

**GRAND
ROUNDS**

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Treatment in the face of uncertainty following traumatic anhydrous ammonia exposure

The patient lost consciousness and his vision. He then experienced incomplete sight recovery, anxiety, and recurring nightmares. How would you proceed with his care?

JD is a previously healthy 33-year-old white man, married and father of 2 children, who, while working as an agronomist, was inadvertently exposed to anhydrous ammonia. His only recollection of the event was a "puff of smoke" and the smell of ammonia. He lost consciousness almost immediately and awoke several days later in the intensive care unit. He was blind. Over the days that followed, he regained central vision; however, the loss of peripheral vision in all fields persisted. He said that upon first waking in the morning, he could "only see shadows." For the rest of the day, he had "tunnel vision." Ophthalmology and neurology evaluations uncovered no obvious reasons for the persistent vision loss.

The patient also complained of mild headache and discomfort behind his eyes for which he was taking aspirin. The discomfort behind his left eye was worse than on the right. He remained on disability following his work injury, and began to feel increasingly distressed and hopeless. His wife noted he was uncharacteristically irritable with her and the children, and that he had vivid nightmares and said he could smell ammonia. He also had trouble keeping up his yard because of the agitation and anxiety he experienced in approaching his workshed and equipment on the property.

A month later, an ophthalmologist reexamined JD and, again, found no cause for the ocular abnormality and suggested artificial tears for dry eyes. Two months later, he saw an optometrist, who documented constricted visual fields and referred JD to a second ophthalmologist. This consultant suggested possible brain injury and doubted it was psychosomatic in nature. He referred the patient to a neurologist. The neurologist found no organic explanation for his vision loss. He suspected a somatoform disorder and told JD his vision should recover. JD and his wife initially declined the neurologist's idea of a neuro-ophthalmology consultation, but eventually agreed. The neuro-ophthalmologist also suspected a functional disturbance as the cause for visual impairment; and he required the patient to stop driving a motor vehicle until his vision improved.

The patient was subsequently referred for psychological evaluation. When initially seen by a psychologist and a family medicine resident, JD was working as a farmhand to make ends meet.



What symptoms are typical of anhydrous ammonia exposure?



Effects of ammonia exposure

Ammonia is a water-soluble, colorless gas—an alkaloid with a unique odor. In the past, most exposures were related to its use as a fertilizer, as was the case with JD. In recent years, it has also been used to illegally manufacture methamphetamine, which has led to ammonia accidents and increased exposures.¹⁻³

Systems commonly injured are the respiratory tract, ocular system, skin, and gastrointestinal tract (only if ingested).²

Ammonia destroys the mucosal barrier of the respiratory tract, causing loss of cilia, edema, and smooth muscle contraction.^{3,4} Long-term effects include chronic cough or hoarseness, obstructive or restrictive airway disease, reactive airway disease, or bronchiectasis.^{1,3}

The extent of ocular injury is related to the degree of ammonia exposure. In mild cases, there is eye irritation, increased tear production, a sensation of stinging or burning, and perhaps conjunctivitis or spasmodic winking. The patient may also experience photophobia.^{1,3,4} In more severe cases, there may be corneal ulcerations, iritis, anterior or posterior synechia, opacification of the cornea, cataracts, glaucoma, atrophy of the retina, or severe pain.^{1,3} Blindness may occur, temporarily or permanently.⁴ This complete or partial vision loss is secondary to physical damage that can be seen during an ophthalmologic examination.^{1,4}

Skin injuries can range from a mild erythematous rash to a full thickness burn with bullae and even denudation.¹ Long-term effects include scarring or dermatitis.³

Our patient had respiratory and skin symptoms that fit with classic ammonia exposure (respiratory distress requiring intubation, rash). His initial blindness was consistent with ammonia exposure; however, his subsequent peripheral loss was inconsistent with known reaction to ammonia.

Q What are some of the causes of acute visual loss?

A _____

Causes of acute visual loss

Vision loss can be caused by injury to the me-

dia of the eye (cornea, lens, etc), the retina, or the neural visual pathways. It may also have a psychogenic component.⁵ Media-related causes of acute vision loss include keratitis or uveitis, edema of the cornea, blood in the anterior chamber (hyphema), disturbance of the lens, or hemorrhage into the vitreous.^{5,6} Retinal causes include occlusion of the central retinal artery or vein, detachment of the retina, or acute maculopathy.⁵⁻⁸ Neurologic causes include injury to the optic nerve itself (normally monocular) or defects in the chiasmal or retrochiasmal regions (causing partial loss in both eyes).^{5,9} If all of the above possibilities have been ruled out, consider psychogenic contribution to visual loss.⁵ Often this diagnosis is called “functional vision loss,” which can include feigning visual loss for secondary gain or subjective blindness as is seen with a somatoform disorder (eg, conversion disorder).

