Iontophoresis blocks eccrine glands by passing a low-intensity electric current. It is effective in 80% of cases, but requires several sessions per week, with an average efficacy of thirty-five days [9-11]. Botulinum toxin injections inhibit presynaptic release of acetylcholine at the neuromuscular junction and contraction of sweat glands, with an average efficiency of six months. This technique is only available in specialized centers. The main limitation is the pain of injections, which is greater on the soles than on the palms because of their higher innervation [9,10,12,13]. Anticholinergics are used in cases of severe hyperhidrosis, with a number of contraindications that must be respected [9,14]. Conservative treatments are only suspensive and in case of failure, surgery may be considered.

The eccrine sweat glands are innervated by cholinergic fibers of the sympathetic nervous system. Sympathectomy surgery involves cutting the sympathetic chain to stop hypersudation in a specific area. The procedure requires general anesthesia. The sympathetic chain is either completely sectioned (resection) or clipped, depending on the surgeon's decision and experience. Thoracic sympathectomy has been reported to be an effective and

safe way of treating palmar and axillary hyperhidrosis [15,16]. However, lumbar sympathectomy for plantar hyperhidrosis remains marginal. One meta-analysis by Lima et al reports encouraging results from nine studies with a mean follow-up of 17.8 months [17]. Only one French study mentions lumbar sympathectomy, but in the same operating time as thoracic sympathectomy and only in female patients, with a mean follow-up of 28 months [18].

The primary objective of this study is to report our regional experience of lumbar sympathectomy for plantar hyperhidrosis through a postoperative satisfaction questionnaire. The secondary objective is to report short- and long-term postoperative complications.

Materials and Methods

We conducted a multicentre retrospective observational study of patients who underwent mechanical lumbar sympathectomy (resection or clipping) for the treatment of primary plantar hyperhidrosis. Three surgeon colleagues agreed to participate in the study, allowing the recruitment of nineteen patients operated on at Le Mans, Angers and Tours hospitals between December 2012 and October 2022. All lumbar sympathectomies were performed with L2 preservation. The interval between surgery and completion of the questionnaire was at least four months. Three of the nineteen patients were excluded. Thus, a total of sixteen patients were included in the analysis. The questionnaire response rate was 100%. Patients' characteristics were collected from medical records. Quality of life, postoperative satisfaction, and side effects were evaluated using a telephone satisfaction questionnaire inspired by de Campos et al [19] adapted to the plantar location of hyperhidrosis and the retrospective nature of the study (Figure 1). The primary objective was to assess the overall satisfaction through three questions: Are you satisfied with the surgery, would you recommend it to other patients with plantar hyperhidrosis and rate your postoperative hyperhidrosis on the validated Hyperhidrosis Disease Severity Scale (HDSS) scale from 1 to 4 (Figure 2). Secondary objectives were to report postoperative complications including recurrence of hyperhidrosis, compensatory hyperhidrosis, dryness of lower limbs, pain and sexual disorders.

1) Medical history			
- When does hyperhidrosis begin ?			
- Do you have a family history of hyperhidrosis ?			
- Which areas are affected by hyperhidrosis ?			
- What treatments have you tried before surgery ?			
2) Post operative quality of life			
Functional Domain			
- Has your walking discomfort improved after surgery?			
- Have you ever suffered from plantar mycosis linked to excessive perspiration?	YES	NO	
- If so, has there been any improvement since surgery?	YES	NO	NA
- Have you ever suffered from plantar eczema (dyshidrosis)?	YES	NO	
- If so, has it improved since surgery?	YES	NO	NA
- Have you ever suffered from unpleasant plantar odor (bromhidrosis)?	YES	NO	
- If so, has it improved since surgery?	YES	NO	NA
Social Domain			
- Has your perspiration ever interfered with your friendly relationships?	YES	NO	
- If so, has it improved since surgery?	YES	NO	NA
- Has your perspiration ever interfered with your professional relationships?	YES	NO	
- If so, has it improved since surgery?	YES	NO	NA
- Has your perspiration ever interfered with your intimate relationships?	YES	NO	
- If so, has it improved since surgery?	YES	NO	NA
Emotional Domain			
- Have you ever given up on an activity because of your perspiration?	YES	NO	

