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Ocular superglue injury: a case report and review of literature



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ABSTRACT

Background: Cyanoacrylate (superglue) is a durable adhesive substance that is widely available in the commercial market. It is packaged with a small plastic packaging that resembles eye drops or ointments, so it frequently causes an inadvertent instillation resulting in ocular injury.

Purpose: To present an inadvertent cyanoacrylate (superglue) adhesive instillation case causing an ocular injury with a comprehensive literatures review.

Case Presentation: A 69-year-old female patient mistakenly took the glue instead of an ophthalmic solution, causing chemical

conjunctivitis, eyelash clumping, and foreign body in her conjunctiva. The patient showed a pleasant treatment response following the foreign body removal and topical antibiotics-steroid administration.

Conclusion: Ocular cyanoacrylate injury is still quite steadily to be found nowadays. Pediatrics and geriatrics being the most vulnerable population who are experiencing the injury. Strict supervision and prevention should be encouraged to avoid the recurrence of the events in the future.

Keywords: cyanoacrylate, adhesives, superglue, eye injury

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INTRODUCTION

Cyanoacrylate is one of the strong and instant-acting adhesive materials that is often used for household, biomedical, and industrial needs.¹ Its use has been evolving since it was first manufactured commercially around the 1950s and currently widely available at a low cost for public consumers.² Chemically, cyanoacrylate is part of the ester acid compound. This compound has several types of derivatives, one of which is often found to be traded as household adhesives, namely Ethyl-cyanoacrylate (ECA).^{1,2} In the market, it is commonly known as superglues, power glues, or instant glues. Cyanoacrylate is colorless, mild smelling, and liquid in form.²

Generally, commercially-available cyanoacrylate adhesive is packaged using small plastic container that resembles the packaging of the eye drops or ointments.³ This contributes to the incidence of inadvertent cyanoacrylate instillation to the eye, causing ocular injury. The incidences often result from the unintentional errors by the patients, carelessness of children playing with the glue, and can also be a result of splash accident.⁴⁻¹² The first ocular superglue injury was documented in 1982.¹³

Even in the twentieth century, the incidences of ocular cyanoacrylate injury are still common.

Tabatebaei and colleagues reported 105 cases of ocular superglue injuries within three months at the emergency department of Farabi Ophthalmology Hospital, Iran.¹⁴ Previous cases have also been reported along with various kind of managements and recommendations.⁴⁻¹² This study presents an ocular injury case due to the inadvertent cyanoacrylate (superglue) adhesive instillation and summarizes the appropriate management based on a comprehensive literatures review.

CASE REPORT

A 69-year-old woman came to the ophthalmology clinic in Wangaya Public Hospital with a history of mistakenly instilled a drop of liquid superglue (cyanoacrylate), instead of an artificial tear eyedrop, to her right eye. When the patient realized what had happened, she immediately rinsed her eye using tap water. The patient was then immediately taken to the nearest emergency unit, where she received secondary irrigation using normal saline. Due to the absence of an ophthalmologist, the patient was treated on an outpatient basis and referred to the public hospital to obtain further examination and medication.

In the hospital, the patient complained of red-eye and unusual blurred vision in the same eye;

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however, she had no eye pain or discomfort either at rest or with movement. She explained that she had a prior history of eye irritation and intended to use an over-the-counter eye drop. The patient also had a history of bilateral visually compromising cataracts that had not been treated. There was no history of other systemic diseases.

Visual acuity was 6/12 in the right eye and 6/9 in the left eye, with no improvement with pinhole. Intraocular pressure was measured using a non-contact tonometer with a result of 12 mmHg in the right eye and 13 mmHg in the left eye. Slit-lamp examination in the right eye revealed the findings of conjunctival injection, secretion, eyelash clumping, and the presence of glue fragments on the surface of the conjunctiva (Figure 1). No epithelial defect was found on the corneal surface. Both palpebrae were intact and did not stick together.

The ophthalmologist extracted the glue fragment and removed the remaining residual pieces of glue from the lid margin and the lashes using cotton buds without any topical anesthesia. The patient was prescribed tobramycin eye drops every three hours, dexamethasone-neomycin sulfate-polymyxin B sulfate eye ointment once a day at night, and oral corticosteroid 4 mg three times a day. Vision on both eyes remained the same after a one-week follow-up, but other symptoms and signs were completely healed. On routine examination, the lid and lash were found to be anatomically and functionally normal. The patient had agreed and given written informed consent for this publication.

