# Ingestion of a Denture Cleanser: Did It Cause Gastric Perforation?

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## ABSTRACT

**Introduction:** Human ingestion of denture cleansers leading to gastric perforation has not previously been described.

**Case Report:** A 27-year-old male ingested three denture cleanser tablets in water over two days in an attempt to cause a false-negative result on a workplace urine drug screen. Seven days later he presented to an emergency department with a perforated gastric ulcer.

**Discussion:** A literature review of cases and the chemistry of the components of his ingestion was conducted to determine the possible relationship between these events. Ingestion of intact fragments of the tablets would be likely to result in significant gastric toxicity, but ingestion of dissolved tablets would be unlikely to have caused his illness.

## INTRODUCTION

Efferdent is a product designed to cleanse dentures in a container when added to water. The outside of the package clearly states in large, highlighted, capitalized letters: "Do not put tablets or solution directly in mouth." Despite this warning and similar ones found on other denture cleansing products, there were 1,512 reported exposures to denture cleanser products by the Toxic Exposure Surveillance System in 2005. Of these, 77% were in adults over 19 years old. Only 38 (2.5%) were intentional, 97.5% were accidental, 82 (5.4%) were treated in a healthcare facility, 8 (0.5%) were found to cause "moderate" complications, and only one resulted in death, though no further information is reported about this case [1].

## CASE REPORT

A 27-year-old man presented to an Emergency Department (ED) complaining of severe abdominal pain, diarrhea, and blood-tinged vomitus. Ten days prior the patient had been offered a job interview that required pre-employment urine drug testing. Because he had been smoking marijuana regularly, he followed a friend's suggestion to attempt manipulation of the cannabinoid assay through ingestion of Efferdent tablets. Seven days prior to presentation he ingested one tablet in a glass of water, which quickly resulted in abdominal pain. The following day he ingested two more tablets in water, which resulted in abdominal pain that continued to increase until presentation. He did not comment on whether the tablets were fully dissolved.

The patient had no significant past medical or surgical history, took no medications, and had no allergies to medications. His family history was non-contributory. He denied any prior gastrointestinal symptoms. His social history was positive for tobacco abuse and negative for alcohol use.

The patient's vital signs were: oral temperature, 36.1° C, heart rate 62 bpm, respiratory rate 18/minute, blood pressure 150/78 mmHg, and $O_2$ saturation 98% on room air. On physical examination, he was a thin male in moderate distress secondary to

**Keywords:** denture cleanser, ingestion, toxicity, gastric perforation

**Notes:** There was no outside funding of any kind used for this study.

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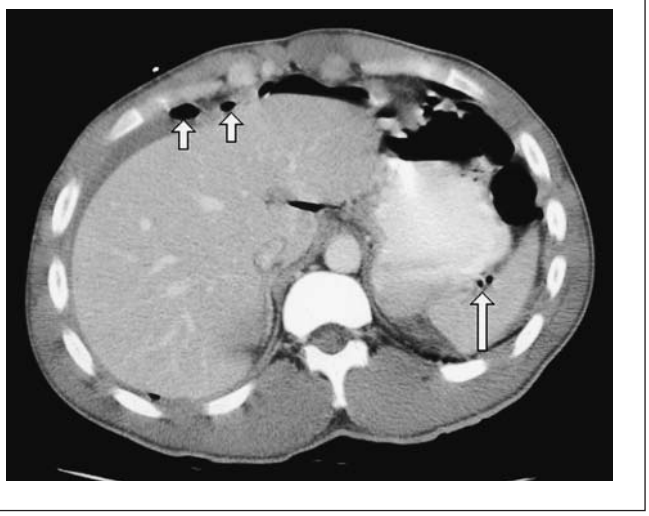

