ABSTRACT: Aim The aim of this study is to study the treatment efficacy of surgical excision of keloids with postoperative high dose-rate (HDR) brachytherapy. Material and methods Between January 2013 and April 2016, 30 patients with 42 keloids were treated with excision of the keloid scar followed by postoperative HDR brachytherapy. Patients were followed-up after 10 days, 3 months and 6 months. Patient satisfaction and recurrence of keloids were measured. Results No patient had symptoms of any recurrence, but 4 had unacceptable results (score of more than 3). Conclusions Surgical excision with postoperative high-dose rate brachytherapy is effective in preventing recurrence of keloid scars. It also provides cosmetically acceptable results. However, the cost involved in such treatment is a hindrance on the Indian subcontinent.

KEY WORDS: high-dose rate brachytherapy, keloids, surgical excision

INTRODUCTION

Keloids are benign fibrous dermal tumors that are caused by the hyper-production of collagen due to abnormal and prolonged cutaneous wound healing [1]. Many extensive studies have been performed in the topic of keloid treatment. Despite a fair amount of research, a comprehensive protocol has not yet been developed. Because of less known etiology and the clinical behavior of keloids, elaborating such protocol is extremely difficult. The site, size, race, sex and foreign body, all these determine the end result of treatment. It is a well-known fact that only combination therapy of surgical excision and postoperative radiotherapy is effective especially in preventing recurrences [2–6]. The risks involved in radiotherapy are damage to surrounding normal structure and the risk of radiotherapy-induced malignancy. In this paper we present the results of our study using surgical excision with monitored high-dose rate (HDR) – brachytherapy, which is effective as well as causes less or no damage to surrounding structures.
MATERIAL AND METHODS

Between January 2013 and April 2016, 30 patients with 42 keloids were treated with excision of the keloid scar followed by postoperative HDR brachytherapy.

Inclusion criteria: patients with clinically diagnosed keloids were included in the study.

Exclusion criteria: pregnant and breastfeeding women were excluded from the study. People who were unwilling to consent to radiotherapy and/or had any contraindication for radiotherapy were excluded from the study.

All patients were well informed and consent was taken for both surgical excision and radiotherapy.

SURGICAL TECHNIQUE

Majority of patients with single keloids were excised under local anaesthesia. General anaesthesia was given in those cases in which multiple keloid excision was needed. Complete excision of the keloid scar was performed so as to obtain a healthy margin was done. The healthy margins of the wound were closed subcutaneously with absorbable suture over which a 6F flexible polyethylene tube was placed. The closed end of the tube was placed at least 5 mm beyond the wound margin. The subcutaneous sutures act as a support for the tube. The tube is placed along the suture line. The skin is closed using simple nylon sutures. With the use of postoperative CT scan and 3D reconstruction, brachytherapy was planned limiting the irradiation to surrounding normal structures.

RADIATION

High-dose rate Cobalt-60 brachytherapy was given. Total of 15 Gy in divided doses, 5 Gy of radiation in 3 fractions. The first fraction was administered within 24 hours of surgery and the following 2 fractions were given within the next 2 days. As soon as the last brachytherapy fraction was administered, the tube was removed and the wound covered with a gauze pad. The patient was instructed to remove the pad the following day and follow up on the 10th post-op day for suture removal.

FOLLOW UP AND ASSESSMENT

Follow up at 10 days, 3 months and 6 months was done. At the end of 6 months, a scoring system was used to assess the recurrence as well as cosmetic acceptability (Table 1 shows the assessment characters).

RESULTS

Out of 30 patients, 19 patients were female and 11 were male. The age of the patients ranged from 14 to 71 years. The most common symptoms observed was tumor followed by skin redness and pruritus. Ear piercing was the most common cause for keloid occurrence. Among 19 female
Fig. 1A. Right ear keloid.

Fig. 2A. Shoulder keloid – excised.

Fig. 3A. Keloid on chest.

Fig. 1B. 10th day follow-up.

Fig. 2B. Shoulder keloid excised with tube in situ.

