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Harold Koenig MD
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Dear Dr. Koenig,

Below please find the protocol Dr. Kenneth Swan and I have developed for *Treatment of Mass Casualties Resulting from a Manhattan Nuclear Explosion: Scenario based on 10,000 casualties transported to New Jersey*. I would be interested to hear both your and SMCAF's comments on the protocol. Please feel free to contact me with any thoughts on you may have.

A hard copy is to follow.

Sincerely,

Norman Ende MD
Capt. Mc USNR (ret.)

Treatment of Mass Casualties Resulting from a Manhattan Nuclear Explosion: Scenario based on 10,000 casualties transported to New Jersey

Logistics, communication, housing and transportation of casualties will not be covered in this report, only matters directly related to triage and treatment of radiation and trauma casualties.

The report will cover:

1. Continuously functioning trauma and burn triage for the 1st 72 hours based on Hospital A. (B & C are extrapolation of Hospital A). All hospitals capable of handling trauma.
 2. Therapy for mass radiation casualties for the immediate response (72 hrs) period.
 3. Blood supply to support emergency surgery for first 72 hours.
- 3 Hospitals (A,B,C) available to triage patients and handle trauma, operating at full capacity for 72 hours.
- A- 12 operating units
 - B- 18 operating units
 - C- 18 operating units

Assumptions Concerning Triage Assessments of 10,000 casualties

1. 72 hours period of surgical resuscitation
2. three hours of OR time per patient
3. 48 operating rooms (OR) x 72 hrs= 3456/3hrs per patient =1152 patient capability. All OR personnel, including surgeons, anesthesiologists, nurses, technicians, will be “on” 12 hours, “off” 12 hours
4. Two surgeons (primary and secondary, or 1st assistant surgeons) needed per OR-96 primary surgeons, 96 first assistant surgeons.
5. Each OR case requires two units of blood replacement

If the disaster is the result of conventional explosion or dirty bomb, casualties will be primarily traumas and secondarily radiation; estimating 25% in need of emergency surgical care. Radiation casualties will be far less than in a nuclear explosion and conventional treatment (as in 100 or less casualties) may be used.

For every 10,000 casualties, 65% are “walking wounded”, 10% are “expectant” and 25% are “priority”. All the latter, “those who probably will survive, with a meaningful survival if resources (time, personal, and equipment) are used most efficiently...” require operative intervention (surgery OR time)

Therefore:

- a. 25% of 10,000= 2,500 patients need OR time
- b. 3 hours per patient = 7,500 hours of surgery required
- c. 48 OR x 72 hours = 3,456 hours available/3 = 1152 patients
- d. Therefore, if the number of OR cases increases the number of surgeons and other OR personnel must increase by 3
- e. 3,104 casualties will need to be relocated to other facilities

If the disaster is the result of a nuclear explosion, radiation injury will be disproportionately greater than trauma/burn injury; estimating 10% need emergency surgical care.

For every 10,000 casualties, 90% will be “walking wounded” and 10% will require immediate surgical care. This protocol is based on 10% immediate care/90% radiation or suspected radiation casualties.

Therefore:

- a. 10% of 10,000 = 1,000 patients need OR time
- b. 3 hours per patient = 3,000 hours of surgery required
- c. 48 Operating Rooms between 3 hospitals x 72 hours= 3456 hours / 3 = 1152 patients
- d. 1152 OR cases x 2 units of blood = 2304

Radiation casualties of fewer than 100

Based on existing information on stem cell therapy (ref AABB *Protocol for the emergency Management of Radiation Victims* March 2006), in radiation casualties fewer than 100, each patient should receive 1-2 units of cord blood (1-2 billion mononuclear cells, blood type specific, and partially or completely HLA matched). These patients will receive antibiotics, various cytokines and colony growth factors as utilized in marrow injury (current, standard of care treatment). Whole blood or packed cell transfusions for

trauma patients will be irradiated according to current AABB concepts (ref. *AABB Protocol for the emergency Management of Radiation Victims*).

Disproportionately more Radiation Victims

In a scenario where a ground level explosion occurs in Manhattan, radiation victims will be disproportionately more frequent than trauma or burn victims. Tall buildings vent burns and blast injury upward; radiation should affect many without their knowledge. 1st responders will likely need treatment for radiation exposure (ref. Homeland Security Council and Department of Homeland Security's National Planning Scenario: Radiological Attack, Scenario 11, April 2005). There should be a high number of "walking wounded", unaware of having received irradiation, while those with traumatic injuries will be presumed to have received varying degrees of irradiation.

Blood for the operating rooms

Type specific, whole blood units are recommended for transfusion in mass disaster emergency condition. Based on 3 hospitals (48 operating units) operating continuously, it is estimated that 2,500 units (2,304) of blood will be needed for the first 72 hour period.

