JHTAM Journal of High Threat & Austere Medicine
The Official Journal of the Australian Tactical Medical Association

Expert commentary
Official Journal of the Australian Tactical Medical Association

Understanding Adaptive Bioterrorism Methods: Counter Terrorism Medicine implications of Bongkrekic Acid Poisoning

Derrick Tin, MBBS; [1,2*] Attila J. Hertelendy, PhD;[1,2,3] Fadi Issa, MD; [1,2] Gregory R. Ciottone, MD, FACEP, FFSEM[1,2]

[1]*Fellowship in Disaster Medicine, Department of Emergency Medicine, Beth Israel Deaconess Medical Centre, Boston, Massachusetts, USA*
[2]*Department of Emergency Medicine, Harvard Medical School, Boston, Massachusetts, USA*
[3] *Department of Information Systems and Business Analytics, College of Business, Florida International University, Miami, Florida, USA*

*Corresponding Author:
Derrick Tin
Senior Fellow Disaster Medicine
Beth Israel Deaconess Medical Center and
Harvard Medical School, Boston MA, USA.
derrick@tacmedaustralia.com.au

Terrorist attacks fall under a unique category within the disaster medicine (DM) spectrum. Unlike accidental man-made disasters where there is an inherent pre-disaster objective to reduce risk and mitigate potential hazards, terrorist events have the aim of intentionally inflicting maximum casualties and disrupting the day to day functioning of society. Bioterrorism in particular, has been an attractive methodology by terrorists as certain naturally occurring biological agents are relatively easy and inexpensive to obtain, can be easily disseminated, and can cause widespread fear and panic. The development of Counter Terrorism Medicine (CTM) as a subspecialty of Disaster Medicine, and the recent non-terrorism related deaths as a result of bongkrekic acid (BKA) poisoning after consuming homemade corn noodles, reignited the dialogue on the potential adaptation of naturally occurring biological agents into a bioterrorism tool, and highlights the subsequent terrorism risk mitigation strategies required for this potential attack modality (Court et al., 2020).

BKA is a little known toxin produced in fermented coconut or corn contaminated by the bacterium Burkholderia gladioli pathovar cocovenanans. BKA is odourless and tasteless and affected food products can have a normal appearance, smell and taste. Outbreaks of BKA poisoning affecting thousands were documented since the mid '70s in Indonesia where fermented food products made out of coconut residues are popular local dishes. In 2015, the first outbreak of BKA outside of Asia was documented in Mozambique, which led to 230 poisonings and 75 deaths.

Onset of symptoms varies from 1-10 hours post exposure, with the liver, brain and kidneys as the primary affected organs. Symptoms include malaise, dizziness, somnolence, excessive sweating, palpitations, abdominal pain, vomiting, diarrhea, oliguria, hematuria and urinary retention. Clinical findings include hypotension, arrhythmias, hyperthermia, icterus, jaundice, rigidity of extremities, Cheyne-Stokes respirations, lethargy, delirium, shock, coma, and death (Anwar et al., 2017). Laboratory abnormalities include an initial hyperglycaemia, followed by hypoglycaemia, abnormal liver function tests, normal red blood cell count and haemoglobin, and an increase in white blood cell count (Meng et al., 1988). Death from multi organ failure and diffuse cellular dysfunction can occur 1-20 hours post onset of initial symptoms, with an estimated mortality rate of 40-60%. 1-1.5 mg of BKA is considered fatal to humans (Deshpande, 2002). The use of such naturally occurring, easy and inexpensive biotoxins with low detectability and high potential for injury has been well documented as a method of biological warfare and bioterrorism (Riedel, 2004).

While BKA has not historically been recognised or used as a bioweapon, there needs to be increased vigilance, research and discussion for the potential conversion from any naturally occurring threat to an intentional one. While there are currently collective efforts by all levels of government, along with private enterprise and other stakeholders in the US to carry out biodefence activities, there needs to be a more robust global multi agency collaboration to identify, anticipate, research, and mitigate the healthcare risks associated with them. This has led to the development of CTM and reiterates the need to broaden the discussion to include experts in security, intelligence and health to mitigate potential novel bioterrorism agents.

References

Anwar, M., Kasper, A., Steck, A. R., & Schier, J. G. (2017). Bongkrekic Acid—a Review of a Lesser-Known Mitochondrial Toxin. In *Journal of Medical Toxicology* (Vol. 13, Issue 2, pp. 173–179). Springer New York LLC. https://doi.org/10.1007/s13181-016-0577-1

Court, M., Edwards, B., Issa, F., Voskanyan, A., & Ciottone, G. (2020). Counter-Terrorism Medicine : Creating a Medical Initiative Mandated by Escalating Asymmetric Attacks. *Prehospital and Disaster Medicine*, 1–4. https://doi.org/10.1017/S1049023X2000103X

Deshpande, S. S. (2002). Handbook of Food Toxicology. In *Handbook of Food Toxicology*. CRC Press. https://doi.org/10.1201/9780203908969

Meng, Z., Wang, D., Li, Z., Jin, J., Bai, J., Zhang, Y., Liu, X., Cai, L., Li, X., & Ren, H. (1988). Studies on fermented corn flour food poisoning in rural areas of China. II. Isolation and identification of causal microorganisms. *Biomedical and Environmental Sciences : BES*, *1*(1), 105–114.

Riedel, S. (2004). Biological Warfare and Bioterrorism: A Historical Review. *Baylor University Medical Center Proceedings*, *17*(4), 400–406. https://doi.org/10.1080/08998280.2004.11928002