A new type of surgery for the treatment of bromhidrosis

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Abstract
It is common to treat bromhidrosis by surgery, but postoperative complications such as subcutaneous exudate and subcutaneous hematoma can occur and lead to delayed healing of the wound and eventually lead to the formation of unattractive scars. In this study, we evaluated our new surgical treatment for bromhidrosis, which we believe improves prognosis over conventional surgery. The new procedure was performed on 22 patients with bromhidrosis. Our procedure is as follows. One centimeter-long incisions are made along the skin and cleaning of the subcutaneous apocrine glands using a special serrated scraping device is completed. Then, several 0.5 cm-long drainage holes are made according to the design of the Sudoku puzzle and 4 anchoring points identified to stabilize the oil gauze. Finally, the incisions were sutured and the wound covered with a bandage.

Of 44 axillas, the bromhidrosis of 42 axillas was completely cured, and greatly reduced in 2 axillas. Local epidermal necrosis occurred in 5 axillas, but there was no full-thickness skin necrosis. Subcutaneous hematoma was not observed, and postoperative scarring was minimal. We found that our modified surgery can effectively reduce the occurrence of subcutaneous hematoma, avoid delayed healing of the wound, and minimize postoperative scarring.

Keywords: bromhidrosis, drainage, epidermal necrosis, subcutaneous hematoma

1. Introduction
Bromhidrosis is a common disease that seriously affects quality of life. The etiology for this disease is very complex. One important pathomechanism is the interaction of axillary apocrine sweat gland secretion with bacteria, which generates unsaturated fatty acids that have a particular odor. The presence of this odor is also important for the diagnosis of bromhidrosis.[1] Presently, laser interference and surgery are the most commonly used treatments for bromhidrosis.[2,3] Surgery is more preferable and commonly used for serious cases. However, postoperative complications and the formation of scars remain the problems with surgical treatment. Conventional surgery entails 1 or 2 longitudinal incisions in the axillary area, and the use of ophthalmic scissors to destroy subcutaneous apocrine sweat glands to achieve the targeted therapeutic outcomes. However, because a large area of subcutaneous skin is free after surgery, the formation of a subcutaneous hematoma cannot be fully avoided by merely applying a compressive bandage. In addition, due to the restricted number and locations of the incisions, it is difficult to drain off the subcutaneous exudate, which aggravates the subcutaneous hematoma, and directly affects the survival of the flap in the surgical area. To this end, in our new procedure, we added more anchor points and drainage holes. Results showed that a postoperative subcutaneous hematoma was effectively avoided, skin flap necrosis was reduced, and postoperative scarring was lessened. The improved scar characteristics could result in higher patient satisfaction from a cosmetic standpoint.

2. Patients and methods
2.1. Patients
This study was designed according to the Helsinki Declaration, and approved by the ethics committee of the Affiliated Hospital of Qingdao University. All patients signed the informed consent form. A total of 22 patients were treated, with an average age of 25 years (range, 16–35 years; male to female ratio, 1:4). Preoperative and postoperative assessments included the degree of odor, perspiration, hair loss, and scarring. The follow-up time was during the 3rd to 10th month after the operation. All the selected patients had bilateral bromhidrosis. Exclusion criteria were the presence of injury in the axillary fascia or axilla, and pregnancy.
3. Surgical techniques

3.1. Preoperative preparation and tumescent anesthesia

We prepared the skin of the surgical site preoperatively. The patient was placed in the supine position with his/her arms tied to a position of 90 degrees from the operating table. We adopted the designing principle of the Sudoku puzzle to mark the surgical area in advance. Using this principle, we determined the locations of the drainage holes and anchor points and sterilized the surgical area with iodophor (Fig. 1). An anesthetic consisting of a 0.4% lidocaine solution (1 ml 1:1000 epinephrine, 10 ml 2% lidocaine, and 40 ml saline) was injected in each side of the axillary fossa.

3.2. Operative method

First, we made 1 cm-long incisions along the axillary skin, and used ophthalmic scissors to separate the skin and subcutaneous tissue of the marked surgical area until it was completely detached. The thickness of the flap was similar to that of the full-thickness graft flap. Then we used a specialized serrated scraping device (Fig. 2) to remove the remaining subcutaneous apocrine glands; scraping was performed until the skin appeared slightly flushed to ensure that the apocrine glands had been thoroughly removed. Next, we made several 0.5 cm-long drainage holes at the positions marked before the surgery to drain the subcutaneous exudate and secured the oil gauze to the subcutaneous tissue at the 4 anchor points (Fig. 3). Finally, we used 6/0 monofilament nylon sutures, excluding the drainage holes, to close the incisions, wrapped the wound with sterile wound dressings, and compressed the wound with elastic bandages. It is recommended that patients restrict arm movement for 1 week after the surgery. Based on each individual patient’s progress, we removed the sutures between the 8th and 10th day after surgery, and encouraged patients to gradually return to their normal daily life.