DISCUSSION

A few studies regarding the ocular trauma due to the exposure of cyanoacrylate or superglue have been previously published. Based on the systematic

literature search performed using the PubMed/Medline search engines, the author retrieved at least ten articles relevant to this topic; including one research article, five case reports, and four letters to editor reporting cases (Table 1).

Superglue belongs to the alkyl cyanoacrylate family. The family derives into several monomers, ones are generally marketed commercially including the Methyl-cyanoacrylate and Ethyl-cyanoacrylate.² In addition to these monomers, other types of newer cyanoacrylates, such as n-Butyl cyanoacrylate, isobutyl cyanoacrylate, and 2-Octyl cyanoacrylate, are also often used in medical and cosmetic applications, due to their less toxicity.^{2,15} Examples of medically used cyanoacrylates are as tissue adhesive, leak control glue on ruptured blood vessels or organs, components for manicure nails, and fingerprint processing.² Cyanoacrylates have also been used in ophthalmic surgical intervention for sterile and infectious perforated corneal ulcers.^{15,16}

In our case, the use of cyanoacrylate adhesive containing Ethyl-cyanoacrylate ($C_6H_7NO_2$) occurred. The product investigation showed that this type of adhesive is colorless, sweet and acrid odor, and liquid in form, with the physical characteristics including the viscosity level of 2-3 cPs, gap-fill up to 0.04 millimeters, setting-velocity of 5 seconds, and tensile-shear strength of 100-160 kgf/cm². The most common application of this adhesive is purposed for woodwork, plastic, and rubber.¹⁷

Although some studies stated that cyanoacrylate tends to bond on a dry surface,¹¹ actually the polymerization (hardening) reaction occurs with the presence of hydroxyl ions (OH⁻) derived from water.² One literature stated that cyanoacrylate requires moist conditions to work well; thus, the instillation of cyanoacrylate on the surface containing water, aqueous, or saline will instantly solidify the glue.¹⁵ This explains why the glue drop reacts instantly in the eye resulting in the bonding of the surface of the eyeball, eyelids, or lashes.^{2,15} The Methyl- and Ethyl-cyanoacrylate have shorter alkyl-side chains of carbons (< 4 carbons) and are toxic to the human tissue, leading to acute and chronic inflammation.¹⁶ Cyanoacrylate is also a chemical irritant, so its inadvertent instillation can cause an ocular chemical injury, manifested as conjunctivitis, keratitis, or both.¹¹

The strong and instant-acting adhesive property of the cyanoacrylate glue most often results in difficulty opening eyes due to partial or complete ankyloblepharon-like appearance, which is defined as the closure of the eyelids by an adhesion between the upper and lower eyelid margins. Sometimes, hardened glue particles cause



Figure 1. Clinical manifestation of the patient's right eye on examination

Table 1. Literature search on the previous ocular cyanoacrylate injury case reports from the year 2000 –2020

