A Case of Fatal Ingestion of a 10% Benzalkonium Chloride Solution

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Abstract
Benzalkonium chloride (BAC) is a mixture of quaternary ammonium compounds of alkyl-dimethylbenzylammonium chlorides. It has wide ranging use as a disinfectant, germicidal cleaner, algacide, cationic detergent and topical dermal antiseptic. Ingestion of BAC can cause local caustic effects and systemic effects. The present report involved a 78 year old male with a history of severe dementia who ingested up to 240ml of a germicidal disinfectant containing 10% benzalkonium chloride. Shortly after, he complained of oral pain and nausea, and experienced one episode of vomiting. Upon arrival to the emergency department approximately 45 minutes post-ingestion the patient’s complaints included oral pain, sialorrhea, drooling, spitting, nausea, and coughing, but no increase in work of breathing. Initial evaluation of the oral cavity and oropharynx showed mild erythema and swelling, but without lesions or erosions. A chest x-ray showed no acute abnormalities. Over the next three hours, the patient developed rhonchi and increasing respiratory distress. Approximately 12 hours post-ingestion, an esophagogastroduodenoscopy (EGD) and bronchoscopy were performed revealing: sloughing of the mucosa in the posterior oropharynx, and throughout the length of the esophagus, multiple gastric ulcers with bleeding, severe laryngeal edema, tracheobronchial mucosal edema, sloughing of mucosa of the larynx, severe tracheobronchomalacia with 75-90% collapse of distal trachea and possible aspiration. The patient was extubated, provided palliative care and expired 24 hours after arrival at the hospital. The risks after ingestion of BAC appear to be related to caustic injury, airway impairment and respiratory compromise if aspirated. In cases with a fatal outcome the terminal event appears to be airway compromise. In summary a case is reported of a fatal ingestion of a 10% BAC solution producing severe oral tracheal, esophageal, and stomach injury.

Keywords
Benzalkonium chloride; Caustic; Cationic; Fatal; Death

Introduction
Benzalkonium chloride (BAC) is a mixture of quaternary ammonium compounds of alkyl-dimethylbenzylammonium chlorides. It has wide ranging use as a disinfectant, germicidal cleaner, algacide, over-the-counter oral treatment for herpes, preservative in medicines, cationic detergent, microbial corrosion inhibitor in industry and topical dermal antiseptic. Perhaps because of this widespread use, there is a high incidence of poisoning with the benzalkonium chloride compounds. There were more than 5000 exposures involving cationic detergent/disinfectant compounds reported to US poison centers each year more with than 200 severe outcomes annually [1]. However, despite this frequent incidence, there is limited data published on injury after ingestion of benzalkonium chloride, with the few case reports involving primarily the very old and very young [2-7] (Table 1). Ingestion of BAC can cause local caustic effects and systemic effects [2]. The caustic injury is likely related to dissociation of cellular membrane lipid bilayers causing loss of membrane integrity and cell death. While the injuries are often categorized with the alkaline or acid caustic injuries, the risk of injury is not pH dependent but rather dependent on the concentration of the solution. Reports suggest concentrations of 10% or greater may produce injury to the mucosa, with concentrations as low as 0.02% potentially causing corneal injury [2,3,8]. The present report involved ingestion of a 10% solution of BAC germicidal disinfectant in an elderly male with dementia producing caustic injury and respiratory compromise leading to death.

Case Report
A 78 year old male with a history of severe dementia, depression, coronary artery disease (CAD) and diabetes was residing in a “memory unit” of a skilled nursing facility. During the late evening he managed to enter the locked kitchen on the unit, located a bottle of germicidal disinfectant containing10% benzalkonium chloride and ingested an unknown amount up to 8 ounces, confusing it with one of the available beverages. Part of the patient’s personality changes that occurred with his dementia was an obsessive focus on eating, and it was believed likely that an 8 ounce glass was ingested. Shortly after, he complained to the facility nursing staff of oral pain and nausea, and experienced one episode of vomiting. Upon arrival to the emergency department approximately 45 minutes post-ingestion the patient presented alert but not oriented. He was able to recognize his spouse, which was reported to be similar to his baseline level of dementia. He was able to point to the bottle of germicidal cleaner and remarked to family “I drank that and now I hurt”. Documentation of the BAC content and concentration was based on verification of the available beverages. Part of the product label, brought with the patient to the Emergency department (ED). Vital signs were HR 82 bpm, respirations 20/ min, O2 saturation 96%, BP 146/96 and temperature of 98.6 F. The patient’s complaints included oral pain, sialorrhea, drooling, spitting, nausea, and coughing, but no increase in work of breathing. Initial evaluation of the oral cavity and oropharynx showed mild erythema and swelling, but without lesions or erosions. A chest x-ray showed no acute abnormalities. Initial chemistries and CBC were unremarkable except for a blood glucose of 197 mg/dl. The patient continued to have sialorrhea, with coughing and grunting. Over the next three hours, the patient developed rhonchi and increasing respiratory distress. The patient had a DNR designation but after discussion with family he was electively intubated to allow for evaluation of the extent of injuries. A chest x-ray 4 hours post arrival showed new patchy airspace disease involving the right lower lung. Approximately 12 hours post-ingestion, an esophagogastroduodenoscopy (EGD) and bronchoscopy were performed revealing: significant edema and...
sloughing of the mucosa in the posterior oropharynx, cricopharyngeus and throughout the length of the esophagus, multiple gastric ulcers with bleeding, severe laryngeal edema, tracheobronchial mucosal erythema and edema, erythema and sloughing of mucosa of the larynx, severe tracheobronchomalacia with 75-90% collapse of distal trachea and possible aspiration. It was discussed with the family that there was a low likelihood of restoration of his breathing function and bronchial structure and it was requested by family he be returned to his Do Not Resuscitate (DNR) status. The patient was extubated, provided palliative care and expired 24 hours after arrival at the hospital. At the family’s request an autopsy was not performed.

