CASE REPORT

RF (Body Contouring Treatment) Induced Partial Thickness Burn Complicated by Cellulitis: A Case Report Following Selective Radiofrequency Therapy for Fat Reduction

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Abstract: Non-invasive body contouring has rapidly gained prominence as one of the most rapidly evolving fields in aesthetic medicine. A notable addition to this arena is Vanquish™ a novel non-invasive treatment designed to reduce waist circumference through the thermolysis of subcutaneous fat. Vanquish™ employs a selective, focus-field radiofrequency (RF) mechanism to achieve deep tissue heating, specifically targeting the abdomen and flanks. In this case report, we presented a case of partial thickness burn and cellulitis following selective contactless multipolar RF as a body-shaping treatment in a 62- year-old lady with co-morbidities and a BMI of 39.2. After the first session, the patient developed complications and was scheduled for treatments and daily dressings at the clinic. However, she expressed a preference for self-dressing at home. This case highlights the importance of patients following up with healthcare providers, communicating any changes in their condition, and adhering to recommended referral pathways to ensure appropriate and timely medical care. Complications can best be avoided through proper patient selection, adequate counselling, and ensuring sufficient hydration before and after the procedure.

Keywords: Burns, Cellulitis, Non-invasive body contouring, Radiofrequency, Subcutaneous fat

Introduction

Abdominal adiposity, the accumulation of fat in the abdominal area, is recognized as a significant risk factor for cardiovascular diseases and diabetes. Beyond its impact on physical health, obesity can also lead to concerns about appearance, potentially resulting in psychological issues [1]. The proposed biological mechanism behind this is the dysregulation of the hypothalamic–pituitary–adrenocortical (HPA) axis and its overactivity due to obesity, particularly abdominal obesity [2]. This theory aligns with findings that associate abdominal adiposity with anxiety and depression in both males and females [1].

The intersection of health and aesthetics has driven a gradual increase in the demand for fat reduction and body-shaping procedures [3]. While liposuction remained the most common surgical procedure in 2022, non-surgical and non-invasive fat reduction methods have also gained popularity, with an estimated annual growth rate of 21% [4]. Recent global survey data from the International Society of Aesthetic Plastic Surgery (ISAPS) found that non-surgical fat reduction is among the top five most popular non-surgical procedures [5]. Several techniques aim to reduce localized fat deposits without the need for surgery, including cryolipolysis, low-level lasers, high-intensity focused ultrasound (HIFU), and radiofrequency (RF) devices.

The body contouring device using RF employs selective focused-field RF to heat subcutaneous adipose tissue. The key principle is the targeted application of RF energy to adipose tissue while minimizing its impact on the skin. The differentiation in water content and impedance between adipocytes (fat cells) and the skin allows for focused energy delivery [6]. Adipose tissue, being higher in impedance and lower in water content compared to the skin, selectively absorbs and retains RF energy. This selective absorption generates heat primarily within the subcutaneous adipose tissue. The goal is to induce heat that leads to fat cell disruption or reduction without significantly affecting the surrounding skin. The ability to concentrate RF energy in the target tissue, based on differences in water content and impedance, is a key feature of the technology [6].

While contactless selective RF devices are designed to minimize direct contact with the skin, it is crucial to recognize that adverse effects or complications, such as burns, may still occur. Even without direct contact, the transfer of energy through the skin carries inherent risks, and individual responses can vary. Advances in technology, proper training of practitioners, and adherence to safety protocols aim to minimize these risks. Nonetheless, as with any medical procedure, there are potential risks, and patients should be informed about possible complications before undergoing treatment. In this report, the authors present a previously unreported case of partial thickness burn and cellulitis following non-invasive selective RF therapy (Vanquish™) for fat reduction.