Study (Author, Year, Place)	Sex	Age	Cause	Clinical Findings	Management	Follow-up
Leibowitz and colleague ⁴ 2000, Israel	F	43 years	Glue mistakenly as eye drop	Conjunctival and corneal abrasion, foreign body, eyelash clumping	Removal of foreign body, conservative management	Complete healing
Knight ⁵ 2001, United Kingdom	M	60 years	Glue mistakenly as eye drop	Eyelid closure, temporary symblepharon	N/A	Complete healing
Needham and colleagues ⁶ 2003, United Kingdom	N/A	3 months	Glue mistakenly as eye drop	Partial eyelid closure, corneal abrasion, eyelash clumping	Release of eyelids, topical antibiotic	Complete healing
	N/A	3 years	Child playing with glue	Partial eyelid closure, corneal abrasion, eyelash misdirection	Release of eyelids, topical antibiotic	Complete healing
Spencer and Clark ⁷ 2004, Australia	N/A	N/A	Glue mistakenly as eye drop	Eyelid closure, corneal abrasion, periocular dermatitis, loss of lashes	Surgical release of eyelids, topical antibiotic	Complete healing
	N/A	N/A	Glue mistakenly as eye drop	Eyelid closure, corneal abrasion, periocular dermatitis, loss of lashes	Surgical release of eyelids, topical antibiotic	Complete healing
Desai and colleagues ⁸ 2005, United Kingdom	N/A	7 years	Glue mistakenly as eye drop	Eyelid closure, corneal abrasion	Conservative management	Complete healing
	N/A	11 years	Glue mistakenly as eye drop	Eyelid closure, corneal abrasion	Conservative management	Complete healing
	N/A	15 years	Glue mistakenly as eye drop	Eyelid closure, corneal abrasion	Conservative management	Complete healing
Terman ⁹ 2009, United States	F	11 years	Glue mistakenly as eye drop	Eyelid closure, eyelash adhesion, corneal abrasion	3% sodium bicarbonate solution compress, pain management, topical antibiotic	Complete healing
Yusuf and colleague ¹⁰ 2010, United Kingdom	M	64 years	Glue mistakenly as eye drop	Partial eyelid closure, corneal abrasion	Irrigation using tap water, release of eyelids, topical antibiotic-steroid, cycloplegics	Complete healing
Reddy ¹¹ 2012, Malaysia	F	6 years	Glue mistakenly as eye drop	Partial eyelid closure	Release of eyelids, epilation, removal using acetone, topical antibiotic	Complete healing
	M	3 years	Child playing with glue	Eyelid closure	Release of eyelids, epilation, topical antibiotic	Complete healing
	M	8 months	Accidental splash of glue	Partial eyelid closure, corneal ulceration	Release of eyelids, topical antibiotic	Complete healing
Cookey and colleagues ¹² 2018, Nigeria	F	29 years	Glue mistakenly as eye drop	Eyelid closure, corneal ulceration	Release of eyelids, topical antibiotic	Complete healing

N/A, not available; M, male; F, female.

irregular casts to form, which manifests as foreign bodies scratching the surface of the eye, leading to conjunctival or corneal abrasion and ulceration. Other manifestations include lid swelling, eye pain, eyelash clumping or adhesion, loss of lashes, and periocular dermatitis.^{4-12,14}

The mechanism of eye injury from reported cases is mostly related to inadvertent misidentification between the packaging of the superglue and the eye drop or ointment, whether due to patient's carelessness or mistakes due to poor eyesight.^{4,5,7-10,12} Some cases reported that the incidents occur when patients use eye drops in dim light areas.⁴ Incidents are also reported to occur in children caused by inadvertent misidentification by the caregiver, childhood curiosity, and caregiver's lack of supervision of the children.^{6,11} Meanwhile, injuries from assault had not been reported in the last 20 years.

Cyanoacrylate adhesives have been manufactured and packaged using 5-10 ml plastic containers in bottles or tubes that resemble ophthalmic drops or ointments. Most packaging also does not come with a child-resistant cap or warning signs. Even if available, it is generally printed with small lettering or in a foreign language that is not commonly understood by the users. Therefore, children and elderly people with poor eyesight frequently become the populations that are susceptible to ocular cyanoacrylate injuries.⁴⁻¹² In our case, the patient had the oldest age compared to other published articles. She also had cataracts, that may interfere with her vision ability.

The main purpose of the management of ocular cyanoacrylate injury is to restore the anatomical shape and function of the eyelids so that a more comprehensive ocular evaluation can subsequently be carried out.¹¹ Jijelava and colleagues established a technique for the treatment of adhesives injury to the eye using topical anesthesia and Jameson muscle hook. The technique begins by identifying an open gap in the glued eyelid margin, followed by applying topical anesthesia and insertion of Jameson muscle hook through the open gap. The hook is subsequently pulled through parallel and away from the eye surface, releasing the adhesion.¹⁸ Epilation and trimming of the eyelashes can also be attempted to mechanically release the adhesion. In children, surgical release under general anesthesia is usually needed. Untreated ankyblepharon is at risk of causing amblyopia among children.¹⁰⁻¹²

Chemical release of the eyelids using the acetone-based solution can be useful.¹¹ However, the process must be done very carefully, because the penetration to the conjunctival or corneal surface may result in further ocular chemical burns. A

report also mentioned the use of high-molecular-weight oils present in margarine or vegetable oil to dissolve the cyanoacrylate bonds.^{10,19} Nevertheless, if applied, this material still cannot be used on the inside of the eye.