- Has your psychological condition improved since the surgery?	YES	NO	
3) Post operative satisfaction			
- On the HDSS scale from 1 to 4, how would you rate your hyperhidrosis after surgery?			
- Are you satisfied with the surgery?	YES	NO	
- Would you recommend surgery to other patients?	YES	NO	
4) Post operative complications			
- Have you had a recurrence of plantar hyperhidrosis?	YES	NO	
- If so, how soon ?			
- Have you developed compensatory hyperhidrosis?	YES	NO	
- If so, how soon ?			
- If so, in which areas?			
- Are you more affected by compensatory hyperhidrosis than by your initial hyperhidrosis?	YES	NO	NA
- Have you suffered from dry skin on your lower limbs?	YES	NO	
- Have you experienced any post-operative pain?	YES	NO	
- If so, what type of pain?			
- If so, in which areas?			
- If so, how soon ?			
- Have you experienced any sexual dysfunction?	YES	NO	
- If so, what type of dysfunction?			
- If so, how long have you suffered?			
- Have you had any other complications?			

Figure 1: Quality of life questionnaire for evaluation of plantar hyperhidrosis.

Hyperhidrosis Disease Severity Scale	
"How would you rate the severity of your hyperhidrosis?"	
<input type="checkbox"/> 1.	My sweating is never noticeable and never interferes with my daily activities
<input type="checkbox"/> 2.	My sweating is tolerable but sometimes interferes with my daily activities
<input type="checkbox"/> 3.	My sweating is barely tolerable and frequently interferes with my daily activities
<input type="checkbox"/> 4.	My sweating is intolerable and always interferes with my daily activities

Figure 2: Hyperhidrosis Disease Severity Scale.

Data are presented in terms of numbers, percentages, minimum and maximum values, mean and standard deviation. Quantitative variables were compared using the Wilcoxon Mann Whitney test. Qualitative variables were compared using the Fisher test. Two patients were excluded from secondary comparative analyses, because they underwent unilateral surgery or they were operated on using two different surgical techniques. P-value was considered statistically significant if below 0.05.

This study was carried out in accordance with the Helsinki Declaration of 2013 and in application of the French Data Protection Act (MR-004). It was approved by the Ethics Committee of Le

Mans Hospital (Ethics approval number: 2022-018). Informed consents were obtained from all the participants enrolled in the study.

Results

In this study, sixteen patients including two men and fourteen women with a mean age of 37.4 years underwent lumbar sympathectomy, with a total of thirty-one procedures. Patients suffered from palmoplantar hyperhidrosis in 50% of cases and from isolated plantar hyperhidrosis in 25%. All of the patients had used aluminum chloride antiperspirant as first-line therapy, 37.5% had tried iontophoresis and only 18.8% botulinum toxin injections. Eleven patients had previously undergone thoracic sympathectomy for the treatment of palmar hyperhidrosis (68.8%) (Table 1).

Each patient had undergone bilateral surgery, except for one whose second surgery had not yet taken place by the time the questionnaire was submitted. The resection technique of the lumbar sympathetic chain was used in 80.6% of cases, compared with 19.3% for the clipping technique. Average hospital stay was 2.3 days. The average follow-up time from surgery to questionnaire completion was 5.5 years (Table 1).

	Mean	SD	Min	Max
Age at surgery (years)	37,4	13.2	21	65
Hospital stay (days)	2.3	1.6	0.5	8
Delay (years)	5.5	3.1	0.3	10
		n = 16		%
Gender	Female	14		87.5
	Male	2		12.5
Onset of symptoms	Childhood	12		75
	Adolescence	3		18.5
	Adulthood	1		6.3
Family history	None	7		43.8
	First degree	7		43.8
	Second degree	2		12.5
Location	Plantar only	4		25
	Palmoplantar	8		50
	Palmoplantar and axillary	4		25
Preoperative treatments	Topical	16		100
	Iontophoresis	6		37.5
	Botulinum toxin	3		18.8
	Thoracic sympathectomy	11		68.8
Surgical technique	Clipping	6		19.4
	Section	25		80.6
<i>SD Standard deviation</i>		<i>n Number of patients</i>		<i>% Percentages</i>

Table 1: Population characteristics.

