

Full Length Research Paper

Clinical investigation of CT-guided ozone-blowing and fumigation therapy for the chronic refractory cutaneous sinus and ulcer

Meng-Qi Wei¹, Jian-Shou Zhou¹, Hai-Tao Liu², Yuan Yuan¹, Jun-Qing Xu¹, Yong Yang¹, Jin-Song Zhang¹, Yong Peng^{1*} and Yi Huan^{1*}

¹Department of Radiology, Xijing Hospital, Fourth Military Medical University, Xi'an, China.

²Department of Cardiology, Xijing Hospital, Fourth Military Medical University, Xi'an, China.

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The purpose of this article is to investigate the clinical effect of CT-guided ozone-blowing and fumigation in the treatment of chronic refractory cutaneous sinus and ulcer. Twenty-six cases of chronic refractory sinuses and ulcers caused by different diseases were retrospectively analyzed in our study. After sterilization, all patients were scanned by computed tomography and the sinuses and ulcers pre-located by CT were treated by O₃-blowing and fumigation. Twenty-one patients treated with traditional surgery were randomly assigned into control group. A total number of 15 patients were completely cured in 45 days after receiving CT-guided ozone-blowing fumigation treatment. Four patients exhibited markedly therapeutic effects and three cases showed improvement. The effective ratio was 85%. In control group, seven patients were completely cured in 45 days after being treated by traditional surgery. Four patients exhibited markedly therapeutic effects and five cases showed improvement. An obvious statistical difference exists between two groups. Application of CT-guided O₃-blowing and fumigation therapy is an effective approach in the treatment of chronic refractory cutaneous ulcer and sinus with shorter therapeutic duration, less suffering, better curative effect and less adverse effect.

Key words: Computed tomography, ozone, blowing, fumigation, sinus, ulcer.

INTRODUCTION

Chronic refractory sinus and ulcer are mainly caused by traumatic infection, abscess formation, poor drainage of abscess incision or foreign bodies stimulation, repeated infection of the unhealed wound and hyperplasia of connective tissues surrounding the wound. The mechanism of the disease is very complex and it is very hard to be cured. Although traditional methods including excision, drainage or antibiotics can provide certain effects, big surgical trauma, low recovery rate, long recuperative time and high recurrence rate significantly limited the therapeutic effects. Meanwhile, these methods might worsen the patient's condition and lead to greater problems for further therapy. Thus, new approach should be applied to offer

more clinical benefits. Ozone (O₃) has strong oxidative, anti-inflammatory and analgesic effects and it has been widely used in many aspects in recent years with deeper understanding. However, little data was available about its distinct roles in the treatment of sinus and ulcer. In this study, we attempted to treat chronic refractory cutaneous sinus and ulcer with O₃-blowing and fumigation which was guided by computed tomography (CT). All patients were retrospectively analyzed to evaluate the effect of CT-guided O₃-blowing and fumigation treatment in chronic refractory cutaneous sinus and ulcer.

MATERIALS AND METHODS

General data

From October 2006 to December 2008, 26 patients (17 male, 9 female) were randomly enrolled in ozone treatment group and another 21 patients (15 male, 6 female) were randomly assigned

*Corresponding authors. E-mail: wangshengshao@fmmu.edu.cn. and huanyi@fmmu.edu.cn

Abbreviation: CT, Computed tomography.

Table 1. The patients' data of two groups.

Groups	Number	Average age	Male	Average depth
Ozone	26	51.5	17	4.3
Surgery	21	48.4	15	4.7

No significant difference was seen between the two groups.

Table 2. The different causes of ulcer and sinus in two groups.

Groups	Surgery operation	Comminuted fracture	Buttock injection	Cervical tuberculosis	Varix rupture	Diabetic foot
Ozone	15	3	1	3	1	3
Surgery	9	3	2	2	3	2

No significant difference was seen between the two groups.

into traditional surgical group. The general data of two groups showed as Tables 1 and 2.

Treatment protocols

All patients were examined by CT scanning to determine whether there was abscess or the sites of abscess in the sinus and whether it communicated with the outside. Then, the course and depth of sinus or ulcer were identified and measured. Based on the scanning results, pre-treatment was processed, which included cleansing the wound surface, sucking pus with paracentetic needle, exposing the wound surface after scoraping the hyperplastic fibrous tissues and clearing the pus and necrotic tissues within the sinus or ulcer.

After the clearance of sinus, optional catheter was selected and inserted 2.0 - 3.0 mm above the sinus bottom under the guidance of CT. Through the catheter, O₃ at the concentration of 40 µg/ml was blown into for 5 min. Then the catheter was removed out and drainage gauze was placed. The treatment was operated every other day until the sinus was cured.

The outside ulcer of sinus was covered by sterilized dressings which was rounded by a 5 F sheath (Cock Company) and then covered by adhesive tape to form a relatively closed cavity. The air within the cavity was drawn out through the sheath. 30 ml O₃ at the concentration of 40µg/ml was injected through the sheath and the O₃ fumigation was lasted for 20 min. This treatment was operated 1 time per day until the ulcer was cured.

