



A Review of Hyperhidrosis Treatment Methods

Afsaneh Dadarkhah¹ and Alireza Asgharpour Masouleh^{1,*}

¹AJA University of Medical Sciences, Tehran, Iran

*Corresponding author: AJA University of Medical Sciences, Tehran, Iran. Email: alirezaasgharpour@gmail.com

Received 2021 October 25; Accepted 2022 September 10.

Abstract

Context: Hyperhidrosis is known to cause numerous individual and social problems with sweating more than the body's physiological needs. Researchers have discussed the causes of this disease so far; however, factors such as heredity, nervous system defects, infections, and drugs have been introduced as the causes.

Evidence Acquisition: Firstly, 127 articles were identified from different databases. After categorizing and removing duplicate papers and reviewing the abstracts and full texts, we selected 50 articles to review and include in this study.

Results: Hyperhidrosis is a burdening disorder leading to physical and social problems. Hyperhidrosis patients are not able to efficiently use specific tools such as metallic and electronic devices. Limitations of this disorder show great concern about the performance of military personnel, too. Therapeutic methods such as topical antiperspirants, anticholinergic drugs, surgery, and Botox injections are the therapeutic measures used to treat this disease; each of these treatments is prescribed at different stages of the disease, and the effect of each is observed. Topical treatment is at the forefront of treatment methods for this disease, followed by oral anticholinergic drugs. Iontophoresis is one of the methods considered in the treatment of hyperhidrosis. Besides surgery, Botox injection is one of the effective methods in treating this disease, especially in the palm.

Conclusions: This review presents standard treatment methods used in treating hyperhidrosis with particular attention to iontophoresis as an engineering solution to solve health problems. Based on the severity of sweating and the region of hyperhidrosis incidents, there are different solutions to treat hyperhidrosis. Topical and anticholinergic therapies are the most common treatment options. However, there are other more effective treatment methods, such as iontophoresis and Botox delivery. Iontophoresis is effective and has a long-term effect on preventing sweating with fewer side effects. Suction curettage surgery is an invasive method to treat patients with hyperhidrosis.

Keywords: Primary Hyperhidrosis, Tap Water Iontophoresis, Topical Antiperspirant, Anticholinergic

1. Context

Hyperhidrosis is more severe sweating than the body's physiological needs to balance the body's temperature (1, 2). It often appears in the palms, soles of the feet, and armpit area with the accumulation of perspiration glands and causes individual and social problems (3, 4). People with hyperhidrosis have difficulty using metal, paper, and electronic tools, which impairs the social functioning of individuals and causes material and spiritual damage to societies (5, 6). According to studies, the prevalence of this disease is between 1% and 2%. Based on the causes of hyperhidrosis, this disease can be divided into 2 categories: Primary and secondary hyperhidrosis (7). In primary hyperhidrosis, except for heredity (8), the causes of the disease are unknown. However, the secondary type of the disease can be attributed to diseases, intense exercise,

or certain medications (9). Nowadays, there are various treatment methods for effective treatment of this disease, and the method of choosing these treatment methods depends on the severity of the disease, area of the disease, age of the patient, and costs. The first step in the treatment of hyperhidrosis is to diagnose the disease. To diagnose primary hyperhidrosis, observing severe and concentrated sweating for 6 months without any cause with 2 symptoms of Table 1 is required.

The secondary type of hyperhidrosis can generally be due to secondary factors such as neurological diseases and social anxiety diseases. In some cases, damage to peripheral nerves and stroke can also be the causes of this disease in people.

