



## EFFICACY OF POTASSIUM HYDROXIDE (KOH) ON THE TREATMENT OF CONDYLOMA ACUMINATA

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### ABSTRACT

Condyloma acuminata (CA) represents one of the most prevalent sexually transmitted infections globally. Current treatment modalities focus primarily on lesion removal rather than viral eradication, with no universally accepted gold standard therapy. Potassium hydroxide (KOH) has emerged as a promising alternative treatment option. Objective to systematically review the efficacy and safety of potassium hydroxide in treating condyloma acuminata compared to other established treatments. A systematic literature review was conducted using PubMed, Google Scholar, Science Direct, Wiley Online Library, and Cochrane Library databases. Search terms included combinations of "potassium hydroxide," "KOH," "condyloma acuminata," and "genital warts." Studies published within the last decade comparing KOH with other established treatments were included. From 1195 articles screened, 5 articles were finally obtained on 2014 to 2025. Screening was performed by the authors using Mendeley Reference Manager. Five comparative studies involving 351 patients were analyzed. KOH 5% solution achieved complete response rates ranging from 65% to 88.9%, comparable to established treatments including cryotherapy (54.7-72.3%), trichloroacetic acid (78.6%), and CO<sub>2</sub> laser therapy (88.9%). KOH demonstrated shorter treatment duration and lower recurrence rates in several studies. The safety profile was favorable, with common adverse effects being superficial erosions (14-50%), mild burning sensation, and transient erythema. A 5% potassium hydroxide solution demonstrates comparable efficacy to established therapies, with potential advantages including a shorter treatment duration, patient self-application capability, and a favorable safety profile. KOH represents a viable treatment option for condyloma acuminata, particularly valuable in resource-limited settings.

Keywords: condyloma acuminata, genital warts, human papillomavirus, KOH, potassium hydroxide, sexually transmitted infections, topical treatment

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## INTRODUCTION

Condyloma acuminata (CA), commonly known as genital warts, is caused by human papillomavirus (HPV) infection and represents one of the most prevalent sexually transmitted infections worldwide (Centers for Disease Control and Prevention, 2025). In the United States, genital HPV infections affect approximately 10-20% of the population, with clinical manifestations occurring in approximately 1% of infected individuals (Dițescu *et al.*, 2021). The condition poses a significant healthcare burden, with annual costs estimated at approximately \$4 billion in 2004 (Insinga *et al.*, 2003). Low-risk HPV types, particularly HPV-6 and HPV-11, are responsible for more than 90% of genital wart cases (Purzycka-Bohdan *et al.*, 2022). The pathophysiology involves viral infection of stratified squamous epithelium, leading to characteristic hyperkeratotic, papillomatous lesions (Ferenczy, 1995). While over 90% of HPV infections resolve spontaneously within two years, persistent infections can lead to progressive lesion development and increased transmission risk (Sugai *et al.*, 2021).

Current therapeutic approaches encompass patient-applied treatments (imiquimod, podophyllotoxin) and provider-administered treatments (cryotherapy, trichloroacetic acid, laser

therapy, surgical excision) (Park *et al.*, 2015). Despite this therapeutic diversity, no single treatment has emerged as universally superior, with cure rates typically ranging from 50% to 90% and recurrence rates of 10% to 40% across different modalities (Saputera, 2018). Most treatments focus on lesion destruction rather than viral eradication, which explains the substantial recurrence rates (de Carvalho *et al.*, 2021). Potassium hydroxide (KOH), a potent alkaline compound traditionally used in dermatology for diagnostic purposes, has emerged as a promising therapeutic agent for viral skin conditions (Al-Hamdi & Al-Rahmani, 2012). The rationale for using KOH stems from its potent keratolytic properties, which enable deep tissue penetration and the selective destruction of virus-infected epithelial cells (Makki *et al.*, 2022). The mechanism involves both direct cytotoxic effects through protein denaturation and an indirect impact through the induction of an inflammatory response (Navone & Speight, 2018). This systematic review aims to evaluate the current evidence regarding the efficacy and safety of KOH in treating condyloma acuminata compared to established therapies, providing evidence-based recommendations for clinical implementation.