Case Presentation

A 62-year-old woman with a history of obesity, type 2 diabetes, hypertension, and a minor stroke with no residual weakness sought treatment at an aesthetic clinic for weight loss management. Her initial anthropometric measurements **(Table 1)** included a weight of 91.7 kg, a height of 153 cm, and a body mass index (BMI) of 39.2 kg/m^2, classifying her as obese class II. Her body fat percentage was 46%, visceral fat was 16%, and water content was 42.7%, as measured by bioelectrical impedance analysis (BIA) (Tanita Body Composition Analyzer, BC-418). Her abdominal circumference measured 42.5 inches in the upper abdomen, 44 inches in the middle abdomen, and 47.5 inches in the lower abdomen. Her blood sugar levels ranged between 3.0 and 8.0 mmol/L at home, and her blood pressure was 130/85 mmHg prior to treatment.

She was presented with several options for managing her weight, including oral weight loss medication, subcutaneous weight loss injections, and non-invasive RF machines. Due to her frequent hypoglycaemic episodes, she was advised against oral and subcutaneous injection treatments. She chose to try an inch-loss treatment using a contactless RF machine. On examination, she had a flabby stomach but with healthy skin. There were no signs of skin excoriation or non-healing wounds on the abdomen.

The treatment was performed according to the protocol. The patient lay beneath the device with the applicator positioned approximately 1 cm away from the skin, using a standard supplied spacer to standardize the distance and deliver RF-based energy. An initial power setting of 180W was used, with average tuning between 95% and 100%, and skin temperature was checked every 15 minutes using an infrared thermal imager.

Table 1 Anthropometric measurement, abdominal circumference and vital signs of the patient.

Parameters	Measurement
Anthropometric measurements	
Weight	91.7 kg
Height	153 cm
Body mass index (BMI)	39.2 kg/m²
Body fat percentage	46 %
Visceral fat percentage	16 %
Body water percentage	42.7 %
Abdominal circumference	
Upper	42.5 inches
Middle	44.0 inches
Lower	47.5 inches
Blood pressure	130/85 mmHg
Blood sugar level	3.0- 8.0 mmol/L

During the treatment, she did not report any direct skin contact with the machine but experienced some hotspots after 15 minutes. At that point, her skin temperature ranged between 39.4°C and 40.2°C, which was within the therapeutic range for fat apoptosis (39°C to 42.5°C). She was reassured, and the treatment continued for a total of 45 minutes. By the end of the procedure, the patient had no complaints.

On Day 1 post-treatment, the patient developed redness and discomfort on both sides of the abdomen. Subsequently, on Day 2, she developed several blisters in the bilateral hypogastric region. On examination, there were blisters on the right hypogastric region, located 6 cm superolateral to the anterior superior iliac spine (ASIS), measuring 4 x 3 cm. Additionally, two blisters were observed in the left hypogastric region: one 10 cm superior to the ASIS, measuring 1x1 cm (ruptured), and another 2x2 cm intact blister with erythematous surrounding skin and tenderness upon light palpation **(Figure 1).**

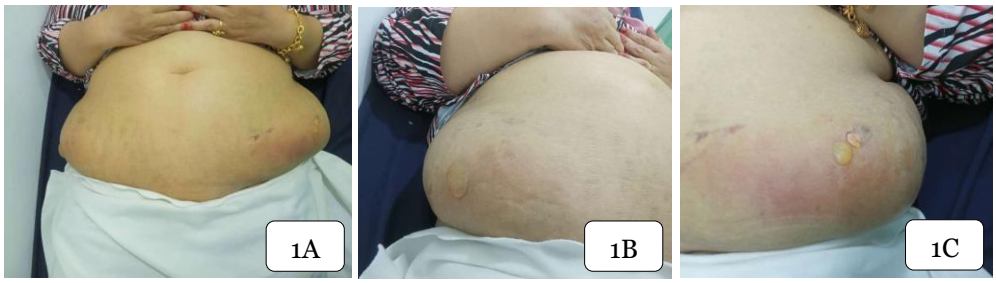

Figure 1A Blisters in the bilateral iliac fossa.; **1B** Blister in the hypogastric region (size 4x3 cm); **1C** Blister (size 2x2 cm) and a ruptured blister in the left hypogastric region.