Table 1. How to Diagnose Hyperhidrosis

Type of Hyperhidrosis	Symptoms
Primary hyperhidrosis	Bilateral and almost symmetrical sweating
	Imperfections in everyday tasks
	Start before the age of 25
	Family history of the disease
	Stop sweating during sleep
Secondary hyperhidrosis	No secondary symptoms
	Severe and general sweating can be attributed to other factors such as medications, respiratory problems, infections, and cardiovascular, malignant, metabolic, and neurological diseases
	Stroke, peripheral nerve damage, spinal cord injury, neuropathy

2. Evidence Acquisition

In this narrative review, the data about hyperhidrosis treatments were selected and reviewed from databases such as ScienceDirect, PubMed, Springer, Wiley Online Library, Google Scholar, etc. The time range of articles includes from 1980 to 2021. Selecting articles started with searching for keywords such as hyperhidrosis, topical antiperspirants, tap water iontophoresis, Botox injection, hyperhidrosis surgical solutions, etc.

3. Results

3.1. Topical Therapy

Local antiperspirants are at the forefront of treatment methods for hyperhidrosis (10, 11). These drugs are simply available in pharmacies and have very few side effects. This family's most widely used drugs are aluminum chloride hexahydrate (12, 13) and aluminum chloride 20% (14, 15). The efficiency of these drugs is that aluminum metal salts interact with sweat mucopolysaccharides and cause obstruction of the sweat duct by creating sedimentation (16). In using these drugs, sweating is done within the body, but these drugs reduce sweating by mechanical obstruction of the exit site of the perspiration glands. This treatment is a temporary method that is suitable for less severe cases. One of the results of using these drugs is changes in the form of sweating glands. Recently, studies have shown that topical antiperspirant therapy can alter the form of perspiration glands (17). The use of these drugs should also be taken into consideration. For example, the maximum efficiency of using these drugs is at the time of minimum sweating. As a result, it is recommended to use the drug in the area of the disease for between 6 and

8 hours at night. The most common side effect of this method is feeling discomfort in the area of use. The use of aluminum chloride in the armpit area has a high effect due to low skin thickness, although palm and foot sweating decreases due to increased skin thickness and inability to penetrate the skin (12, 18). This treatment method is a suitable option for starting hyperhidrosis patients, especially in less severe cases. This method is inexpensive, simple, and effective and is of interest to physicians.

3.2. Anticholinergic Therapy

Anticholinergic drugs prevent sweating by preventing the effect of acetylcholine, which stimulates postsynaptic muscarinic receptors to force sweat glands to secrete sweat (19, 20). Glycopyrrolate and oxybutynin are used to treat hyperhidrosis. These drugs block acetylcholine activity in parasympathetic spots in smooth muscles, the central nervous system, and sweat glands. This process stops sweating in the perspiration glands. Glycopyrrolate usage has been approved for patients over 11 years old in the USA, and this treatment has been studied in several studies (21, 22). Studies have shown that up to 79% of patients with concentrated hyperhidrosis are treated with glycopyrrolate (21). The required amount of this drug for children is 2 mg daily and for adults up to 4 mg per day (19). However, higher doses may be used to diagnose more severe cases. Methantheline bromide is among the anticholinergic drugs used at a dose of 50 mg and 2 to 3 times a day in Europe to treat subcutaneous hyperhidrosis. Cholinergic drugs show their effectiveness 1 week after treatment. Due to the lack of severe side effects, these drugs can be used for the required period until the results are stable. Due to the systematic absorption of anticholinergic drugs based on the dosage used, side effects can vary. These drugs' most common side effects are dry mouth, nausea, and headaches. The combination of topical antiperspirants and anticholinergic drugs can also reduce sweating in severe cases of hyperhidrosis. This treatment is used after topical medications for the treatment of hyperhidrosis. However, some patients may leave the treatment process halfway due to the side effects of these drugs.

