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Comparative Evaluation of Therapeutic Efficacy of Cryotherapy Versus Trichloroacetic Acid Cautery in Seborrheic Keratosis

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Keywords*Adverse effects, Cryotherapy, Patient satisfaction, Seborrheic keratosis, Therapeutic efficacy, Trichloroacetic acid***ABSTRACT**

Background: Seborrheic keratosis (SK) is a prevalent benign neoplasm of the epidermis which frequently necessitates intervention for aesthetic or clinical reasons. Cryotherapy and trichloroacetic acid (TCA) cautery are prevalent, although comparative data about their efficacy and tolerability remains few. **Aim:** This study aimed to assess the therapeutic efficacy, adverse effect profile, and patient satisfaction of cryotherapy and TCA cautery in the treatment of SK. **Methodology:** A prospective, open-label, single-center study was performed with 60 individuals diagnosed with seborrheic keratosis after clinical and dermatoscopic evaluation. Two randomized groups were established: Group A underwent treatment with liquid nitrogen cryotherapy, whereas Group B received TCA cautery (50–65%). Outcomes including lesion removal (PLA scale), adverse effects, and patient satisfaction were monitored over a duration of 12 weeks. Statistical analysis was performed using SPSS version 27.0. **Results:** The baseline characteristics were comparable among the groups. Cryotherapy exhibited superior lesion clearance, with the PLA scale diminishing from 3.5 mm to 0.5 mm, while the TCA group experienced a reduction to 1.2 mm. The cryotherapy group exhibited considerably reduced pain, burning, and pigmentary alterations. Patient satisfaction was higher with cryotherapy (50% vs to 23.3%). **Conclusion:** In conclusion, both modalities demonstrated effectiveness; however, cryotherapy shown greater efficacy, tolerability, and patient satisfaction, whereas TCA persists as a cost-effective alternative in resource-constrained environments.

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1. INTRODUCTION:

Seborrheic keratosis (SK) constitutes one of the most commonly observed benign epidermal tumors in dermatology, primarily affecting middle-aged and elderly populations [1]. Its frequency varies from roughly 69% to nearly 100% among those over 50 years of age, rendering it a prevalent issue in the aging demographic [2]. Clinically, seborrheic keratosis manifests as well-defined, hyperpigmented papules or plaques featuring a waxy, hyperkeratotic, and occasionally verrucous surface, frequently characterized by a distinctive "stuck-on" appearance [3]. Lesions exhibit variability in size, thickness, morphology—spanning from flat to polypoid—and in color, encompassing shades of brown, gray, and black. They usually manifest on the face, neck,

trunk, and extremities, although the palms, soles, and mucous membranes are frequently unaffected [4]. Despite lacking malignant potential, SK represents a common reason for dermatological consultations due to aesthetic problems, pruritus, persistent irritation, or patient anxiety regarding potential malignancy [5].

The exact etiopathogenesis of seborrheic keratosis (SK) has not been fully understood; nevertheless, research suggests that aberrant keratinocyte proliferation, hereditary predisposition, and diminished apoptosis are significant contributing factors [6]. Extended sun exposure, ultraviolet (UV) radiation, mechanical abrasion, and intrinsic aging accelerate the formation of lesions [7]. Histopathologically, seborrheic keratosis (SK) manifests in various forms, including acanthotic, reticulated, verrucous, clonal, irritable, lichenoid keratosis (LPLK), melanoacanthoma, and stucco keratosis, each characterized by distinct microscopic features [8]. Dermoscopic assessment assists in distinguishing seborrheic keratosis from malignant lesions, including melanoma and basal cell carcinoma, which often display well-defined borders, comedo-like openings, milia-like cysts, cerebriform or fingerprint patterns, hairpin vessels, and localized regions of opaque brown pigmentation [9].