In traditional surgery group, the surgical procedure was carried out as mentioned in the previous study (Zhang et al., 2008).

Therapeutic effects evaluation

The standards of therapeutic effects evaluation were described as follows:

Cured: The sinus or ulcer is healing with scar. Markedly effective: the diameter of the sinus or the size of the ulcer is less than half of the original with less secretion.

Effective: the diameter of the sinus or the size of the ulcer is decreased but still larger than half of the original. Invalid: no evident morphological change can be observed.

Statistical analysis

All data were expressed as means ± S.E.M. Statistical software. Graph pad Prism 5.0 was used and all values were analyzed using X²-test. Differences were considered statistically significant if P < 0.05.

RESULTS

After receiving CT-guided ozone-blowing and fumigation treatment, 15 of the 26 patients with chronic refractory sinus and ulcer were cured, four showed markedly effects and three were improved. The effective ratio is about 85%. The other four cases (1 caused by reliquus suture left in the sinus, 1 by patch left after herniorrhaphy, 1 sequestrum residue because of traumatic fracture and 1 inadequate drainage of mammary abscess) were invalid. However, the ratio of effectiveness in traditional surgical group was lower than it is in the ozone group (P < 0.05), which is shown in Table 3.

DISCUSSION

Nowadays, the non-surgical treatments for chronic refractory cutaneous sinus or ulcer include systemic antibiotics administration, local dress changing and sinus scoraping. Surgical treatments include expanding incision and drainage of sinus or fistula, skin flap transplantation and debridement and suturing. Other therapies include hyperbaric oxygen, ultraviolet irradiation of autogenous blood, microwave treatment and medical dipping. However, all these methods can not give satisfactory results because of poor blood supply, multiplicity of infection and granulation tissue formation within or around the sinus and ulcer. On the other hand, the trauma of surgical injury to sinus or ulcer is heavier and the treatment may be incomplete.

Table 3. The different treatment results of two groups.

Groups	Cured	Effective	Improvement	Invalid	Ratio of effectiveness (%)*
Ozone	15	4	3	4	85.61
Surgery	7	3	5	6	71.42

*Significant difference was seen between the groups.



Figure 1. Images in a 45-year-old woman with cutaneous ulcer. (A) Right lower limb cutaneous ulcer due to varicose veins. (B) The ulcer was cured 25 days after treatment using O₃.

Recently, O₃ treatment is considered as an innovative therapeutic strategy, especially for the sinus and ulcer. Many studies (Ross et al., 2002) have shown that O₃ has strong oxidative, anti-inflammatory and contrastimulant effects. It facilitates the formation of free radical enzymes and reactive oxygen. Oxygen free radical is a strong polar group and the bacteria in the wound surface appeared to be the target of free radicals. Oxygen free radical would change the structure of the unsaturated fatty acids of the bacteria membrane and subsequently caused fatal damage (Menabde et al., 2006). Reactive oxygen provides a favorable circumstance for normal cells to repair and regenerate and to promote sinus healing. A certain concentration of O₃ can promote oxidase over-expression (Lua and Glukhov, 2001), which neutralizes excessive reactive oxidation products and cytokines during inflammatory responses, thus, dilates blood vessels, increases blood oxygen content and accelerates soft tissue healing (Figure 1).

As for the sinus by tubercle bacillus infection (Figure 2A), it is a kind of anaerobic bacteria and its pathogenicity is correlated to the lipid component, in particular the derivant of glycolipids, known as cord-like factor. O₃ increases the activity of free radical enzymes and promotes lipid decomposition and consumption and ultimately decreases the tubercle bacillus' pathogenicity and facilitates sinus healing (Figure 2B).

In present study, we took full advantages of CT scanning technique to determine whether there was abscess in the sinus and the site of abscess and to determine whether it communicated with the outside. The course and depth of sinus or ulcer was carefully identified and measured. All the therapeutic procedures were based on the scanning results. CT scan guarantees complete drainage and ensure that cavity was thoroughly filled with O₃.

O₃ concentration is another key factor to determine the curative effect. The concentration from 20 to 40µg/ml can fully activate the immune response. Therapeutic concentrations of active oxygen promote the production of lipid peroxides and O₃-like peroxides in the blood. These active peroxides transit into the cytoplasm and activate nuclear factor-KB and then promote cell gene transcription and translation, accelerate the release of cytokines, which exhibit anti-inflammatory and immunity effects (Hanley et al., 2004). Tafil-Klawe et al. (2002) reported that O₃-bathing could cure chronic skin ulcer with high efficiency and low amputation rate.

In conclusion, the CT-guided O₃-blowing and fumigation treatment for chronic refractory cutaneous sinus or ulcer, characterized by simple operation, low charge, quick healing of sinus or ulcer and satisfactory effect is a convenient and feasible method without surgery. The curative effect of the 26 cases is notable. However, few



Figure 2. Images in a 36-year-old woman with cutaneous sinus. (A) Left cervix refractory cutaneous sinus from tubercle bacillus infection. (B) The sinus was cured two weeks after treatment using O₃.

cases were investigated and the long-term efficacy should be studied in further investigations.

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