3.3. Iontophoresis

Iontophoresis is one of the most common treatment methods for hyperhidrosis in the palm of the hand and soles of the feet (23-25). In this treatment method, direct electrical energy with a current of up to 20 mA is used for treatment. Anode and cathode electrodes, an electrical current source, anode and cathode electrodes, a

container containing water, and cloth coating are required to treat iontophoresis. The electrical current source provides the necessary electrical energy for the treatment and transmission of ions, and the anode and cathode electrodes are responsible for transferring this current among the skin in the treatment area. Using fabric coating prevents direct contact with the skin and the surface of electrodes from preventing side effects. The use of tap water in this treatment is expected so that water and solutes help transfer ions into the skin. In some studies, antiperspirants are added to the urban water container to occur in the middle of the skin using the drug-supplying iontophoresis method (26). Kim et al. treated palm hyperhidrosis by the iontophoresis method (15). Their study was performed on 29 patients with severe sweating for 2 weeks, with 5 weekly treatment sessions. They showed an improvement in 92.9% of patients, and it was concluded that iontophoresis was a safe and effective method with the help of municipal water. In another study, Yaghoubi et al. (27) compared the effect of municipal water and the normal saline solution on treating a 21-year-old female patient with primary hyperhidrosis. This study showed that using a normal saline solution could be up to 1.7 times more effective than urban water solution in treating this disease. So far, the mechanism of the effectiveness of this treatment has not been investigated, but reasons such as nervous system stimulation, increased threshold of stimulation, and mechanical obstruction of sweating glands have been mentioned as effective methods of this treatment. This treatment is usually a 4-week treatment period and performed in the first week of 4 sessions, in the second week 3 sessions, in the third week 2 sessions, and in the last week for 20 minutes. With all the benefits of this treatment, there are also limitations to using this method. Before starting the treatment session, patients are asked questions to ensure the absence of metal implants, pacemakers, and pregnancy. Side effects of this treatment are rare and include burning sensation, redness, and blistering in the treatment area, which can be prevented by using creams. This treatment is one of the most effective treatment options for hyperhidrosis in the palms and soles of the feet.

3.4. Suction Curettage Surgery

Suction curettage is the beginning of invasive treatments to prevent severe sweating (28, 29). Suction curettage is mainly used for the treatment of hyperhidrosis in the axillary area. In this treatment, sweating glands remove with relatively low invasiveness. This method is a surgical technique with the least possible

invasiveness for the treatment of hyperhidrosis. Local anesthesia is used for this treatment, and patients will see sweating discontinuation in a short time. This treatment is invasive, and one of the most critical factors in such treatments is the surgeon's skill. One of the side effects of this treatment is scar incidence and, in some cases, infection.

3.5. Botox Injection

Botox injections are used as a non-surgical method for treating hyperhidrosis at different severities of the disease (30, 31). Botox blocks acetylcholine release from presynaptic nerve terminals by targeting the snar protein and preventing sweating. The most common type of botulinum used in treating this disease is botulinum type A (32). Patients with myasthenia gravis disease and pregnant women are prohibited from using this treatment. One of the weaknesses of using this treatment method is the temporary inability of people to use palm muscles after Botox injection. It is also a painful procedure for children. The optimum concentration of botulinum type A is between 1 and 2.5 U per 0.1 mL (33, 34). The volume of toxin injected into the skin is 0.1 to 0.2 mL per square centimeter. The injection method should be in the form of an array of injection sites. Depending on the patient's response, 100 - 150 units of type A toxin are needed to treat each hand. Studies show that patients' satisfaction after using this treatment is between 80% and 90% (35, 36), and treatment should continue periodically every 6 to 9 months. One of the common side effects of Botox injection is a pain in the injection area. This treatment is effective and straightforward. However, it is costly to repeat the treatment for several periods.

3.6. Sympathectomy

Sympathectomy is the last treatment used in hyperhidrosis treatment if all the mentioned methods do not answer (37-42). Thoracic sympathectomy surgery blocks the upper thoracic sympathetic chain through an incision or clamp. This treatment is suitable for severe sweating in the upper extremities, especially in the palms. One of the requirements for implementing this treatment is the patient's physical health. Postoperative complications include arterial bleeding, pneumothorax, hemothorax, and limb drowsiness (43, 44).