**METHOD**

This systematic review was conducted in August 2024 using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines from various databases including Google Scholar, Science Direct, Wiley Online Library, Cochrane, and Pubmed. The keywords used were ("Efficacy" OR "Comparative" OR "Study" OR "treatment") AND ("Potassium Hydroxide" OR "KOH") AND ("Condyloma Acuminata" OR "Condyloma Acuminatum" OR "Genital Warts"). Articles included from 2014 to 2025. The inclusion criteria for this study include articles written in the English language, those published within the last 10 years, and original articles that discuss the effects of KOH on Condyloma acuminata. Exclusion criteria included non-English language publications, articles published more than 10 years ago, and articles other than original research articles, such as case reports, books, reviews, theses, and others. All relevant articles were then compiled using Mendeley Reference Manager, which automatically removes duplicates. A screening process was then conducted, from the title to the full text. During the screening process, any doubts about the selection of articles were resolved through consensus among the authors. The extracted data included study characteristics (author, year, country, and study design), patient demographics (sample size, age, and gender), treatment protocols, efficacy outcomes (complete response rates and time to resolution), safety outcomes (adverse events), and follow-up duration.

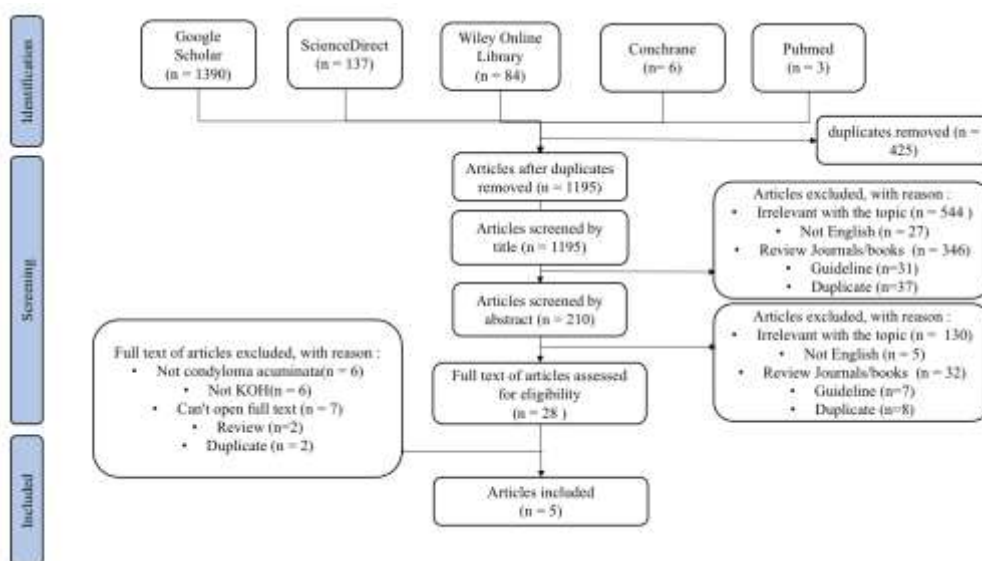


Figure 1. PRISMA statement of the studied article.

The initial search yielded 1,620 articles. After removing duplicates and applying inclusion/exclusion criteria, five studies were selected for final analysis, involving a total of 351 patients. The screening steps are shown in the PRISMA chart (Figure 1). The studies included diverse patient populations with ages ranging from 15-74 years. Gender distribution varied across

studies, with some focusing on specific populations (Asadi study: female only; Camargo study: male only) while others included both genders (Table 1). The included studies were conducted across diverse geographical regions, including Iran (2 studies), Turkey, Brazil, and Ethiopia, spanning from 2014 to 2025. All studies employed comparative designs with control groups receiving established treatments.

