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Review Article

Superficial Radiotherapy (SRT-100) as an Effective Noninvasive Treatment for Pyogenic Granuloma: Case Report and Literature Review

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Introduction. Pyogenic granuloma (PG) is a common condition characterized by the appearance of a small raspberry-like vascular growth that may appear on any part of the skin. PG usually occurs secondary to acute or chronic trauma. The primary treatment for PG is noninvasive therapy. In refractory cases, surgical resection is an alternative. Superficial radiation therapy system (SRT-100) is a new technology that uses low-energy radiotherapy to treat nonmelanoma skin cancers. SRT may also be used for the treatment of patients with PG who are unwilling to undergo surgery. *Case Presentation*. A 27-year-old woman presented with a recurrent neoplasm in the middle finger of the left hand after surgical resection. She refused to undergo reoperation or other aggressive options such as electrocautery or liquid nitrogen cryotherapy, so we prescribed only superficial radiotherapy (SRT-100) alone, with a total dose of 14 Gy in four fractions. *Conclusion*. The neoplasm gradually flattened after treatment with 14 Gy in four fractions and disappeared completely 3 months after completion of treatment.

1. Introduction

Pyogenic granuloma (PG) is a common dermatologically benign neoplasm presenting primarily as an exophytic mass in the trunk of the extremities, which is fragile in consistency, hemorrhagic on palpation, and refractory to spontaneous arrest. PG should be treated with noninvasive therapies, such as common salt under occlusion. In refractory cases, surgical resection can be an alternative. However, superficial radiation therapy (SRT) is recommended in patients who are unwilling to undergo surgery or whose conditions are not suitable for a surgical procedure. Furthermore, SRT can effectively remove the hyperplastic mass, which is described in the following sections.

2. Case Report

A 27-year-old woman presented with a neoplasm in the middle finger of the left hand, without itching, pain, or any other specific discomfort. Without proper medical treatment, the neoplasm gradually enlarged, leading to uncontrollable spontaneous bleeding after trauma. Then, the patient sought medical attention in a local hospital, where the neoplasm was removed surgically. Briefly, the surgeon removed the entire lump in the finger, expanded the wound area by 1 mm, and then sutured the wound. Approximately 3 months later, the neoplasm recurred at the original site and rapidly enlarged in the short term. Then, the patient came to our hospital for further treatment.

The patient refused to undergo reoperation or other aggressive options such as electrocautery or liquid nitrogen cryotherapy; therefore, we prescribed only superficial radiotherapy (SRT-100) alone. The radiation volumes included all areas involved with PG; the regimen consisted of 14 Gy in four fractions given once per week for 4 weeks, with a voltage of 70 kV and 3.5 Gy per fraction. The skin lesion was photographed before treatment, at the time of completion of four treatments, and 3 months after completion of treatment. The neoplasm in the finger of the left hand