4. Conclusions

There are several major treatments to confront hyperhidrosis (Table 2). These treatments start

Table 2. A Summary of Treatment Methods for Hyperhidrosis

Treatment	General Hyperhidrosis	Axillary Hyperhidrosis	Head and Face Hyperhidrosis	Plantar Hyperhidrosis	Palmar Hyperhidrosis
Topical antiperspirants	Negative	Positive	Positive	Positive	Positive
Tap water iontophoresis	Negative	Negative	Negative	Positive	Positive
Botox injection	Negative	Positive	Positive	Positive	Positive
Oral anticholinergic drugs	Positive	Positive	Positive	Positive	Positive
Medical equipment such as radiofrequency, ultrasound, laser	Negative	Positive	Negative	Negative	Negative
Curettage	Negative	Positive	Negative	Negative	Negative
Sympathectomy surgery	Negative	Positive	Positive	Positive	Positive

with low-cost topical medicines, which are useful for less severe cases. Another family of treatments includes anticholinergic therapy, which can be used in combination with topical antiperspirants to treat severe cases of hyperhidrosis. Iontophoresis, as a novel and promising treatment for different diseases, has been used. This method may provide a uniform, high-quality treatment for hyperhidrosis patients. This method is straightforward and has long-term efficacy and promising results, especially in certain areas such as palmoplantar regions. However, there is not sufficient information about the procedure of the treatment. Botox injection shows great results in preventing hyperhidrosis. Patients are able to pursue their normal life for about 6 months after a single treatment session. However, this method is costly and invasive and may lead to temporary disabilities in injection sites and areas. Suction curettage surgery stands as the last choice of hyperhidrosis treatment. This method is mainly used in severe cases and needs surgeons with enough experience. However, in most cases, there are scar incidents and even, in some cases, infections. The use of laser waves, ultrasound, magnetic waves, and radiofrequency waves (45-50) is one of the most modern treatments for hyperhidrosis. Radiofrequency heat therapy is our solution between minimally invasive and surgical methods to treat hyperhidrosis in armpits. It has been shown that radiofrequency heat therapy can be an effective treatment option according to the patients' satisfaction. However, the emerging methods have not been able to replace classical treatment methods.

Footnotes

Authors' Contribution: All authors contributed equally to this work.

Conflict of Interests: The authors declare no conflict of interests.

Funding/Support: There is no external fund.

References

- Hoverson K, Kandula P. Hyperhidrosis. *Advances in Cosmetic Surgery*. 2020;3(1):155-63. <https://doi.org/10.1016/j.yacs.2020.01.014>.
- Fealey RD. Disorders of Sweating. In: Robertson D, Biaggioni I, Burnstock G, Low P. A, Paton JFR, editors. *Primer on the autonomic nervous system*. 3rd ed. Massachusetts, United States: Academic Press; 2011.
- Rice ZP, Pieretti LJ, Wheeler A, Payne J, Gillard KK, Devlin T, et al. 51. Clinical Presentation and Quality of Life Burden Associated With Hyperhidrosis in Children and Adolescents. *J Adolesc Health*. 2021;68(2). <https://doi.org/10.1016/j.jadohealth.2020.12.060>.
- Kamudoni P, Salek MS, Mueller B. The Burden of Primary Hyperhidrosis On The Patient: Eq-5d-5l Utilities, Willingness To Pay And Daily Time Spent In Managing The Condition. *Value Health*. 2014;17(7). A611. [PubMed ID: 27202131]. <https://doi.org/10.1016/j.jval.2014.08.2141>.
- Augustin M, Radtke MA, Herberger K, Kornek T, Heigel H, Schaefer I. Prevalence and disease burden of hyperhidrosis in the adult population. *Dermatology*. 2013;227(1):10-3. [PubMed ID: 23988406]. <https://doi.org/10.1159/000351292>.
- Kamudoni P, Mueller B, Halford J, Schouveler A, Stacey B, Salek MS. The impact of hyperhidrosis on patients' daily life and quality of life: a qualitative investigation. *Health Qual Life Outcomes*. 2017;15(1):121. [PubMed ID: 28595584]. [PubMed Central ID: PMC5465471]. <https://doi.org/10.1186/s12955-017-0693-x>.
- Walling HW. Clinical differentiation of primary from secondary hyperhidrosis. *J Am Acad Dermatol*. 2011;64(4):690-5. [PubMed ID: 21334095]. <https://doi.org/10.1016/j.jaad.2010.03.013>.