The condition of patients suffering from mycosis, dyshidrosis or bromhidrosis was improved in 100% of cases. Socially, in their professional lives and intimate relationships, 100% of patients experienced an improvement postoperatively. 93.75% of patients reported an improvement in their psychological state after surgery (Figure 3). 87.5% of patients were satisfied with the results of lumbar sympathectomy, and 87.5% would recommend it to other patients, while only two patients regretted the surgery. 87.5% of patients had a postoperative HDSS score of 1, corresponding to the absence of impact of hyperhidrosis on their daily activities.

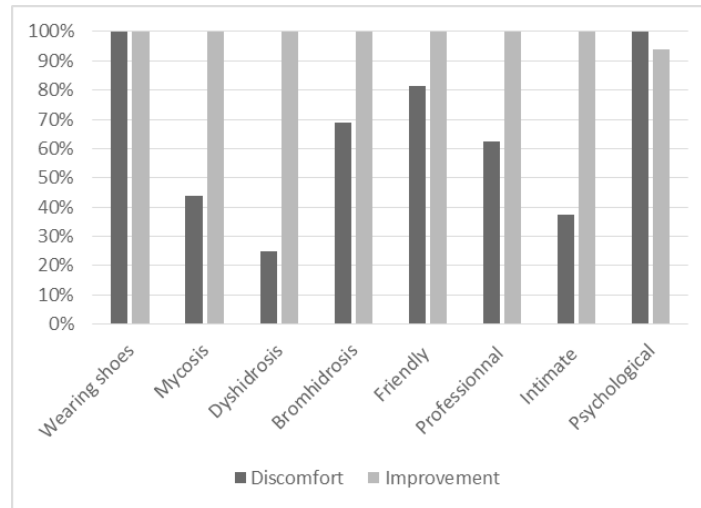


Figure 3: Postoperative quality of life.

Recurrence of hyperhidrosis concerned 31.3% of patients. However, 80% of these patients were satisfied with surgery. Compensatory hyperhidrosis affected 75% of patients: it concerned the trunk (83.3% of cases), abdomen (33.3%), limbs (16.6%) and underarms (8.3%). Compensatory hyperhidrosis appeared in the first three months postoperatively, with an average of 2.3 months. However, 100% of patients with compensatory hyperhidrosis were satisfied with surgery. 93.8% of patients reported dryness of the lower limbs. 68.8% reported postoperative pain, localized in 81.8% at surgical incisions, and in 18.2% of cases in the lower limbs. Three patients reported paresthesia of the lower limbs or abdominal dysesthesia. Pain always regressed within a few months. Three patients (18.8%) had experienced postoperative sexual dysfunction. One of the two male patients had experienced transient ejaculation disorders. Two patients described vaginal dryness (Table 2).

		n = 16	%	
Recurrence	Yes		5	31.3
	No		11	68.8
	Location	Right	3	60
		Left	1	20
		Bilateral	1	20
	Delay	Immediately	2	40
		Months	1	20
		Years	2	40
	Duration	Transient	1	20
		Persistent	4	80
Satisfaction	Yes	4	80	
	No	1	20	

Compensatory hyperhidrosis	Yes		12	75	
	No		4	25	
	Location	Trunk		10	83.3
		Abdomen		4	33.3
		Limbs		2	16.6
		Underarms		1	8.3
Delay	< 1 week		4	33.3	
	< 3 months		12	100	
Duration	Transient		3	25	
	Persistent		9	75	
Satisfaction	Yes		12	100	
	No		0	0	
Dryness	Yes		15	93.8	
	No		1	6.2	
Pain	Yes		11	68.8	
	No		5	31.2	
	Location	Abdomen		9	81.8
		Limbs		2	18.2
	Type	Postoperative		8	72.7
Neuropathic			3	27.3	
Duration	Weeks		9	81.8	
	Months		2	18.2	
Sexual dysfunction	Yes		3	18.8	
	No		13	81.2	
	Type	Ejaculation		1	33.3
		Vaginal dryness		2	66.7
	Duration	Transient		1	33.3
Persistent			2	66.7	
<i>n</i> Number of patients			<i>%</i> Percentages		

Table 2: Postoperative complications.