She was prescribed with prophylactic amoxicillin tablets (500 mg three times daily for one week) to prevent bacterial infection as patient is diabetic and at risk of getting infection, moist exposed burn ointment (MEBO) cream application every 6 hours, and paracetamol tablets (1 g as needed). She was also advised on maintaining good hygiene and attending daily dressings at the clinic. However, the patient chose to perform normal saline dressings at home, MEBO ointment application every 4 to 6 hours and covering the wound with gauze and Tegaderm. She was followed up once a week at the clinic. The wound initially developed dry, necrotic patches, which eventually detached after three weeks **(Figures 2A and 2B)**. Later, the wound exhibited granulation tissue mixed with pus discharge **(Figure 2C).**

Despite advice and a hospital referral, the patient insisted on continuing her daily self-dressing routine at home. Additionally, her blood sugar levels were poorly controlled, ranging from 8 to 10 mmol/L. After two months, the wound and swelling on the left side worsened. Examination revealed that the wound over the right hypogastric region had healed well, showing

Figure 2A Ruptured abscess wound, 5 cm in size, with a dry necrotic patch 1 cm apart over the left hypogastric region; **2B** Surrounding skin erythema with a dry necrotic patch measuring 6x6 cm; **2C** Ruptured abscess wound, 2 cm in size, with an ulcerated wound 4 cm wide and 2 cm deep, showing moderate pus discharge, surrounded by soft tissue swelling and erythema in the left hypogastric region.

no redness or tenderness. However, the swelling in the hypogastric area had increased in size to 10x6 cm and was erythematous, indurated, tender, and discharging pus. The patient was hospitalized and treated for an abdominal wall abscess with cellulitic changes. She received a 10-day course of intravenous (IV) Augmentin, along with daily normal saline dressings, and was discharged in good condition **(Figure 3).**

Figure 3 Skin burn healed well following intravenous antibiotic treatment and daily dressings.

Discussion

Radiofrequency technology is an effective, non-invasive aesthetic treatment commonly used for reducing circumference and improving abdominal contouring [7]. The medical application of RF involves an oscillating electrical current that causes collisions between charged molecules and ions, which are then converted into heat. When the temperature of subcutaneous tissue reaches 44-45°C, apoptosis of adipocytes occurs with minimal impact on the skin, muscle, and other internal organs [8]. The tissue heating produced by RF induces different biological and clinical effects depending on the depth of the targeted tissue and the frequency used [9]. **Table 2** illustrates the heat effects on cells or tissues.

Selective focused field RF therapy works by overheating fat without direct contact with the patient's body, targeting the adipose tissue layer while minimizing the risk of overheating the skin, muscle, or internal organs. Complications such as second- and third-degree burn injuries are typically associated with percutaneous RF treatments but are less common with transcutaneous RF [10]. Reports of RF burn injuries related to Magnetic Resonance Imaging (MRI) accidents indicate that such burns most frequently occur when the human body comes into contact with an object [11,12].

Table 2 Heat effects on cells/tissues

Temperature	Effect on cells/tissues
40 – 45°C	Denaturation of protein and collagen in skin [8].
42°C	Maximum temperature for skin and muscle [8].
44 – 45°C	Apoptosis of adipocytes [8].
>49 °C	Second-degree burn occurs [24]

As the RF field heats the human body, the accumulation of heat on the skin may be a key factor in RF burn injuries in this patient. The patient subsequently developed an infection following a thermal burn, complicated by underlying poorly controlled diabetes mellitus.

Studies have shown that diabetic patients are more likely to experience complications after burns, with infections being more prevalent compared to non-diabetic patients [13]. Therefore, strict diabetic control should be advised before the procedure, as complications from the RF device can be exacerbated by poorly managed diabetes mellitus. Other possible side effects include pain during or after the procedure, swelling, temporary increased skin sensitivity to heat, and occasional excessive sweating at the end of the treatment [8].

Superficial partial thickness burn management

In this patient, the progression of a superficial second-degree burn to skin necrosis, involving partial thickness of the skin extending from the epidermis into part of the dermis, is rather unusual. Normally, first-degree and superficial partial thickness burns heal with conservative treatment and do not result in scar development [14]. For both acute and chronic wound, wound toilet or wound bed preparation is considered the first step in the local treatment. This process involves removing the slough, non-vital tissue, and necrosis tissue through thorough cleaning and mechanical debridement. This approach helps reduce bacterial load and stimulates granulation tissue formation. Generally, cleaning the wound with sterile water is sufficient to remove debris. Management of blisters in patients with partial thickness burns is controversial; however, compelling evidence suggests that small blisters (less than 6 mm) should be left intact, while large blisters with thin walls should be debrided [15].

