Simonis and de Lange *International Journal of Emergency Medicine* (2024) 17:174
https://doi.org/10.1186/s12245-024-00756-5

International Journal of Emergency Medicine

CASE REPORT Open Access

# Facial high-pressure injection injury with air in a child

S. A. Simonis[1*] and D. H. de Lange[2]

## Abstract

**Background** High-pressure injection injuries are rare injuries and are frequently underestimated due to the limited external damage. Because of their association with occupational activities, these injuries are predominantly seen in hands. Facial involvement in such traumas is extremely rare. The difference in facial anatomy compared to the extremities demands careful consideration of both associated complications and treatment options.

**Case** A 6-year-old girl with no significant medical history was presented to the Emergency Department with a high-pressure injection injury to her right eye with a high-pressure cleaner. This resulted in injection of air at a pressure of 8 bar into the eye. She developed significant subcutaneous emphysema in the facial and neck regions. Additionally, intraorbital and intracranial emphysema were identified without any fractures. Treatment consisted of inpatient observation and antibiotic treatment. The patient was discharged after one day of observation for continued antibiotic treatment at home. Two weeks later, the patient had no residual symptoms and there were no signs of secondary infection.

**Conclusion** High-pressure injection injuries to the face are rare and demand a different approach compared to the most common high-pressure injection injuries to the extremities. The nature of the injected material is paramount in choosing the appropriate treatment. This case illustrates that a high-pressure injection injury with air in the facial region, leading to extensive emphysema, can be managed conservatively with antibiotic therapy and inpatient observation.

**Keywords** High-pressure injection, Facial trauma, Orbital injection injury, Air injection, Conservative treatment, Antibiotic treatment

## Background

High-pressure injection injuries are rare injuries and are often underestimated when presented to the Emergency Department (ED) due to the limited symptoms and external damage [1–3]. Due to their association with occupational activities, these injuries are predominantly seen in hands, with the non-dominant hand being most affected [1, 2, 4]. Incidence rates are scarce. In 1980, the incidence of hand injection injuries was estimated at 1 in 600 hand injuries presenting to the ED [4]. Injection injuries can occur with various types of materials, with oily substances and paint being the most frequent. Such injuries

*Correspondence:
S. A. Simonis
Simonis.sofie@gmail.com
[1]Emergency Department, OLVG (Onze Lieve Vrouwe Gasthuis), Oosterpark 9, Amsterdam 1091AC, The Netherlands
[2]Surgery Department, Groene Hart Ziekenhuis, Bleulandweg 10, Gouda 2803HH, The Netherlands

are associated with severe deep infections and compartment syndrome, caused by an increase in compartmental volume with foreign material. Therefore, treatment of these injuries in most cases involves surgical intervention [2, 3]. The face is rarely involved in these types of injuries. There is limited literature available that describes injection injuries concerning the face resulting in the absence of specific incidence rates and treatment guidelines. The difference in anatomy of the face compared to the extremities demands consideration of differences in both associated complications and treatment options.

## Case presentation

A 6-year-old girl, with no significant medical history and vaccinations according the Dutch National Immunization Program, was presented to the ED due to an injury to her right eye sustained while playing with a high-pressure cleaner, which her father had been using for cleaning, with her brother. This resulted in air being injected into the right eye with a pressure of 8 bar. Upon arrival at the ED, the patient experienced significant swelling of the eye accompanied by visual impairment.

The patient was hemodynamically stable with normal vital parameters. There was swelling of the entire right side of the face involving the upper and lower eyelid (Fig. 1.). Additionally, there was significant conjunctival chemosis with slight external bleeding. Crepitus was felt with palpation of the swollen side of the face, extending to the temporal region of the scalp. The skin was pink and warm and palpation was painful. There were no signs of rhinorrhea. The affected eye was assessed by the attending Ophthalmologist. The visual acuity with manual opening of the eye was 90%. The pupil was reactive to light and ocular movements were intact. The intraocular pressure (IOP) was 29mmHg, indicating an elevated pressure.

In addition, a CT scan of the face was performed which revealed extensive subcutaneous and intraorbital emphysema, surrounding the globe, and in the retrobulbar fat (Fig. 2.). The emphysema extended intracranially trough the orbital fissure and through the parapharyngeal spaces into the neck. There were no fractures and no signs of compression of the optic nerve. Due to the presence of intracranial emphysema, the Neurology department was consulted and an additional CT scan of the brain was performed. This showed no abnormalities in the brain parenchyma and no visible air in the cerebrospinal fluid (CSF). Emphysema was present in the cavernous sinus continuous with the retrobulbar air, with minimal air in the prepontine epidural space and minimal air in the middle cranial fossa.