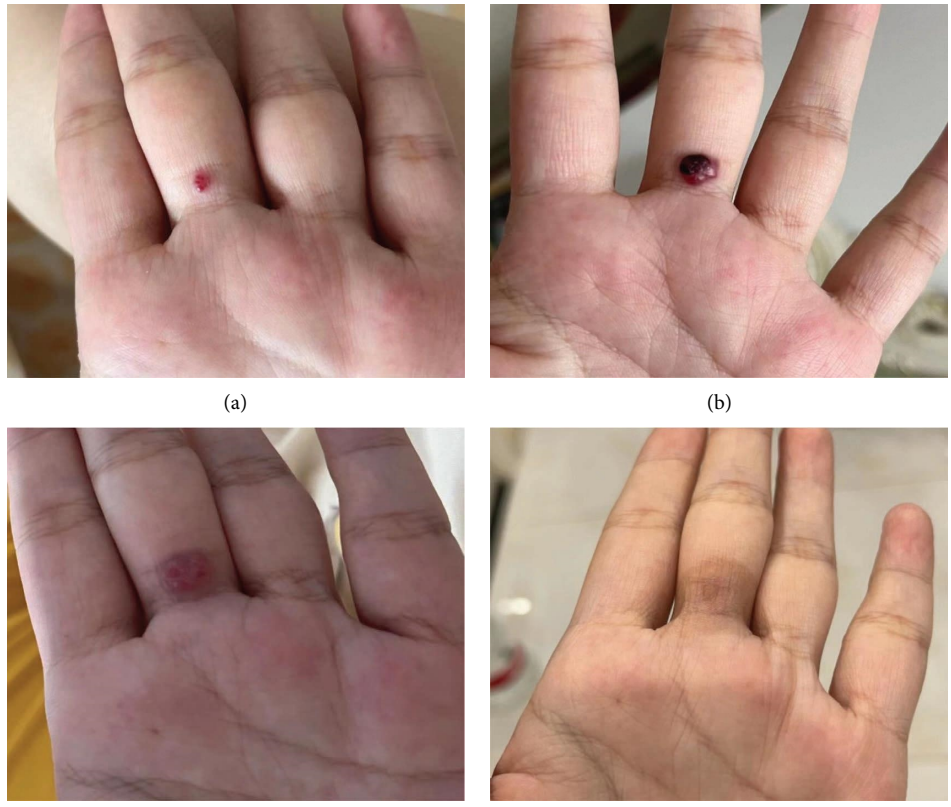

Figure 1: Pyogenic granuloma located on the patient's middle finger in the left hand. (a) Recurrence of a neoplasm after surgical removal. (b) Progressive enlargement of the neoplasm. (c) The neoplasm flattened after treatment with 14 Gy in four fractions. (d) Three months after completion of treatment, the neoplasm disappeared completely, leaving pigmentation.

Table 1: Patient's superficial X-ray radiation therapy plan.

Location	Voltage (kV)	Single radiation dose (Gy)	Frequency	Fractions	Total dose (Gy)
Left hand	70	3.5	Once a week	4	14

gradually flattened after treatment with 14 Gy in four fractions and disappeared completely 3 months after completion of treatment. After 1 year of follow-up, no recurrence was observed (Figure 1 and Table 1).

3. Discussion

Pyogenic granuloma or lobular capillary hemangioma was first described by French surgeons Antonin Poncet and Dor [1] in 1897, and it was first named botryomycosis hominis. PG is a commonly occurring benign vascular tumor that is small, round, and usually bloody red. It frequently involves the periungual tissues and presents as an exophytic mass on both mucosa and skin due to different factors [2]. Furthermore, PG usually occurs secondary to acute or chronic trauma, infection, drug use, or the hormonal changes of pregnancy [3]. Bigby and Stern reported a case of PG caused by the overgrowth of the distal and lateral nail folds, with the association of excess granulation tissues [4]. Systemic retinoids are known to cause PGs, and they are rarely reported as a side effect of isotretinoin. Kathleen reported four cases of PGs that were observed during isotretinoin therapy [5]. Robert reported that osimertinib and ramucirumab also induce PGs. Others reported the occurrence of PGs followed by burn wounds or being secondary to infection by *Botryomyces* species or pyogenic bacteria, specifically *Staphylococci* species [6–8].

Traditional noninvasive treatment modalities include topical beta-blockers: timolol, imiquimod, and corticosteroids. Furthermore, lesions can be removed by promoting vasoconstriction and downregulating proangiogenic factors such as vascular endothelial growth factor A, matrix metalloproteinase-1, and interleukin-6; topical corticosteroids potentially target several key pathways implicated in the pathogenesis of PG [9–11]. Recently, the use of common salt under occlusion has emerged as a first-line treatment. It is simple, inexpensive, scar-free, and recurrence is very rare [12]. For periungual PGs, treatment with topical steroids under occlusion and topical antibiotics for 2-3 weeks is suggested in the literature [3]. Topical treatment may be continued until improvement is noted; if PG fails to improve, or if adverse effects are noted, an alternative topical

agent or procedure may be pursued. Lesions that exhibit concerning features should be evaluated and may require a biopsy as infectious, malignant, or other vasoproliferative lesions remain on the differential diagnosis [13].

