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Original Article

Evaluation of the Efficacy and Tolerability of Potassium Hydroxide Solution for Treatment of the Warts

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Abstract

Warts are benign proliferation of the skin and mucous membrane that result from infection with the HPVs. This study was aimed to evaluate the efficacy and tolerability of topical potassium hydroxide (KOH) solution in the treatment of warts. 60 patients were enrolled in a study that was conducted at the Department of Dermatology of Al-Kish specialized center and primary health care from February 2022 to January 2023. Patients who received treatment with steroids or immunosuppressive drugs, genital warts, patients with chronic or immunosuppressive diseases, pregnant and lactating women were excluded. The patients were divided into two groups: the group A was treated with topical KOH (10%) solution; group B was treated with topical KOH (20%) solution; and the treatment was applied by the patient once daily at night with used topical petroleum jelly on uninvolved skin around the warts. All patients were evaluated at the second and fourth weeks with follow-up. For both groups (66.66%) showed complete response according to type warts for both concentrations of KOH solution. The side effects of topical KOH were itching and erythema; for both concentrations were reported in 21% of group A and 25% of group B. It has been shown that patients with fewer numbers of warts and warts with shorter duration responded better to the treatment of KOH solution. Topical KOH solution is proven to be an effective and safe treatment of common warts, plantar warts, and plane warts in both concentrations (10% and 20%) with no important side effects.

Keywords: *wraths, potassium hydroxide, treatment and human papilloma virus.*

Introduction

Warts, or verruca, are benign proliferation of skin and mucosa that are caused by human papillomavirus infection (HPV). Wart occurs at any age. HPV is a double-stranded DNA virus, with more than 150 types being identified [1]. Human papillomavirus can be grossly divided into high-risk types and low-risk types for their carcinogenic potentials. The life cycle of HPV is closely associated with the proliferation and differentiation of epithelium [2]. Cutaneous HPV infection commonly manifests as warts, including common warts (Verruca vulgaris), plane warts (Verruca plana, on face and hands), plantar warts (Verruca plantar is on soles and feet), and condyloma acuminate (anogenital warts, on genitalia, anus, or perianal area) [3,4]. Patients suffering from warts generally seek medical treatment from general practitioners, pharmacists, naturopaths, and allied health professionals and may present with recalcitrant warts that have been previously treated with anything from folk remedies to over-the-counter medicine [5]. There are many modalities for the treatment of warts, depending on number, type, site size, age, duration, cost, cosmetic sequels, and previous therapies used for their success and failure [6]. Potassium hydroxide (KOH) is a strong metallic base. In medical practice, it is used in the diagnosis of fungal infection. KOH acts by its keratolytic effects that lead to the destruction of virus-infected cells, causing the resolution of the warts. Potassium hydroxide solution (20%) was used as a treatment for Molluscum contagiosum [7]. Finally, we evaluated the effectiveness of potassium hydroxide as one of the treatment options for warts and studied the difference in its effectiveness according to age of the patient, his gender, and their anatomical location, and a comparison between the two concentrations of (10%) and (20%) of this solution in terms of the effectiveness of the treatment and the side effects [8].

This study aimed to evaluate the efficacy and safety of topical potassium hydroxide solution in the treatment of plane warts, common warts, and plantar warts. In addition to the comparison with other data throughout the world.

Methods

Study design

The study sample consisted of patients with plane warts, common warts and plantar warts visiting the dermatology department at Al-Kish specialized center and primary health care. Sixty patients with warts of different sexes and ages enrolled in this study. A physical examination conducted to each patient to assess the types, number, and location of warts. The samples were collected during the period from February 2022 to January 2023; they met the entry criteria for the study, namely: the number of patients participating was sixty patients; they should not have received any other treatment of warts. Excluded criteria of the study were all patients who received treatment with steroids or immunosuppressive drugs, as well as patients with genital warts and patients with chronic diseases or immunosuppressive diseases, in their medical history, in addition to pregnant and lactating women.