TCA cautery is a recognized method that utilizes the regulated topical application of trichloroacetic acid in differing doses to provoke chemical coagulative necrosis, epidermal exfoliation, and subsequent skin regeneration [10]. Its applications in dermatology encompass not just seborrheic keratosis but also actinic keratoses, solar lentigines, verrucae, and signs of photoaging [11]. The degree of epidermal penetration is directly proportional to the concentration of TCA used; lesser concentrations (10–25%) produce superficial effects, while larger concentrations (35–65%) result in medium-depth ablation [12]. When performed accurately, TCA cautery is economical, necessitates no specialist apparatus, and produces favorable aesthetic results with a low risk of scarring [13]. However, it requires careful application to prevent chemical burns and is contraindicated in instances of active infection or specific chronic skin disorders. Consistent sun protection reduces the likelihood of pigmentary changes [14].

Despite the widespread application of cryotherapy and TCA cautery for the removal of seborrheic keratosis, there is a lack of well-designed comparative studies evaluating their therapeutic efficacy, safety, recurrence rates, and aesthetic results [15]. Cryotherapy is the most frequently employed technique due to its speed and

availability; nevertheless, various clinical studies indicate that TCA may yield superior aesthetic results, faster recovery, and diminished pigmentary side effects [16].

Moreover, this study intended to assess the therapeutic efficacy of cryotherapy and TCA cautery in managing seborrheic keratosis, emphasizing lesion clearance rates, healing duration, cosmetic outcomes, recurrence, and patient satisfaction.

2. Methodology

2.1. Study Design and Setting

This prospective, open-label, comparative, non-blinded, single-center study carried out in the Department of Dermatology, Venereology, and Leprosy (D.V.L.) at Maharishi Markandeshwar University and College Hospital (MMMUCH), Kumarhatti, Solan, over an 18-month duration.

2.2. Study Population

A total of sixty patients of either gender, aged 18 years and older, with two or more clinically and dermatoscopically verified common seborrheic keratosis lesions were recruited. The exclusion criteria included pregnancy or lactation, a history of keloid formation, lesions in inaccessible locations (such as the periorbital region and external auditory canal), prior treatment for seborrheic keratosis within the last two months, and contraindications to cryotherapy, which encompassed Raynaud's phenomenon, open wounds, local infections, or cold hypersensitivity.

2.3. Clinical and Dermoscopic Assessment

A comprehensive demographic, dermatological, and lesion-specific evaluation was conducted for all patients. Lesions were documented regarding their quantity, anatomical location, classification, and dimensions using a standard ruler and assessed with a polarized dermatoscope.

2.4. Treatment Allocation

➤ Group A – Cryotherapy

- Liquid nitrogen cryospray applied with a cryogun held 1–2 cm from the lesion.
- Lesions ≤ 1 mm: Two freeze–thaw cycles of 5 seconds each.
- Lesions > 1 mm: Two freeze–thaw cycles of 10 seconds each.

➤ Group B – Trichloroacetic Acid (TCA) Cautery

- Lesions ≤ 1 mm: 50% TCA applied with a toothpick until frosting was observed.
- Lesions > 1 mm: 65% TCA applied similarly.
- Perilesional skin protected with petroleum jelly; excess TCA blotted with sterile gauze.

2.5. Data analysis

Data were recorded in a structured proforma and compiled in Microsoft Excel. Statistical analysis was performed using SPSS v27.0 (IBM, USA).

3. Results

3.1. Demographic characteristics

The baseline demographic and clinical characteristics of patients in the cryotherapy and TCA groups were mostly comparable, suggesting useful randomization and negligible selection bias. Both groups exhibited a comparable age distribution, predominantly comprising individuals aged 31–50 years, and maintained an almost equal sex ratio. Occupational profiles exhibited diversity, with no significant group domination. The length of lesions was consistent, with the majority lasting beyond 12 months, indicating chronicity. The quantity and severity of lesions were similar; however, slightly greater percentage of TCA patients

exhibited more than five lesions as shown in Fig 1. All instances pertained to common seborrheic keratosis, with dermatoscopic patterns evenly distributed; milia-like cysts with prominent demarcation were notably prevalent. Lesion distribution patterns were analogous, predominantly impacting the upper extremities and torso. These data indicate that both groups were adequately matched in demographic and clinical factors, therefore allowing for more confidence that subsequent outcome discrepancies can be attributable to the treatment method rather than baseline disparities.

