

# Long Term Cardiotoxic Effects of Sarin

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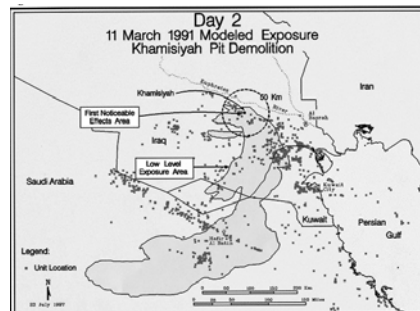
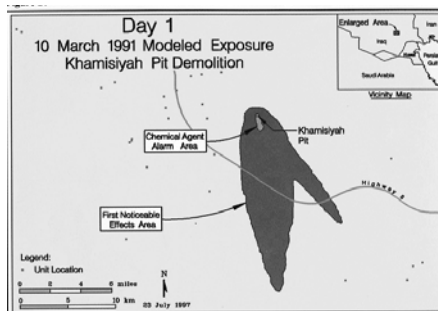
## HISTORICAL PERSPECTIVE THE USE OF SARIN GULF WAR 1991



**Demolition of bunkers at Khamisiyah, 4 March 1991.**

CIA, 1997; [http://www.fas.org/irp/gulf/cia/970409/cia\\_wp.html](http://www.fas.org/irp/gulf/cia/970409/cia_wp.html)

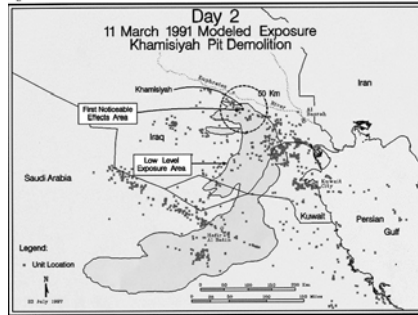
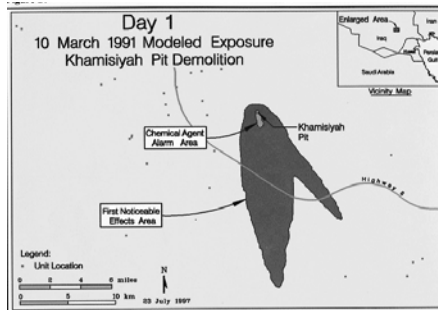
## HISTORICAL PERSPECTIVE USE OF SARIN GULF WAR 1991



**Plume Models for the Demolition of Bunkers at Khamisiyah, 12 March 1991.**

CIA, 1997; <https://www.cia.gov/library/reports/general-reports-1/gulfwar/555/425055597.html>

## POTENTIAL EXPOSURE OF 100,000 PERSONS

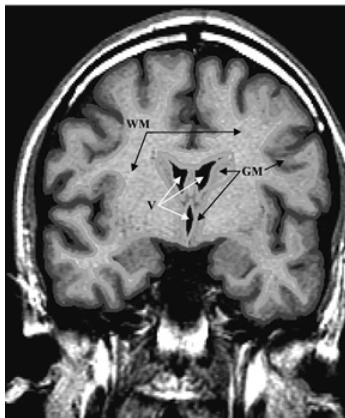


### Plume Models for the Demolition of Bunkers at Khamisiyah, 12 March 1991.

CIA, 1997; <https://www.cia.gov/library/reports/general-reports-1/gulfwar/555/425055597.html>

### Quantitative magnetic resonance brain imaging in US army veterans of the 1991 Gulf War potentially exposed to sarin and cyclosarin

Kristin J. Heaton, Carole L. Palumbo, Susan P. Proctor,  
Ronald J. Killiany, Deborah A. Yurgelun-Todd, Roberta F. White

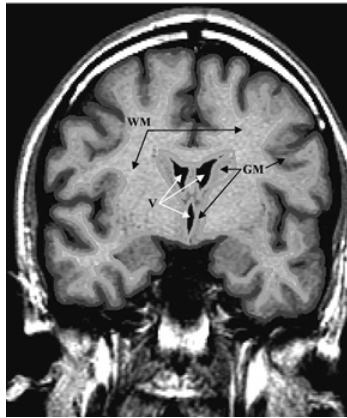


Neurotoxicology 28: 2007

- Reduced white matter
- Enlarged left cerebral ventricle
- Persistent CNS pathologies

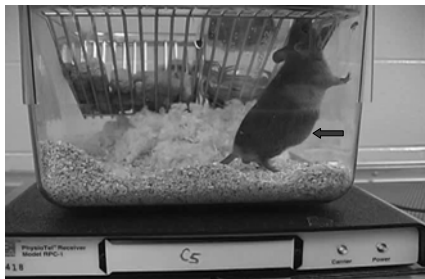
## Case Report: Long term cognitive sequelae of sarin exposure

Loh et al., Neurotoxicology, 2010



- Recent exposure Army captain
- Munition disposal
- Sustained neurocognitive deficits