Study groups

The patients were randomly divided into two groups: group A, which included 28 patients, received treatment with potassium hydroxide solution (10%), and group B, which included 32 patients, received treatment with potassium hydroxide solution (20%). The patients have explained the nature of the disease, its course, prognosis, complete information about the treatment, and the exact method of application. Before inclusion in this study.

Study form

A structured Performa for history, clinical examination and treatment assessment were recorded.

Methods of treatment with KOH solution

A 10% potassium hydroxide solution was prepared by dissolving 100 g of KOH in 1 liter of distilled water. While the concentrate KOH (20%) was prepared by dissolving 200 g of the same substance in 1 liter of distilled water.

The solution was applied by the patient's hand at home with a cotton swab saturated with the solution by touching the wart once a day at night for four weeks. With used topical petroleum jelly on uninvolved skin around the warts.

The treatment was evaluated at the end of the second week of daily application of the solution in order to record the response and side effects. The resulting treatment is based on clinical examination as well as imaging. Treatment should be carried out in case of complete removal of lesions. Consider the patient responsive completely to treatment. In the absence of any change, the patient is considered unresponsive to treatment.

Statistical Analysis

Iterative tables were used with the calculation of ratios and averages that summarize the study data and help to understand them better; we also used graphs that express the figures given in the iterative tables. Statistical tests used in the study: Pearson correlation coefficient. Spearman correlation coefficient. One-Way ANOVA test—mean test—chi-square test SPSS software and version 22 were used in the statistical study Statistical significance level: differences at the value-p threshold less than or equal to 0.05 were considered statistically significant.

Results

A total of 60 patients (26 males and 34 females) with plane warts, common warts, and plantar warts were included in this study. The mean age of patients was 11.8 years, with an age range of 3 to 21 years. It has been shown in (Table 1).

Table 1. Demographic characteristics of patients with warts lesions

Variables	Frequency	Percentage
Age/years		
Less than 10	20	33.3
10-15	25	41.7
More than 15	15	25
Sex		
Male	26	43.3
Female	34	56.7

Total	60	100

To determine whether the difference in response rate according to age means that there are no significant differences in response to treatment according to age between the two groups. It has been shown in Fig. 1 (p-value = 0.81).

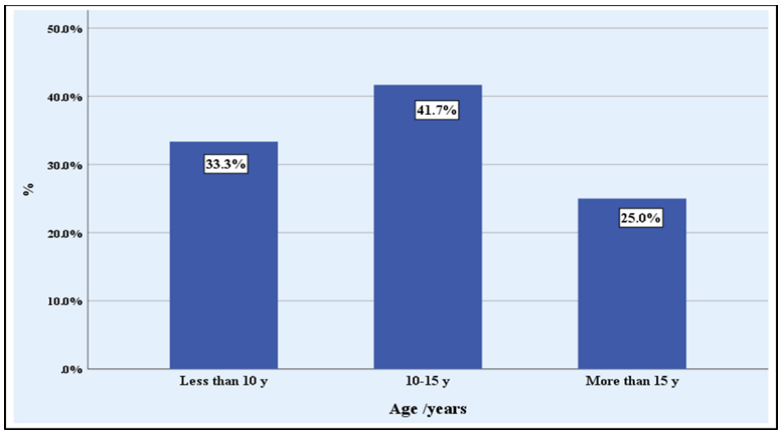

Figure 1: Distribution of patients according to age

There were 26 males (43.3%) and 34 females (56.7%), as shown in (Fig. 2.) When comparing the treatment groups according to sex, the statistical choice was applied as the p-value was the larger than 0.05 adopted for the statistical significance, as well as for age, then the statistical test was (P-value = 0.48), which indicated that there were no statistically significant differences in the sex and age composition between the two groups.