Table 1: Baseline Demographic and Clinical Characteristics of Patients in Cryotherapy and TCA Groups

Variable	Category	Cryotherapy Group (n=30)	TCA Group (n=30)
Age Group (years)	18–30	5 (16.7%)	6 (20.0%)
	31–40	7 (23.3%)	8 (26.7%)
	41–50	8 (26.7%)	7 (23.3%)
	51–60	6 (20.0%)	5 (16.7%)
	>60	4 (13.3%)	4 (13.3%)
Sex	Male	16 (53.3%)	17 (56.7%)
	Female	14 (46.7%)	13 (43.3%)
Occupation	Employed (Office Work)	8 (26.7%)	9 (30.0%)
	Manual Laborer	7 (23.3%)	6 (20.0%)
	Self-Employed	5 (16.7%)	4 (13.3%)
	Housewife	6 (20.0%)	7 (23.3%)
	Student	4 (13.3%)	4 (13.3%)
Duration of Lesions	≤6 months	6 (20.0%)	7 (23.3%)
	7–12 months	7 (23.3%)	8 (26.7%)
	13–24 months	9 (30.0%)	8 (26.7%)
	>24 months	8 (26.7%)	7 (23.3%)
Number of Lesions	2–3 lesions	8 (26.7%)	7 (23.3%)
	4–5 lesions	10 (33.3%)	9 (30.0%)
	>5 lesions	12 (40.0%)	14 (46.7%)
Extent of Lesions	Small (<1 cm ²)	9 (30.0%)	8 (26.7%)
	Moderate (1–3 cm ²)	13 (43.3%)	14 (46.7%)
	Large (>3 cm ²)	8 (26.7%)	8 (26.7%)
Type of Lesion	Common SK	30 (100%)	30 (100%)
Dermatoscopic Features	Comedo-like openings	8 (26.7%)	7 (23.3%)
	Fissures & ridges	7 (23.3%)	8 (26.7%)
	Milia-like cysts	10 (33.3%)	9 (30.0%)
	Moth-eaten border	6 (20.0%)	7 (23.3%)
	Hairpin blood vessels	5 (16.7%)	6 (20.0%)
	Sharp demarcation	9 (30.0%)	10 (33.3%)
Location of Lesions	Face	5 (16.7%)	4 (13.3%)
	Neck	6 (20.0%)	7 (23.3%)
	Upper limb	7 (23.3%)	8 (26.7%)
	Lower limb	5 (16.7%)	6 (20.0%)
	Trunk	7 (23.3%)	5 (16.7%)





Fig 1: Clinical Presentation of Seborrheic Keratosis (SK) Lesions at Different Anatomical Sites: The figure depicts multiple seborrheic keratosis lesions with characteristic hyperpigmented, verrucous, and stuck-on appearances over various anatomical regions

3.2. PLA Scale for Assessing Lesion Thickness

The graph illustrates the comparative reduction in PLA scale (mm) over a 12-week period between cryotherapy and TCA groups. Both groups began with an identical baseline mean score of 3.5 mm, but cryotherapy demonstrated a more pronounced and consistent reduction across time intervals compared to TCA. By week 12, cryotherapy achieved a mean reduction to 0.5 mm, whereas TCA remained higher at 1.2 mm, indicating superior lesion resolution with cryotherapy. This trend suggests that cryotherapy is more effective than TCA in reducing PLA scale over

time, highlighting its greater therapeutic efficacy.

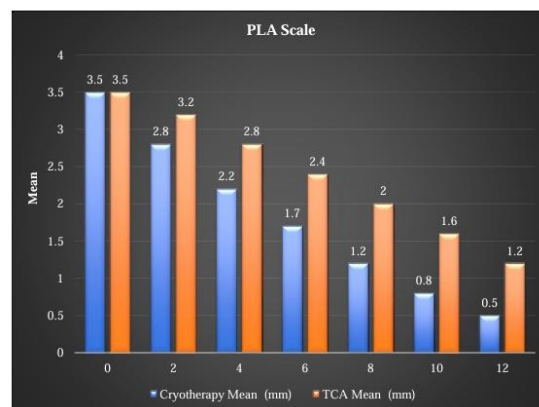


Fig 2: Graphical illustration of PLA Scale - in Lesion Thickness.