## OBJECTIVE 1: Autonomic Cardiovascular Effects of Low Dose Sarin

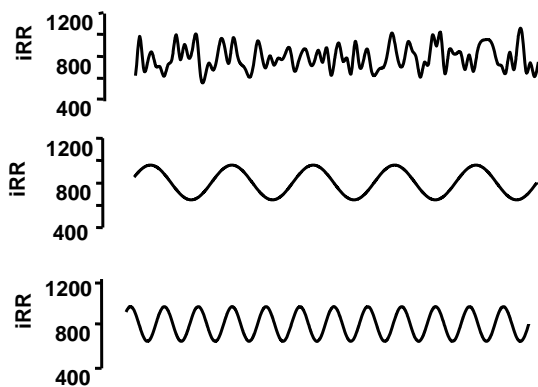


- Radiotelemetry
- Sarin sc  
0.4 LD<sub>50</sub>
- Spectral analysis -  
autoregressive  
method
- Blood and brain  
AChE

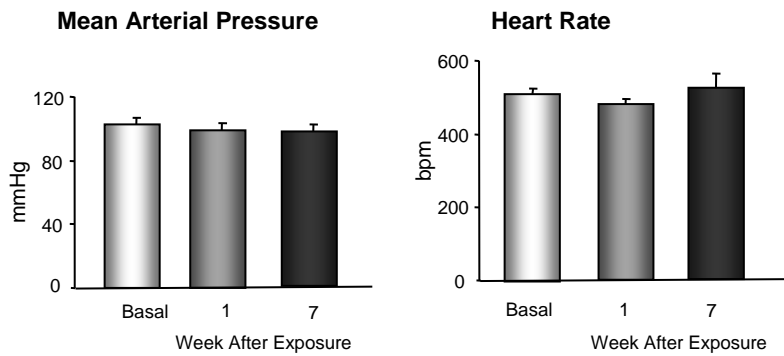
## Spectral Analysis for Characterization of Autonomic Balance

Statistical method for characterization of variability. Spectra of variability are composed of 2 oscillatory components; low frequency (0.1-1 Hz) and high frequency (1-5.0 Hz). Spectra are associated with autonomic balance, sympathetic and parasympathetic

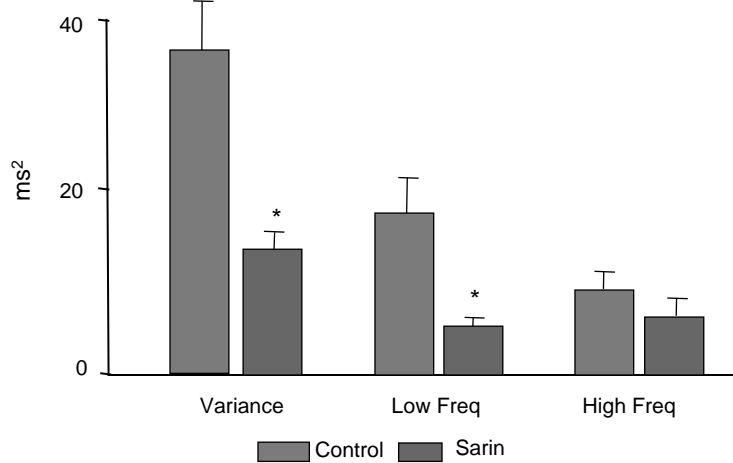
### Signal Analysis



## Low Dose Sarin Blood Pressure and Heart Rate

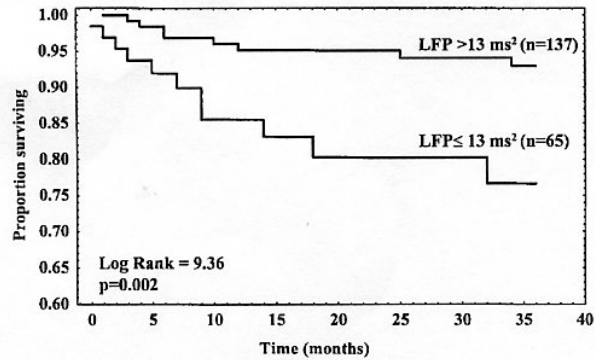


## Effect of Sarin on Heart Rate Variance and Frequency Domains



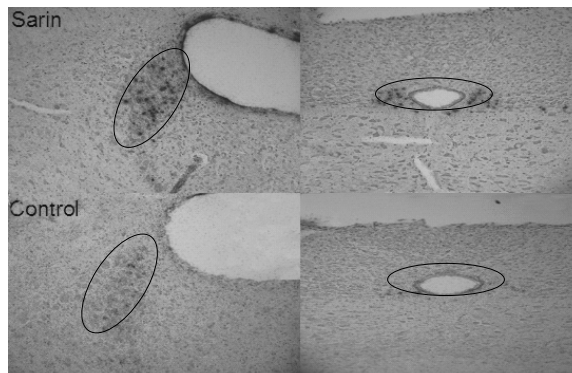
Farah et al., *Autonomic Neuroscience: Clinical and Basic*, 2007