8. Ro KM, Cantor RM, Lange KL, Ahn SS. Palmar hyperhidrosis: evidence of genetic transmission. *J Vasc Surg.* 2002;**35**(2):382-6. [PubMed ID: 11854739]. <https://doi.org/10.1067/mva.2002.119507>.
9. Shargall Y, Spratt E, Zeldin RA. Hyperhidrosis: what is it and why does it occur? *Thorac Surg Clin.* 2008;**18**(2):125-32. v. [PubMed ID: 18557586]. <https://doi.org/10.1016/j.thorsurg.2008.01.001>.
10. Kirsch B, Smith S, Cohen J, DuBois J, Green L, Baumann L, et al. Efficacy and safety of topical sofipironium bromide gel for the treatment of axillary hyperhidrosis: A phase II, randomized, controlled, double-blinded trial. *J Am Acad Dermatol.* 2020;**82**(6):1321-7. [PubMed ID: 32068049]. <https://doi.org/10.1016/j.jaad.2020.02.016>.
11. Pariser DM, Ballard A. Topical therapies in hyperhidrosis care. *Dermatol Clin.* 2014;**32**(4):485-90. [PubMed ID: 25152341]. <https://doi.org/10.1016/j.det.2014.06.008>.
12. Goh CL. Aluminum chloride hexahydrate versus palmar hyperhidrosis. Evaporimeter assessment. *Int J Dermatol.* 1990;**29**(5):368-70. [PubMed ID: 2361796]. <https://doi.org/10.1111/j.1365-4362.1990.tb04766.x>.
13. Woolery-Lloyd H. Aluminum chloride 15% a hexahydrate in a salicylic acid 2% gel: A novel topical agent for hyperhidrosis with decreased irritation. *J Am Acad Dermatol.* 2009;**60**(3). <https://doi.org/10.1016/j.jaad.2008.11.280>.
14. Yanagishita T, Tamada Y, Ohshima Y, Ito K, Akita Y, Watanabe D. Histological localization of aluminum in topical aluminum chloride treatment for palmar hyperhidrosis. *J Dermatol Sci.* 2012;**67**(1):69-71. [PubMed ID: 22429702]. <https://doi.org/10.1016/j.jdermsci.2012.02.016>.
15. Kim B, Kim M, Huh C. Comparison of 20% aluminum chloride solution and botulinum toxin A injection in the treatment of patients with primary palmar hyperhidrosis. *J Am Acad Dermatol.* 2008;**58**(2). <https://doi.org/10.1016/j.jaad.2007.10.175>.
16. Holzle E. Topical pharmacological treatment. *Curr Probl Dermatol.* 2002;**30**:30-43. [PubMed ID: 12471696]. <https://doi.org/10.1159/000060693>.
17. Holzle E, Braun-Falco O. Structural changes in axillary eccrine glands following long-term treatment with aluminium chloride hexahydrate solution. *Br J Dermatol.* 1984;**110**(4):399-403. [PubMed ID: 6712884]. <https://doi.org/10.1111/j.1365-2133.1984.tb04653.x>.
18. Swaile DF, Elstun LT, Benzinger KW. Clinical studies of sweat rate reduction by an over-the-counter soft-solid antiperspirant and comparison with a prescription antiperspirant product in male panelists. *Br J Dermatol.* 2012;**166** Suppl 1:22-6. [PubMed ID: 22385032]. <https://doi.org/10.1111/j.1365-2133.2011.10786.x>.
