Appendix 4

Hazardous Materials Exposure

Hazardous Materials Incident

Rationale:

This protocol describes the procedures used by the Special Response Team (SRT) when caring for chemically injured patients. The goal is to provide guidelines for the safest and best possible care for patients and rescuers.

Responsibilities:

SRT Members and EMS personnel will maintain a working knowledge of its content.

Procedure:

The team will set up controlled areas of relative exposure. The areas will be a hot zone (in which exposure may be expected), a warm zone (in which decontamination is begun), and a cold zone (in which patients and rescuers should be safe from additional exposure).

Patients who are in contact with a contaminant are in the hot zone and will be removed to the warm zone by rescuers who are protected by appropriate personal protective equipment. Treatment for victims will begin in the warm zone by properly protected hazardous materials operations level personnel. The Decontamination Team will initiate respiratory care as soon as decontamination has progressed to removal of the patient's Self Contained Breathing Apparatus (SCBA). The team will then send patients to the Treatment/ Transport Area for chemical exposure related problems or to the Medical Assessment Area for post-entry assessment and rehydration as needed.

Patients who pose a threat of contaminating others (secondary contamination) will be treated in the treatment area by properly protected hazardous materials personnel. Rescue units used to transport contaminated patients will be protected as much as possible against secondary contamination. Any removable equipment not required for patient care will be removed from the rescue unit before a patient is loaded. Patients requiring specialized medications will be treated by paramedics who have received approved training in Hazardous Materials Toxicology.

A rescue unit will transport patients who offer no risk of secondary contamination to an appropriate facility. If the patient meets criteria found in section III of the TTP, the TTP will dictate where the patient will be transported.

Hazardous Materials Treatment

Rationale:

Proper care of chemically exposed patients by the SRT may require treatments that are not in the EMS protocol. These treatments have been approved by the Medical Directors and may be used with approval of Medical Control at a receiving hospital. **All treatments are level III and require a physician's order.**

Treatment:

- Chemical exposure to the eyes, which require irrigation consider:
  Tetracaine eye drops, 1-2 gtts. per eye

- Chemically induced asthma consider:
  Ventolin (Proventil) 2.5mg/3ml (1 unit does) aerosol
  Solu-Cortef, 100 - 500mg, IV over 30 seconds

- Chlorine Gas inhalation with dyspnea and associated respiratory irritation consider:
  Sodium Bicarbonate aerosol breathing treatment, 3mEq 8.4%/2ml of NS nebulized at 6 LPM.

- Symptomatic Cyanide Poisoning consider:
  Sodium Nitrite 3% solution, 300mg, given over 2.5 to 5 minutes, followed by
  Sodium Thiosulfate 25% solution, 12.5gm, given over 2.5 to 5 minutes. Repeat ½ dose in 20 m'

  - Initiate O2 immediately while preparing for intravenous administration
  - Simultaneously with the oxygen, administer Amyl Nitrite Inhalant for 15 to 30 seconds q 2 or 3 minutes
  - Discontinue Amyl Nitrite and then inject adults with 300 mg (10 mL of a 3% solution) of sodium nitrite intravenously at the rate of 2.5 to 5 mL/minute. The recommended dose of sodium nitrite for children is 6 to 8 mL/square meter (approximately 0.2 mL/kg of body weight) but is not to exceed 10 mL.
  - Immediately thereafter, inject adults with 12.5 g (50 mL of a 25% solution) of sodium thiosulfate. The dosage for children is 7 g/square meter of body surface area, but dosage should not exceed 12.5 g. The same needle and vein may be used for both steps.
  - If the poison was taken by mouth, gastric lavage should be performed as soon as possible, but this should not delay the treatments outlined above.

- Hydrocarbon and Active Metal exposure consider:
  Mineral oil topically
  Epinephrine is contraindicated

- Hydrofluoric Acid exposure with muscle tetany, QT segment prolongation, or cardiac arrest consider:
  Calcium Gluconate 10% gel, mixed 1gm Calcium Gluconate with 5oz Water-soluble lubricant, applied topically over Hydrofluoric (HF) Acid burns.
  Calcium Gluconate 10% solution, 1 gm IV

- Symptomatic Hydrogen Sulfide poisoning consider:
  Sodium Nitrite 3% solution, 300mg, given over 2.5 to 5 minutes

- Symptomatic Methemoglobinemia consider:
  Methylene Blue 1% solution (10mg/ml) 1-2mg/kg, over 10 minutes

- Symptomatic Organophosphate or Carbamate poisoning consider:
  Atropine Sulfate, 2mg. Repeat doses every 3-5 minutes.