Topical antimicrobial agent or an absorptive occlusive dressing should be used in treating partial-thickness burn to reduce pain, promote healing, and prevent wound desiccation. A commonly used topical antimicrobial agent is silver sulfadiazine (SSD) [16]. However, for this patient, we prescribed MEBO ointment as the topical treatment. This oil- based herbal paste Moist Exposed Burn Ointment (MEBO) or Moist Exposed Burn Therapy (MEBT) was created in Beijing in 1989. Its main ingredient is beta-sitosterol, which is a plant-derived sterol with reported anti-inflammatory, antibacterial, and analgesic properties [17-19]. Additionally, supportive pharmacological treatment, such as oral analgesics (e.g., paracetamol tablets), was also administered to the patient.

In order to facilitate tissue regeneration, the ideal wound dressing should be easy to apply and remove, protect the wound, provide a moist environment and maintain an appropriate wound temperature [20]. Particularly, a moist wound dressing as it creates a desired environment that helps to accelerate wound healing process thus promote tissue regeneration and lowers the risk of infection, scarring, and discomfort. Moist dressings can be categorized into films, foams, hydrocolloid dressings, hydrogels, and alginate dressings [21].

Dressing changes are mostly dependent on the condition of the wound and can be unpredictable. The dressing's absorptive capacity and its integrity in terms of structure or attachment to the wound are the two main variables that affect how long it takes to wear out. Dressing changes should be frequent enough to control exudate but not so frequent as to interfere with wound reepithelialisation. Depending on the type of dressing, changes can vary from 2 to 7 days [21]. For this patient, a film dressing (Tegaderm and gauze) was used, with MEBO ointment applied every 4 to 6 hours. Since patient is diabetic and at risk of infection, prophylactic oral antibiotics were started. However, a systematic review showed that prophylactic systemic antibiotics are not recommended for burns [22]. In order to reduce the length of empirical antibiotic therapy, early specimen collection for microbiological testing of the wound is advocated. This enables early drug adjustments based on the detected microbial flora thus preventing the emergence of multi-drug resistance bacteria and improve the precision and efficacy of therapy [23].

Conclusion

In conclusion, the increasing use of selective RF therapy for abdominal weight loss raises the risk

of skin burns at the treatment site. As demonstrated in our case report, there remains a risk of skin burns even when all appropriate guidelines and protocols are followed. Although there have been no reported cases of second-degree burns with this machine, such complications are significant and may require long-term follow-up and wound care, especially in patients with underlying medical conditions. Chronic illnesses such as hypertension and diabetes must be well-controlled, as maintaining stable blood pressure and glucose levels supports burn wound healing and helps prevent secondary complications like infection and ulceration. Adjusting medications and implementing dietary changes, such as a low-salt and low-glycemic diet, can further enhance the healing process. Additionally, proper wound care and patient adherence to post-care advice are essential for achieving better outcomes.

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Potential Conflict of Interest

Authors declare no potential conflict of interest.