19. Cruddas L, Baker DM. Treatment of primary hyperhidrosis with oral anticholinergic medications: a systematic review. *J Eur Acad Dermatol Venereol.* 2017;**31**(6):952-63. [PubMed ID: 27976476]. <https://doi.org/10.1111/jdv.14081>.
20. Toledo-Pastrana T, Marquez-Enriquez J, Millan-Cayetano JF. Oral Oxybutynin for Local and Multifocal Hyperhidrosis: A Multicenter Study. *Actas Dermosifiliogr.* 2017;**108**(6):597-9. [PubMed ID: 28388990]. <https://doi.org/10.1016/j.ad.2016.11.013>.
21. Lee HH, Kim DW, Kim DW, Kim C. Efficacy of glycopyrrolate in primary hyperhidrosis patients. *Korean J Pain.* 2012;**25**(1):28-32. [PubMed ID: 22259713]. [PubMed Central ID: PMC3259134]. <https://doi.org/10.3344/kjpp.2012.25.1.28>.
22. Walling HW. Systemic therapy for primary hyperhidrosis: a retrospective study of 59 patients treated with glycopyrrolate or clonidine. *J Am Acad Dermatol.* 2012;**66**(3):387-92. [PubMed ID: 21820204]. <https://doi.org/10.1016/j.jaad.2011.01.023>.
23. Roustit M, Blaise S, Cracowski JL. Trials and tribulations of skin iontophoresis in therapeutics. *Br J Clin Pharmacol.* 2014;**77**(1):63-71. [PubMed ID: 23590287]. [PubMed Central ID: PMC3895348]. <https://doi.org/10.1111/bcp.12128>.
24. Dhote V, Bhatnagar P, Mishra PK, Mahajan SC, Mishra DK. Iontophoresis: a potential emergence of a transdermal drug delivery system. *Sci Pharm.* 2012;**80**(1):1-28. [PubMed ID: 22396901]. [PubMed Central ID: PMC3293348]. <https://doi.org/10.3797/scipharm.1108-20>.
25. Walia NS, Rathore BS, Jaiswal AK. Treatment of Palmoplantar Hyperhidrosis by Iontophoresis. *Med J Armed Forces India.* 2000;**56**(1):27-8. [PubMed ID: 28790639]. [PubMed Central ID: PMC5531963]. [https://doi.org/10.1016/S0377-1237\(17\)30085-0](https://doi.org/10.1016/S0377-1237(17)30085-0).
26. Khademi Kalantari K, Zeinalzade A, Kobarfard F, Nazary Moghadam S. The effect and persistency of 1% aluminum chloride hexahydrate iontophoresis in the treatment of primary palmar hyperhidrosis. *Iran J Pharm Res.* 2011;**10**(3):641-5. [PubMed ID: 24250398]. [PubMed Central ID: PMC3813027].
27. Yaghobi Z, Goljarian S, Oskouei AE. Comparison of tap water and normal saline iontophoresis in idiopathic hyperhidrosis: A case report. *J Phys Ther Sci.* 2014;**26**(8):1313-5. [PubMed ID: 25202204]. [PubMed Central ID: PMC4155243]. <https://doi.org/10.1589/jpts.26.1313>.
28. Ibrahim O, Kakar R, Bolotin D, Nodzinski M, Disphanurat W, Pace N, et al. The comparative effectiveness of suction-curettage and onabotulinumtoxin-A injections for the treatment of primary focal axillary hyperhidrosis: a randomized control trial. *J Am Acad Dermatol.* 2013;**69**(1):88-95. [PubMed ID: 23591103]. <https://doi.org/10.1016/j.jaad.2013.02.013>.