Fig. 3B. Keloid on chest – 10 days post-op.

Fig. 1C. 6 months post-op.

Fig. 2C. Shoulder keloid 6 months follow up.

Fig. 3C. Relation between sternum and tube on CT-scan.
patients 12 had bilateral ear keloids, one had a unilateral ear keloid, one had keloids on the shoulder bilaterally and 2 patients had keloids over chest and arm. Eleven patients were male patients, 5 of them had sternal keloids, 3 had forearm keloids, 2 had keloids located in the shoulder area and one had a keloid in retrosternal area. Seven patients had recurrent keloids and all of them were ear keloids excised one or more times earlier (Table 2). After the treatment, all signs and symptoms improved in all of the patients. None of the patients had keloid recurrence, but 4 had unacceptable results like hypopigmentation and thinning of skin. According to the scoring system only 4 had scored 3, the rest – 27 patients – had excellent results (Fig. 1–3).

DISCUSSION

Treatment of any medical and/or surgical condition depends upon its pathology, the etiological factors and the disease process. Once any of these factors is unknown, the treatment becomes extremely difficult. Keloids and hypertrophic scars are such conditions. Chen et al. studied a gene microarray for screening differentially expressed genes in keloids and normal skin [7]. Two hundred and fifty genes like: transforming growth factor gene, beta-1 gene and c-Myc gene were upregulated and 152 genes were downregulated. This shows keloids are a result of many gene abnormalities.

Pathogenesis of keloids and hypertrophic scars is not well understood [8]. Histopathology of both situations shows abundance of collagen. In hypertrophic scars, the collagen laid down is in regular pattern and in less abundance. Hence, they tend to improve naturally and gradually [9]. However, in keloids collagen is over-abundant, disorganized, thick and abnormal [10]. As both conditions contain collagen, they can be considered as manifestation of same the fibroproliferative disorder explained in continuum of features [11]. As both are different grades of the same disease process, differentiating hypertrophic scars and keloids is difficult. However, few clinical features differentiate keloids from the hypertrophic scars. Keloid grows beyond the margin of the wound and is elevated from the level of the skin [9]. Similar to the difficulty of diagnosing keloids, identifying the risk factors and etiological factors for keloid formation is also difficult. Some of the risk factors are: mechanical force (stretch), wound infection and foreign body [12]. Apart from these known factors, there are unknown factors too. In Asian and African population, the prevalence of keloid is higher compared to other areas, the cause for this remains unknown [13]. Genetic predisposition is an important risk factor as often the keloid patients present with a family history of keloid as compared to hypertrophic scar [14].

Clinical differentiation of keloids from hypertrophic scars is a must as both need different treatment. But because of the uncertainty of the cause and the pathology, the treatment of keloids is very difficult and poses a challenge in the plastic surgeon’s practice. A meta-analysis of the various studies to determine the ideal keloid treatment done by Durani et al., failed to conclude any definite protocol [15]. A number of studies has proposed various treatment methods like: continuous pressure after surgery [16], intralesional corticosteroid injections [17], silicone gel [18], retinoic acid [19], silastic sheet coverage [20], carbon dioxide laser [21], Nd:YAG laser [22], 5-fluorouracil, interferon. However, not many of these are effective in treating these keloid or hypertrophic scars. Recurrences are high with monotherapy like 33% by ILS, above 50% with laser therapy [17, 23]. International ethical recommendations on scar management state consider radiotherapy to be the most effective treatment available for keloids. However, non-surgical monotherapy may not work for keloid treatment. Surgery alone also has a high rate of recurrences too (45–100%) [9]. Hence surgery in combination with postoperative radiation has
been suggested as a more effective treatment with a success rate of 67% and 98% [24, 25].

