

Critical airway induced by formalin injection: case report

C-F YE^{1,2}, T-L LEE^{1,2}

¹Department of Otolaryngology, Taipei Veterans General Hospital, and ²Department of Otolaryngology, National Yang-Ming University, Taipei, Taiwan

Abstract

Background: Formalin is a saturated aqueous solution comprising 37–40 per cent formaldehyde. It is often used in histopathology laboratories as a tissue preservative. The ingestion or injection of formalin has an immediate, powerful and destructive impact on humans. This paper reports a case of formalin injection and reviews the relevant world literature.

Case report: A 36-year-old male attempted suicide by injecting formalin into the right side of his neck, resulting in a critical airway situation. An endotracheal tube was inserted and a tracheostomy was then performed to secure his airway. After receiving medical treatment, including antibiotics and N-acetyl cysteine, the status of the patient's airway improved.

Conclusion: When examining patients who have injected substances into their neck, the possibility of deep neck inflammation with airway compromise should be considered. Immediate management, which should include establishment of a definitive airway and prophylactic infection control, is crucial.

Key words: Formalin; Airway Obstruction; Computed Tomography, X-Ray

Introduction

Formaldehyde is a chemical used throughout the world, particularly in the manufacturing industry. It is a colourless and highly reactive gas, with a strong, suffocating and pungent odour. It causes irritation and burning, and is considered to be a group 1 carcinogen (i.e. carcinogenic to humans) by the International Agency for Research on Cancer.¹

Formaldehyde is manufactured as a saturated aqueous solution called formalin, which contains 37–40 per cent formaldehyde stabilised with 10–15 per cent methanol.^{2,3} The ingestion or injection of formalin has an immediate, powerful and destructive impact on humans. Cases of formalin ingestion have been described previously; mortalities have been reported.^{4–6}

This paper describes a patient who injected formalin into his neck, causing an immediate critical airway event. This unique case report may inform clinical physicians encountering similar emergent and potentially fatal events.

Case report

A 36-year-old male with a history of bipolar disorder attempted suicide by injecting formalin into the right side of his neck. He was transferred from a local hospital to our emergency room.

He was fully conscious upon arrival. His body temperature was 37.8°C (100.0°F), with blood pressure of 155/79 mmHg, heart rate of 94 beats per minute, respiratory rate of 20 breaths per minute and oxygen saturation of 97 per cent.

The patient stated that he had stopped injecting formalin almost immediately, after a small amount of formalin had

entered his neck, because of the severe burning and irritation experienced. He complained of right neck pain and dysphagia, but no dyspnoea.

Upon physical examination, mild swelling and erythema were evident on the right side of his neck. Mild stridor, drooling and muffled voice were noted.

Laboratory examination revealed a white blood cell count of 12 500/mm³, with 81.7 per cent neutrophils. Mild prolonged prothrombin time (13.7 seconds), and high levels of C-reactive protein (8.75 mg/dl) and creatine kinase (639 U/l) were noted. Arterial blood gas analysis revealed the following: a pH of 7.355, partial pressure of oxygen was 83.1 mmHg, partial pressure of carbon dioxide was 44 mmHg, bicarbonate was 24.4 mmol/l and base excess was –1.3 mmol/l. Levels of haemoglobin, platelets, creatinine, sodium and potassium were all within normal range.

Electrocardiography showed a normal sinus rhythm. Fibre-optic nasopharyngoscopy revealed extreme swelling of the pharynx and larynx, with a minimal airway; vocal folds were invisible. Neck computed tomography (CT) demonstrated an irregular-shaped mass with infiltrative margins deep in the right side of the neck. The lesion involved the right tonsil, right mandibular angle region, right submandibular region and right hypopharynx. The lesion extended downwards to a low part of the anterior neck, with the larynx pushed towards the left side. An abnormal collection of air was also noted in the lesion (Figure 1).

In light of the impending airway compromise, an endotracheal tube was inserted in the emergency room. Flomoxef sodium was used as a prophylactic antibiotic. Aggressive intravenous hydration was initiated, at a rate of 3 litres per



FIG. 1

Axial, contrast-enhanced neck computed tomography image at the horizontal level of the epiglottic tip, showing irregular-shaped mass (asterisk) in right side of neck. The larynx (arrow) is pushed towards the left side. An abnormal air collection can be seen (arrowhead).

day. Tracheostomy was then performed. N-acetyl cysteine 600 mg was administered twice daily from a nasogastric tube.