Due to the rare nature of the injury, consultation was sought with a specialized pediatric surgical center. A conservative treatment with antibiotics and inpatient

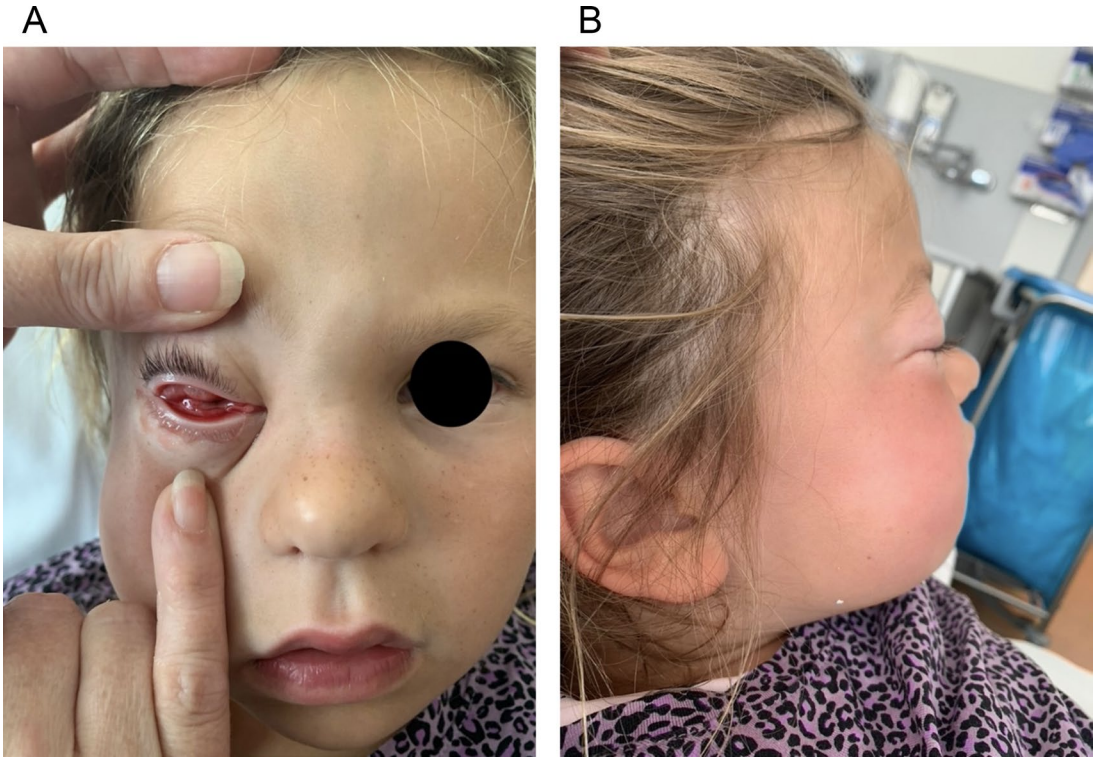


**Fig. 1** This photograph shows the visible damage of the face of the patient. **A**, Swelling of the eyelids and surrounding tissues and conjunctival emphysema. **B**, Lateral view, showing extensive swelling of the right side of the face