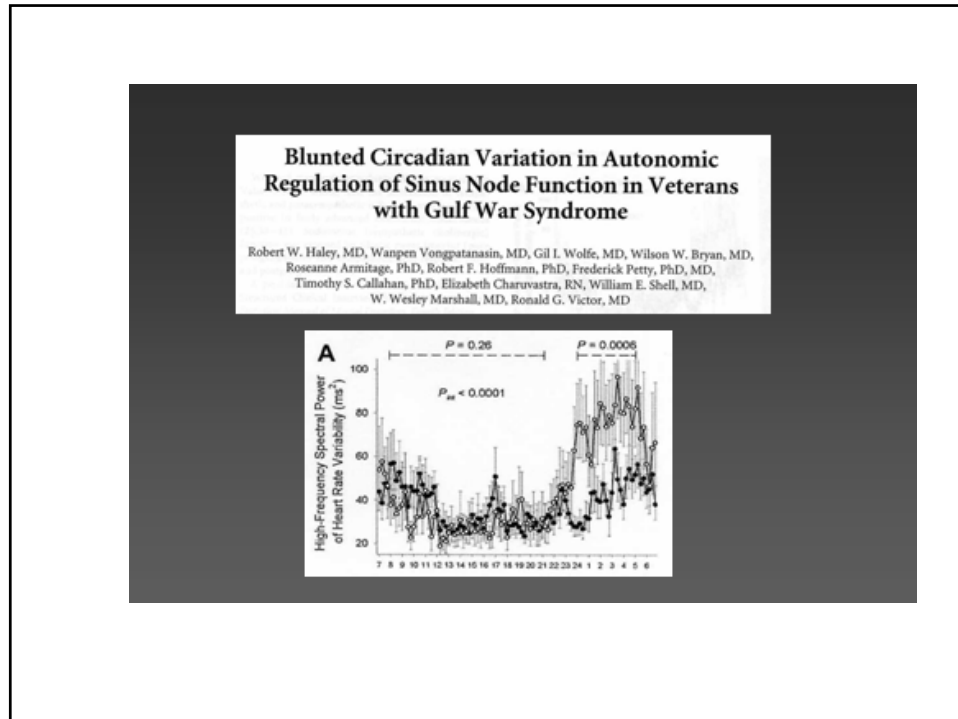
## CLINICAL IMPLICATIONS OF LOW HR VARIABILITY



*LaRovere et al. 2003*

## Low Dose Sarin on Brainstem Catecholamine Systems



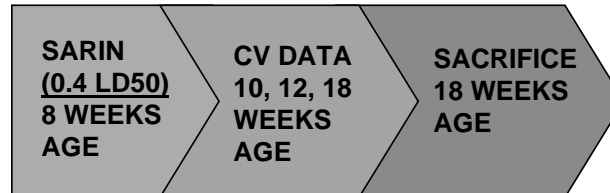


## OBJECTIVE 2:

To identify the long term effects of low dose sarin on cardiac structure and function in mice

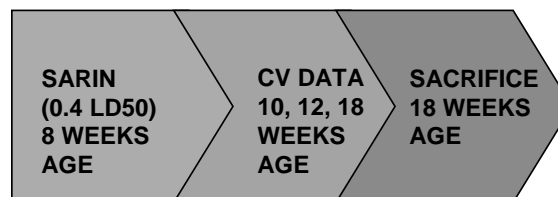


## TIME COURSE PROTOCOL



ECHOCARDIOGRAPHY (ECHO)
ELECTROCARDIOGRAM (ECG)
CV STRESS TEST
CARDIAC MARKERS
HEART AND CELL SIZE

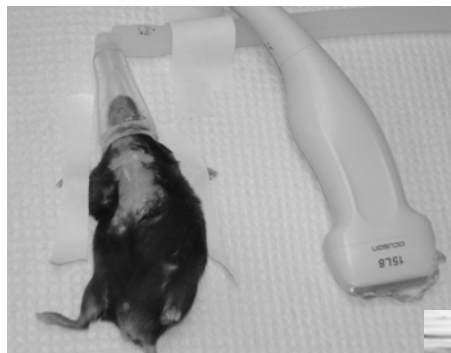
## METHODS PROTOCOL



- 2D and M mode ECHO were used to measure left ventricular structure and performance at baseline and after dobutamine stress test at 2, 4, and 10 wks after sarin.
- ECG tracings were recorded at the 10 week point, baseline and after dobutamine.
- Histological and immunochemical parameters (i.e., natriuretic peptides) were measured upon sacrifice

## Echocardiography

- Piezoelectric crystals convert electrical current into sound waves
- Tissues of varying impedance create reflected sound waves
- Reflected sound waves produce electrical currents that are processed into images



## ECHO RECORDING UNDER ANESTHESIA

## M-MODE ECHO