**RESULT**

Table 1.  
Study Characteristics

| No | Author (Year)                   | Country  | Number of Subjects and Sex | Age         | Duration of therapy (weeks) | Comparison on Therapy             | Outcome   |
|----|---------------------------------|----------|----------------------------|-------------|-----------------------------|-----------------------------------|---|
| 1  | Asadi <i>et al.</i> (2015)      | Iran     | 63 female                  | 15-55 years | 9 weeks                     | CO <sub>2</sub> laser             | Therapy with 5% KOH showed complete healing of lesions in 88.9% of cases, which is the same as therapy using a CO <sub>2</sub> laser (88.9%). Topical 5% KOH therapy is as effective as CO <sub>2</sub> laser in treating lesions.  |
| 2  | Işik <i>et al.</i> (2014)       | Turkey   | 41 male and 19 female      | ≥ 18 years  | 12 weeks                    | 5-fluorouracil and salicylic acid | The mean number of lesions decreased from baseline to week 12 from 17.03 ± 12.64 to 3.73 ± 7.30 in the KOH group, while from 16.13 ± 12.97 to 3.10 ± 4.90 in the 5-FU + SA group, p < 0.001, respectively. Excellent healing was achieved by 70.0% of patients in the KOH group and 76.7% of patients in the 5-FU + SA group. A marked improvement was observed in 13.3% of patients in the KOH group and 20.0% of patients in the 5-FU + SA group. Both treatment groups showed a significant decrease in the number of lesions during the treatment period (p < 0.05). However, the difference between the treatments was not statistically significant at the end of the 12th week (p > 0.05). |
| 3  | Camargo CL <i>et al.</i> (2014) | Brazil   | 48 male                    | 18-74 years | 2-12 weeks                  | Cryotherapy                       | Thirteen patients (65%) treated with 5% KOH experienced successful treatment, and 54.2% of patients experienced success without recurrence. In the cryotherapy group, 50.0% of patients were cured without recurrence. The success rate in the KOH group was 65% compared with 54.7% in the cryotherapy group. The KOH group showed a lower mean treatment duration (mean 6.9 vs. 9.6 weeks). No recurrence was observed in the KOH group, whereas the cryotherapy group exhibited a recurrence rate of 10%.  |
| 4  | Hailu SG and Areda SA (2021)    | Ethiopia | 35 male and 47 female      | 4-52 years  | 12 weeks                    | 80% Trichloroacetic Acid (TCA)    | At the end of the 12th week of therapy, 87.5% of patients receiving KOH therapy and 78.6% of patients receiving TCA therapy experienced a complete response, which was not statistically significant (p = 0.28). The average healing time for KOH was 4.2 ± 2.7 weeks, while for TCA it was 7.43 ± 3.3 weeks with a p value < 0.0001.   |
| 5  | Ghazvini <i>et al.</i> (2025)   | Iran     | 43 male and 55 female      | 23-36 years | 12 weeks                    | Cryotherapy                       | Complete response was found in 34 patients in the cryotherapy group (72.3%) and 31 patients in the KOH group (70.5%), while relapse occurred in 3 patients in the cryotherapy group (6.4%) and two patients in the KOH group (4.5%).  |

KOH 5% solution demonstrated complete response rates ranging from 65% to 88.9% across all studies. Comparative analysis showed: (1). KOH vs Cryotherapy: Ghazvini study (70.5% vs 72.3%,  $p=0.510$ ); Camargo study (65% vs 54.7%), (2). KOH vs CO<sub>2</sub> laser: Asadi study (88.9% vs 88.9%), (3). KOH vs TCA: Hailu study (87.5% vs 78.6%,  $p=0.28$ ). (4). KOH vs 5-FU+SA: Isik study (70% vs 76.7%,  $p>0.05$ ). No study reported significantly inferior efficacy for KOH compared to control treatments. Studies reporting time to resolution consistently favored KOH: (1). Camargo study: KOH 6.9 weeks vs cryotherapy 9.6 weeks, (2). Hailu study: KOH  $4.2 \pm 2.7$  weeks vs TCA  $7.43 \pm 3.3$  weeks ( $p<0.0001$ ). Available recurrence data suggested potential advantages for KOH: Ghazvini's study shows KOH 4.5% vs cryotherapy 6.4% ( $p<0.999$ ), and Camargo's study shows KOH 0% vs cryotherapy 10%. The safety profile of KOH was generally favourable as presented in Table 2. Most adverse events were local, predictable, and self-limiting. Comparative data from the Camargo study showed KOH patients experienced significantly less pain (16.7% vs 100% with cryotherapy) and lower rates of residual hypopigmentation (16.7% vs 45.8%).

Table 2.

Adverse Events with KOH Treatment

| Adverse Event        | Frequency    | Severity         | Management            |
|----------------------|--------------|------------------|-----------------------|
| Superficial erosions | 14.28% - 50% | Mild to moderate | Supportive care       |
| Erythema             | 6% - 16%     | Mild             | Self-limiting         |
| Burning sensation    | Variable     | Mild to moderate | Patient counseling    |
| Hyperpigmentation    | 3.17%        | Mild             | Usually resolves      |
| Pain                 | 16.7%        | Mild to moderate | Less than cryotherapy |

## DISCUSSION

This systematic review provides compelling evidence that a 5% potassium hydroxide solution represents an effective treatment option for condyloma acuminata, with efficacy comparable to established therapies (Asadi *et al.*, 2016; Camargo *et al.*, 2014; Hailu & Areda, 2021; İşik *et al.*, 2014; Javame Ghazvini *et al.*, 2025). The consistency of results across diverse geographical regions and healthcare systems strengthens confidence in KOH's therapeutic value.