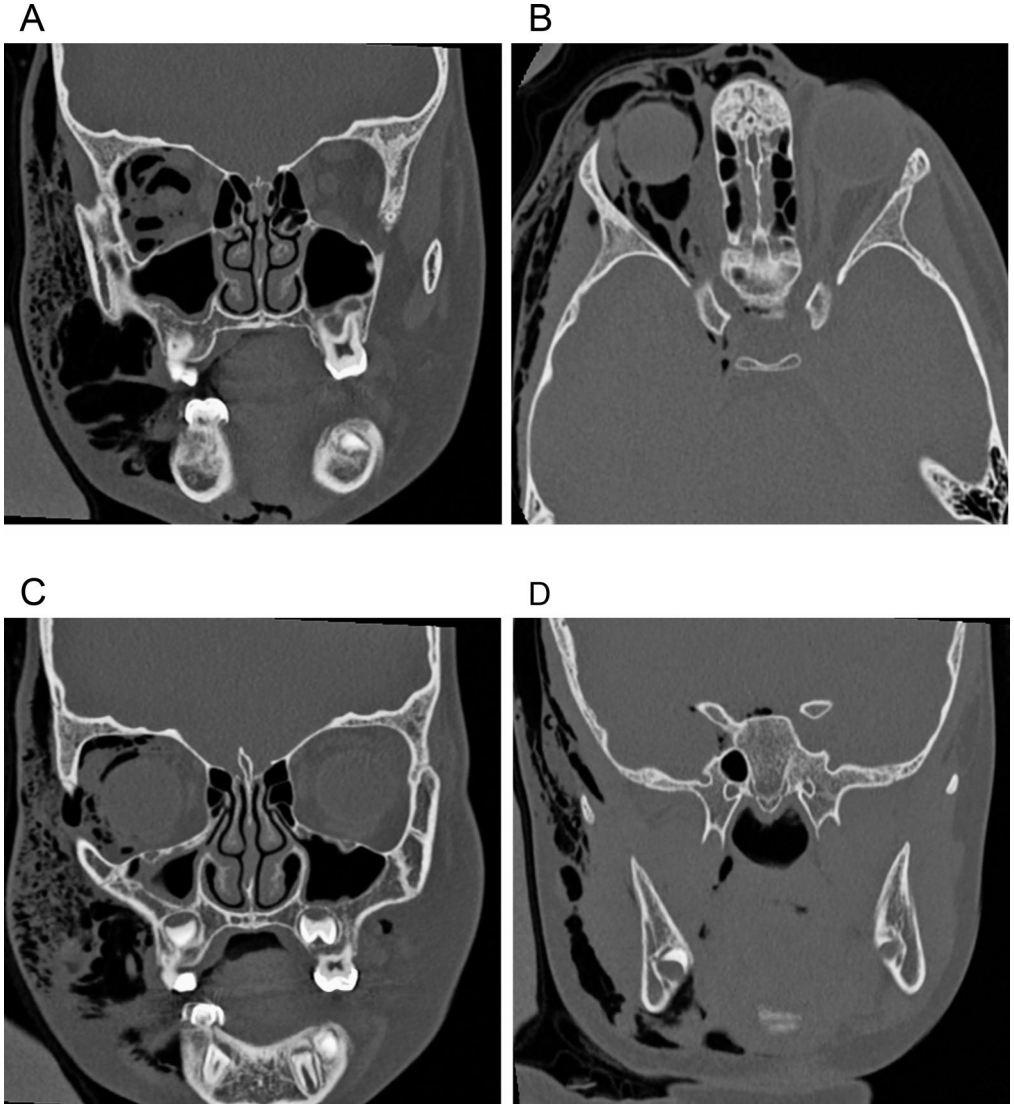


**Fig. 2** Various sections of the CT scan of the face showing significant subcutaneous, intraorbital, intracranial, and parapharyngeal emphysema. **A**, **B**, **D**; Coronal view. **C**, Axial view

observation was advised. The patient was admitted to the pediatric ward of our hospital and treated with intravenous Amoxicillin-clavulanate. She remained stable with normal vital signs and an uncompromised airway. The swelling of the face did not progress, visual acuity remained stable, and the pain was adequately controlled with Paracetamol. Due to the favorable clinical course, it was decided that the patient could be discharged after one day of observation with clear instructions for follow-up. Antibiotic treatment with Amoxicillin-clavulanate was continued for one week and the right eye was treated with Chloramphenicol for one week. After two weeks, the visual acuity was fully recovered and the swelling of the face had almost completely resolved. The patient had no residual symptoms and there were no signs of a secondary infection.

## Discussion

High-pressure injection injuries are a rare type of injury and predominantly seen in the extremities. Due to the limited external damage, the severity of this type of injury is often underestimated. The prognosis of the injury is determined by several factors:

the nature and volume of the injected material, injection pressure, injection site and the delay in presentation to the ED [1–3]. The nature of the injected material is the most important prognostic factor and therefore also leading in treatment choices [4]. Injection of materials such as air and water generally have a better prognosis compared to oil and paint. Paint particularly contains many toxic elements that induce a more severe inflammatory response. However, injection with water or air should not be underestimated, as these materials can also lead

to severe infections and compartment syndrome. Bacteria that are present on the skin or in the equipment are injected into deep tissues with a high pressure. In severe cases, this can result in necrotizing fasciitis. A pressure of 7 bar is sufficient to penetrate the skin, even without direct contact between the tool and the skin [5, 6]. Our case describes air injection into the eye with a pressure of 8 bar. In contrast to the skin, there is no known minimum pressure for conjunctival penetration. However, in 1986, an ocular injection injury was described with a minimal pressure of 3.4 bar (50 psi) [7]. Current literature mainly describes patients with injection injuries to the extremities. Due to the anatomical differences between the face and the extremities, different treatment options and potential complications should be considered. Regardless of the location, treatment of this type of injury always involves prevention of infection through tetanus immunization and adequate antibiotic therapy. Our patient had extensive subcutaneous emphysema and emphysema present in the orbit, intracranially and in the parapharyngeal spaces. It is important to be aware that bacteria, present on the conjunctival surface and in the pressure cleaner itself, were spread to these locations and that these bacteria can cause severe infections.