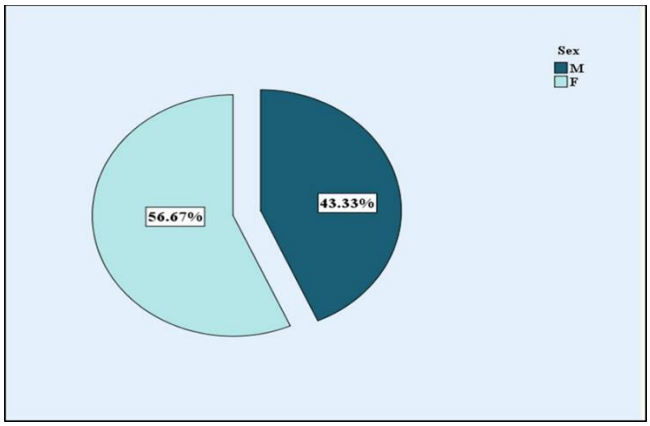

Figure 2: Distribution of patients according to sex

The patients were divided into two groups: the first group (group A) included 28 patients who received treatment with potassium hydroxide solution (10%), and the second group (group B) included 32 patients who received treatment with potassium hydroxide solution (20%). the treatment groups were randomly distributed. It found that forty patients (66.67%) showed complete recovery, while 20 patients (33.33%) showed no response to treatment with both concentrations (Table (2)). The response of the patients to treatment according to concentration of potassium hydroxide solution: group A showed 19 patients (67.9%) complete recovery, whereas 9 patients (32.1%) showed no response; group B showed 21 patients (65.6%) showed complete recovery, whereas 11 patients (34.4%) had no response. (Table (3)). To determine a statistical difference between two groups, we find that there is no significant difference to treatment with two concentrations after 4 weeks of treatment. (P-value =0.147).

Table 2: Efficacy of topical KOH

KOH	Response to treatment		Total No. (%)
	Complete improvement No. (%)	No improvement No. (%)	
KOH 10%	19 (67.9%)	9 (32.1%)	28 (100%)
KOH 20%	21 (65.6%)	11 (34.4%)	32 (100%)
P =0.147 X2=3.83 df=2			

Table 3: Response to treatment according to concentration of KOH:

Efficacy and safety of topical KOH	Frequency	Percentage
KOH concentration		
KOH10%	**28**	**46.7**
KOH 20%	**32**	**53.3**
Response after treatment		
Complete improvement	**40**	**66.7**
No improvement	**20**	**33.3**

The response of patients to treatment according to type of warts, we found that patients with plane warts to treatment with both concentrations were 14 patients (882.4%) showed complete recovery, whereas 3 patients (17.6%) had no response. Common warts were 11 patients (52.4%) showed complete recovery, whereas 10 patients (47.6%) had no response. And plantar warts were 15 patients (68.2%) showed complete recovery. whereas 7 patients (31.8%) had no response (Fig. 3).