29. Bechara FG, Gambichler T, Bader A, Sand M, Altmeyer P, Hoffmann K. Assessment of quality of life in patients with primary axillary hyperhidrosis before and after suction-curettage. *J Am Acad Dermatol.* 2007;**57**(2):207-12. [PubMed ID: 17368632]. <https://doi.org/10.1016/j.jaad.2007.01.035>.
30. Aoki KR, Guyer B. Botulinum toxin type A and other botulinum toxin serotypes: a comparative review of biochemical and pharmacological actions. *Eur J Neurol.* 2001;**8** Suppl 5:21-9. [PubMed ID: 11851731]. <https://doi.org/10.1046/j.1468-1331.2001.00035.x>.
31. Swartling C, Naver H, Lindberg M. Botulinum A toxin improves life quality in severe primary focal hyperhidrosis. *Eur J Neurol.* 2001;**8**(3):247-52. [PubMed ID: 11328333]. <https://doi.org/10.1046/j.1468-1331.2001.00207.x>.
32. Naumann M, Hamm H, Kinkelin I, Reiners K. Botulinum toxin type A in the treatment of focal, axillary and palmar hyperhidrosis and other hyperhidrotic conditions. *Eur J Neurol.* 1999;**6**:s111-5. <https://doi.org/10.1111/j.1468-1331.1999.tb00027.x>.
33. Doft MA, Kasten JL, Ascherman JA. Treatment of axillary hyperhidrosis with botulinum toxin: a single surgeon's experience with 53 consecutive patients. *Aesthetic Plast Surg.* 2011;**35**(6):1079-86. [PubMed ID: 21559989]. <https://doi.org/10.1007/s00266-011-9738-4>.
34. Heckmann M, Ceballos-Baumann AO, Plewig G. Hyperhidrosis Study G. Botulinum toxin A for axillary hyperhidrosis (excessive sweating). *N Engl J Med.* 2001;**344**(7):488-93. [PubMed ID: 11172190]. <https://doi.org/10.1056/NEJM200102153440704>.
35. Campanati A, Giuliadori K, Martina E, Giuliano A, Ganzetti G, Offidani A. Onabotulinumtoxin type A (Botox((R))) versus Incobotulinumtoxin type A (Xeomin((R))) in the treatment of focal idiopathic palmar hyperhidrosis: results of a comparative double-blind clinical trial. *J Neural Transm (Vienna).* 2014;**121**(1):21-6. [PubMed ID: 24052109]. <https://doi.org/10.1007/s00702-013-1074-1>.
36. Campanati A, Giuliadori K, Giuliano A, Martina E, Ganzetti G, Marconi B, et al. Treatment of palmar hyperhidrosis with botulinum toxin type A: results of a pilot study based on a novel injective approach. *Arch Dermatol Res.* 2013;**305**(8):691-7. [PubMed ID: 23800969]. <https://doi.org/10.1007/s00403-013-1380-3>.
37. Yang C, Li Z, Bai H, Mao H, Li JX, Wu H, et al. Long-Term Efficacy of T3 Versus T3+T4 Thoracoscopic Sympathectomy for Concurrent Palmar and Plantar Hyperhidrosis. *J Surg Res.* 2021;**263**:224-9. [PubMed ID: 33691245]. <https://doi.org/10.1016/j.jss.2020.11.064>.
38. Vasconcelos CFM, Aguiar WS, Cordeiro GG, Silveira KC, Moreira RS, Lisboa DL, et al. Modified R5-R8 Thoracic