Some literatures reported that the immediate irrigation, which is done in the ocular chemical burns protocol, can be useful to physically remove the residual glue fragments and reduce the rate of injury.^{10,20} However, considering the theory that cyanoacrylate reacts well with water and saline solutions, it may be necessary to conduct a further study regarding the proper timing and effectiveness of irrigation on ocular cyanoacrylate injuries. Irrigation possibly results in benefits if it is carried out after the polymerization occurs to mechanically remove the glue casts left on the ocular surface. Glue cast can also be extracted from the ocular surface by performing gentle flicking motion using sterile cotton buds, 25- to 27-gauge needle on 1-ml syringe, or forceps.^{14,21} Instillation of fluorescein drops are often needed to evaluate the presence of corneal epithelial disruption.¹⁰

One study reported the use of a 3% sodium bicarbonate solution compress in the management of ocular cyanoacrylate injury in children. The mechanical or surgical release of the eyelid was unable to perform because of the child's anxiety and discomfort. The chemical reaction is still unable to be explained clearly. However, this practice was able to help to remove the glue gradually.⁹

Topical antibiotics are routinely prescribed to reduce the risk of secondary bacterial infection in the presence of foreign materials in the eye. Chloramphenicol 0.5% drop or 1% ointment is one of the broad-spectrum antibiotic agents that is commonly used.^{4,7,10} Other options include polymyxin B/trimethoprim, levofloxacin 0.5%, and ofloxacin 0.3% drops or ointments. Dosage recommendation is up to four to six times daily for five to seven days.^{21,22} Aminoglycoside antibiotics, such as gentamicin 0.3% and tobramycin 0.3% drops or ointments, should be avoided in the presence of corneal injuries due to their potential toxicity. Topical ciprofloxacin 0.3% had been reported to cause crystalline punctate deposits and promote delayed healing of the cornea; thus, its usage should also be avoided.²³

Combined preparations of topical antibiotics-steroid or steroids alone are uncommonly prescribed in this type of injury. However, it can be considered to reduce the inflammation and relieve symptoms such as pain, redness, or irritation.¹⁰ In the presence of corneal abrasion and ulceration, topical steroids are contraindicated due to the risk of delayed epithelial wound healing process and

increase risk of infection.²² Topical anesthetics may be used to temporarily relieve the pain during examination or management procedure, but should not be used routinely at home. One report showed the use of topical cycloplegic (cyclopentolate 1% drop) in the injury. This is aided to relieve the ciliary muscle spasms and reduce the pain. Recent evidences suggest that these agents are no longer used because it does not provide additional clinical benefits.^{21,22} Hospitalization is typically not needed in patients with ocular cyanoacrylate injuries.^{4-12,14}

All mentioned case reports revealed no serious morbidity occurs in ocular cyanoacrylate injury. Corneal abrasion takes 48–72 hours to heal and most patients take less than one-month follow-up to completely healed.^{4-12,21} Nonetheless, prevention control must still be done considering the continuing incidents to this day. The effort should focus on the modification of the design, shape, and replacement of the containers into child-resistant packaging. Besides, an obvious distinction of the color and odor of the superglue preparation is also needed to distinguish them from ophthalmic drops and ointments. Storage and usage instructions, as well as suggested actions that must be taken if the user inadvertently instilled the glue on the mucosal surfaces, must be printed boldly and clearly.¹¹ Warnings can also be made in Braille to prevent the occurrence among blind people.⁵ Doctors' warnings to patients should be emphasized to always double-check the label of the drug before use and to keep it separated with similarly-appearing containers.

CONCLUSION

Ocular cyanoacrylate (superglue) injury is a preventable ophthalmic traumatic injury that is still common due to the inadvertent instillation of the glue to the eye. Pediatrics and geriatrics are the most vulnerable population to experience the injury. Ocular abnormalities ranging from mild to those that require surgical intervention may occur. Therefore, strict supervision and prevention should be encouraged to avoid the recurrence of the events in the future.

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CONFLICT OF INTEREST

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