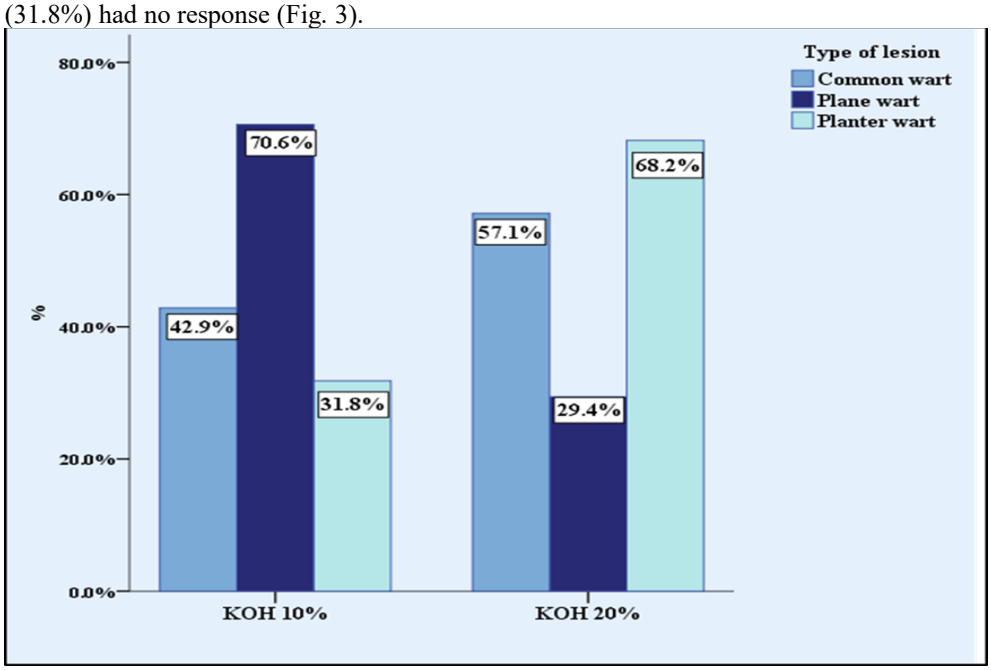

Figure 3: Response according to Type of warts and concentration of KOH
P =0.05 X2=5.980. df=2

To determine whether the response rate of treatment according to a type of warts with two concentration is a statistical difference between the two groups, we find that there is significant difference in treatment with two concentrations according to the type of warts treatment (P-value = 0.05). Plane warts showed complete recovery treated with KOH10% (Fig. 4, 5).

Figure.4: Before treatment, 8 years old boy with plane warts for 4 months duration

Figure 5: Two weeks treatment after using10% KOH solution, complete recovery

Plant warts showed complete recovery treated with KOH20% (Fig. 6, 7, 8).

Figure.6: plantar wart before treatment

Figure.7: plantar wart after two weeks treatment with KOH 20%

Figure.8: plantar wart after four weeks treatment complete recovery

Out of 60 patients, 16(26.7%) had lesion on face, 28(46.7%) on foot, 13(21.6%) on hand and 3(5.0%) on scalp, it has been shown in (Fig. 9). Characteristics of lesion according to symptoms: patients with no symptom: 42 patients (70.0%), 14 patients (23.3%) had pain, and 4 patients (6.7%) complained disfigurement. According to types of lesions, the common wart was 21 patients (35.0%), the plane wart was 17 patients (28.1%) plantar wart was 22 patients (36.7%).