Comparative secondary analyses of the two mechanical sympathectomy techniques (resection and clipping) showed a difference in the delay between surgery and completion of the questionnaire, with an average of 6.8 years for the resection group and of 1.7 years for the clipping group (p-value 0.05). Hospitalization time was significantly longer in the resection group, with an average of 2.8 days and of 0.5 days in the clipping group (p-value 0.03). No compensatory hyperhidrosis was reported in the clipping group compared with 91.6% in the resection group (p-value 0.03). There was no difference in patient satisfaction, recurrence of hyperhidrosis, pain or sexual dysfunctions.

Discussion

Surgical treatment is the only definitive option for treating hyperhidrosis. The development of minimally invasive endoscopic techniques has shortened hospital stays, reduced the risk of bleeding

and postoperative pain [20]. In our study, the average hospital stay was 2.3 days, with the recent development of mainly outpatient procedures. The significant difference in hospital stay between clipped and sectioned patients is explained by the development of these minimally invasive techniques in recently operated patients (patients were clipped from 2020 to 2022). Postoperative pain was reported in 68.8% of patients, resolving within a few months. Although the risks of surgery are low, it is an invasive technique requiring general anesthesia. Only 37.5% of patients had previously tried iontophoresis and only 18.8% botulinum toxin injections, which are effective and validated options for the management of plantar hyperhidrosis. Surgical treatment should be considered after the failure of conservative approaches.

Lumbar sympathectomy often results from a patient's request for a definitive solution, the appearance of compensatory hyperhidrosis after surgery is the main source of dissatisfaction.

The recent development of clipping offers interesting potential for reversibility, with the possibility of removing the clips in the event of excessively disabling complications. Reversibility varies from study to study, ranging from 48% to 77% [21,22]. The clipping technique did not present significant differences in terms of resection regarding the cure of plantar hyperhidrosis [17]. In our study, clips were used in only 19.4% of operations. This can be explained by their recent development and by different surgical habits in each center. The clipping technique should be preferred, given its shorter operating time and its interesting reversibility potential in patients at risk of severe compensatory hyperhidrosis.

The meta-analysis by Lima et al. reports resolution of plantar hyperhidrosis following lumbar sympathectomy in 92% of cases, while Rieger et al. report a postoperative satisfaction rate of 96% [17,23]. The main result of our study is consistent with previous studies, reporting a patient satisfaction rate of 87.5%. In our study, only two patients regretted the surgery. One patient presented bilateral ankle edema responsible for a more disabling impact on her daily activities than their initial plantar hyperhidrosis. The second unsatisfied patient reported a bilateral recurrence of plantar hyperhidrosis, although moderate (HDSS 2), two years after surgery. However, this patient had a concomitant history of depression, which may explain the postoperative dissatisfaction.

Compensatory hyperhidrosis is the main limiting complication of sympathectomy. We report 75% of compensatory hyperhidrosis in our study, in line with the literature, which finds a variation from 7.5 to 90% [17]. The areas affected were mainly the trunk (83.3%) and abdomen (33.3%), similar to compensatory hyperhidrosis following thoracic sympathectomy [18, 24, 25]. It occurred within the first three months postoperatively, the same delays were found for thoracic sympathectomy [26,27]. However, 100% of affected patients were satisfied with the surgery. 87.5% of patients had a postoperative HDSS score of 1, indicating that their daily activities were not affected despite compensatory hyperhidrosis. Several studies have used different techniques to objectively quantify hyperhidrosis, using a vapometer [24,28], or infrared thermal cameras [29], or gravimetry [30]. These techniques would provide quantitative and objective information on the intensity of hyperhidrosis pre- and postoperatively. This may partly explain the discordance between the occurrence of compensatory hyperhidrosis and patient satisfaction. Our study found significantly more compensatory hyperhidrosis in patients treated by resection compared with clipping (p-value 0.03). However, several biases existed. The mean delay between surgery and completion of the questionnaire was longer in the resection group (p-value 0.05). The literature reports that 70% of compensatory hyperhidrosis occurs in the first postoperative year [28], evaluation of compensatory hyperhidrosis was probably premature in the clipping group. 75% of patients operated by