In patients in whom topical treatment is insufficient, surgical curettage is performed under local anesthetic [3]. First-line invasive treatments for PG include full-thickness excision. A previous study reported that excision of PGs followed by primary closure resulted in minimum recurrence among 408 patients [14]. For patients who refuse surgery or whose conditions are not suitable for a surgical procedure [15], other noninvasive treatments include liquid nitrogen cryotherapy, laser therapy, and skin grinding therapy. These methods can rapidly remove skin lesions, but in many patients, scarring and pigmentation may occur at the site of treatment. In addition, soon after treatment, the recurrence rate of lesions at the same area is high. Thus, there is an urgent need for a new noninvasive therapy that is cost-effective and scar-free and reduces the risk of recurrence.

Radiation therapy (RT) can be used as an alternative to surgery in inoperable cases. The goal of RT is to achieve tumor control by inhibiting tumor cell proliferation and reducing the recurrence rate [16]. For RT, photon or electron beams can be used. Appropriate electron beam energies can reduce damage to deeper structures; the use of a photon beam is recommended when the disease is associated with an adjacent lesion. However, entry-surface doses are too low with electrons and require a bolus in contact with the skin [17], which poses a change in calculating the exact dose of each beam. In addition, the radiation energy generated by a linear accelerator is high and can damage vital organs and tissues, so it is not suitable for treating lesions around important glands. Furthermore, this treatment is not suitable for underage population.

Since the 1950s, superficial X-rays have been used to treat skin tumors such as basal and squamous cell carcinomas [18]. Electron beam treatments produce comparable results to soft X-rays in the treatment of these diseases; however, the implementation of soft X-rays is much simpler and cost-effective [19]. The superficial radiotherapy system (SRT-100) precisely calculates the dose required and directs the radiation beams to the target site so that the radiation can be concentrated on the superficial part of the skin while minimizing damage to normal cells. For treating most skin lesions, particularly those around the eyes and glands, SRT-100 is preferable due to ease in field shaping, as well as superior protection to sensitive nearby structures from scatter radiation. In the case of our patient with PG, the mass disappeared completely 3 months after completion of treatment, very few significant adverse reactions were observed, only pigmentation remained, and no recurrence was observed after 1 year of follow-up. It should be noted that SRT-100 has strict radiation dose limitations and cannot be used multiple times or at excessive doses. The SRT-100 treatment is not suitable for pregnant and lactating women, which is a limitation of this treatment. In addition, after treatment, there will be significant pigmentation on the skin of patients, and very few patients experience tingling reaction after receiving SRT-100 treatment, but this tingling reaction can disappear on its own after a few days to weeks.

4. Conclusions

Radiation therapy is a relatively safe treatment option for PG patients; it leaves no obvious scarring, does not lead to limb disability, and has few adverse effects. However, it may leave residual pigmentation. SRT could be a well-tolerated alternative treatment in refractory cases to noninvasive therapies such as common salt under occlusion, but whether it can be a definitive and potentially curative treatment option for PG requires further research with longer-term follow-up.

Ethical Approval

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (ethical code of the Università degli Studi della Campania "L. Vanvitelli," approved with D. R. 992/2012) and with the Helsinki Declaration of 1964, as revised in 2013.

Consent

Informed consent was obtained from the patient for being included in the study.

Disclosure

Conflicts of Interest

The authors declare that they have no conflicts of interest to report regarding the present study.

Authors' Contributions

Ying-hua Song wrote the manuscript. Liang Zhang was responsible for manuscript revision. Dan Chen and Shuang Deng were responsible for collecting the patient's information. Wei-na Cai was responsible for taking the photos before and after radiation therapy. All named authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published.

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