JD had bilateral peripheral vision loss of both the medial and lateral visual fields with macular sparing bilaterally. But he had an otherwise normal physical examination. At this point, the neurologist suspected conversion disorder, while one ophthalmologist thought a neuropathic disorder was responsible.

Q What is your working diagnosis for this patient’s symptoms?

A _____

Q What are some of the psychological sequelae of traumatic events such as the one this patient experienced?

A _____

The neurologist had, early on, recognized that JD was significantly distressed by the accident and encouraged a psychological consultation. With the absence of identifiable ophthalmologic pathology, the patient reluctantly accepted this referral.

The psychologist, aided by family medicine residents, entertained the diagnoses of Post-Traumatic Stress Disorder (PTSD) and



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CBT, including gradual exposure to anxiety triggers, is effective both for treating conversion disorders and for rehabilitating damaged neurologic pathways.

somatoform disorders, particularly conversion. PTSD is unique among psychiatric diagnoses in that a patient must meet all 6 DSM V criteria:¹⁰

- exposure to a traumatic event involving actual or threatened death or serious injury
- recollections, dreams, or hallucinations in which the trauma is re-experienced
- avoidance of stimuli associated with the trauma
- persistent symptoms of increased arousal (eg, irritability, agitation)
- symptoms and behavior that last for longer than one month
- distress that is clinically significant.

He met the criteria for a PTSD diagnosis and likely would benefit from treatment for it. However, sensory loss related to PTSD alone would be unusual, perhaps as unusual as peripheral vision loss secondary to ammonia exposure. Other factors needed to be explored.

Conversion disorders consist of disorders of movement, such as seizures or paralysis, or disorders of sensations, such as numbness or blindness. These may be episodic or sustained and have acute or chronic onset.¹¹

Psychological factors are judged to be associated with the symptom or deficit because conflicts or other stressors precede the initiation or exacerbation of the symptom or deficit. This was possible in JD, but a degree of uncertainty lingered because he did not exhibit behavior typically seen with factitious disorder, and performance anxiety could conceivably account for the outcome on his vision tests.

In general, he could meet the criteria for conversion disorder, but questions remained. The biggest question is whether the accident resulting in PTSD is the cause of the psychological stress, or is the peripheral vision loss the source of the psychological stress, which would mean it is not a conversion disorder?



How would you treat this patient?



Treatment of visual defects

As is the case in many disorders, a definitive diagnosis of the cause of vision loss is not nec-

essary to begin treatment. When you suspect a somatoform disorder including conversion, start therapy and treat the symptoms as “real.”¹² Tell the patient that no specific treatment will completely resolve the symptoms, but that it can help.¹³ Whether the primary cause is neurologic or conversion based, there is often some spontaneous recovery of vision that occurs between 2 weeks and 3 or more months.¹⁴ Peripheral field defects have a guarded prognosis, although an extensive rehabilitation program may improve the vision fields somewhat.¹⁵⁻¹⁸

Conversion disorders effectively respond to cognitive behavioral therapy (CBT) including gradual exposure to anxiety triggers.¹⁹ Rehabilitation for neurologic damage based on remodeling of pathways responds to a similar gradual exercise or exposure to the lost function. Since these interventions are similar processes, a definitive diagnosis was unnecessary in JD’s case. A proprietary visual rehabilitation therapy program is available¹⁷ that exposes the patient to visual field activity that requires a cognitive reaction.¹⁵ This treatment facilitates recovery even into the sixth month of therapy.¹⁶ However, the cost of the software is approximately \$6000 and is not yet covered by insurance.¹⁵

JD could not afford the commercially available programmed therapy. Therefore, we introduced an alternative treatment plan to challenge the transitional zone. With this plan, JD would play video games for 30 minutes at least twice a week, and preferably daily. He sat close enough to the television so that the transitional zone was approximately 1 to 2 inches from the peripheral portion of the television screen. The game was an action-packed video in which the peripheral portion of the screen was important (such as in first-person shooter games). He was to continue staring at the center of the screen during play in order to truly exercise the peripheral vision. Every day, he reassessed where the transitional zone was located and adjusted his seating accordingly. JD practiced this at least once a day and found that he had to sit closer and closer to the television screen to allow the transitional zone to remain in the screen’s periphery.

The patient, being very motivated, also developed treatments that worked well. He

would stare at a blank white wall approximately 2 feet away, focusing on one location. One of his family members would take a laser pointer and start very far away, then slowly move the light closer to the patient's center of vision. JD would tell his family member when he could see the light and they would move on to a different portion of his visual field.