- Sympathectomy for Severe Compensatory Hyperhidrosis. *Ann Thorac Surg.* 2021;**111**(1):e57-9. [PubMed ID: 32687829]. <https://doi.org/10.1016/j.athoracsur.2020.05.099>.
39. Wolosker N, Faustino CB, de Campos JRM, Kauffman P, Yazbek G, Fernandes PP, et al. Comparative analysis of the results of videothoroscopic sympathectomy in the treatment of hyperhidrosis in adolescent patients. *J Pediatr Surg.* 2020;**55**(3):418-24. [PubMed ID: 32063368]. <https://doi.org/10.1016/j.jpedsurg.2019.11.004>.
 40. Leiderman DBD, Milanez de Campos JR, Kauffman P, Tedde ML, Yazbek G, Teivelis MP, et al. The relation between age and outcomes of thoracic sympathectomy for hyperhidrosis: The older the better. *J Thorac Cardiovasc Surg.* 2018;**156**(4):1748-56. [PubMed ID: 30054140]. <https://doi.org/10.1016/j.jtcvs.2018.05.084>.
 41. Salim EF, Ali GA. Impact of Thoracoscopic T2 Sympathectomy on Patients With Primary Palmar and Axillary Hyperhidrosis. *Ann Thorac Surg.* 2018;**106**(4):1032-7. [PubMed ID: 29885980]. <https://doi.org/10.1016/j.athoracsur.2018.05.023>.
 42. Horslen LC, Wilshire CL, Louie BE, Vallieres E. Long-Term Impact of Endoscopic Thoracic Sympathectomy for Primary Palmar Hyperhidrosis. *Ann Thorac Surg.* 2018;**106**(4):1008-12. [PubMed ID: 29885977]. <https://doi.org/10.1016/j.athoracsur.2018.04.063>.
 43. Macia I, Moya J, Ramos R, Rivas F, Urena A, Rosado G, et al. [Primary hyperhidrosis. Current status of surgical treatment]. *Cir Esp.* 2010;**88**(3):146-51. [PubMed ID: 20153461]. <https://doi.org/10.1016/j.ciresp.2009.12.014>.
 44. Moraites E, Vaughn OA, Hill S. Endoscopic thoracic sympathectomy. *Dermatol Clin.* 2014;**32**(4):541-8. [PubMed ID: 25152348]. <https://doi.org/10.1016/j.det.2014.06.007>.
 45. Schick CH, Grallath T, Schick KS, Hashmonai M. Radiofrequency Thermotherapy for Treating Axillary Hyperhidrosis. *Dermatol Surg.* 2016;**42**(5):624-30. [PubMed ID: 27110892]. <https://doi.org/10.1097/DSS.0000000000000703>.
 46. Sanchez-Carpintero I, Martin-Gorgojo A, Ruiz-Rodriguez R. Microwave Treatment for Axillary Hyperhidrosis and Bromhidrosis. *Actas Dermosifiliogr.* 2017;**108**(5):418-22. [PubMed ID: 28284421]. <https://doi.org/10.1016/j.ad.2016.12.011>.
 47. Weiner SF. Radiofrequency Microneedling: Overview of Technology, Advantages, Differences in Devices, Studies, and Indications. *Facial Plast Surg Clin North Am.* 2019;**27**(3):291-303. [PubMed ID: 31280844]. <https://doi.org/10.1016/j.fsc.2019.03.002>.
 48. Garcia-Barquin P, Aquerreta Beola JD, Bondia Gracia JM, Espana Alonso A, Perez Cajaraville J, Bartolome Leal P, et al. Percutaneous CT-Guided Sympathicolysis with Radiofrequency for the Treatment of Palmar Hyperhidrosis. *J Vasc Interv Radiol.* 2017;**28**(6):877-85. [PubMed ID: 28366656]. <https://doi.org/10.1016/j.jvir.2017.02.025>.
 49. Fouad W. Management of essential hyperhidrosis of upper limbs by radiofrequency thermocoagulation of second thoracic ganglion. *Alexandria J Med.* 2019;**47**(3):193-9. <https://doi.org/10.1016/j.ajme.2011.07.006>.
 50. Andrade R, D'Cunha J. Percutaneous Radiofrequency Ablation for Hyperhidrosis: Ready for Primetime? *Semin Thorac Cardiovasc Surg.* 2018;**30**(3):367-8. [PubMed ID: 30227215]. <https://doi.org/10.1053/j.semtcvs.2018.09.008>.