3.3. Treatment-Related Side Effects in Cryotherapy and TCA Groups

The table 2 provides a comparative study of treatment-associated adverse events noted in the cryotherapy and TCA groups. TCA was linked to an increased incidence of adverse outcomes across all metrics. Mild pain occurred in 40% of cryotherapy instances compared to 60% in TCA cases, whereas burning or stinging sensations were noted in 50% of cryotherapy patients against 70% in the TCA cohort. Additionally, pigmentary alterations were less prevalent with cryotherapy (30%) compared to TCA (50%). These findings suggest that cryotherapy is more effectively tolerated, resulting in fewer and less severe adverse effects than TCA.

Table 2: Various side effects observed for each treatment modality

Side Effect	Cryotherapy Group	TCA Group
Mild Pain	12 (40%)	18 (60%)
Burning Sensation/Stinging	15 (50%)	21 (70%)
Pigmentary Changes	9(30%)	15 (50%)

3.4. Patient Satisfaction Rate

The table 3 highlights patient satisfaction outcomes at the conclusion of follow-up in the cryotherapy and TCA cohorts. A higher percentage of patients in the cryotherapy group reported optimal results (50%) compared to the TCA group (23.33%), indicating superior overall treatment satisfaction. Conversely, a greater proportion of patients in the TCA group classified the procedure as the most painful (66.67%) compared to cryotherapy (33.33%), indicating reduced tolerability. Cryotherapy received more endorsement for expedited recovery (16.67%) compared to TCA (10%). These results indicate that cryotherapy offers superior satisfaction, more tolerability, and a considerably faster resolution of lesions compared to TCA.

Table 3: Patient Satisfaction Rates at the end of follow up.

Parameters	Cryotherapy Group (n=30)	TCA Group (n=30)
Best Result	15(50%)	7(23.33%)
Most Painful	10(33.33%)	20(66.67%)
Healed Quickest	5(16.67%)	3(10.00%)

4. DISCUSSION:

Seborrheic keratosis is a frequent benign epidermal tumor for which numerous therapeutic techniques have been explored to achieve safe and effective lesion removal [17]. Cryotherapy and trichloroacetic acid (TCA) cautery are widely employed, primarily owing to their non-invasive characteristics and ease of application [18]. Each treatment possesses a distinct mechanism, aesthetic outcome, and tolerance profile in patients, rendering comparative evaluation essential for determining their clinical application and best treatment selection [19].

This study assessed the acceptability and efficacy of trichloroacetic acid (TCA) compared to cryotherapy in the treatment of seborrheic keratosis (SK), emphasizing lesion resolution, adverse effects, and patient satisfaction. The clinical and demographic characteristics of the two groups were comparable, so reducing baseline bias and improving the validity of outcome comparisons for the treatment. The study's two groups demonstrated similar age, sex, occupation, duration, amount, and dermatoscopic characteristics, leading to a consistent distribution. This conforms to the protocols of randomized treatment trials in dermatology, as evidenced by the findings of Yiu et al. (2019), which employ baseline homogeneity to guarantee that the therapeutic intervention can be directly associated with the outcome, rather than discrepancies within the populations [20]. Similarly, Kaur et al. (2017) demonstrated that analogous baseline factors across the chemical cautery and cryotherapy groups facilitated more accurate efficacy comparisons within a similar study design [21]. The results of our research of prolonged lesion duration (greater than 12 months in most patients) correspond with the findings of Ozçelik et al. (2019), which suggest that SK lesions typically endure longer and require active treatment for resolution, thereby supporting the chronicity pattern within the study cohort [22].