Surgical excision remains the mainstay of keloid treatment, yet not in case of every hypertrophic scar [26]. It is always better to confirm the diagnosis before starting any surgical procedures. Scars can mature up to 2 years post-ocurrence. As time progresses, they may soften, flatten and re-pigment. Hence, some of the hypertrophic scars may not actually need treatment and surgical excision may worsen the end result. Still, keloids definitely need treatment and surgical excision alone has a high recurrence rate [9]. Since keloids extend beyond the scar, excision of margins may frequently result in a longer scar than the original keloid, and recurrence in this new area of trauma may lead to an even larger keloid [27, 28]. Therefore, surgical excision can be done in two ways either by radical excision or by reducing the mass or core excision, with low-tension wound closure. The aim of core excision is to take out the infected part or to debulk the keloid to give symptomatic relief [12].

In an established keloid the cells are no longer rapidly proliferating. They have already laid down collagen, so radiotherapy is not very effective in shrinking it. Radiotherapy slows down both normal wound healing and the uncontrolled collagen production that leads to development of keloids. Hence, radiotherapy which is administered immediately after excision of a keloid, can limit wound healing to normal levels by inhibiting the rapidly proliferating fibroblasts (the reason for keloid development) [5]. Surgeons are reluctant in prescribing postoperative radiotherapy for a benign condition. A major concern in radiotherapy is damage to the surrounding tissues and radiation induced malignancy. Hence, we used the preradiation CT scan which defines the extent of lateral spread in our brachytherapy. Using this along with limited dose radiation, high dose rate brachytherapy delivering was much safer and effective. Next, regarding the risk of radiation induced malignancy, literature shows that only 5 in 6500 cases treated are known to have developed malignancy. Earlier methods of radiation delivery like X-rays and electron beam therapy are far inferior compared to high-dose rate brachytherapy [2]. Considering all the literature review, we choose to use high dose rate brachytherapy in postoperative treatment.

Although initially in our study the dose given was volume based, later a fixed dose was used. Ogawa et al recommended a different dose for different sites but we used a fixed dose [6]. Kal et al. described the relation between the biologically equivalent dose (BED) and the recurrence rate [29, 30]. According to the study, recurrence rate decreased at BED >30 Gy. In order to achieve BED >30 Gy he recommended a dose of 13 Gy as a single fraction. In our study we used 5 Gy at a 24 hours interval in 3 fractions (total of 15 Gy over 72 hours). The dose used was fixed irrespective of the site or size of the keloid. Various studies proposed a different dose (Table 3 shows the comparison) [31–39]. Although the dose used in our study is comparable to other studies, the recurrence rate was 0%.

All our patients had excellent recovery and no keloids recurred in the follow-up period of 6 months. Some of the patients had unsatisfying effects of therapy such as alopecia, hypopigmentation, but recurrence of keloid or any features of malignancy were not reported in any patient. Our study shows promising results, literature review worldwide shows that a site-dependent dose protocol should be developed before concluding on to one dose [40]. Etiological factors of keloids are numerous. The site, the size, race, age and sex of patients also are major contributory factor in determining the treatment outcome [12]. Not only the site or the dose of radiotherapy also influenced the end result. In our population, surgical excision and brachytherapy has given excellent results. Our primary goal of treatment is to have low recurrence as well as significant cosmetic and symptomatic improvement [41]. We achieved all these goals in our patients with the use of our treatment protocol; however we still need studies on large populations in order to confirm its efficacy.

CONCLUSIONS

Treatment of keloids in the plastic surgeon’s practice is still challenging. Many therapies have been described, but recurrence rate is high with monotherapy. Combination therapy especially surgical excision with postoperative radiotherapy is effective and provides least recurrence. High-dose rate brachytherapy with 15 Gy in divided doses irrespective of the site/size has provided good initial results with less recurrence and good cosmetic result. The technique provides a high local control rate without significant complications. It is well tolerated and does not present significant side effects. The advantages of HDR brachytherapy over superficial X-rays or low energy electron beams is that it provides a better selective deposit of radiation in tissues within a short duration and causes lower degree of normal tissue damage. No, long term follow-up still required to make out occurrence of malignancy. Studies involving large numbers will prove the efficacy. The cost involved in brachytherapy is a major hindrance for therapy in Indian subcontinent.

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