Discussion

The greatest risk of severe caustic injury with BAC appears to be with concentrated solutions of 10% or greater [2-6] (Table 1). Commercial germicidal products containing BAC contain 10 to 50% BAC and are generally intended to be diluted prior to use. Germicidal and cleaning products with BAC available to the consumer generally contain solutions <3% and usually 1% or less. No published reports of caustic injury after ingestion in these more dilute solutions could be located. This negative evidence combined with the continued widespread availability of BAC to the public provides some support for the idea that lower concentrations are generally lower risk. BAC in concentrations <10% can produce dermal irritation, mucosal irritation, rhinitis and ocular injury [8-13]. In lower concentrations BAC may produce what appears to be a hypersensitivity reaction, but this has been suggested to be evidence of the irritant properties [14]. Direct localized tissue necrosis has occurred after inadvertent injection in the oral cavity [15].

The limited data available suggests caution, but the risks after ingestion of BAC appear to be related to caustic injury, airway impairment and respiratory compromise if aspirated (Table 1). In cases with a fatal outcome the terminal event appears to be airway compromise. A neurologic component post-ingestion of BAC has been suggested, but the limited published case reports provide little data to support this contention. In the present case the patient’s mental status did not change from baseline despite a large ingestion but this has been suggested to be evidence of the irritant properties [14]. Direct localized tissue necrosis has occurred after inadvertent injection in the oral cavity [15].

Table 1: Summary of published case reports of BAC ingestion.

<table>
<thead>
<tr>
<th>Age</th>
<th>Concentration of BAC, amount ingested</th>
<th>Circumstances of ingestion</th>
<th>Outcome</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>78 YO</td>
<td>10%, up to 240 ml</td>
<td>Dementia, confusion of substance for beverage</td>
<td>Sialorrhoea, coughing, nausea and diarrhea, x-ray evidence of pneumonia, edema and sloughing in the oropharynx, cricopharyngeus and esophagus, multiple gastric ulcers with bleeding, severe laryngeal edema, edema, erythema and sloughing of the larynx, severe tracheobronchomalacia. Death within 24 hours.</td>
<td>Present case</td>
</tr>
<tr>
<td>6 “newborns”</td>
<td>10%</td>
<td>Mistake by parents, confusion of solution for antipyretic medication</td>
<td>Endoscopic grade of injury to esophagus Grade I in 4 patients and lila in two patients</td>
<td>Turan C, et al. (Ref 4)</td>
</tr>
<tr>
<td>5 patients, 73 YO to 91 YO</td>
<td>10 %, “less than 50 ml”</td>
<td>Senile dementia, confusion of substance for beverage.</td>
<td>4 patients with sialorrhoea oral irritation. 1 patient with CNS depression and rapid collapse. Death within 3 hours. Autopsy showed corrosive injury to tongue, pharynx, larynx, esophagus and stomach.</td>
<td>Hitosugi, et al. (Ref 6)</td>
</tr>
<tr>
<td>2 patients (twins), 2 months</td>
<td>11%, applied via cotton tips swabs</td>
<td>Pharmacy dispensing error,</td>
<td>Sialorrhoea, oral and pharyngeal lesions, drooling, x-ray evidence of pneumonia</td>
<td>Wilson, et al. (Ref 3)</td>
</tr>
<tr>
<td>70 YO</td>
<td>33.3%, 40 ml</td>
<td>Suicide attempt</td>
<td>Confusion, diarrea, hypotension and metabolic acidosis. Bullae and lesions in oral palate. Edema and greyish-white membranes in hypopharynx, esophagus and stomach</td>
<td>Van Berkel, et al. (Ref 2)</td>
</tr>
<tr>
<td>2 days old</td>
<td>10%, 10 ml (2 “teaspoonful”)</td>
<td>Mistake by parents, confusion of solution for sterile water.</td>
<td>Sialorrhoea, lips, oral and pharyngeal edema and lesions, edematous epiglottis and vocal cords, respiratory acidosis, x-ray evidence of pneumonia</td>
<td>Okan, et al. (Ref 5)</td>
</tr>
<tr>
<td>45 YO</td>
<td>50% (30 ml)</td>
<td>Mistake by bar staff, served to customer as a beverage</td>
<td>Vomiting, disorientation, labored breathing, cyanosis. Death approximate 25 minutes post ingestion</td>
<td>Adelson L, et al. (Ref 7)</td>
</tr>
</tbody>
</table>

doi:http://dx.doi.org/10.4172/2325-9841.1000113
References


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