The patient's levels of white blood cells, C-reactive protein and creatine kinase all showed improvement over time. Repeat neck CT was performed 21 days after treatment, which revealed lesion regression.

The tracheostomy tube was removed 23 days after its insertion. The patient's respiratory pattern was regular. The patient was discharged 26 days later.

Discussion

Formalin is often used in histopathology laboratories as a tissue preservative. It is also used in the management of uncontrolled intravesical haemorrhage and radiation-induced haemorrhagic proctitis.² However, the ingestion of

larger amounts of formalin has a deleterious effect on all systems of the human body.^{2,5} When ingested, formaldehyde (the main component of formalin) and methanol are metabolised to formic acid in the blood, causing metabolic acidosis. Cardiovascular collapse, loss of consciousness, gastrointestinal haemorrhage and acute respiratory distress syndrome may develop.² Studies have shown that formalin is fatal when as little as 60–90 ml is ingested.²

There are no antidotes for formalin toxicity; the main treatment is supportive therapy.² Haemodialysis has been advocated to remove formic acid from the blood, especially when vital signs begin to deteriorate.^{2,5} N-acetyl cysteine has also been suggested as an effective therapy to prevent the conversion of formaldehyde to formic acid.^{5,7}

- **Formalin injected into the neck caused severe inflammation and immediate airway compromise**
- **Fibre-optic nasopharyngoscopy and neck computed tomography can be used to evaluate regions injected with unknown substances**
- **Treatment includes immediate airway management, broad spectrum prophylactic antibiotics and N-acetyl cysteine (for formalin)**

Our literature search revealed five cases that involved accidental injection of formalin (Table I).^{8–12} All five cases required hospitalisation for further management. In two of the cases, formalin had been injected into the patients' gingiva and progressive swelling was noted after injection.^{8,9} One of these patients was treated by incision and drainage,⁸ and the other was managed medically;⁹ both patients recovered well. In these two cases, there was obvious change in the appearance of the patient's gingival mucosa after treatment. In the other three cases, formalin was injected into the eyelids; all three patients required plastic surgery to restore eyelid functionality.^{10–12}

In the case reported here, there were no signs of systemic formalin toxicity such as metabolic acidosis, cardiovascular collapse, acute kidney injury, liver failure or loss of consciousness. The patient's respiratory pattern was regular, with just mild neck swelling at first. However, a critical airway situation developed, as identified by fibre-optic nasopharyngoscopy and neck CT. Such cases are truly emergent medical events with potentially lethal consequences. Immediate management, which should include establishment of a definitive airway and prophylactic infection control, is crucial.

TABLE I
CASES OF FORMALIN INJECTION

Study	Year	Age (y), sex	Location	Presentation	Hospitalisation?	Treatment	Outcome
Arakeri & Brennan ⁸	2012	35, M	R upper gingiva	Swelling	Yes	Surgery	Recovered
Gupta <i>et al.</i> ⁹	2011	23, M	L upper gingiva	Swelling	Yes	Medication	Recovered
Putterman ¹⁰	1990	59, F	Bilateral eyelids	Eyelid necrosis	Yes	Surgery	Improved
Lisman <i>et al.</i> ¹¹	1988	?, F	L eyelid	Eyelid sloughing	Yes	Surgery	Improved
Smith & Nesi ¹²	1979	46, F	L eyelid	Eyelid sloughing	Yes	Surgery	Improved

Y = years; M = male; R = right; L = left; F = female

Conclusion

A small amount of formalin can cause severe, deep neck inflammation, leading to larynx compression and a critical airway situation. The case reported here is unique; such a case has not been reported previously in the relevant English-language literature. It therefore serves as a reference for the examination of patients who have injected substances into their neck; the possibility of deep neck inflammation with airway compromise should be considered in such cases. Neck CT and fibre-optic nasopharyngoscopy can be used to evaluate the area involved. Immediate airway management, broad spectrum prophylactic antibiotics and N-acetyl cysteine (to prevent the conversion of formaldehyde to formic acid) should be considered where appropriate.

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Address for correspondence:

Dr T-L Lee,
Department of Otolaryngology,
Taipei Veterans General Hospital,
201, Section 2, Shih-Pai Road,
Taipei 112, Taiwan, Republic of China

Fax: +886 2 28757338

E-mail: ent2424@gmail.com

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