

# EVOLUTION OF AN ACUTE RADIATION SYNDROME IN A CRITICALITY ACCIDENT

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## INTRODUCTION

On September 23 rd., 1983, during the assembling of the Ra-2 critical facility, located at the Constituyentes Atomic Center, Buenos Aires, Argentina, an uncontrolled increase of power occurred, causing the operator's death. The RA-2 is a critical facility with a nominal power of 0.1 W. It has been under operation since 1966 for experimental purposes and for training courses. It works with high enriched uranium plate fuel and with light water as a moderator and as a reflector. The reactor pool is cylindrical with a diameter of 2 m and a height of 1.5 m. To be assembled, the reactor core can be reached through an open upper surface. The reactor shielding consists of rectangular blocks placed in such a way that the radiation field to the surrounding laboratories is limited.

The accident occurred when the operator was trying to change the core configuration, resting on the edge of the reactor pool (1). According to the operation procedure, it was necessary to fully evacuate the moderator, but this was, in fact, only partially done. During the core configuration change, a transient reactivity occurred. Under these circumstances, the operator, who was the only person present in the facility, resulted highly overexposed. Some other people located in the control room and in contiguous laboratories were exposed at a much lower level.

## PRIMARY MEDICAL INTERVENTION

All the people were exposed to a field of gamma and neutrons beams liberated in a very short time. Initially, measurements to detect personal external and internal radioactive contamination, as well as measurements of body induced activity of Na-24 and hair induced activity of P-32 and activation of personal elements were done. In the meantime, the dosimetric system, consisting of personal dosimeters and dosimeters for criticality accidents located in the area, was processed.

The medical evaluation was clinical, haematological and cytogenetic, by chromosome aberration analysis. Thirty minutes after the overexposition, the operator had nausea, vomiting and diarrhea. When examined, prostration and facial and right hand erythema were observed. Two hours later, lymphocytes count had dropped to 46 % of normal values. All these events made it possible to diagnose Acute Radiation Syndrome in severe evolution. The initial clinical and dosimetric results on the other persons involved made it possible to estimate whole body doses below 1 Gy, values that were confirmed later (2). None of

them showed located injuries.

#### PLANIFICATION OF THE MEDICAL ASSISTANCE

According to the expected risks, the following decisions were taken to treat the overexposed persons:

- 1- Hospitalization of the operator in Prodromal Stage of Acute Radiation Syndrome, with skin injuries and
- 2- Ambulatory control of the remaining personnel without clinical, haematological and ,local manifestations.

#### CLINICAL EVOLUTION OF THE HOSPITALIZED PATIENT

The chronometry of the events that were observed during 48 hours and 25 minutes to the lethal evolution is as follow:

During the next two hours following the overexposure, it was observed after 15 minutes, gastrointestinal and neuromuscular symptoms of the Prodromal Stage, different from the manifestations of the psychologic reactive phase of the Adaptation General Syndrome, that in its primary phase mimethasies it (3). It started at 15 minutes with painful vomiting that did not respond to medication. During this period of time skin-mucous located non-stochastic effects like conjuncional hyperaemia and erythema on the right hand were detected. The pharynx's pain could be related with the oedema observed some hours later.

Between hours 2 and 26, the evolution was apparently calm without clinical manifestations. However, during this period the haematopoyetic harm increased; lymphocytes were less than 100 per microliter and neutrophils were more than 12000 per microliter, the latter indicating reactive alarm against the accidental stress. The important decrease in lymphocytes, as well as the possible harm to the cell membranes of the surviving ones, prevented the estimation of dose by chromosome analysis. During this period the skin-mucous injuries on the pharynx, forearm, and right hand increased. Besides, erythema on the right side of the chest appeared.

After 26 hours, the patient was in oliguria and arterial hypotension, without changes in ECG; 25000 neutrophils per microliter were counted, LDH, SGOT and SGPT were elevated.

After 29 hours, the patient had a sanguinolent vomiting. The platelet count was not too low (100000/microliter).

Between 32 and 38 hours, the patient became anxious and excited. He had 44 breaths/minute and his respiratory difficulty increased. Laboratory tests indicated metabolic acidosis. The chest film showed diffuse haziness on the right lung. Physical dosimetry estimated a dose by neutrons on the right lung of 20 Gy and on the left one of 6 Gy (4).

After 48 hours, the patient did not respond to painful stimulus and did not display pupillary light reactions. Convulsions started, this was the onset of coma, quick evidence of the Crisis Stage of the Neurological Form of the Acute Radiation Syndrome.

The ECG presented a broadening of the QRS complex, specially at the expense of the repolarization component, possibly associated with the destruction of the active transport mechanisms in the

myocardium fibers.

Three cardiopulmonary arrests followed, one after the other, during the last one he died. The necropsy at brain level showed vascular injuries, intravascular coagulation, demyelination and nervous cell destruction.

The distribution of the damage caused upon the tissues and its clinical manifestations is consistent with the estimated doses in the reconstruction done by physical dosimetry, characterized by a craniocaudal decreasing of dose with prevalence upon the right side of the body.

Death occurred after 48 hours and 25 minutes of evolution of the Acute Radiation Syndrome, with superposition of clinical manifestations of the Cardiovascular and Neurological Forms including radiopneumonitis in the right lung.

The reconstruction of physical dosimetry estimated a whole body dose of 43 Gy, 21 Gy by gamma and 22 Gy by neutrons (4).

#### REFERENCES

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