resection had previously undergone thoracic sympathectomy for the treatment of their palmar hyperhidrosis, compared with 50% of clipped patients (p-value 0.07). The potential pre-existence of compensatory hyperhidrosis could have influenced the assessment of compensatory hyperhidrosis attributable to lumbar sympathectomy [17]. Lima et al report a worsening of pre-existing compensatory hyperhidrosis in 53% of patients at twelve months after lumbar sympathectomy [31]. Compensatory hyperhidrosis remains the main postoperative complication, and its severity is unpredictable. Patients must be informed of this risk during the preoperative consultation.

We report a significant recurrence of plantar hyperhidrosis, estimated at 31.3%. This percentage is high compared with other studies: Lima et al. report 2% of recurrence at twelve months' follow-up, 3% in Rieger et al. with a maximum follow-up of 45 months [31,32]. This result is closer to the recurrence rate described after thoracic sympathectomy with 19% of recurrence reported by Woo et al. and 13.7% by Campos et al. [19,26] The incidence of recurrence varies widely from study to study, ranging from 0 to 65%. This variability is due to the different definitions of recurrence, the surgical techniques used, the level of section and the length of patient follow-up [33]. Secondary analyses comparing clipping and resection found no significant difference in recurrence, in line with the meta-analysis by Lima et al. and with studies on thoracic sympathectomy [17,34].

Sexual dysfunction, particularly retrograde ejaculation, has been reported in several studies and remains the main complication limiting the surgical indication in male patients [35,36]. These studies concerned elderly patients with peripheral obliterating arteriopathy and possible pre-existing sexual dysfunctions. The meta-analysis by Lima et al. reports 3.3% of sexual dysfunction in patients treated by lumbar sympathectomy, and justifies sectioning the sympathetic chain below L2 in order to limit this risk without reducing efficacy on hyperhidrosis [17]. In our study, all lumbar sympathectomy were performed with L2 preservation. Three patients (18.8%) experienced sexual dysfunction postoperatively. One of the two male patients presented ejaculation disorders that appeared six months after the operation, and resolved within a few months. Two patients described vaginal dryness, which persisted after surgery. For one patient, peri-menopausal estrogen deficiency was imputable. Loureiro et al. reported 13.3% of sexual dysfunction in operated patients (decreased libido, vaginal dryness) but with no impact on their intimate relationships [24]. Our results and the data put forward by the literature, are reassuring: sexual dysfunction remains a rare and transient complication of lumbar sympathectomy. Sympathetic sectioning below L2 limits this risk and extends the surgical indication to men invalidated by plantar hyperhidrosis.

The strengths of our study lie in the rarity of the surgical option to treat a frequent disease with a major impact on patients' quality of life. It reports the experience of different surgical techniques at three large French hospitals (Angers, Le Mans and Tours). Despite the small number of patients (sixteen), the number of patients lost to follow-up was limited to 15% (three patients), with a questionnaire response rate of 100%. The mean interval between surgery and completion of the questionnaire was 5.5 years, with a maximum follow-up time of ten years. This allows us to assess the short-, medium- and long-term results and complications of lumbar sympathectomy, compared with only twelve to twenty-four months' follow-up in most studies.

The main limitations are related to the small number of patients, due to the low prevalence of surgery in this indication, limiting the interpretation of results by the lack of statistical power. Its retrospective and descriptive design provides a low level of scientific evidence. Further prospective studies with larger numbers of patients would be relevant to support these results. It would be interesting to develop a standardized pre- and post-operative quality of life questionnaire, and objective quantification of hyperhidrosis to enable comparative analyses. Finally, systematic multidisciplinary dermatological and surgical follow-up should be established. An expert consensus on thoracic sympathectomy recommended postoperative follow-up at one month, six months and one year, then at least annually for five years. However, this follow-up is rarely performed in practice [33]. The adoption of a standardized questionnaire and follow-up would allow evidence-based clinical practice recommendations to be developed.

