

# Comment on treatment methods for ethylene glycol intoxication

D. Wiles\*, J. Tzeng, J. Russell, M.J. Casavant

Medical Toxicology Fellowship, Ohio State University/Nationwide Children's Hospital, Columbus, Ohio, United States of America, \*corresponding author: e-mail: devin.wiles@nationwidechildrens.org

To the Editor,

We were very interested in the article by Rietjens *et al.*<sup>1</sup> regarding antidotal therapies utilised in the treatment of ethylene glycol and methanol intoxication. We were especially interested in the cost analysis of ethanol versus fomepizole treatment. In the United States (US), the use of ethanol is rare; either fomepizole or haemodialysis is utilised, with cost often the determining factor in deciding which to use.<sup>2</sup> At our facility we utilise a cost minimisation method for determining when to use haemodialysis versus fomepizole in minimally symptomatic patients. As an example, assume a theoretical patient: an 18-year-old male, 173 cm, weighing 70 kg. A 14.2 hour half-life for ethylene glycol following administration of fomepizole is assumed<sup>3</sup> and this formula, developed by Hirsch, *et al.*<sup>4</sup> to determine required dialysis time for removal of ethylene glycol to a serum level of 6 mmol/l (37.2 mg/dl) is used:

$$T = [-V \ln (5/A)/0.06k]$$

V = Watson estimate of total-body water in litres (41.25 l)

A = Initial toxin concentration in mmol/l (40.0 mmol/l)

k = 80% dialyser urea clearance in millilitres/minute at the initial observed blood flow rate (152 ml)

We compare medication, procedure, room, laboratory charges and risk of complications based on US national statistics. We assume a cost difference of 5% or less to be equivalent.

We calculated the time required for a serum ethylene glycol level of 180 mg/dl to fall to  $\leq 20$  mg/dl<sup>5</sup> to be ~44.6 hours. This would require a total of four doses of fomepizole.<sup>6</sup> At our hospital, the fomepizole regimen is administered on a general medical floor without telemetry.

Our haemodialysis patient would likewise receive an initial ethylene glycol level and the first dose of fomepizole while awaiting lab results. Per Hirsch,<sup>4</sup> an initial ethylene glycol level of 180 mg/dl could be dialysed to safe levels with a single 8-hour treatment. The patient would receive two additional fomepizole doses during his haemodialysis therapy.<sup>7</sup> At our hospital, a patient receiving dialysis would be placed in the intensive care unit.

Thus, the cost per dialysed patient is \$ 15,053.79. With fomepizole only: the cost/patient is \$ 15,657.00. The difference falls within our equivalency range of 5%.

**Table 1.** Direct cost comparison by category for serum ethylene glycol 180 mg/dl

Cost category (US Dollars)	Fomepizole only	Haemodialysis and fomepizole
Room cost	5998.00 (2x gen-med)	3727.50 (1x ICU)
Medication	9503.64 (x4 1.5 ml vials)	7127.73 (x3 1.5 ml vials)
Labs	156.00 (x3)	104.00 (x2)
Procedure		2801.00
Total	15,657.64	13,760.73

Sznajder *et al.*<sup>8</sup> note a complication rate during catheterisations of 8.1/100 patients and Klevins *et al.*<sup>6</sup> report an infection rate of 0.53/100/day. In 2005, inpatient facility and physician costs for haemodialysis catheterisation complications alone reached \$ 12,957.<sup>9</sup> This adjusts from 2005 to 2013 (the year of our other charge data) to \$ 14,983.28.<sup>10</sup>

With an equivalent cost and greater safety associated with the pharmaceutical approach, we recommend fomepizole monotherapy in minimally symptomatic patients with an initial ethylene glycol level < 180 mg/dl. Costs and treatment protocols vary; therefore our level should not be considered a universal guideline for the addition of haemodialysis therapy. Rather, the methods employed in this analysis should be adapted by hospitals to implement cost-effective integration of haemodialysis into the treatment of patients with ethylene glycol poisoning.

## REFERENCES

1. Rietjens SJ, de Lange DW, Meulenbelt J. Ethylene glycol or methanol intoxication: which antidote should be used, fomepizole or ethanol? *Neth J Med.* 2014;72:73-9.
2. Darracq MA, Rentmeester LL, Clark RF. Cost of hemodialysis versus fomepizole-only for treatment of ethylene glycol intoxication. *Clin Toxicol (Phila).* 2013;51:188.
3. Levine M, Curry SC, Ruha AM. Ethylene glycol elimination kinetics and outcomes in patients managed without hemodialysis. *Ann Emerg Med.* 2012;52: 527-31.
4. Hirsch DJ, Jindal K, Wong P. A simple method to estimate the required dialysis time for cases of alcohol poisoning. *Kidney International.* 2001;60:2021-4.
5. Caravati EM, Erdman AR, Christianson G, et al. American Association of Poison Control Centers. Ethylene glycol exposure: an evidence-based consensus guideline for out-of-hospital management. *Clin Toxicol (Phila).* 2005;43:327-45.
6. Kleivins RM, Edwards ER, Andrus ML. Dialysis Surveillance Report: National Healthcare Safety Network (NHSN) Summary 2006. *Semin Dial.* 2008;21:24-8.
7. Fomepizole Package insert. 300 Daniel Zenker Dr, Horseheads, NY 14845: X-Gen pharmaceuticals 2007 OCT; [http://www.x-gen.us/injectables/fomepizole/Fomepizole\\_files/insert/Fomepizole\\_pi.pdf](http://www.x-gen.us/injectables/fomepizole/Fomepizole_files/insert/Fomepizole_pi.pdf). Accessed February 3 2014.
8. Sznajder JL, Fabio RZ, Bitterman H, et al. Central vein catheterization. Failure and complication rates by three percutaneous approaches. *Arch Int Med.* 1986;146:259-61.
9. U.S. Renal Data System, USRDS 2013 Annual Data Report: Atlas of End-Stage. Renal Disease in the United States, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, 2013.
10. United States Bureau of Labor statistics. Inflation Calculator 2014; [http://www.bls.gov/data/inflation\\_calculator.html](http://www.bls.gov/data/inflation_calculator.html). Accessed March 2 2014.