Consider Pralidoxime Chloride (2-PAM), 1gm, over 5-10 minutes. Repeat in 1 hour PRN.

- Phenol exposure consider:
  Polyethylene Glycol (GUNK) topically

Atropine Sulfate

CLASS:

ANS- Anti-Cholinergic, Parasympatholytic

MECHANISM OF ACTION:

It is a competitive antagonist for muscarinic acetylcholine at post-synaptic receptor sites and in the CNS.
HEART: It has positive chronotropic effects particularly in the SA node, atrial and junctional tissues. Cardiac output increases due to increased heart rate. It increases cardiac muscular consumption of oxygen (MVO2). It has positive dromotropic effects through the entire conduction system except the purkinje fibers. Ventricular brady dysrhythmia may be stabilized as a result of a increased cardiac rate. SYSTEMIC: CNS stimulation particularly with toxic doses may precipitate psychosis, restlessness, excitation, confusion, hallucinations, delirium. It may also cause mydriasis as a result of paralysis of the ciliary muscle with resultant photophobia. It dries mucous membranes of respiratory system and relaxes smooth muscles of the airways. Decreased smooth muscle tone, decreased sphincter tone, decreased pancreatic enzyme secretion (insulin, glucagon) may all result from its use.

INDICATIONS:

Cholinergic crisis due to organophosphate or carbamate poisonings.

CONTRAINDICATIONS:

- Glaucoma-(relative)- due to increased intraocular pressure. The iris is crowded against the back of the anterior chamber and drainage of aqueous humor is inhibited. There may be absence of cholinergic effects, especially bronchorrhea.

- Organochlorine insecticides (aldrin, benzene hexachloride (BHC), HCH, hexachlor, hexachloran, chlordane, chlordecone, DDT, Kepone, chlorobenzilate, dicofol, Kelthane, dieldrin, dieldrite, dienochlor, pentac, endosulfan, endrin, hexadrin, heptachlor, hexachlorobenzene, lindane, gamma BHC or HCH, Kwell, mehtoxychlor, Marlate, mirex, terpene polychlorinates, strobane, toxaphene

- Nitrophenolic and Nitrocresolic Herbicides (dinitrocresol, dinitrophenol, dessin, acrex, talan, dinocap, crotothane, karathane, dinopenton, dinoprop, dinosam, dinoseb, acricid, Hel-Fire, vertac CS (Tear gas) or CN (mace)

DRUG INTERACTIONS:

Increased effect of other anticholinergic (antimuscarinic) agents.
Increased effect of sympathomimetic agents.
Concomitant use of Pralidoxime may potentiate antimuscarinic toxic effects.

DOSAGE:

Moderately severe poisoning (hypersecretion and other end-organ manifestations without CNS depression)

- Adults & Children > 12 years: 2.0 – 4.0 mq q 15 min.
  Until pulmonary secretions are controlled, which may be accompanied by other signs of atropinization (flushing, dry mouth, dilated pupils, and tachycardia > 140/min)
- Severe poison: may need two or more times the dose

Atropine Sulfate Cont.

- Pediatric- 0.05 mg/kg every 3-5 minutes (minimum dose .1 mg)

SUPPLIED:

8mg/20ml vials (0.4mg/ml)

ROUTES OF ADMINISTRATION:

IV, ET, IO

Notes :

Do not administer atropine or pralidoxime prophylactically
Do not administer in fungicide poisoning (not a cholinesterase inhibitor)

Calcium Gluconate

CLASS:

Cation

ACTIONS:

Supplies calcium to tissues, and the calcium binds with fluoride to make calcium fluoride

INDICATIONS:

- Mild to moderate skin burns resulting from exposure to hydrofluoric acid
- Hydrofluoric Acid exposure with QT prolongation, tetany, or cardiac arrest

CONTRAINDICATIONS:

- Hypercalcemia
- Ventricular fibrillation
- Digitalized patients

CAUTION:

- Mild necrosis and abscess formation may occur with topical administration.
- Rapid IV administration may cause vasodilatation, decreased B/P, cardiac arrhythmias, syncope, and cardiac arrest.
- Use caution when administering to a pregnant woman.

DRUG INTERACTIONS:

Do not administer to digitalized patients.

DOSAGE:

Topical:

- Mix 1 gram 10% calcium gluconate with 5 oz. water soluble lubricant (KY or Surgilube) and apply over painful areas. Cover with sterile dressings.

Intravenous:

- Adult: 1 gram over 5 minutes (10% solution)
- Pediatric: 0.5 gram over 5 minutes (10% solution)

SUPPLIED:

1 gram in 10ml's. Each gram includes 93 mg (4.65 mEq) calcium.