Conclusion

We report a consistent satisfaction rate of 87.5% in the treatment of plantar hyperhidrosis by lumbar sympathectomy. Surgery improves patients' quality of life with acceptable postoperative complications, regardless of gender. Compensatory hyperhidrosis is the most frequent complication but with less impact on quality of life than initial plantar hyperhidrosis. Data regarding the risk of sexual dysfunction for men are reassuring, since ejaculation disorders remain rare and transient.

IRB Approval Status

Reviewed and approved by the Ethics Committee of Le Mans Hospital (Ethics approval number: 2022-018) and in application of the French Data Protection Act (MR-004).

Patient Consent on File

Consent for the publication of identifiable material was obtained from all the participants enrolled in the study and included at the time of article submission with the understanding that this information may be publicly available.

References

1. Nawrocki S, Cha J (2019) The etiology, diagnosis, and management of hyperhidrosis: A comprehensive review. *J Am Acad Dermatol* 81:657-666.
2. Doolittle J, Walker P, Mills T, Thurston J (2016) Hyperhidrosis: an update on prevalence and severity in the United States. *Arch Dermatol Res* 308:743-749.
3. Moraites E, Vaughn OA, Hill S (2014) Incidence and prevalence of hyperhidrosis. *Dermatol Clin* 32:457-465.
4. Ro KM, Cantor RM, Lange KL, Ahn SS (2002) Palmar hyperhidrosis: evidence of genetic transmission. *J Vasc Surg* 35:382-386.
5. Higashimoto I, Yoshiura K, Hirakawa N, Higashimoto K, Soejima H, et al. (2006) Primary palmar hyperhidrosis locus maps to 14q11.2-q13. *Am J Med Genet A* 140A:567-572.
6. Chen J, Lin M, Chen X, Cao Z, Tan Z, et al. (2015) A novel locus for primary focal hyperhidrosis mapped on chromosome 2q31.1. *Br J Dermatol* 172:1150-1153.
7. Bragança GMG, Lima SO, Pinto Neto AF, Marques LM, Melo EVD, et al. (2014) Evaluation of anxiety and depression prevalence in patients with primary severe hyperhidrosis. *A Bras Dermatol* 89:230-235.
8. Walling HW (2009) Primary hyperhidrosis increases the risk of cutaneous infection: a case-control study of 387 patients. *J Am Acad Dermatol* 61:242-246.
9. Maillard H, Lecoufflet M (2015) Prise en charge d'une hyperhidrose. *Ann Dermatol Vénérologie* 142: 252-261.
10. Singh S, Kaur S, Wilson P (2016) Plantar hyperhidrosis: A review of current management. *J Dermatol Treat* 27:556-561.
11. Pariser DM, Ballard A (2014) Iontophoresis for palmar and plantar hyperhidrosis. *Dermatol Clin* 32:491-494.
12. Weinberg T, Solish N, Murray C (2014) Botulinum neurotoxin treatment of palmar and plantar hyperhidrosis. *Dermatol Clin* 32:505-515.
13. Vlahovic TC (2016) Plantar Hyperhidrosis: An Overview. *Clin Podiatr Med Surg* 33:441-451.
14. Wolosker N, de Campos JRM, Kauffman P, Yazbek G, Neves S, et al. (2013) Use of oxybutynin for treating plantar hyperhidrosis. *Int J Dermatol* 52:620-623.
15. Wei Y, Xu Z-QD, Li H (2020) Quality of life after thoracic sympathectomy for palmar hyperhidrosis: a meta-analysis. *Gen Thorac Cardiovasc Surg* 68:746-753.
16. Felisberto G, Maria Cataneo AJ, Cristina Cataneo D (2021) Thoracic sympathectomy for the treatment of primary axillary hyperhidrosis: systematic review and proportional meta-analysis. *Ann Med* 53:1216-1226.
17. Lima SO, Santos RS, Moura AMM, de O Neto EG, de Andrade RLB, et al. (2019) A systematic review and meta-analysis to evaluate the efficacy of lumbar sympathectomy for plantar hyperhidrosis. *Int J Dermatol* 58:982-986.
18. Nicolas C, Grosdidier G, Granel F, Barbaud A (2000) Hyperhidroses palmoplantaires : traitement par sympathectomie endoscopique chez 107 malades. *Ann Dermatol Venerol* 7.