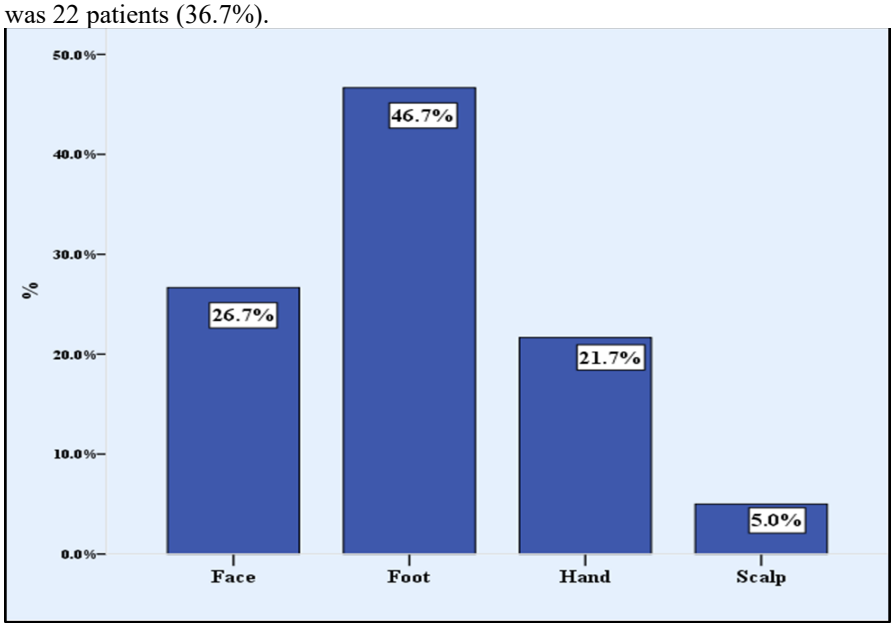

Figure 9: Distribution of patients according to site of lesion

Number of patients with Size of lesion less than 15 mm were 50 patients (83.3%), and number of patients with size more than 15 mm were 10 patients (16.7%). Clinical characteristics of the surface of the lesion, either verruca or smooth; number of patients with verrucal surfaces: 41 patients (68.3%) and number of patients with smooth surfaces: 19 patients (31.7%). color of lesion: white-colored lesion 29 patients (48.3%), pink-colored lesion 11 patients (18.3%) Tan-colored lesion 13 patients (21.7%) and skin-colored lesion 7 patients (11.7%). (Table 4) shows clinical characteristics of patients with warts lesion.

Table 4: Clinical characteristics of patients with warts lesions:

Clinical characteristics of lesion	**Frequency**	**Percentage**
Symptoms:		
No symptom	42	70.0
Pain	14	23.3
Disfigurement	4	6.7
Duration:		
Less than12months	49	81.7
12m and more	11	18.3
Types of lesions:		
Common wart	21	35.0
Plane wart	17	28.3
Planter wart	22	36.7
Site of lesion:		
Face	16	26.7
Foot	28	46.7
Hand	13	21.6
Scalp	3	5.0
Size of lesion / mm:		
1-15	50	83.3
16-30	10	16.7
Surface of lesion:		
Verrucus	41	68.3
Smooth	19	31.7
Top of lesion:		
Papular	50	83.3
Plaque	10	16.7
Color of lesion:		
White	29	48.3
Pink	11	18.3
Tan	13	21.7
Skin color	7	11.7

Applying the ANOVA selection to study the statistical relationship between the two treatment groups (KOH 10%, KOH 20%), there was no statistically significant difference in terms of the location of the lesion ($p = 0.85$). The lesions with duration less than 12 months were the number of patients with complete improvements: 36 patients (73.5%) and the number of patients with no improvements: 13 (26.5%). There were 4 patients (36.4%) who had been on the treatment for more than 12 months, and 7 patients (63.6%) who had not improved. Table (4).

To determine whether the differences in response rates according to duration of lesion indicate that there are significant differences in response to treatment according to duration of lesion (p-value = 0.01). The side effects were compared between the two treatment groups after two weeks of treatment; it was found that a total number of 46 patients (100%) showed no local side effects of potassium hydroxide solution; they were 22 patients (47.8%) from group A and 24 patients (52.2%) from group (Table 5).

Table 5: Side effect of KOH after two weeks treatment

Side effect after 2 weeks	**KOH**		**Total No. (%)**
	KOH 10% No. (%)	KOH 20% No. (%)	
No side effect	22(47.8%)	24 (52.2%)	46(100)
Itching	1 (25.0%)	3 (75.0%)	4 (100%)
Erythema	5 (50.0%)	5 (50.0%)	10(100)

In group A, one patient (25.0%) and 3 patients (75.0%) from group B showed itching, and 5 patients (50.0%) from group A and 5 patients (50.0%) from group B showed erythema. The total number of the patients with side effects after 2 weeks were 14 patients, and the common side effect was erythema (Fig. 10).

Figure 10. plane wart treated with (KOH 20%) showed side effect (erythema)

We did not notice a statistically significant difference when using the statistical test in the incidence of the following side effects: erythema and itching when treating with concentration and KOH10% ($p > 0.05$), but we noticed the occurrence of itching and erythema when using concentration KOH 20 % ($p = 0.66$).

Side effects were compared between the two treatment groups after four weeks treatment; it was found that total number of patients was 49 (100%) with no side effects, 25 patients (51.0%) from group A and 24 patients (49.0%) from group B with no local side effects of potassium hydroxide solution (Table 6). In group A, one patient (25.0%) showed itching and in group B, three patients (75.0%) showed itching, and 2 patients (28.6%) from group A and 3 patients (75.0%) from group B showed erythema. The total number of patients with side effects of topical potassium hydroxide solution (both concentrations) were 11 patients (Fig. 10).

