Current Advancements in Skin Barrier Creams and Wound Care as Countermeasures for Chemical Warfare Agents

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8 November 2006
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Research for the Warfighter
USAMRICD

USAMRICD

Research, Education, and Training for Medical Chemical Defense
Vision and Mission

Vision
To be the recognized Center of Excellence, the national asset, and the world leader for medical chemical defense, education, and training.

Mission
To discover and develop medical countermeasures to chemical warfare agents and to train and educate personnel in the medical management of chemical casualties.
Populations at Risk

- Primary mission - warfighter: healthy, physically fit; 18-45 yr
- First Responders
- Civilian Communities
  - Geriatric
  - Pediatric
  - Sensitive population groups
Medical Countermeasures Against CWAs

Technical Approach:
- Develop and evaluate products: prevent or counter adverse effects
- Develop diagnostic systems and assays
- Identify mechanisms of action
- Develop methods to measure effectiveness of countermeasures in animal models predictive of human response (FDA Animal Rule)

Technology base provides medical product candidates

Blood Agents

H-C≡N

Nerve Gases

Nerve Agents

CH₂CH₂-Cl

S

S

CH₂CH₂-Cl

Vesicant Agents

S

S

Medical countermeasures against CWAs

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Vesicant Agent
Vesicant agents are likely weapons

- Can be effectively used for terrain denial, casualty production, terrorism

- Relatively easy to produce in quantity

- Can be disseminated as an aerosol, liquid, or viscous liquid
Topical Skin Protectant (TSP)

- Concept recognized during WWI
- Much development work before and during WWII
- M-5 Ointment kit, using S-330, fielded by the end of WWII
- Skin Exposure Reduction Paste Against Chemical Warfare Agents (SERPACWA)
Skin Exposure Reduction Paste Against Chemical Warfare Agents

INSTRUCTIONS FOR USE FOR MILITARY PERSONNEL:
This product is intended for use prior to exposure to CWA and only in conjunction with MOPP gear.
- Before you put on the chemical protective overgarment, use a dry towel to wipe off the sweat, insect repellent, camouflage paint, sand or dirt from your skin at the areas shown in the picture below and on the label.  • The barrier properties of SERPACWA may be reduced if any insect repellents and/or camouflage paints remain on the skin surfaces to which SERPACWA is applied.  • Tear open the packet and squeeze about one third of the pouch into the palm of your hand and rub it evenly around the wrists (site 1), neck (site 2), and boot tops of lower legs (site 3) until it forms a white film which is barely noticeable. Remove the remaining two thirds of the SERPACWA from the pouch and rub it evenly on your armpits (site 4), groin area (site 5), and waistline (site 6).  After the product is applied, if exposure to CWA is either confirmed or suspected, follow the appropriate protocol for decontamination. • For removal of SERPACWA in the absence of exposure to CWA, scrub the sites with a dry towel, or if possible, with a cloth using both soap and water. • For personnel who smoke, hands should have no visible traces of SERPACWA prior to handing of smoking products. If smoking products have an unusual or unpleasant taste during smoking, this may indicate that the products have been contaminated with SERPACWA. If this occurs, personnel are advised to cease smoking and discard the potentially-contaminated products. Even in the absence of an unusual or unpleasant taste, the smoking product may still be contaminated, so smoking should be avoided. Clothing or other materials exposed to SERPACWA and SERPACWA packaging should not be destroyed by burning, because of the release of toxic fumes.
Operational Uses for SERPACWA

- Used with protective suit (MOPP) to increase efficacy at junction points
- Applied every 8 hours when threat of chemical warfare agent use is high, before exposure occurs
- Protects against sulfur mustard, nerve agents, and T-2 micotoxin
- Considering extending use to all non-covered skin areas
Other Uses for SERPACWA

- Chemical agent inventory workers
- Chemical incident first responders
- Pesticide workers
- Firefighters, homeowners, and hikers
  - Protects against poison ivy and poison oak
- General laboratory workers
  - Solvents and other caustic chemicals
The Need for an Active TSP (Active SERPACWA)

- Decon as well as protect
- Increase efficacy
- Protection against HD vapor
Skin Decontamination
Demonstrate safety and efficacy of a reactive topical skin protectant

Accomplishments:
- Identified reactive moieties to improve SERPACWA
- rTSP provides significantly improved protection against HD vapor; extends decontamination window
DECONTAMINATION SOLUTION:
Hierarchy: Priority of Utilization

- M291 (Do not apply to wounds)
- Soap and water
- Bleach 0.5% wipe with water rinse
Decontamination of Skin

- Reactive Skin Decontamination Lotion (E-Z-EM Canada, Inc.)

