Acute and Long-Term Impact of Chemical Weapons: Lessons from the Iran-Iraq War

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ABSTRACT: Chemical weapons have given the human experience of warfare a uniquely terrifying quality that has inspired a general repugnance and led to periodic attempts to ban their use. Nevertheless, since ancient times, toxic agents have been consistently employed to kill and terrorize target populations. The evolution of these weapons is examined here in ways that may allow military, law enforcement, and scientific professionals to gain a perspective on conditions that, in the past, have motivated their use–both criminally and as a matter of national policy during military campaigns. Special emphasis is placed on the genocidal use of chemical weapons by the regime of Saddam Hussein, both against Iranians and on Kurdish citizens of his own country, during the Iran-Iraq War of 1980–88. The historical development of chemical weapons use is summarized to show how progressively better insight into biochemistry and physiology was adapted to this form of warfare. Major attributes of the most frequently used chemical agents and a description of how they affected military campaigns are explained. Portions of this review describing chemical-casualty care devote particular focus to Iranian management of neurotoxic (nerve) agent casualties due to the unique nature of this experience. Both nerve and blistering "mustard" agents were used extensively against Iranian forces. However, Iran is the only nation in history to have sustained large-scale attacks with neurotoxic weapons. For this reason, an understanding of the successes and failures of countermeasures to nerve-agent use developed by the Iranian military are particularly valuable for future civil defense and military planning. A detailed consideration of these strategies is therefore considered. Finally, the outcomes of clinical research into severe chronic disease triggered by mustard-agent exposure are examined in the context of the potential of these outcomes to determine the etiology of illness among US and Allied veterans of the 1991 Persian Gulf War.

KEY WORDS: Acetylcholine, acetylcholinesterase, adamsite, anticholinergic, arsenic, biological, bronchospasm, BZ, cancer, carbamates, central apnea, chemical, chloroacetone, cholinergic effects, cholinesterases, cyclosarin, ethyl bromoacetate, exposure, methyl isocyanate, miosis, mustard, oxime, oxime-phosphonate, parasympatholytic, phosgene, psychotropic, sarin, soman, status epilepticus, sulfide, tabun, verdigris, weaponized, weapons.

INTRODUCTION — Moral, Ethical, and Practical Perspectives on the Use of Chemical and Biological Weapons

The use of poisonous substances to gain tactical or strategic advantage during wartime has traditionally evoked a sense of repugnance among military personnel and civilians alike. Nevertheless, such moral reservations are counterbalanced by recognition that failure to use these weapons may mean military defeat.

This perspective is captured very succinctly by Robert Harris and Jeremy Paxman in the introduction to their landmark book, first published in 1982, *A Higher Form of Killing: The Secret History of Chemical and Biological Warfare*, which provides an elegant and lucid description of the unique combination of political events and technical advances that have driven the evolution of chemical and biological weapons in modern times [53].

Soldiers interviewed for this book described the unique horror evoked by use of these weapons that transcended the fear of other means of death or injury in combat. The ability of a pervasive and invisible agent to inflict particularly gruesome injury with little or no warning, and often with no means of escape, is viewed by many military personnel as "dirty" warfare, infused with an intrinsic evil not accorded to other weapons systems [53].

I. HISTORICAL USE OF CHEMICAL AND BIOLOGICAL WEAPONS

A. Ancient Precedent for Chemical and Biological Weapons Use

Substantial historic precedent for military use of both biological agents and toxicants has been documented. For example, the Assyrians employed weaponized poisons in their campaigns, becoming well known for use of various toxic fungi to contaminate enemy water supplies, with accounts of such incidents dating to 600 B.C.E. [76]. The ancient Hellenic nation states also became adept at creative use of toxic substances, including a rudimentary form of napalm known as "Greek Fire", which was often used with devastating effectiveness during battles such as the siege of Athens by Sparta in 423 B.C.E. during the Peloponnesian War [76]. This preparation made from a blend of sulfur and pitch was used by Byzantine defenders of Constantinople in 673 C.E. to set fire to Saracen ships participating in the attack on the city [76].

Interest in alchemy, and the gradual emergence of insight into evidence-based physical science, motivated further advances in weaponization of toxicants in the following centuries. A notable contributor to this trend during the Renaissance was Leonardo da Vinci, who

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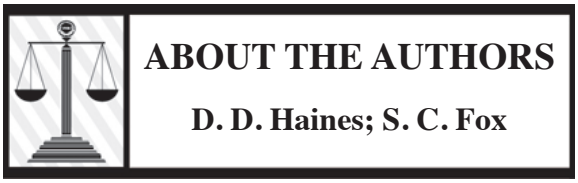

ABOUT THE AUTHORS

D. D. Haines; S. C. Fox

David Haines completed his undergraduate training at Rhode Island College (Providence, RI), graduating *cum laude* with degrees in chemistry and biology; he received a Ph.D. in immunology from the University of Connecticut Health Center (Farmington, CT).

Dr. Haines served as a US Army officer in Saudi Arabia, Iraq, and Kuwait during the 1990–91 Persian Gulf War and helped re-establish cultural and scientific interaction between Iran and the USA from 2000 until the present. He has worked extensively with military and scientific authorities in the USA, Iran and Iraq and has devoted his career to characterization of chronic illness among populations exposed to military toxicants. He is co-founder and chief science officer for Summative Synergy Pharmaceutical Group (*http://www.sspg.org/about/our-team*), a Delaware biotechnology corporation established to make use of findings in studies of war-linked illness for development of novel approaches to prevention of and therapy for serious chronic disease.

He is widely published in peer-reviewed scientific literature and is currently director of TRINITY, a program focused on cellular senescence, designed to utilize adaptive responses to oxidative stress in ways with potential for lifespan extension. Dr. Haines is currently employed as a pharmaceutical researcher at the Faculty of Pharmacy, Department of Pharmacology, University of Debrecen, in Debrecen, Hungary and is an affiliate of University of Connecticut's Department of Molecular and Cell Biology.

Stephanie C. Fox is a historian, writer, and editor. She received her B.A. in history and women's studies from William Smith College (Geneva, NY), and her J.D. from the University of Connecticut's School of Law (Hartford, CT). She is founder and president of QueenBeeEdit (Bloomfield, CT), a specialized editing service that caters to politicians, military officers, physicians, and scientists.

While living in Kuwait in 2004–2005, she participated in efforts to bring equal voting rights to women. She has assisted in the preparation, organization, and formatting of numerous reports by Iranian, European, and US scientists, describing features of chronic illness among chemical-attack survivors. This work includes a landmark 2009 genetic study published in *Mutation Research*, linking lung cancer to mustard-agent exposure in Iranian military veterans. She is currently co-authoring the political memoir of Dr. Fatemeh Haghighatjoo, a reformist Iranian politician.

Ms. Fox has written several books on a variety of topics, including the effects of human overpopulation on the environment, the economic meltdown of 2008, a history and travelogue about Hawai'i, Asperger's, and the evolution of democratic trends in Islamic societies.