

A new drug with a nasty bite: A case of krokodil-induced skin necrosis in an intravenous drug user



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INTRODUCTION

Krokodil is a commonly used street name for desomorphine, an injectable opioid derivative that is associated with severe dermatologic effects. We report a case of a woman who had extensive ulcerations after a single use of this narcotic. To our knowledge, this is the first case report of the cutaneous manifestations of *krokodil* use in the dermatologic literature.

CASE REPORT

A 23-year-old woman with a history of intravenous drug abuse presented to the emergency department complaining of increased pain and swelling in her hands and forearms secondary to nonhealing ulcers. These ulcers were present for approximately 12 months and appeared shortly after the patient used a new injection street drug called *krokodil* for the first time. She injected this substance into both forearms and immediately noticed a burning sensation during infusion. Within 24 hours, significant pain and swelling developed in both arms in addition to purulent drainage from puncture sites. The patient noted gradual progression of the ulcers over several months, which eventually became malodorous with areas of necrosis. Although she has not injected *krokodil* since, she does admit to occasionally injecting heroin into other body parts, which has not resulted in a similar reaction.

On physical examination there were large wounds measuring approximately 10 cm in length on the forearms bilaterally (Figs 1 and 2). In both wounds, there was a central portion of deep

ulceration measuring approximately 3 cm in length and extending to the deep fascia, with the remainder of the wound primarily composed of hypertrophic scarring. No peripheral erythema or significant drainage, purulence, or foul odor was appreciated.

Two 4-mm punch biopsies specimens were obtained from the right forearm for histopathology and tissue culture analysis. Results revealed acanthosis and a sparse perivascular infiltrate. Deeper sections revealed dome-shaped skin with pseudoepitheliomatous hyperplasia, dermal scarring, focal lymphoplasmacytic infiltrate, and mildly ectatic blood vessels. There were few collections of neutrophils in the keratin layer. Gram-Weigert stain yielded a few gram-positive cocci on the surface keratin. Tissue cultures were positive for light skin flora, and immunostains for human herpesvirus 8 and syphilis were negative. A contrast-enhanced computed tomography scan of the bilateral upper extremities found extensive soft tissue thickening and stranding in the distal forearms. No drainable fluid collection, soft tissue gas, or osseous erosions were noted.

DISCUSSION

Initially introduced in Russia, *krokodil* is considered an inexpensive and highly addictive substitute for heroin.^{1,2} Its name is derived from *crocodile* (*krokodil* in Russian) and refers to the scaly, green-black skin discoloration frequently noted in its users.³ *Krokodil* is produced by synthesizing desomorphine from codeine and combining it with other low-cost, easily obtained additives.² These additives can include hydrochloric acid, red

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Fig 1. Krokodil-induced necrotic ulcerations of the bilateral forearms.



Fig 2. Krokodil-induced deep ulceration of the right forearm with nearly exposed tendon.

phosphorus (from matchbook striking surfaces), iodine, gasoline, and paint thinner and have been proposed to contribute to krokodil's severe cutaneous and systemic effects.^{2,3}

Existing reports of the dermatologic sequelae of krokodil use describe the development of significant swelling and pain in the areas of intravenous or subcutaneous injection, followed by a discolored (greenish-black) scaling and large-scale necrotic ulceration.^{4,5} This ulceration can progress to severe muscle and cartilaginous tissue damage.⁴ Subsequent skin and muscle decay can cause the skin to slough off, often exposing the underlying bone.⁴ Thrombophlebitis and gangrene have also been reported at and around injection sites.^{3,6} With 10 times the potency of morphine, krokodil's extreme analgesic effects may cause users to ignore the severity of these deleterious consequences, which may contribute to the delayed medical attention often seen in its users.^{1,3,7} The described tissue injuries seem to consistently manifest shortly after injection of krokodil, and users report relatively short histories of abusing the drug.³

Krokodil appears to be more associated with gangrenous and necrotic tissue destruction than do other intravenously injected illicit substances, including heroin.³ This finding may be related to the ingredients used to create krokodil, but the exact mechanism behind its toxicity remains unknown. Several reports emphasize the lack of purification of this concoction before injection, which has been implicated as a cause for immediate irritation and cutaneous damage.^{1,3,8} However, krokodil contains many ingredients that are known to be toxic to the skin.⁴ It has been suggested that the presence of gasoline and hydrochloric acid in the injected solution induces discolored scaling and ulceration, whereas iodine has been to cause severe damage to the muscles and endocrine system.^{4,7,8} Reports also implicate red phosphorous as a cause for cartilaginous tissue and bone damage.⁷⁻⁹ Atypical

jaw osteomyelitis and necrosis has been reported in patients who use intravenous narcotic drugs containing red phosphorous.⁹ Toxic byproducts such as iron, zinc, and lead have been associated with neurologic, liver, and kidney impairments.⁷ The more severe harms associated with krokodil use may also be because of its relatively short half-life, leading to more frequent administration.³ Concomitant intravenous abuse of other medications such as tianeptine (antidepressant) has been reported³ and may contribute to some of the vascular complications frequently seen in krokodil users.¹⁰

In addition to addiction counseling, current reports cite intensive wound care and antibiotic therapy as the primary interventions for krokodil-induced skin and soft tissue damage,^{5,6} although patients can present without evidence of infection, as was the case in our patient. In severe cases, extensive debridement, skin grafts, and amputation may be required.³ Many of these patients are lost to follow-up after hospital discharge^{5,6}; therefore, it has been difficult to characterize the long-term outcomes. However, current reports suggest that many of the krokodil-associated injuries often lead to death within a few years after initial presentation.^{7,8}

The prevalence of krokodil continues to be much lower than heroin use, but, as evidenced by this case, its side effects are substantial. It is important that dermatologists are able to recognize the unique injuries associated with this drug, which can mimic other conditions such as necrotizing fasciitis or pyoderma gangrenosum. In cases in which these conditions are on the differential diagnosis, we recommend that dermatologists inquire about a history of krokodil use, even in patients who initially deny a history of intravenous drug use.

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