ROUTES OF ADMINISTRATION:

Topically, IV

Cyanokit Protocol

Rationale:

Cyanide poisoning may result from inhalation, ingestion, or dermal exposure to various cyanide-containing compounds, including smoke from closed-space fires. Sources of cyanide poisoning include hydrogen cyanide and its salts, cyanogenic plants, aliphatic nitriles, and prolonged exposure to sodium nitroprusside. The presence and extent of cyanide poisoning are often initially unknown. There is no widely available, rapid, confirmatory cyanide blood test. Treatment decisions must be made on the basis of clinical history and signs and symptoms of cyanide intoxication. If clinical suspicion of cyanide poisoning is high, Cyanokit should be administered without delay.

Assessment Checklist

- Evidence of trauma/burns- if so proceed to trauma protocol, use spinal immobilization as indicated
- Soot in nose/mouth/oropharynx
- Airway/breathing
- Circulation- BP/Perfusion
- LOC (Level of Consciousness) – GCS, pupil size/reactivity

Smoke Inhalation – Adult

Exposure Level I:

(Mild – soot in nose/mouth/oropharynx)

- Don appropriate PPE
- Remove patient from source of smoke/inhalation
- Administer 100% O2 via non-rebreather
- Monitor pulse-oximetry
- Monitor ECG, if indicated
- Reassess frequently

Exposure Level II:

Moderate – soot in nose/mouth/oropharynx

- ***confusion, disorientation, altered LOC***
- ***Hypotension***

- Administer 100% O2, ventilate with BVM if needed
- Intubate/PEEP as indicated
- Collect blood sample via closed vacutainer technique before starting IV (purple top tube). Transport blood sample with patient to receiving hospital.
- Initiate IV/NS @TKO
- Monitor ECG/Pulse oximetry if available (Note: pulse oximetry monitors may give false readings in patients exposed to CN/methemoglobin or CO).
- If hypotensive, consider fluid challenge and administer Cyanokit 5 gm IV pgb on scene or enroute (Contact Medical Control as needed)
- Treat other presenting symptoms
- Transport to appropriate facility

Exposure Level III:

Severe - soot in nose/mouth/oropharynx
- Coma, respiratory/cardiac arrest
- Hypotension

- Administer 100% O2 with BVM or intubate/PEEP, as indicated
- Collect blood sample via closed vacutainer technique before starting IV (purple top tube).
- Initiate IV/NS @TKO

- Administer Cyanokit 5g IV pgb and monitor for clinical response/and need for second 5 g dose (Contact Medical Control as indicated)
- If hypotensive, consider fluid challenge
- Monitor ECG/Pulse oximetry if available (Note: pulse oximetry monitors may give false readings in patients exposed to CN/methemoglobin or CO).

Hydroxocobalamin
(Cyanokit)

CLASS:

Antidote

ACTIONS:

Cyanokit (hydroxocobalamin) has a high affinity for cyanide ions and is converted to cyanocobalamin (vitamin B12). B12 is a water soluble vitamin that is then removed from the circulation and is readily excreted in the urine.

INDICATIONS:

Cyanokit is indicated for the treatment of known or suspected cyanide poisoning and Haz-mat and terrorist incidents involving cyanide

CONTRAINDICATIONS:

None

ADVRESE REACTIONS:

- Chromaturia (red urine)
- Erythema (skin redness), rash
- Increased blood pressure, headache
- Nausea/vomiting, diarrhea

DOSAGE:

After reconstitution, each vial contains 25 mg/ml

- **Adult:**
  - 5gms (two 2.5 gm vials) over 15 minutes
- **Pediatric:**
  - 70 mg/kg (max 5 gms)

SUPPLIED:

Pre-filled syringes and ampules of 2 ml and in vials of 10 ml, in a concentration of 5 mg / ml

ROUTES OF ADMINISTRATION:

IV infusion through a dedicated IV line

Therapeutic Effects:

Cyanokit (hydroxocobalamin) has a high affinity for cyanide ions and is converted to cyanocobalamin (vitamin B12). B12 is a water soluble vitamin that is then removed from the circulation and is readily excreted in the urine.

