Advances in the Treatment of Bromhidrosis

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Abstract
Armpit odor is a common disease with genetic tendency in cosmetic surgery. The odor emitted by it often affects the quality of life and social communication of patients, leading to psychological disorders in patients and seriously jeopardizing their mental health. With the continuous development and progress of medicine, there are many ways to treat armpit odor at present, but there is still no perfect way to treat armpit odor. This article reviews the progress of treatment methods in recent years.

Keywords
Bromhidrosis, Treatment, Research Progress

1. Introduction
Bromhidrosis, also known as “body odor”, is a common disease in cosmetic surgery. It is clinically believed that the disease is mainly caused by excessive secretion of apocrine sweat glands through the skin surface bacterial decomposition. The highest incidence of the disease is middle-aged people and adolescents, mainly manifested by unusually pronounced underarm odor. Armpit odor causes psychological disorders in patients, thus affecting life, work and social interaction [1] [2]. Although the mechanism of armpit odor formation is not fully understood, the current research shows that it is a physiological state produced by the interaction of bacteria with the secretion of the apocrine sweat gland of the armpit. The number and density of apocrine sweat glands, secretion of (E)-3-methyl-2-hexenoic acid and ABCC11 gene were closely related to axillary odor [3]. The treatment of bromhidrosis can be divided into surgical treatment and non-surgical treatment, among which the surgical treatment mainly includes spindle skin excision, subcutaneous curettage, subcutaneous pruning,
destumescence suction and so on. Non-surgical treatment mainly includes botox type A injection, laser therapy, electroion therapy and so on. Although the therapeutic methods and mechanisms used in clinical practice vary, most of them are aimed at clearing or destroying apocrine sweat glands [4].

2. Non-Surgical Treatment

2.1. Topical Drugs

Patients with armpit odor should pay attention to personal hygiene, take a bath frequently, change underwear frequently, keep the armpit dry and clean, and avoid excessive exercise, which can reduce the odor. At present, the commonly used drugs mainly include antibacterial drugs, antiperspirants, deodorants, etc. [5]. Glononium bromide, as an anticholinergic drug, can block the action of acetylcholine in nerve endings, thereby reducing sweat gland secretion. Gregoriou et al. [6] found in a study on the treatment of 19 patients with bromhidrosis that 2% glonium bromide cream was effective and safe in the treatment of axillary bromhidrosis patients. In addition, deodorants work by inhibiting the growth of foul-smelling bacteria through antibacterial bacteriostatic agents such as triclosan, while perfumes, fragrances, and essential oils can mask unpleasant body odor. As for antiperspirants, long-term use can have complications such as pigmentation or dry skin, so they are only suitable for short-term treatment [7]. The search for more sustainable and natural drugs should be the future research trend [8].

2.2. Subcutaneous Drug Injection Therapy

Subcutaneous drug injection is also one of the effective ways to treat bromhidrosis. Although there are many kinds of drugs injected, botulinum toxin type A and Shao Bi injection are widely used, and their mechanism of action is to reduce sweat production by inhibiting or destroying apocrine sweat gland ducts and glands [9].

2.2.1. Local Injection of Botox Type A

Botulinum toxin type A BtX-A, as A neurotoxin, has a therapeutic mechanism by affecting the release of acetylcholine, thereby reducing the secretion of sweat by sweat glands [10]. Intradermal injection of botox type A is one of the effective ways to reduce sweat production [11]. The side effects of botox type A in axillary odor are temporary and are usually described as injection-related pain, compensatory sweating, muscle weakness, local skin infections, and flu-like symptoms. Glaser et al. [12] found that type A botulinum toxin injection was also beneficial to adolescents with primary bromhidrosis. However, Naumann et al. [13] found that its deficiency was that the curative effect lasted for a short time, and repeated injection was needed to prolong the curative effect. At present, local injection of botulinum toxin type A is the first choice of non-surgical treatment for bromhidrosis.
2.2.2. Shao Bei Injection Treatment
Paenoflorin in Shao Bei injection is used to treat bromhidrosis due to its anti-
oxidant and free radical scavenging functions [14]. Shao Bei injection has a sof-
tening and atrophy effect, and is also effective in the treatment of internal hem-
orrhoids [15]. Liu Xiaojun et al. [16] found that Shao Bei injection with a con-
centration of 66.6% had obvious effect in the treatment of bromhidrosis, and was
minimally invasive without traces. It has the advantage of being more effective and
lasting longer than botox. However, whether a higher concentration of Paeonia
can bring a higher efficacy evaluation needs to be verified experimentally.

2.2.3. Local Ethanol Injection
Local injection of ethanol can cause cell dehydration and necrosis, but this
method is transient and self-limited. At present, it is rarely used because of the
high risk of complications in practical application [17]. Injection therapy is ac-
cepted by patients because of its advantages of convenience, speed and less
trauma, but at the same time, there are complications such as multiple injection,
icritis, skin induration and recurrence, and the therapeutic effect is worse than
that of surgical treatment.

3. Methods of Physical Therapy
The main physical treatment of armpit odor includes laser therapy, electroion
therapy, microwave therapy, RF microneedle therapy and other methods, and
the most commonly used is laser therapy.

3.1. Laser Irradiation Therapy
Nd:YAG laser and CO₂ dot matrix laser are the two most commonly used laser
treatment for armpit odor. Among them, the common wavelength of Nd:YAG
laser is 1444 nm. YAG laser irradiation can reduce the production of volatile
unsaturated fatty acids, steroids and associated unpleasant odors in armpits [18]
[19]. Jung et al. [20] found that pulse Nd: With a wavelength of 1444 nm, a fre-
quency of 40 Hz and an energy of 15 mJ (operating at 6 W), the YAG laser is the
optimal parameter for the treatment of bromhidrosis, providing the highest de-
gree of efficacy for selective ablation and thermal restriction of adipose tissue,
allowing the removal of fat from different areas in a short period of time. The
study of Jeong et al. [21] also believed that laser with wavelength of 1444 nm was
found to be a reliable method for the treatment of armpit osmosis, which has the
advantages of small wound, rapid operation, no obvious scar and fast recovery.
However, the actual parameters in clinical treatment should still be adjusted ac-
cording to the actual situation of patients.