The complete response rates of 65-88.9% with KOH treatment compare favorably to published efficacy data for other established treatments (Park *et al.*, 2015; Saputera, 2018). The most recent and methodologically robust study by Ghazvini *et al.* (2025) demonstrated non-inferiority to cryotherapy, one of the most widely accepted treatments (Javame Ghazvini *et al.*, 2025). The split-lesion design employed by Asadi *et al.* provided particularly compelling evidence by eliminating patient-related confounding factors (Asadi *et al.*, 2016).

The shorter treatment duration observed with KOH in multiple studies represents a significant clinical advantage (Hailu & Areda, 2021; Javame Ghazvini *et al.*, 2025). Faster resolution can improve patient compliance, reduce healthcare utilization, and minimize the risk of transmission. The mechanism underlying this rapid response may relate to KOH's immediate cytotoxic effects combined with deep tissue penetration capability (Makki *et al.*, 2022; Navone & Speight, 2018).

The safety profile of KOH emerges as generally favorable, with most adverse events being local, predictable, and manageable (Asadi *et al.*, 2016; Camargo *et al.*, 2014; Hailu & Areda, 2021; İşik *et al.*, 2014; Javame Ghazvini *et al.*, 2025). The predominance of superficial reactions without significant systemic adverse events supports its use in a broad range of patients (Al-Hamdi & Al-Rahmani, 2012). Comparative safety data suggest lower pain levels than those with cryotherapy, which enhances patient acceptability (Hailu & Areda, 2021).

Potassium hydroxide is a strong metallic base. KOH is commonly used to diagnose yeast infections and as a whiff test for bacterial vaginosis (Javame Ghazvini *et al.*, 2025). Several studies have reported the effectiveness of KOH solution in treating CA and molluscum contagiosum. The mechanism of action of KOH solution is thought to be related to its keratolytic effect, which results in damage to virus-infected cells. This effect is also possibly caused by its irritating action, which

triggers an inflammatory response and reaction, thus facilitating wart resolution (Hailu & Areda, 2021). KOH solutions can cause varying degrees of irritation depending on their concentration. A 5% concentration is as effective as a 10% solution and has fewer side effects (Javame Ghazvini *et al.*, 2025).

KOH offers several practical advantages, including patient self-administration capability, cost-effectiveness, and accessibility (Al-Hamdi & Al-Rahmani, 2012; Makki *et al.*, 2022). These characteristics make it particularly valuable in resource-limited settings or for patients seeking privacy and autonomy in treatment. The ability for self-administration addresses essential barriers to care, including healthcare access limitations and treatment convenience (Park *et al.*, 2015). KOH's dual mechanism involving direct cytotoxicity through protein denaturation and inflammatory response induction may explain its efficacy and potentially lower recurrence rates (Makki *et al.*, 2022; Navone & Speight, 2018). The keratinolytic properties enable selective targeting of hyperkeratotic tissue characteristic of viral warts while the inflammatory response may enhance viral clearance mechanisms (Al-Hamdi & Al-Rahmani, 2012).

Several limitations should be acknowledged. Most studies had relatively short follow-up periods that may not capture long-term recurrence patterns. The heterogeneity in study designs, patient populations, and outcome measures limits the ability to perform formal meta-analysis. Quality of life and patient-reported outcomes were not extensively evaluated. Future research should focus on long-term efficacy studies with extended follow-up periods, standardised outcome measures, and quality-of-life assessments. Investigation of optimal treatment protocols, combination therapy approaches, and implementation strategies would further enhance clinical utility.

Based on available evidence, 5% KOH solution can be recommended as first-line treatment for appropriate candidates with small to moderate external genital lesions. It can also be an alternative therapy for patients who are intolerant to other modalities, and is a preferred option in resource-limited settings or when patients prefer self-treatment. This treatment requires careful patient selection and monitoring protocols.

## **CONCLUSION**

Potassium hydroxide 5% solution emerges as a promising, cost-effective alternative for treating condyloma acuminata, demonstrating comparable efficacy to established therapies with several potential advantages, including patient self-application capability, shorter treatment duration, and a favourable safety profile. The evidence supports KOH as a viable first-line or alternative treatment option, particularly valuable in resource-limited settings or for patients seeking self-administered therapy, including in rural areas where electrocauterization is unavailable. However, standardised application protocols, long-term efficacy studies, and quality-of-life assessments remain areas that require further investigation to optimise clinical implementation and patient outcomes.

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