On a given day in New Jersey, approximately 1,000 units of adult blood are available. Therefore, additional blood will be needed and possible varying amounts of processing beyond blood typing performed. For example, irradiation of blood can be logistically difficult and should be utilized only in emergency with 100 or fewer casualties.

1,000 - 10,000 casualties

All 1st responders, as well as trauma or burn victims, should be considered to have received a significant level of irradiation and treated with 1-3 cord blood units, depending on availability. Those not treated for trauma or burn but suspected of significant radiation exposure will be treated (paramedical, volunteers etc) by 1-3 cord blood units (frozen) matched by blood-group, depending on availability. If there is adequate number of cord blood units and there is adequate support, one to two units (2 billion cells) will be blood type and HLA matched (Shoemans 2006). It is highly unlikely that this level of support could be carried out in the foreseeable future. **Therefore**, it is recommended that 1-3 units of cord blood, matched for blood group only, be administered by paramedics to all patients suspected of exposure to lethal levels of irradiation. All patients, **with or without trauma**, suspected of radiation injury will receive a broad spectrum antibiotic and a non absorbable enteric antibiotic (administered by paramedics). Patients previously treated with cord blood but suspected of radiation injury should return in 72 hours for evaluation when medical emergency support becomes available (FEMA) and treated in a conventional manner.

Source of Cord blood

Based on available information from the existing cord blood banks, 9,000 to 11,000 frozen, undesignated units are available for emergency use in New Jersey. This does not include the National Cord Blood bank, planned for 150,000 units.

Review of current and past literature

When 2 units of partially matched cord blood are given to marrow ablated patients at least 24% will develop a chimera of both donors, one will dominate (Shoemans 2006, Barker 2005, DeLema 2002). There is limited information on immunosuppressed patients receiving greater than 2 units of cord blood. From 1964 to 1974, we gave 139 units of various volumes to 15 patients dying from malignancies (Ende M. 1972, Ende M. 1995). Although the patients were receiving the conventional therapy of that time, which could be considered suppressive, no adverse events were noted in these patients. Reviews suggest as least 4 transplants occurred and several showed a significant rise in hemoglobin. On review of medical records, only one case of cold antibodies was noted.

Shen reported four patients that received 15 units of cord blood transfusion with no evidence of GVHD (Shen 1993).

In cases where multiple units are utilized, one donor or more may persist. From the various published cases, 21 patients have received multiple units (greater than 2) of cord blood. There is one noted incident of severe graft versus host disease; little detail is given on this case (Weinreb 1998). In a recent review (Shoemans 2006), two partially HLA matched cord blood units given after marrow suppression or ablation, indicated greater implantation and less graft versus host disease than in bone marrow transplants (Shoemans 2006, Barker 2003).

In animal studies using human cord blood mononuclear cells, not previously frozen, we noted administration of cells from multiple units produced superior clinical results. In addition, we saw evidence that radiation survival was directly related to cord blood mononuclear cell dose (Ende N. 2001). We have been able to obtain high rates of survival in the lethally irradiated mice (Ende N. 1996), in some instances survival was 100%. The mice appear to have two types of responses to the cord blood transfusions following irradiation— a chimera with evidence lasting up to 12 months (Ende N. 1995), and stimulation of the host's own immune system to recover (Rameshwar 1999, Czarneski 1999). In these multiple studies (Ende N. 1995, Ende N. 2000, Ende N. 2001, Ende N. 1999), no evidence of graft versus host disease was noted in animals with or without immunosuppressant.

Back up

All hospitals (Ende M. 2004) with facilities to collect cord blood should immediately start collection of umbilical cord blood, with the intention of fresh transfer to appropriate treatment centers, processing only for blood type (and additional tests deemed necessary).

72 hours

At the end of 72 hours of national support (FEMA), the medical facilities will begin to revert treatment of casualties to “standard of care” appropriate for the available support.

Critical Issues

Good Samaritan law in NJ exempts paramedics from malpractice law suits in the time of an emergency; however, participating clinicians may **not be exempt** from malpractice suits. This must be corrected on a national basis.

During the emergency:

- Available paramedic volunteers must be identified in large numbers to administer aid to the “walking wounded” (radiation victims without significant visible trauma).
- Primary and assistant surgeons must be organized, identified and available for call.

Summary

Currently there are 9-11,000 undesignated, frozen cord blood units in the state of New Jersey. The three hospitals could conduct emergency life support surgery on 1000 (1152) patients and triage several thousand “walking wounded” with the adoption of a plan and organization of paramedical support. At this point, the establishment of a logistical plan could potentially save thousands. Currently, no money is needed, simply a plan for basic communication, logistics and use of existing facilities.

(Barker et al., 2005; Barker et al., 2003; Czarneski et al., 1999; Ende, 1995; Ende and Ende, 1972; Ende, 2000; Ende et al., 2001; Ende et al., 1999; Ende et al., 1995; Rameshwar et al., 1999; Schoemans et al., 2006; Shen, 1993; Weinreb et al., 1998)

(Ende, 2004)

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