Since intracranial emphysema was not detected in the cerebral spinal fluid or subarachnoid space and the patient did not have any signs of CSF leakage, it was less probable that the patient would develop post-traumatic meningitis [8]. In our case, antibiotic therapy consisted of intravenous Amoxicillin-clavulanate on the first day, followed by oral Amoxicillin-clavulanate treatment for one week. This antibiotic was chosen for its adequate coverage of the most common skin flora and anaerobic oral and pharyngeal flora. The patient was participating in the Dutch National Immunization Program, thus no additional tetanus immunization was necessary.

Subsequently, it should be determined whether acute surgical intervention is necessary. For injection of paint and oily substances, emergent decompression and debridement is required in the majority of the cases due to the severe chemical reaction that occurs. For non-toxic materials, such as water or air, a conservative treatment with careful observation can be sufficient in certain cases. In these cases, it is important to consider not only the ratio between the size of the affected body part and the amount of injected material, but also the injection pressure. Compartment syndrome is a feared complication in injection injuries and requires emergent decompression. While compartment syndrome is predominantly seen in the extremities, it can also develop in the orbit. Orbital compartment syndrome (OCS) is a rare condition, developing in less than 0.1% of all facial traumas [9] and in 3.6% of patients with orbital injuries [10]. Any condition that causes an increase in intraorbital mass and subsequently an increase in intraorbital and intraocular pressure can potentially lead to OCS. Normal range of IOP in adults is 10-20mmHg [11]. In children IOP increases with age, approaching adult levels at 12 years. Sihota et al. [12] described an average IOP of $12.02 \pm 3.74$ mmHg in children aged 0–12 years. The most common cause of OCS is facial or ocular trauma that results in retrobulbar hemorrhage [13]. The rapid increase in intraorbital pressure causes compression of the optic nerve. Simultaneously the increase in intraocular pressure causes compression of the central retinal artery resulting in retinal ischemia. Symptoms of OCS include severe pain, swelling of the eyelids, proptosis, chemosis, impaired vision, relative afferent pupillary defect (RAPD) and elevated IOP [13]. OCS is a clinical diagnosis based on the history and the findings at physical examination. Treatment of OCS consists of orbital decompression which can be achieved by an emergent lateral canthotomy and cantholysis (LCC) [13]. Delay in decompression can result in complete vision loss. Our patient had an increased risk of developing OCS based on the trauma mechanism, the elevated IOP of 28mmHg, the swelling of the eyelids, chemosis, slight proptosis and slight reduction in visual acuity. However, the proptosis was not severe (Fig. 2.), pain was adequately controlled with only Paracetamol, there were no signs of RAPD, ocular movements were uncompromised and IOP was below the threshold of 40mmHg which is an indication for acute LCC [14]. It was decided not to perform any type of emergent surgical intervention. An important factor in this decision was the non-toxic nature of the injected material. As earlier described, air does not cause the same severe chemical reaction as toxic materials and is naturally absorbed over time by the surrounding tissues. It was not expected that the injected air would cause further swelling of the involved tissues or that IOP would continue to increase at this stage. However, the patient was admitted to the pediatric ward for close observation and was kept nil per os (NPO) for potential emergent surgery. During admission, the patient did not develop any signs of a compromised airway despite the parapharyngeal emphysema. Swelling of the eye, proptosis and pain did not progress. Visual acuity remained stable and the patient did not develop any additional abnormalities of the eye. Due to the favorable clinical course, there was no indication for a surgical intervention or repeated imaging. After discharge, the patient was followed up at the out-patient clinic. After two weeks visual acuity was completely recovered, subcutaneous emphysema had almost completely resolved and there were no signs of complications. In 2018, Bagheri et al. [15] published a case report describing a similar injection injury with air in a child's eye. In both cases, patients were treated with prophylactic systemic and local antibiotics. However, in the case that Bagheri et al. described,

patient underwent aspiration of the subconjunctival air in addition to the antibiotic treatment. In both cases, the patient's visual acuity fully recovered.

In conclusion, high-pressure injection injuries to the face are rare and demand a different approach compared to the most common high-pressure injection injuries to the extremities. The nature of the injected material is paramount in choosing the appropriate treatment. This case illustrates that a high-pressure injection injury with air in the facial region, leading to extensive emphysema, can be managed conservatively with antibiotic therapy and inpatient observation.