Indications:

- Cyanokit is indicated for the treatment of known or suspected cyanide poisoning. Cyanide poisoning may result from inhalation, ingestion, or dermal exposure to various cyanide containing compounds, including smoke from closed-space fires (smoke inhalation).
- Haz-mat and terrorist incidents involving cyanide

Contraindications:

- None

Adverse Reactions:

- Chromaturia (red urine)
- Erythema (skin redness), rash
- Increased blood pressure, headache
- Nausea/vomiting, diarrhea

Administration and Dosage:

    - IV infusion through a dedicated IV line.
- After reconstitution, each vial contains 25 mg/ml
- **Adult:**
    - 5gms (two 2.5 gm vials) over 15 minutes
- **Pediatric:**
    - 70 mg/kg (max 5 gms)

Duodote

Therapeutic Effects:
DuoDote is an auto-injector containing Atropine and Pralidoxime Chloride. Atropine's ability to block acetylcholine receptors reduce respiratory secretions, relieve airway constriction, and may reduce respiratory paralysis. Pralidoxime reactivates the enzyme acetylcholinesterase, which allows acetylcholine to be degraded, thus relieving the parasympathetic over-stimulation (cholinergic crisis) caused by excess acetylcholine. Pralidoxime potentiates the effect of Atropine, and their ability to reduce respiratory paralysis is significantly improved when the two medications are administered together.

Indications:
- Organophosphate poisoning
- Nerve agent exposure

Contraindications:
- Hypersensitivity (rare)

Precautions:
- None

Adverse Reactions:
- Cardiac dysrhythmias, especially tachycardias
- Hypertension
- Hyperventilation
- Muscle weakness
- Nausea

How Supplied:

- Pre-filled syringes and ampules of 2 ml and in vials of 10 ml, in a concentration of 5 mg / ml

Administration and Dosage:

ADULT / PEDIATRIC:
- Mild symptoms, including dyspnea, increased secretions, chest tightness, nausea, vomiting, and cardiac dysrhythmias: One auto-injector = Atropine 2.0 mg and Pralidoxime 600 mg IM. If patient condition stabilizes, no additional doses are necessary; if patient's symptoms progress to include severe symptoms below, administer two additional auto-injectors.
- Severe symptoms, including copious secretions, severe dyspnea, involuntary urination/defecation, convulsions, altered mental status or unconsciousness: Administer three auto-injectors; consider anticonvulsants

Methylene Blue

CLASS:

Antidote

ACTIONS:

This compound has an oxidation/reduction action and a tissue staining property. It has two opposite actions on hemoglobin:

> Low concentrations will reduce methemoglobin to hemoglobin.
> High concentrations oxidize iron in the ferrous state (Fe2+) to ferric iron (Fe3+) that results in the formation of methemoglobin. Only iron in the ferrous state can bind with oxygen. ***SRT will be using the low concentration***.

INDICATIONS:

Chemically induced methemoglobinemia

CONTRAINDICATIONS:

History of glucose-6-phosphate dehydrogenase (G6PD) deficiency

DRUG INTERACTIONS:

- Be cautious when using in the treatment of antidote induced methemoglobinemia in cyanide poisoning. Too much methylene blue may cause cyanide to be re-released into the system.
- Rapid administration may produce increased methemoglobinemia.
- Observe for elevated B/P, nausea, and disorientation.

DOSAGE:

- Adult: 1-2mg/kg over 5-10 minutes. Repeat hourly PRN.
- Pediatric: Same as adults

SUPPLIED:

100 mg in 10 ml vials (10 mg/ml)

ROUTES OF ADMINISTRATION:

IV only

Pralidoxime Chloride
(Protopam Chloride, 2 Pam)

CLASS:

Cholinesterase reactivator

MECHANISM OF ACTION:

Pralidoxime reactivates cholinesterase (mainly outside the CNS) inactivated by phosphorylation due to toxicity by an organophosphate or related compound. Destruction of accumulated acetylcholine can then proceed, allowing neuromuscular junctions to function normally. It also slows the "aging" of phosphorylated cholinesterase to a non-reactive form, and detoxifies certain organophosphates by direct chemical reaction. The drug's most critical effect is relieving respiratory muscle paralysis.

INDICATIONS:

Antidote in poisoning due to organophosphate pesticides and chemicals with anticholinesterase activity.

CONTRAINDICATIONS:

Known hypersensitivity

DRUG INTERACTIONS:

- When atropine and pralidoxime are used together, the signs of atropinization may occur earlier than expected.
- Barbiturates are potentiated.
- It is not recommended in the treatment of carbamate poisonings.

