

Full-thickness Pediatric Burn following Reaction between Cyanoacrylate Nail Adhesive and Cotton Shirt

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Abstract

Cyanoacrylate is an acrylic resin that is used as an adhesive in acrylic nail glues and various other strong, rapidly acting adhesives, such as “Dermabond” and “Super Glue.” This adhesive is very effective in a variety of settings; however, when cyanoacrylate comes into contact with cotton fibers, an exothermic reaction occurs that is severe enough to cause a full-thickness burn to the underlying skin. Full-thickness burns requiring excision and skin grafting can be psychologically devastating for patients, especially the pediatric population and their parents, who may believe they are to blame for their child’s burn. We present the case of a 2-year-old boy who developed a full-thickness burn after spilling acrylic nail glue onto his cotton shirt. Fortunately, his burn was small enough that excision with primary closure was able to be performed. However, he unfortunately developed hypertrophic scarring postoperatively. Owing to the widespread use of cyanoacrylate adhesives in the general population, it is important to spread awareness of the potential dangers associated with these adhesives to prevent potential physical and psychological injuries related to improper use of these adhesives.

Keywords: Cyanoacrylate, nail glue, thermal burn

Key messages:

1. Cyanoacrylate glue produces an exothermic reaction when it contacts clothing or fibers containing cellulose.
2. The exothermic reaction produced by cyanoacrylate glue contacting clothing can cause a full-thickness burn injury.
3. Applying cold water with soap detaches the glue to prevent further progression of the burn.

INTRODUCTION

Artificial fingernails are a popular fashion accessory that requires the application of glue to maintain adherence to the fingernail. The chemical that is typically used as this adhesive is cyanoacrylate. This adhesive is generally safe when it comes into contact with skin and may occasionally cause dermatitis, irritant paronychia, or allergic onycholysis with repeated contact with the skin.^[1,2] However, if cyanoacrylate comes into contact with cotton fibers, a severe exothermic reaction occurs that can cause a full-thickness thermal burn injury.^[3-6]

There are only a few reported cases in the literature of cyanoacrylate glue causing a thermal burn injury on contact with cotton clothing in pediatric patients. These cases typically involved an accidental spill of fingernail glue onto clothing overlying skin that resulted in a full-thickness burn injury that required skin grafting in a

majority of the patients.^[7,8] In two of these patients, the exothermic reaction was so severe that it burnt a hole into their jeans or cotton leggings.^[7] A full-thickness burn requiring skin grafting can be psychologically devastating for both the pediatric patient and the parents. Therefore, awareness of the potential dangers associated with adhesive glues and administering appropriate treatment modalities in a timely manner following exposure are critical in minimizing both physical and psychological trauma. In this article, we present the case of a 2-year-old boy who developed a full-thickness burn after spilling cyanoacrylate glue onto his shirt, subsequently requiring excision with primary closure.

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CASE HISTORY

A 2-year-old previously healthy boy sustained an accidental thermal burn while he was playing with a bottle of acrylic nail glue. The glue spilled onto his hands and shirt, causing his shirt to adhere to his chest wall. The child became agitated, and his parents frantically removed his shirt, which caused the skin that was adhered to the shirt to be traumatically separated from the underlying tissue [Figure 1]. The parents subsequently attempted to use lotion to remove the glue from his fingers. They presented to an outside hospital for evaluation and were subsequently transferred to our hospital's burn center for further care.

On evaluation at the burn center, the patient was noted to have a 0.5% total body surface area full-thickness burn injury to his right chest below the nipple–areolar complex involving the inferior aspect of the areola and measuring 7×1.5 cm [Figure 2]. He was taken to the operating room, where he underwent excision of the nonviable tissue with primary closure [Figure 3]. The patient's scar was treated with a compression garment, silicone gel pads, and scar massage, but unfortunately, he subsequently developed a hypertrophic scar. He is currently undergoing fractional CO₂ laser ablation for hypertrophic scar treatment [Figure 4].

DISCUSSION

Cyanoacrylate is the adhesive that is typically used in nail glues, household glues (such as “Super Glue” and “Krazy Glue”), and surgical glues (such as “Dermabond”). It is an acrylic resin that rapidly polymerizes in the presence of hydroxyl groups, which are found in water and certain fabrics, to form strong polymer chains that join the bonded surfaces together. When these glues are applied to dry skin, the humidity in the air initiates the polymerization process and produces a minimal thermal reaction. However, when cyanoacrylate comes into contact with clothing or fibers

containing cellulose, which is abundant in hydroxyl groups, the polymerization process is amplified, producing a rapid and powerful exothermic reaction that can cause thermal burn injury when in direct contact with underlying skin.^[7]

Partial thickness burns begin to occur when temperatures greater than 40°C contact the skin, and full thickness burns are produced within one second with temperatures greater than 80°C. A study performed by Kelemen *et al.*^[7] investigated the temperatures produced by this exothermic reaction between cotton leggings and cyanoacrylate glue. In their experiments, they found that the average



Figure 2: Postburn day 0 photograph showing 0.5% TBSA full-thickness burn injury



Figure 1: The shirt the patient had been wearing during the burn injury, showing a portion of skin adhered to the shirt



Figure 3: Post-op day 0 from excision of full-thickness burn injury with primary closure



Figure 4: Two months post-op with hypertrophic scarring

temperature achieved by this reaction was 68°C with one product reaching a temperature of 75°C. Therefore, the exothermic reaction produced by combining cyanoacrylate with cotton material is sufficiently great to produce a full-thickness burn injury. They also noted that applying cold water with soap decreased the temperature of the exothermic reaction and detached the glue from the leggings.^[7]

Our patient sustained a thermal burn injury secondary to the powerful exothermic reaction produced by the cyanoacrylate nail glue's chemical reaction that was initiated on contact with the abundant hydroxyl groups in the patient's shirt. According to the aforementioned findings by Kelemen *et al.*,^[7] early irrigation of our patient's cyanoacrylate exposure with soap and cold water may have both decreased the temperature of the exothermic reaction and detached the glue from his skin. The patient subsequently underwent excision of his burn with primary closure and did not require skin grafting. However, he eventually developed a hypertrophic scar and continues to undergo treatment to minimize the appearance of his scar. During the patient's hospital admission, his parents

were anxious about this burn injury that was traumatic not only for the patient but also for his sibling and parents. They were evaluated by our hospital psychologist to better cope with this traumatic experience. This case presentation highlights the importance of awareness of the potentially devastating burns that may be caused by cyanoacrylate glue as well as the means by which exposure may be treated to reduce the severity of the burn injury.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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