**Abbreviations**

| | |
|---|---|
| CSF | Cerebrospinal fluid |
| ED | Emergency Department |
| IOP | Intraocular pressure |
| LCC | Lateral Canthotomy and Cantholysis |
| OCS | Orbital Compartment Syndrome |
| RAPD | Relative Afferent Pupillary Defect |

**Acknowledgements**
M. Snabel, Ophtalmology Department, Groene Hart ZiekenhuisH.F. Visser-Trip, Pediatric Department, Groene Hart Ziekenhuis.

**Author contributions**
SS has contributed to the analysis of the case AND written the manuscript AND approved the submitted version. DH has contributed to the analysis of the case AND reviewed the manuscript AND approved the submitted version.

**Funding**
No funding was received for this article.

**Data availability**
No datasets were generated or analysed during the current study.

## Declarations

**Ethics approval and consent to participate**
Written consent from the parents of the patient was acquired for the case report. Approval of the Medical Ethics Review Committee (METC) was not required for this study.

**Consent for publication**
Written consent was acquired for publication of the case report from the parents of the patient. Additional specific written consent was acquired for publication of the figures, since these figures include the face of the patient.

**Competing interests**
The authors declare no competing interests.

Received: 30 August 2024 / Accepted: 25 October 2024
Published online: 11 November 2024

**References**

1. Hogan CJ, Ruland RT. <ArticleTitle Language="En">High-pressure injection injuries to the upper extremity: a review of the literature. J Orthop Trauma. 2006;20:503–11.
2. Smith GD. High pressure injection injuries. Trauma. 2005;7:95.
3. Simon L, Amsdell, Warren C, Hammert. High-Pressure Injection Injuries in the Hand: Current Treatment Concepts. Plastic and Reconstructive Surgery. October. 2013;132:4.
4. Schoo MJ, Scott FA, Boswick JA. High- pressure injection injuries of the hand. J Trauma. 1980;20:229–38.
5. Lewis H, Clarke P, Kneafsey B, Brennen M. A 10–year review of high-pressure injection injuries to the hand. J Hand Surg [Br]. 1998;23B(4):479–81.
6. Neal NC, Burke FD. High-pressure injection injuries. Injury. 1991;22:467–70.
7. Biger Y, Abulafia C. Subconjunctival emphysema due to trauma by compressed air tube. Br J Ophthalmol. 1986;70:227–8.
8. La Russa R, Maiese A, Di Fazio N, Morano A, Di Bonaventura C, De Matteis A, Fazio V, Frati P, Fineschi V. Post-Traumatic Meningitis Is a Diagnostic Challenging Time: A Systematic Review Focusing on Clinical and Pathological Features. Int J Mol Sci. 2020;21(11):4148.
9. Voss JO, Hartwig S, Doll C, Hoffmeister B, Raguse J-D, Adolphs N. The "tight orbit": Incidence and management of the orbital compartment syndrome. Journal of Cranio-Maxillofacial Surgery; Volume 44, Issue 8, 2016.
10. Fattahi T, Brewer K, Retana A, Ogledzki M. Incidence of retrobulbar hemorrhage in the emergency department. J Oral Maxillofac Surg. 2014, Volume 72, Issue 12, 2500–2502.
11. Adam D, Rowh JW, Ufberg, Theodore C, Chan, Gary M, Vilke. Richard A Harrigan. Lateral canthotomy and cantholysis: emergency management of orbital compartment syndrome. J Emerg Med. 2015, Volume 48, Issue 3, 325-330
12. Sihota R, Tuli D, Dada T, Gupta V, Sachdeva MM. Distribution and determinants of intraocular pressure in a normal pediatric population. J Pediatr Ophthalmol Strabismus. 2006 Jan-Feb;43(1):14 – 8; quiz 36 – 7. https://doi.org/10.3928/01913913-20060101-01. PMID: 16491720.
13. Ewan McCallum S, Keren M, Lapira, Jonathan H, Norris. Orbital Compartment Syndrome: An Update With Review of the Literature. Clin Ophthalmol. 2019, 13, 2189–2194.
14. Samples JR, Hedges JR. Ophthalmologic procedures. In: Roberts JR, Hedges JR, editors. Clinical procedures in emergency med- icine. 3rd ed. Philadelphia: W.B. Saunders Co; 1998. pp. 1089–119.
15. Abbas Bagheri MD, Amirreza Veisi MD, Sayed Ezatollah Memarzade MD, Tavakoli M, Orbital MD. Periorbital, and Intracranial Emphysema Caused by Compressed Air Injury in a 5-Year-Old Child. Ophthal Plast Reconstr Surg, 34, 5, 2018.

## Publisher's note