References

1. Kivimäki M, Batty GD, Singh-Manoux A, Nabi H, Sabia S, Tabak AG, et al. Association between common mental disorder and obesity over the adult life course. The British Journal of Psychiatry. 2009;195(2):149–155.
2. Lucassen EA, Cizza G. The hypothalamic-pituitary-adrenal axis, obesity, and chronic stress exposure: sleep and the HPA axis in obesity. Current Obesity Reports. 2012; 1(4):208–215.
3. Qin J, Guo ME, Xu XG, Zhang C, Yu CQ, Li YH, et al. A clinical evaluation of noninvasive and contactless radiofrequency technique in the treatment of abdominal fat. Journal of Cosmetic Dermatology. 2021; 20(9): 2765–2768.
4. Mulholland RS, Paul MD, Chalfoun C. Noninvasive body contouring with radiofrequency, ultrasound, cryolipolysis, and low-level laser therapy. Clinics in Plastic Surgery. 2011;38(3):503–520.
5. ISAPS. International survey on aesthetic /cosmetic procedures. 2022. Available from: https://www.isaps. org /media/a0qfm 4h3/ isaps-global-survey_ 2022.pdf
6. Agochukwu-Nwubah N, Mentz H. Paradoxical adipose hyperplasia after noninvasive radiofrequency treatment: a novel report and review. Journal of Cosmetic Dermatology. 2020; 19(4):866-888.
7. Choi SY, Kim YJ, Kim SY, Lee WJ, Chang SE, Lee MW, et al. Improvement in abdominal and flank contouring by a novel adipocyte-selective non-contact radiofrequency device. Lasers in Surgery and Medicine. 2018 ;50(7):738-744.
8. Fajkošová K, Machovcová A, Onder M, Fritz K. Selective radiofrequency therapy as a non-invasive approach for contactless body contouring and circumferential reduction. Journal of Drugs in Dermatology. 2014;13(3):291-296.
9. Downie J, Kaspar M. Contactless abdominal fat reduction with selective RF™ evaluated by magnetic resonance imaging (MRI): Case study. Journal of Drugs in Dermatology. 2016;15(4):491-495.
10. Duncan DI. Complications of Treatment with Radiofrequency in Aesthetic Medicine. Karger Publishers; 2014.
11. Delfino JG, Krainak DM, Flesher SA, Miller DL. MRI-related FDA adverse event reports: A 10-yr review. Medical Physics. 2019;46(12) :5562–5571.
12. Shellock FG. Radiofrequency energy-induced heating during MR procedures: a review. Journal of Magnetic Resonance Imaging. 2000;12(1):30–36.
13. Sayampanathan AA. Systematic review of complications and outcomes of diabetic patients with burn trauma. Burns. 2016;42(8):1644–1651.
14. Ahuja RB, Gibran N, Greenhalgh D, Jeng J, Mackie D, Moghazy A, et al. ISBI practice

guidelines for burn care. Burns. 2016;42(5): 953–1021.
15. Sargent RL. Management of blisters in the partial-thickness burn: An integrative resea-rch review. Journal of Burn Care & Research. 2006;27(1):66–81.
16. Lloyd EC, Rodgers BC, Michener M, Williams MS. Outpatient burns: Prevention and care. American family physician. 2012;85(1):25-32.
17. Nirmal SA, Pal SC, Mandal SC, Patil AN. Analgesic and anti-inflammatory activity of β-sitosterol isolated from Nyctanthes arbortristis leaves. Inflammopharmaco-logy. 2011;20(4):219 –224.
18. Loizou S, Lekakis I, Chrousos GP, Moutsatsou P. β-Sitosterol exhibits anti-inflammatory activity in human aortic endothelial cells. Molecular Nutrition & Food Research. 2010;54(4):551–558.
19. Gupta MB, Nath R, Srivastava N, Shanker K, Kishor K, Bhargava KP. Anti-inflammatory and antipyretic activities of β-sitosterol. Planta Medica. 1980;39(06) :157-63.
20. Jones V, Grey JE, Harding KG. Wound dressings. British Medical Journal. 2006;332(7544):777–780.
21. Nuutila K, Eriksson E. Moist wound healing with commonly available dressings. Advances in Wound Care. 2021;10(12):685-698.
22. Avni T, Levcovich A, Ad-El DD, Leibovici L, Paul M. Prophylactic antibiotics for burns patients: Systematic review and meta-analysis. British Medical Journal. 2010;340:c241.
23. Ji S, Xiao S, Xia Z. Chinese Burn Association Tissue Repair of Burns and Trauma Committee, Cross-Straits Medicine Exchange Association of China. Consensus on the treatment of second-degree burn wounds (2024 edition). Burns Trauma. 2024;12:tkad061.
24. Moritz AR, Henriques FC. Studies of Thermal Injury: II. The Relative Importance of Time and Surface Temperature in the Causation of Cutaneous Burns. The American Journal of Pathology. 1947;23(5):695-720.