Table 6. Side effects of KOH after four weeks treatment:

Side effect after 4 weeks	**KOH**		**Total No. (%)**
	KOH 10% No. (%)	KOH 20% No. (%)	
No side effect	25 (51.0%)	24 (49.0%)	49 (100%)
Itching	1 (25.0%)	3 (75.0%)	4 (100%)
Erythema	2 (28.6%)	5 (71.4%)	7 (100%)

We did not notice a statistically significant difference when using the statistical test in the incidence of the following side effects, erythema and itching, when treating with low concentration and KOH 10% ($p > 0.05$) ($P = 0.35$) but we noticed the occurrence of itching and erythema when using concentration KOH 20% with a higher percentage ($p=0.05$). Plane wart treated with KOH 20% showed a side effect (erythema) (Fig. 10).

Discussion

Warts are a common cause of morbidity worldwide. It is considered the second most common cause for medical consultation. Although skin disease is rarely lethal, it has a significant impact in terms of treatment cost, days absent from school and work, and psychological distress [9]. Treatment options differ according to location, type, and size of lesion. Commonly used treatments are cryotherapy and electro cauterization, but they can be painful and leave scars and also have high failure and recrudescence rates. Other methods include surgery with curettage, laser ablation with CO2 or dye lasers, and keratolytic agents. In the past, different explanations for warts and different treatments that used plants, animal secretions, precious stones, metals, minerals, and ores, air, earth, fire, heat, moonlight, and sunlight were devised throughout human history.[10] Recently, many modalities of treatment have been used, but none of them proved to be uniformly effective. Potassium hydroxide (KOH) solution is a well-known keratolytic agent with many dermatological uses. The present study aims to determine the efficacy and tolerability of topical KOH solution for treatment of cutaneous warts [10]. The study showed that forty patients (66.67%) showed complete recovery, while 20 patients (33.33%) showed no response to treatment with both concentrations. The response of the patients to treatment according to concentration of potassium hydroxide solution: group A showed (67.9%) of patients complete recovery; group B showed (65.6%) complete recovery, the response of patients with plane warts to treatment with both concentrations was (82.4%) complete recovery, common warts showed (52.4%) complete recovery; and plantar warts showed (68.2%) complete recovery It was noticed that response to KOH concentration according to types of warts at end of second week was better with KOH 10% for treatment of plane warts , and the response was better with KOH 20% at end of fourth week for treatment of common warts and plantar warts, which was statistically significant in response to treatment with two concentrations after four weeks of treatment according to type of warts (P-value = 0.05) . When compared, this study has been also shown that the highly significant difference rate of complete response at end of fourth week (p less than 0.05) [9, 10].

The mechanism by which KOH solution was supposed to act on warts is related mostly to its keratolytic effect that leads to the destruction of the infected cells and also may be attributed to its irritating effect that induces inflammatory responses and immune reactions, so causing resolution of warts.

In this study, mean age of the patients was 11.8 years, and their ages ranged between 3 and 21years.There was no significant difference in response to treatment according to age between the two groups (p-value = 0.81). There were 43.3%%) males and 56.7%%) females When comparing the response to treatment between the two groups according to gender, there were no statistically significant difference in response between two groups (p-value = 0.185), The statistical test showed no statistically significant differences in the response to treatment between the two groups according to gender, Various studies have shown no sex and age difference prevalence of plane warts, common warts, and plantar warts between two groups [8, 9, 10]. In the statistical relationship between the two treatment groups (KOH 10%, KOH 20%), there was no statistically significant difference in terms of the location of lesions.

The mean duration of lesions was 6.6 months, ranging from 1 to 24 months; the lesions with a duration less than 12 months were the number of patients with complete improvements (73.5%), no improvements (26.5%), Lesions lasting more than 12 months were (36.4%) patients, and patients with no improvement (63.6%). It means that lesions with short duration responded better to treatment than lesions with long durations; the response rates according to the duration of lesion show that there are significant differences in response to treatment between the two groups according to the duration of the lesion in the two groups (p-value = 0.01).