*Figure 1: CT scan of abdomen illustrating free air and fluid*

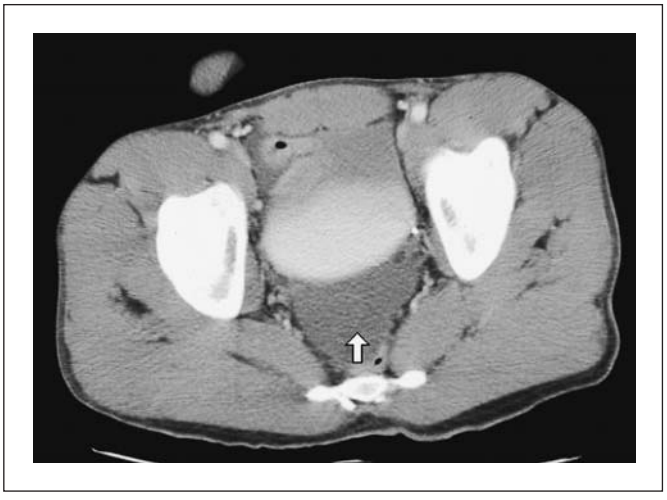

*Figure 2: CT scan of pelvis illustrating free air*

abdominal pain that was exacerbated in the sitting position. His abdominal examination revealed diminished bowel sounds, and marked epigastric tenderness with rigidity and involuntary guarding. He was also vomiting small amounts of blood-tinged emesis. Consultation with the local poison control center revealed that the ingested product contained sodium perborate monohydrate.

An abdominal series showed a non-obstructive bowel gas pattern and no free air. Computed tomography (CT) of the abdomen and pelvis was obtained, which demonstrated extensive free fluid and free air (Figures 1 and 2). Surgical consultation was obtained.

Exploratory laparotomy revealed a 0.5-cm gastric ulcer with perforation and 1 L of pus within the peritoneal cavity. Irrigation, debridement and Heineke-Mikulicz pyloroplasty were successful. The patient recovered without further complications.

## DISCUSSION

We report a case of a gastric perforation after ingestion of a denture cleanser. Review of the medical literature finds only a few cases of ingestion of denture cleansing agents with significant effects and no cases of gastric perforation. Studies in which Denalan, Efferdent, Polident and the Canadian denture cleanser Ansodent were deposited undiluted directly into the esophagus of dogs resulted in extensive local soft tissue necrosis and coagulation necrosis in the stomach and esophagus as demonstrated on necropsy [2,3]. Another study that placed denture cleansing powders in the oral cavity and esophagus of sedated dogs produced similar results [4]. Finally, a case report that discusses two elderly patients who unintentionally ingested denture cleansing tablets containing sodium perborate and trisodium phosphate were found to have esophageal strictures on esophagoscopy [5].

Pfizer, the manufacturer of Efferdent, lists the ingredients in alphabetical order: Blue #2, ethylenediaminetetraacetic acid (EDTA), FDNC Green #3, flavor, polytetrafloroethylene (Teflon, DuPont), potassium monopersulfate, sodium bicarbonate, sodium lauryl sulfoacetate, sodium perborate monohydrate, sodium saccharine, sodium sulfate, and sodium tripolyphosphate anhydrous. The product has a pH of 9.5, weighs 2.1 g/tablet, and has a titratable $O_2$ of 129–162 mg/tablet (personal communication with Pfizer Products Hotline, 2005). The Material Safety Data Sheet (MSDS) for Efferdent states that it is 48% sodium perborate monohydrate, 21% potassium monopersulfate, 20% EDTA, and 11% "non-regulated/non-hazardous ingredients" [6].

The patient ingested a total of 6.3 g of Efferdent over two days, containing 3.0 g of sodium perborate monohydrate, 1.3 g of potassium monopersulfate, and 1.25 g of EDTA. While sodium tripolyphosphate anhydrous, sodium lauryl sulfoacetate, and sodium sulfate are possible mucous membrane irritants, none would be expected to have any significant tissue toxicity in this small quantity [7,8]. EDTA can cause tetany secondary to calcium chelation if injected in sufficient quantities, but this would not be expected with the small quantities ingested in this case [8].

The primary "active ingredient" in Efferdent is sodium perborate monohydrate ($BO_3Na{\bullet}H_2O$). It is one of two commonly used alkaline oxidizing agents in denture cleansers. The other commonly used agent is carbamide peroxide [9]. Sodium perborate monohydrate is an irritant. When added to water, it dissociates to form approximately 36% hydrogen peroxide [9] and 64% sodium borate by weight [8]. The toxicities of ingested hydrogen peroxide and borate salts are considered separately.