After 3 months, we retested JD's vision, which showed great improvement. JD felt he had significant improvement in his vision. The ophthalmologist retested JD about 2 months later and he passed a visual test well enough to obtain a modified driving license so he could return to his work as an agronomist.

Treatment of PTSD

Therapy for PTSD is complex and best approached with a long-term, multifaceted plan.²⁰ Both pharmacotherapy and psychotherapy can be considered for initial treatment; however, no placebo-controlled randomized trials comparing the 2 modalities have been conducted. Combination therapy can also be employed.

Drug therapy, particularly selective serotonin reuptake inhibitors (SSRIs), has been shown to be generally effective in ameliorating positive symptoms associated with PTSD, such as nightmares and flashbacks. But they are less effective at treating negative symptoms such as withdrawal and avoidance.^{21,22}

There is no clinical evidence to support the use of anxiolytics such as benzodiazepines in treating PTSD-specific symptoms. One small study did find a significant reduction in anxiety with alprazolam compared with placebo; however, the response was modest, and specific PTSD symptoms were unchanged.² Given the high prevalence of comorbid substance abuse in PTSD, benzodiazepines are best avoided since evidence for their effectiveness is lacking.²³

Both CBT and eye movement desensitization and reprocessing (EMDR) can be effective therapy for PTSD.²⁴ Both modalities center on desensitization through exposure to traumatic recollections and symptom triggers.

The CBT approach we used focused on JD's phobic reaction to ammonia that prevented his return to work. First, he listened to relaxation CDs to practice deep breath-

ing and relaxation techniques. Once he was familiar with the techniques, he practiced them in the presence of the shed that contained ammonia products, which was a trigger for his anxiety. At first he was only able to approach the shed while using the breathing exercises to calm his anxiety. Over several weeks, he became more comfortable moving closer to the shed, and he eventually stepped into the shed and began staying for longer periods of time. The course of therapy took several months, but by the end of the sessions he was able to perform necessary tasks in the shed with only mild anxiety.

He also suffered from persistent troubling nightmares that significantly affected his sleep and led to physical symptoms of headache and vomiting. These, too, were overcome with the CBT approach.²⁵ We instructed him to immediately write down as much as he could recall of a nightmare upon waking from it. During the following day, he re-read the dream and attempted to re-experience it while using the relaxation techniques to temper anxiety. Over several months of therapy, his nightmares lessened and eventually stopped.

On the last day of therapy, JD reported he had 3 job offers and 2 more interviews lined up, and that he was excited about his opportunities. We congratulated him on his visual recovery and applauded him for his hard work.

Discussion

While it is possible that JD spontaneously recovered his vision loss, it's more likely that treatment can be credited, given that he did not improve in the 6 months prior to treatment and that his condition resolved over the 3-month rehabilitation period.

Research that guides practice must necessarily limit variables, but real-life patients often have multiple variables complicating both diagnosis and treatment. Our patient is a graphic example. He was exposed to anhydrous ammonia with its multiple physiologic sequelae and it was a traumatic event leading to additional sequelae. Furthermore, his inability to perform his job and fulfill social obligations contributed to his impairment.

JD's referral to a neural-ophthalmologist did not provide a definitive diagnosis. He

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then followed up on a referral to the local residency clinic, where the family physician/psychologist team treats patients from a biopsychosocial perspective. Although physicians feel most comfortable when they arrive at a specific diagnosis with a specific evidence-based treatment that predicts a good outcome, this case yielded no definitive diagnosis. Instead, the psychologist and family physician relied on general research findings showing that in the context of traumatic injury or illness followed by debilitating anxiety symptoms, desensitization and rehabilitation provide the best chance of improvement. This shift in treatment approach very likely was responsible for the patient's improvement.

This approach had the added benefit of helping the patient feel empowered. When JD arrived at the consultation with the psychologist and family physician, he was frustrated that no explanation had been found for his problem. As a result, he feared that nothing could be done. When told that a rehabilitation and gradual exposure approach would

likely help him, even if we were uncertain of the absolute cause, he became an eager participant in his treatment. He also embraced the idea that it wasn't up to the doctors alone to improve his condition, but that he could be an active participant. In our view, his enthusiastic efforts contributed to the ultimate treatment outcome.

Often family physicians think they should refer these "complicated" patients to other specialists. However, for patients with combined psychological and physiological pathologies, we believe there are no better experts than family physicians. Properly trained family physicians could have treated this patient without the aid of a psychologist. Other patients who can benefit from this type of integrated biopsychosocial rehabilitation include those with chronic fatigue syndrome, chronic low back pain, and debilitating epilepsy.²⁶⁻²⁸ **JFP**

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Others who can benefit from integrated biopsychosocial rehabilitation are those with chronic fatigue syndrome, chronic low back pain, and debilitating epilepsy.