DOSAGE:

- Adults: Give 1 gram IV, over 5-10 minutes. Repeat dose after 1 hour if muscle weakness is not relieved.
- Pediatrics: Give 20-40 mg/kg to a maximum dose of 1 gram.
- Do not administer prophylactically

SUPPLIED:

20 ml vial containing 1 gram of pralidoxime (powder) to be mixed with a 20ml vial of sterile-water

ROUTES OF ADMINISTRATION:

IV, IO

Sodium Bicarbonate Breathing Treatment

CLASS:

Alkaloid electrolyte

ACTIONS:

Relieves symptoms of chest burning, throat irritation, and dyspnea due to chlorine gas inhalation

INDICATIONS:

Symptomatic Chlorine Gas inhalation

CONTRAINDICATIONS:

None

DRUG INTERACTIONS:

Do not mix with other drugs as it inactivates catecholamines.

DOSAGE:

Mix 3 ml of 8.4% Sodium Bicarbonate with 2 ml NS. Give by nebulizer at 6 lpm.

SUPPLIED:

50 mEq in a 50 ml prepackaged syringe

ROUTES OF ADMINISTRATION:

Inhalation

Sodium Nitrite

CLASS:

Antidote

ACTIONS:

Reacts with hemoglobin to form methemoglobin (oxidizes ferrous Fe ++ iron in normal hemoglobin to ferric FE +++ iron, or methemoglobin). The latter removes cyanide ions from various tissues and couples with them to become cyanmethemoglobin, which has relatively low toxicity. *Chemical Reaction: NaNo2 + Hemoglobin = Methemoglobin + Methemoglobin = Cyanmethemoglobin* * Sodium Nitrite may induce a dangerous methemoglobin level and may also cause hypotension.

INDICATIONS:

- Cyanide Poisoning
- Hydrogen Sulfide Poisoning

CONSTRAINDICATIONS:

- Absence of symptoms
- History of glucose-6-phosphodehydrogenase (G6PD) deficiency

DRUG INTERACTION:

Must be followed by Sodium Thiosulfate in cyanide poisoning to obtain maximum effect Methylene Blue may reverse excessive methemoglobinemia, but it should be used cautiously as it may release CN back into the system.

DOSAGE:

- Adult: 300 mg over 2.5-5 min., repeat at 1/2 of initial dose in 20 minutes if symptoms persist;
- Pediatric: 0.2 ml/kg, not to exceed 300 mg, repeat at 1/2 of initial dose in 20 min. if symptoms persist;

SUPPLIED:

300 mg in 10 ml vial.

ROUTES OF ADMINISTRATION:

IV, IO

Sodium Thiosulfate

CLASS:

Antidote

ACTIONS:

The function of Sodium Thiosulfate is to convert cyanmethemoglobin to thiocyanate, by the enzyme rhodanese. The thiocyanate is excreted by the kidneys. *Chemical reaction: Na2S2O3 + cyanmethemoglobin + O2 = HSCN*

INDICATIONS:

Cyanide poisoning

CONTRAINDICATIONS:

- Absence of indications
- History of glucose-6-phosphodehydrogenase (G6PD) deficiency

DRUG INTERACTIONS:

- Is to be given immediately after Sodium Nitrite in CN poisoning.
- Is not used in Hydrogen Sulfide poisoning.
- Methylene Blue may reverse excessive methemoglobinemia, but it should be used cautiously as it may release CN back into the system.

DOSAGE:

- Adult: Give 12.5 gm over 2.5-5 min., repeat at 1/2 initial dose in 20 minutes if symptoms persist.
- Pediatric: Give 1.65 ml/kg, not to exceed 12.5 gm, repeat at 1/2 initial dose in 20 min. if symptoms persist.

SUPPLIED:

12.5 gm in 50 ml vial

ROUTES OF ADMINISTRATION:

IV, IO

Solu-Cortef
(Hydrocortisone Sodium Succinate)

CLASS:

Steroidal anti-inflammatory

ACTIONS:

This medicine is an anti-inflammatory adrenocortical steroid. It is a highly water-soluble sodium succinate ester of hydrocortisone permitting IV administration. It is particularly useful where high blood levels are required rapidly.

INDICATIONS:

Chemically induced asthma

CONTRAINDICATIONS:

- Known hypersensitivity
- Not to be administered prematurely because the benzyl alcohol contained in the solution may be associated with fatal " gasping syndrome"
- Systemic fungal infections

CAUTION:

Average and large doses may cause elevation of B/P, sodium and water retention, and increased excretion of potassium.

DOSAGE:

- Adult- Give 100 to 500 mg over 30 seconds. The dose is determined by severity.
- Pediatric- The dose is determined by severity and not weight.

SUPPLIED:

250 mg two compartment single dose vial;
The vial contains a compartment with powder and another with 2 ml bacteriostatic water. Directions on mixing the product are found with the vial.

ROUTES OF ADMINISTRATION:

IV, IM