Ingestion of hydrogen peroxide may result in local tissue toxicity and air emboli [10]. Although hydrogen peroxide toxicity is possible following ingestion of a 3% household strength solution, it becomes more likely as concentrations increase to those of industrial strength (≥35%). Bloody emesis and multiple ulcers of the gastric antrum were found in one case of a previously healthy 3-year-old child who ingested 180 mL of 3% hydrogen peroxide [11].

A 2.1-g tablet of Efferdent dissolved in 250 mL of water should yield a solution of 0.174% hydrogen peroxide, which is

approximately 1/17 as concentrated as household hydrogen peroxide [12]. Ingestion of 750 mL of a solution this dilute over two days would not be expected to cause gastric perforation in an adult. However, intact tablet fragments of significant size could be expected to cause marked local tissue toxicity, as demonstrated by the dog studies noted above [2–4].

Boric acid and related borate salts are thought to have approximately equivalent toxicity. They have been reported to produce numerous toxic effects, including nausea, vomiting, gastric irritation, rashes, and central nervous system, renal and hepatic toxicity. Gastric and dermatologic effects may appear regardless of the mechanism of exposure [13].

One Efferdent tablet contains the equivalent of 0.65 g of sodium borate, which dissolved in 250 mL of water would produce a solution of approximately 0.26%. It is difficult to obtain reliable estimates on minimal toxic or lethal single, oral doses of boric acid or borate salts from the literature [14]. Estimates of potentially toxic and lethal doses vary widely. At the extremes, there is a case in which death resulted from a 3-g ingestion in a 2-week-old infant and a report of 88.8 g ingested by one woman that seemed to have little obvious effect [14–16].

Opinions on the toxicity of boric acid and its salts have changed markedly over the last century [16]. Early in the 20th century, boric acid and its salts were included in many healthcare products, including baby powders, contraceptive jellies, and antiseptics [13, 17–19]. Concerns about toxicity that arose in the middle of the 20th century caused its use to decline rapidly. An article from 1953 reviewing 109 cases, mostly chronic exposures, revealed a mortality from boric acid ingestion of 55% [20].

A more recent article from 1988 reviewed 784 cases of acute boric acid ingestion in which toxicity was minimal or absent [16]. The quantity of borate reported to have been ingested ranged from 10 mg to 88.8 g in the 692 asymptomatic patients (mean 0.9 g) and 100 mg to 55.5 g in the remaining symptomatic patients (mean 3.2 g). None experienced serious toxicity, though four were dialyzed. It seems unlikely that an adult ingesting 3 g of sodium perborate monohydrate over two days would develop gastric perforation due to its borate component [19,21,22].

Given that both the amount of borate and concentration of hydrogen peroxide ingestions would not generally be expected to cause toxicity in an adult, possible explanations for the patient's perforated gastric include ingestion of intact tablet fragments and exacerbation of a preexisting but undiagnosed peptic ulcer or pure coincidence.

There is a body of literature on adulterating samples or ingesting substances to produce false negative results on employment-related urine drug screens. However, most methods relate either to adding an adulterant to the urine sample after voiding or ingesting a diuretic or herbal preparation to dilute the urine. A literature review of ingestion of oxidants or denture cleansers for this purpose failed to find any studies or comments on the topic. Presumably this is not a common method, as it appears to not have been previously described.

## CONCLUSION

A 27-year-old male ingested three denture cleanser tablets in water over a two-day period in an attempt to cause a false negative result on a pre-employment urine drug screen. Seven days later he presented to an ED with a perforated gastric ulcer, which was successfully repaired. Literature review and chemical analysis of this product reveal that it is unlikely to cause gastric perforation unless undissolved fragments were ingested. As this patient has no history to suggest a previous peptic ulcer, it is possible that his perforation was related to the ingestion.

*The authors have no potential financial conflicts of interest to report.*

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