3.2. Electroion Therapy
Electroion therapy mainly uses its thermal effect to cauterize the hair follicle,
and then destroys the apocrine gland to make it lose the function of secreting
sweat. Mei Yonghong et al. [22] found that the therapeutic effect of electric ion
in the treatment of armpit odor was lower than that of gold microneedles, and the incidence of armpit bleeding, spot pustules, scar and other complications was higher than that of gold microneedles. Sup et al. [4] found that electroion treatment was lower than YAG laser and CO₂ laser.

### 3.3. Microwave Therapy

Microwave can purposefully damage glandular tissues with more water through heat, so glandular tissues with high water content become the target of microwave heating [23]. Chen et al. [24] compared the comparative study between subcutaneous scratching and microwave treatment of armpit odor, and found that subcutaneous scratching was more effective, with greater improvement effect, lower short-term complication rate and lower recurrence rate. If there are no long-term sequelae, microwave treatment may be appropriate for patients with armpit odor who have cosmetic problems.

### 4. Surgical Treatment

With the continuous development of medicine, the surgical methods for the treatment of armpit odor are also constantly changing and improving. Although there are some complications with surgery, more and more people are willing to undergo surgery because of its immediate results.

#### 4.1. Traditional Surgical Treatment of Bromhidrosis

Traditional bromhidrosis surgery can completely remove the sweat gland tissue to achieve the purpose of treating bromhidrosis. However, due to the large surgical trauma, long postoperative recovery time, and the easy occurrence of surgical opening dehiscus and scar, the therapeutic effect is affected, leading to postoperative recurrence [25]. This method is rarely used today.

#### 4.2. Apocrine Excision with Small Incision

As subcutaneous pruning with small incision requires extensive subcutaneous separation of armpits, large subcutaneous space will be formed, and common postoperative complications include hematoma and skin necrosis [26]. Yang Juan et al. [27] treated 35 patients with traditional small-incision apocrine excision combined with super-pulse carbon dioxide laser, and found that this method had a lower recurrence rate, better clinical symptoms and better therapeutic effect than traditional small-incision apocrine excision alone. Chen Yan et al. [28] found that radical bromhidrosis with small transverse axillary incision not only has the advantages of long operation time, less blood loss, low complication rate, but also beautiful surgical incision. Its safety is higher than fusiform flap resection.

#### 4.3. Subcutaneous Scratching with Small Incision

Studies have found that when the incision is at the outermost edge of the surgi-
The curative effect is not only improved, but also the incidence of complications is effectively reduced [29]. The postoperative complication rate and wound appearance of minimally invasive scratching with small incision are the advantages of smaller incision and less damaged tissue. However, the disadvantage is that the surgical field of view is limited, and it may not be able to completely remove a large range of sweat glands, resulting in postoperative recurrence of patients [2].

4.4. Negative Pressure Suction with Small Incision

The incision of negative pressure suction with small incision is generally at the edge of the armpit. After blunt separation, the free skin tissue is held to wrap the inserted negative pressure tube and the sweat gland tissue is repeatedly aspirated. Yang et al. [30] showed that improved negative pressure suction with small incision not only has small incision, short operation time and simple operation method, but also has high success rate, fast postoperative recovery and low complication rate. Zhang Yan et al. [1] used small incision negative pressure suction and small incision scissors and curettage to observe the treatment of patients with armpit odor, and the results showed that the clinical therapeutic effects of the two methods were similar, but the total effective rate after the treatment of small incision scissors and curettage was slightly higher than that of minimally invasive negative pressure suction, and the removal of sweat glands by small incision scissors and curettage may be more thorough.

5. Other

In addition to the above treatment methods, there are scholars to conduct other treatment research. Qin Qin et al. [31] adopted the axillary fold incision thin flap method for the treatment of armpit odor, the total effective rate was 97.44%, and the postoperative complications were 3%, which was superior to the small incision full thick skin method for the treatment of axillary odor. Chen Bo et al. [32] found through the combined operation of negative pressure suction and scratching to treat armpit odor that this combined operation made up for the shortcomings of incomplete treatment of single operation, with fast recovery, high cure rate and low complications. Hu Xiaotao et al. [33] treated patients with bromhidrosis with small incision and used bromhidrosis clothing to assist in postoperative treatment, which could effectively avoid postoperative complications.

6. Summary and Prospect

At present, the etiology of bromhidrosis has not been fully clarified, and it is mainly believed to be related to apocrine sweat glands, genetics, and sex hormones. Surgical operation is considered to be one of the most effective methods because it can better destroy apocrine sweat glands, but surgical intervention may cause physical damage and postoperative complications. Botulinum toxin
type A injection was the most effective in non-surgical treatment. Non-surgical treatment has the advantages of less injury, rapid recovery and fewer complications, but the disadvantages are incomplete treatment and high recurrence rate. Treatment options for bromhidrosis cannot be determined solely on the basis of safety and efficacy, but should also consider other factors such as gender, age, and patient treatment needs. With the continuous development of medicine and the continuous innovation of surgical methods, the efficacy of some new technologies in the treatment of armpit odor is also being verified, and I believe that the therapeutic effect of armpit odor will be more and more ideal.

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**Conflicts of Interest**

The authors declare no conflicts of interest regarding the publication of this paper.

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