The side effects were compared between the two treatment groups after two weeks; it was found that total number of 46 patients showed no local side effects of potassium hydroxide solution, they were 22 patients (47.8%) from group A and 24 patients (52.2%) from group B. In group A, one patient (25.0%) and 3 patients (75.0%) from group B showed itching, and 5 patients (50.0%) from group A and 5 patients (50.0%) from group B showed erythema. The total number of the patients with side effects after two weeks were 14 patients, of whom the most common side effect was erythema. We did not notice a statistically significant difference when using the statistical test in the incidence of the following side effects after

two weeks, erythema and itching, when treating with concentration of KOH 10% and KOH20% ($p > 0.05$), but we noticed the occurrence of erythema and itching when using concentrations of KOH 20%.

Side effects were compared between the two treatment groups after four weeks; it was found that total number of patients was 49 (100%) with no side effects, 25 patients (51.0%) from group A and 24 patients (49.0%) from group B with no local side effects of potassium hydroxide solution. In group A, one patient (25.0%) showed itching and in group B, three patients (75.0%) showed itching, and 2 patients (28.6%) from group A and 3 patients (75.0%) from group B showed erythema. The total number of patients with side effects of topical potassium hydroxide solution (both concentration) were 11 patients. We did not notice a statistically significant difference when using the statistical test in the incidence of the following side effects after four weeks: erythema and itching in patients who were treated with concentration KOH10% ($p > 0.05$), but we noticed the occurrence of itching and erythema when using concentration KOH 20% with a statistically significant difference ($p< 0.05$).

We assume that the effect of KOH is concentration-dependent and higher concentration is likely to show better results. Regarding the safety of KOH treatment, the patient who experienced mild side effects more in group B. All aforementioned studies reported a similar profile [6, 7, 8]. Erythema and itching are expected to occur with KOH treatment considering its keratolytic effect. Our results are in agreement with the study conducted in Iraq in 2012. The study was entitled "The effectiveness of topical potassium hydroxide solution in a concentration of 5% and 10% in the treatment of plane warts and cure rate at end of the fourth week of treatment was 80.3% of the group used KOH 5%, and cure rate of treatment was 82.1% of the group used KOH10% [6], this study has been also shown that the highly significant difference rate of complete response at end of the fourth week (p0.05) [11]. In a Pakistani study entitled "Evaluation of the efficacy of topical potassium hydroxide a solution 10% for treatment of palmoplantar warts" in 2019, the cure rate was 84% [12]. This study has been also shown a highly significant difference rate of complete response at end of fourth week (p 0.05). When compared this study in that response rate according to age and sex, it has been shown that the statistical test found no statistically significant differences in the age and sex composition between the two groups ($p>0.05$).[12] The Egyptian study in 2022 was entitled "clinical efficacy of topical potassium hydroxide solution 10% for the Treatment of common warts." The cure rate of this study was 70% of patients showed complete recovery with no observation of serious side effects [8], This study has been also shown that the highly significant difference rate of complete response at end of the fourth week (p0.05). [8, 12] In comparison with the healing ratios in our study, we see that potassium hydroxide is effective in the treatment of plane warts, common warts, and plantar warts and relatively safe and easily tolerated by all age groups depending on the concentration of potassium hydroxide solution.

Conclusion

Warts are a common reason for visiting a dermatological clinic, so the doctor should be familiar with all aspects of the disease and various therapeutic methods. Potassium hydroxide solution is an inexpensive and easily available compound. Topical potassium hydroxide solution was found to be an effective and safe treatment of plane warts, common warts, and plantar warts. Besides that, 10% potassium hydroxide solution is as effective as 20% potassium hydroxide solution with fewer side effects. Response of warts to treatment was different according to types of warts; it found that plane warts were effectively treated with a low concentration of potassium hydroxide solution less than 20%. Common warts and plantar warts were effectively treated with a higher concentration of potassium hydroxide solution of more than 10%.

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