3.3. Postoperative follow-up

The follow-up period was from the 3rd to the 10th month (the meantime was the 6th month) after surgery. Patients were informed to visit and review have their wounds evaluated in the 1st, 3rd, and 6th month after surgery.

4. Results

We reviewed and tabulated each patient’s record (Table 1). No patient experienced subcutaneous hematoma after the operation.

| Outcomes                                      | Occurrence (%) |
|-----------------------------------------------|----------------|
| Hematoma                                      | 0.0            |
| Infection                                     | 0.0            |
| Full-thickness necrosis of the flap           | 0.0            |
| Slight necrosis of the flap                   | 11.4           |
| No necrosis of the flap                       | 88.6           |
| Lack of healing                               | 0.0            |
| Delayed healing                               | 0.0            |
| Expected healing                              | 100.0          |
| Complete elimination of the underarm odor     | 95.5           |
| Significant reduction of the underarm odor    | 04.5           |
| Slight reduction of the underarm odor         | 0.0            |
| Relapse of the underarm odor                  | 0.0            |
| Obvious scar                                  | 0.0            |
| Nonobvious scar                               | 100.0          |
| High satisfaction of patients                 | 95.5           |
| Basic satisfaction of patients                | 4.7            |
| Dissatisfaction of patients                   | 00.0           |

Table 1 Investigation of postoperative outcomes.
Since Skoog and Thyresson\(^5\) introduced the surgical approach especially in women, and is tied to the familial genetic history. Unpleasant odor. Bromhidrosis is common in adolescence, reaction is unsaturated fatty acids, which give off a particularly odorous smell. One product of this reaction is unsaturated fatty acids, which give off a particularly unpleasant odor. Bromhidrosis is common in adolescence, especially in women, and is tied to the familial genetic history. Since Skoog and Thyresson\(^5\) introduced the surgical approach for the treatment of axillary hyperhidrosis in 1962, treatment has been improved, even with reports of laser interference for the treatment of secondary axillary hyperhidrosis. In our new procedure, we use a larger incision with a length of about 1 cm. This incision length allows for the use of ophthalmic scissors to eliminate the apocrine glands between the dermis and subcutaneous tissue. We also used a special serrated scraping device to remove the apocrine glands on the dermis. Some believe that this scraping device may destroy part of the dermal vascular plexus, but the results of our follow-up cases showed that when the armpit skin color is slightly red, there is only partial and not full-thickness epidermal necrosis.

The addition of drainage holes can effectively drain off subcutaneous exudate and reduce the degree of swelling. However, based on our experience, 0.3 cm-long drainage holes cannot completely eliminate congestion or exudate production. Therefore, we extended the length of the drainage holes to 0.5 cm and averaged them in the same design as the Sudoku puzzle. At the same time, we used anchors to secure the skin to the subcutaneous tissue. This method has been shown to enable adequate drainage and good fixation, which can effectively reduce the occurrence of subcutaneous hematoma, and leave less obvious scars.

In conclusion, our improved surgical procedure to treat bromhidrosis can effectively eliminate underarm odor and has a low risk of complications. This significantly improves patient quality of life postoperatively compared to that with the traditional procedure.

5. Discussion

Bromhidrosis, as an irresistible disease, not only brings discomfort to the patients, but the resultant odor significantly affects their social life. Moreover, the physical and mental status of patients is greatly affected in a negative way.\(^4\) Studies show that the axillary odor is due to the decomposition of organic compounds from the secretion of apocrine glands in the armpit, which is accomplished by the bacteria. One product of this reaction is unsaturated fatty acids, which give off a particularly unpleasant odor. Bromhidrosis is common in adolescence, especially in women, and is tied to the familial genetic history. Since Skoog and Thyresson\(^5\) introduced the surgical approach for the treatment of axillary hyperhidrosis in 1962, treatment has been improved, even with reports of laser interference for the treatment of bromhidrosis. However, for severe cases of bromhidrosis, surgical removal of the apocrine glands in the armpit remains the best option for patients.\(^6\)

As opposed to direct removal of axillary secretory glands, the small-incision operation is now widely used as postoperative scarring is minimized and limb function is maintained.\(^7\) However, due to the limitations of small incisions and blind elimination of the secretory glands, the risks of subcutaneous hematoma formation and incomplete cleaning of the apocrine glands are higher, which directly affects the postoperative survival of the flap.\(^8\) In our new procedure, we use a larger incision with a length of about 1 cm. This incision length allows for the use of ophthalmic scissors to eliminate the apocrine glands between the dermis and subcutaneous tissue. We also used a special serrated scraping device to remove the apocrine glands on the dermis. Some believe that this scraping device may destroy part of the dermal vascular plexus, but the results of our follow-up cases showed that when the armpit skin color is slightly red, there is only partial and not full-thickness epidermal necrosis.

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Author contributions

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