- Mixture of Dekon 139 and 2,3, butanedione monoxime (DAM) in a polyethylene glycol monomethyl ether (MPEG) and water solvent system

Per the MSDS:
“RSDL should not be used for wound decontamination because its effects on wounds and effects resulting from its absorption through the wound have not been studied. Intravenous injections of DAM have been shown to cause serious systemic toxicity up to and including a transient comatose state.”
Decontamination of Wounds

• Standard irrigation and debridement best
• Remove foreign material in wound
  – Porous material acts as agent depot
  – Risk to casualty and medical staff
  – Remove with no-touch technique

“Do not attempt field decontamination of abdominal, thoracic, or intracranial cavities”
Medical Countermeasures Against Vesicant Agents

Demonstrate safety and efficacy of a candidate medical countermeasure against vesicant agents

Accomplishments:

- Developed *in vitro* and *in vivo* models
- Determined molecular mechanisms and therapeutic strategies
- Screened >700 compounds
- Identified 17 efficacious compounds

Mustard Control

Olvanil + Indomethacin
**Vesicant Countermeasures Research**

- **Post-exposure Therapeutics**
  - Two candidates identified to mitigate effects
  - Combination studies needed

- **Cutaneous Therapeutics**
  - Investigating strategies to mitigate HD (mustard) burns
  - Improved healing rate and greatly reduced scarring
Treatment Strategy

1. Assess extent and depth of injury (shallow vs. deep)
2. Excise and graft deep dermal/ F-T injuries
3. Perform adequate wound debridement of P-T injuries
   - Er:YAG laser (Sciton Profile™)
   - Enzymatic/chemical
   - Saline jet spray (Versajet™ Hydrosurgery system)
Treatment Strategy

4. Apply one or more treatment adjuncts
   - Dressings (hydrocolloids, foams, thin films, matrix metalloprotease-binding, silver-ion delivering)
   - Growth factors (EGF, KGF)
   - Skin substitutes (Apligraf, Biobrane)
   - Keratinocyte spray technology
   - Vacuum assisted closure (V.A.C.)
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Findings

- Silver-ion delivering dressings and spray keratinocyte technology appear to be particularly promising
  - Speedy re-epithelialization and barrier repair
  - Good cosmetic outcome
Medical Chemical Diagnostics

- Analytical Chemistry – verification of CWA exposure
  - Standard methods – TB MED 296
  - R&D – improved methods
- Research Support
  - Cholinesterase Analysis Lab
- BB Area
  - Vault for neat and dilute agent for research
  - Agent QA/QC program
Diagnostics
Specimen Submission
Standing Operating Procedure

- Accessible through our web page
- Comprehensive instructions on collection and chain of custody
  - Standard procedures
    - Obtaining, Handling, and Shipment of Biomedical Samples – user-friendly HTML format: http://usamricd.apgea.army.mil/
    - Standing Operating Procedure for Receipt and Storage of Biomedical Samples
Collaborative Research Facility

Provides a venue through which principal investigators external to the USAMRICD may conduct research related to XCSM exposure, facilitating successful external collaborative efforts.
Education
Chemical Casualty Care Training

- Academy of Health Sciences Numbered Courses
  - Field Management of Chemical Casualties (6H-F37/300-F31)
  - Medical Management of Chemical Casualties (6H-F26)
  - Hospital Management of Chemical, Biological, Radiological/ Nuclear, and Explosive (HM-CBRNE) Incidents Course
IMPACT: This training provides the knowledge and treatment strategy to better equip military and civilian medical personnel and our elite teams to manage chemical agent casualties and to increase survival in both wartime and terrorism scenarios.
USAMRICD
Essential to National Defense

- Changed World – expanding list of emerging and non-traditional agents
- USAMRICD – The Nation’s leader in medical chemical defense
- Interagency Convergence – DHS, DIA, CDC, Edgewood Campus of Aberdeen Proving Ground
United States Army Medical Research Institute of Chemical Defense

QUESTIONS?