19. de Campos JRM, Kauffman P, Werebe E de C, Andrade Filho LO, Kusniak S, et al. (2003) Quality of life, before and after thoracic sympathectomy: report on 378 operated patients. *Ann Thorac Surg* 76: 886-891.
20. Haldipur H, Naniwadekar RG, Janugade HB (2022) Minimally Invasive Procedure Vs Standard Open Approach for Lumbar Sympathectomy. *J Pharm Negat Results* 13: 399-401.
21. Kocher GJ, Taha A, Ahler M, Schmid RA (2015) Is clipping the preferable technique to perform sympathicotomy? A retrospective study and review of the literature. *Langenbecks Arch Surg* 400:107-112.
22. Sugimura H, Spratt EH, Compeau CG, Kattail D, Shargall Y (2009) Thoracoscopic sympathetic clipping for hyperhidrosis: Long-term results and reversibility. *J Thorac Cardiovasc Surg* 137:1370-1378.
23. Rieger R, Pedevilla S, Lausecker J (2015) Quality of life after endoscopic lumbar sympathectomy for primary plantar hyperhidrosis. *World J Surg* 39: 905-911.
24. De Paula Loureiro M, De Campos JRM, Kauffman P, Jatene FB, Weigmann S, (2008) Endoscopic Lumbar Sympathectomy for Women: Effect on Compensatory Sweat. *Clinics* 63:189-196.
25. Bryant AS, Cerfolio RJ (2014) Satisfaction and compensatory hyperhidrosis rates 5 years and longer after video-assisted thoracoscopic sympathectomy for hyperhidrosis. *J Thorac Cardiovasc Surg* 147:1160-1163.e1.
26. Woo W, Kim BJ, Kang D-Y, Won J, Moon DH, et al. (2022) Patient experience and prognostic factors of compensatory hyperhidrosis and recurrence after endoscopic thoracic sympathectomy. *Surg Endosc* 36:8340-8348.
27. Chiou TSM (2005) Chronological changes of postsympathectomy compensatory hyperhidrosis and recurrent sweating in patients with palmar hyperhidrosis. *J Neurosurg Spine* 2:151-154.
28. Yazbek G, Ishy A, Alexandrino da Silva MF, Sposato Louzada AC, de Campos JRM, et al. (2021) Evaluation of compensatory hyperhidrosis after sympathectomy: The use of an objective method. *Ann Vasc Surg* 77:25-30.
29. Hur KJ, Moon HW, Park YH, Bae WJ, Cho HJ, et al. (2021) Retroperitoneoscopic lumbar sympathectomy for the treatment of primary plantar hyperhidrosis. *BMC Surg* 21:397.
30. Stefaniak TJ, Proczko M (2013) Gravimetry in sweating assessment in primary hyperhidrosis and healthy individuals. *Clin Auton Res* 23:197-200.
31. Lima SO, de Santana VR, Valido DP, de Andrade RLB, Fontes LM, et al. (2017) Retroperitoneoscopic lumbar sympathectomy for plantar hyperhidrosis. *J Vasc Surg* 66:1806-1813.
32. Rieger R, Pedevilla S, Pöchlauer S (2009) Endoscopic lumbar sympathectomy for plantar hyperhidrosis. *Br J Surg* 96:1422-1428.
33. Cerfolio RJ, De Campos JRM, Bryant AS, Connery CP, Miller DL, et al. (2011) The Society of Thoracic Surgeons Expert Consensus for the Surgical Treatment of Hyperhidrosis. *Ann Thorac Surg* 91:1642-1648.
34. Inan K, Goksel OS, Uçak A, Temizkan V, Karaca K, et al. (2008) Thoracic endoscopic surgery for hyperhidrosis: comparison of different techniques. *Thorac Cardiovasc Surg* 56:210-213.
35. Quayle JB (1980) Sexual function after bilateral lumbar sympathectomy and aorto-iliac by-pass surgery. *J Cardiovasc Surg (Torino)* 21:215-218.
36. Rose SS (1953) Investigation into Sterility After Lumbar Ganglionectomy. *BMJ* 1:247-250.