In terms of lesion thickness evaluated by the PLA scale, cryotherapy shown greater efficacy than TCA, achieving a significant and enduring reduction from a baseline of 3.5 mm to 0.5 mm after 12 weeks, whereas the TCA group experienced a decrease of 1.2 mm. This discovery underscores the enhanced therapeutic effectiveness of cryotherapy in reducing lesion thickness and volume. Comparable trends have been observed in prior comparative studies. Similarly, Abdel Meguid et al. (2019) shown

a statistically significant higher efficacy of cryotherapy over TCA in the volumetric reduction of lesions linked to benign epidermal proliferations [23]. A Korean study by Chumworathayi et al. (2010) indicated that cryotherapy achieved higher clearance rates and improved flattening of lesions in seborrheic keratosis relative to TCA treatment [24]. Murray et al. (2022) illustrated the superior cytodestructive effectiveness of cryotherapy by ice-crystal induced cell necrosis, leading to a more complete resolution than chemical cautery [25]. Research by Kalegowda et al. (2022) indicated similar results between cryotherapy and TCA for small, superficial SK lesions, but deeper lesions exhibited a more significant response to cryotherapy [26].

The TCA group exhibited a higher prevalence of adverse effects, notably an increased occurrence of burning sensation, pain, and pigmentary changes. In accordance with their findings, Sharquie et al. (2021) demonstrate that TCA was predominantly associated with post-inflammatory pigmentation and delayed erythema, especially in skin types IV and V [27]. Conversely, the adverse effects of cryotherapy, although recorded, were less severe and more readily tolerated, corroborating Mokbel et al. (2025) claim that cryotherapy is a safe procedure, with transient pain and pigmentation changes being the most common, albeit self-limiting, side effects [28]. In the study conducted by Kim et al. (2024), pigmentation changes were noted in 25% of cryotherapy cases, contrasted with 45% in chemical cautery, aligning with our results of 30% and 50%, respectively [29]. In a comparison study by Al-Nosanov et al. (2020), the increased stinging and burning sensations linked to TCA were attributed to the chemical coagulation of proteins, which swiftly activated nociceptors [30]. The research eventually reveals that, in terms of tolerance and adverse effects, cryotherapy is the preminent choice.

Satisfaction is a critical determinant of therapeutic efficacy, especially in cosmetic dermatology. In our study, 50% of patients who received cryotherapy evaluated the procedure as producing the most positive outcome, while just 23.3% in the TCA group did the same. Cryotherapy was found to be less unpleasant (33.3% versus 66.7%) and to promote expedited healing (16.7% compared to 10%). These results validate the findings of Nguyen et al. (2024), who observed heightened satisfaction among patients receiving cryotherapy for benign epidermal lesions, principally attributable to the rapid remission and low recurrence rate [31]. Similarly, Franco et al. (2024) observed that patients receiving cryotherapy expressed more satisfaction with aesthetics and offered higher recommendation ratings than those treated with chemical

cauterization [32]. Daniel et al. (2023) shown in a Nigerian cohort study that patients regarded the therapy as less obtrusive and more acceptable, thereby enhancing adherence to follow-up period of time [33].

However, the findings of the current study substantiate substantial evidence demonstrating that cryotherapy is a more effective, more tolerated, and more acceptable treatment for seborrheic keratosis than TCA. Despite TCA being a cost-effective and accessible alternative in resource-constrained settings, its heightened adverse effect profile and reduced patient satisfaction impede its broader uptake. Cryotherapy offers a combination of safety and effectiveness, making it a more suitable choice for physicians and patients desiring best therapeutic and aesthetic outcomes.

5. CONCLUSIONS:

In conclusion, the current comparative assessment of cryotherapy and trichloroacetic acid (TCA) cautery in the therapeutic management of seborrheic keratosis proves that they are both effective; however, cryotherapy provides superior therapeutic results in terms of clearance of lesions, quicker healing, less perception of pain, and greater patient satisfaction, while TCA, although economical and easily available, revealed relatively poorer efficacy and more discomfort. Based on the results, the application of cryotherapy could be considered superior as a first-line treatment, most especially in patients who regard rapid recovery and fewer side effects, whereas TCA could still remain a reasonable alternative under resource-poor environments. Challenges of the current study comprise the relatively small sample size, narrow follow-up time, and the failure to monitor long-term recurrence, limiting the generalization of the study results. Larger scale randomized controlled studies with longer follow-up must be conducted in the future in order to assess the rate of recurrence, cosmetically acceptable outcomes, and the cost-effectiveness study, and furthermore, test the application of new non-invasive technologies and combination therapy in the best therapeutic management of seborrheic keratosis.

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