References

1. Lessenger JE. Anhydrous ammonia injuries. *J Agromedicine*. 1996;3:191-203.
2. Souther L, Small-Johnson J, Messing R. A description of agricultural releases of anhydrous ammonia in Minnesota. *Chem Health Safety*. 2000;7:16-22.
3. Welch A. Exposing the dangers of anhydrous ammonia. *Nurse Pract*. 2006;31:40-45.
4. Makarovskiy I, Markel G, Dushnitsky T, et al. Ammonia—when something smells wrong. *Isr Med Assoc J*. 2008;10:537-543.
5. Leveque T. Approach to the adult with acute persistent visual loss. In: *UpToDate*, Trobe J (ed), *UpToDate*, Waltham, MA, 2013.
6. Morgan A, Hemphill RR. Acute visual change. *Emerg Med Clin North Am*. 1998;16:825-843,vii.
7. Beran DI, Murphy-Lavoie H. Acute, painless vision loss. *J La State Med Soc*. 2009;161:214-216, 218-223.
8. Vortmann M, Schneider JJ. Acute monocular vision loss. *Emerg Med Clin North Am*. 2008;26:73-96.
9. Chamberlain MC, Chalmers L. Acute binocular blindness. *Cancer*. 2007;109:1851-1854.
10. American Psychiatric Association. *Diagnostic and Statistical Manual*. 5th ed. Arlington, VA: American Psychiatric Publishing, Inc.; 2013.
11. Aybek S, Kanaan RA, David AS. The neuropsychiatry of conversion disorder. *Curr Opin Psychiatry*. 2008;21:275-280.
12. Stone J, Vuilleumier P, Friedman JH. Conversion disorder: separating "how" from "why". *Neurology*. 2010;74:190-191.
13. Tocchio SL. Treatment of conversion disorder. A clinical and holistic approach. *J Psychosoc Nurs Ment Health Serv*. 2009;47:42-49.
14. Mueller I, Gall C, Kasten E, et al. Long-term learning of visual functions in patients after brain damage. *Behav Brain Res*. 2008;191:32-42.
15. Glisson CC. Capturing the benefit of vision restoration therapy. *Curr Opin Ophthalmol*. 2006;17:504-508.
16. Marshall RS, Chmayssani M, O'Brien KA, et al. Visual field expansion after visual restoration therapy. *Clin Rehabil*. 2010;24:1027-1035.
17. Mueller I, Mast H, Sabel BA. Recovery of visual field defects: a large clinical observational study using vision restoration therapy. *Restor Neurol Neurosci*. 2007;25:563-572.
18. Romano JG, Schulz P, Kenkel S, et al. Visual field changes after a rehabilitation intervention: vision restoration therapy. *J Neurol Sci*. 2008;273:70-74.
19. Allen LA, Woolfolk RL. Cognitive behavioral therapy for somatoform disorders. *Psychiatr Clin North Am*. 2010;33:579-593.
20. Cukor J, Olden M, Lee F, et al. Evidence-based treatments for PTSD, new directions, and special challenges. *Ann N Y Acad Sci*. 2010;1208:82-89.
21. Meltzer-Brody S, Connor K, Churchill E, et al. Symptom-specific effects of fluoxetine in PTSD. *Intl Clin Psychopharmacol*. 2000;15:227-231.
22. Stein DJ, Ipser JC, Seedat S. Pharmacotherapy for post traumatic stress disorder. *Cochrane Database Syst Rev*. 2006(1):CD002795.
23. Braun P, Greenberg D, Dasberg H, et al. Core symptoms of post-traumatic stress disorder unimproved by alprazolam treatment. *J Clin Psychiatry*. 1990;51:236-238.
24. Bisson J, Andrew M. Psychological treatment of post-traumatic stress disorder. *Cochrane Database Syst Rev*. 2007(3):CD003388.
25. Aurora RN, Zak RS, Auerbach SH, et al. Best practice guide for the treatment of nightmare disorder in adults. *J Clin Sleep Med*. 2010;6:389-401.
26. Reid SE, Chalder T, Cleare A, et al. Chronic fatigue syndrome. *Clin Evid (Online)*. 2008 Aug 28;2008:1101.
27. Hall H, McIntosh G. Low back pain (chronic) *Clin Evid (Online)*. 2008 Oct 1;2008:1116.
28. Prevedini A, Presti G, Ragitti E, et al. Acceptance and commitment Therapy (ACT): the foundation of the therapeutic model and an overview of its contribution to the treatment of patients with chronic physical diseases. *G Ital Med Lav Ergon*. 2011;33(1suppl A):A53-63.