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SPECIAL ARTICLE

Fifty years since the nuclear accident in Palomares (Almería). Medical repercussions[☆]



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Abstract In January 1966, 2 US military aircraft collided over the skies of Palomares (Almería). One of them carried thermonuclear bombs, which released plutonium and other radioactive materials upon striking the ground.

The most contaminated earth and plants were immediately removed. The Indalo Project was launched to study the effects of nuclear material on the inhabitants and environment of Palomares. A total of 1077 inhabitants have been monitored since then, and the official version is that the ionizing radiation has not been related to any type of disease. However, secrecy has surrounded much of the investigations, and no trustworthy epidemiological study has been conducted in the area.

Approximately 500 g of plutonium and americium remains in Palomares. Although the risk for the population appears to be low, this radioactive material should be removed as soon as possible.

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PALABRAS CLAVE

Plutonio;
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Cincuenta años del accidente nuclear de Palomares (Almería). Repercusiones médicas

Resumen En enero de 1966, 2 aviones de guerra norteamericanos colisionaron sobre el cielo de Palomares (Almería). Uno de ellos transportaba bombas termonucleares que, al impactar con el suelo, liberaron plutonio y otros materiales radiactivos.

Inmediatamente se retiraron las tierras y vegetales más contaminados, y se puso en marcha el Proyecto Indalo destinado a estudiar los efectos del material nuclear sobre los habitantes y el entorno de Palomares. Un total de 1.077 habitantes han sido controlados desde entonces, y la versión oficial es que las radiaciones ionizantes no se han relacionado con ningún tipo de enfermedad. Sin embargo, el secretismo ha rodeado gran parte de las investigaciones, y no se ha realizado ningún estudio epidemiológico solvente en la zona.

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Actualmente quedan en Palomares unos 500 g de plutonio y americio. A pesar de que el riesgo para la población parece ser bajo, este material radiactivo debería retirarse lo antes posible. © 2017 Elsevier España, S.L.U. y Sociedad Española de Medicina Interna (SEMI). Todos los derechos reservados.

On January 17, 1966, 2 US military aircraft collided while performing refueling maneuvers over the skies of Palomares, Almeria, Spain. The aircraft involved were a B-52 bomber and a KC-135 aerial refueler. The bomber carried 4 thermonuclear bombs, each of them with a power 75 times greater than that of the atomic bomb of Hiroshima.^{1,2} A large deployment was immediately organized by the U.S. authorities, which was called "Operation Broken Arrow" designed to locate the 4 bombs.³ Palomares is a district of Cuevas del Almanzora, in the province of Almeria, which at the time had 1200 inhabitants.⁴

Bomb 1 was intact, but 2 other bombs (2 and 3) spread approximately 9 kg of plutonium-239 and other radioactive elements upon striking the ground.^{1,5} Bomb 4 fell into the sea and took 81 days to be recovered but did not release its radioactive content.^{1,6,7} There is a famous photograph of Manuel Fraga Iribarne, the then Minister of Information and Tourism, bathing on the beach of Palomares to try to demonstrate that there was no risk of radioactive contamination.⁸

The nuclear contamination

Nuclear bombs can be essentially 2 types: (1) atomic (the Hiroshima bomb), based on the fission of the radioactive nucleus into fragments, a process that releases energy; and (2) thermonuclear, H or hydrogen bombs (Nagasaki bomb), based on fission–fusion–fission. The fusion is followed by fission phenomena of the radioactive nucleus, and the energy release is far greater.^{5,9}

There are basically 3 types of radioactive particles: alpha (which does not pass through human skin), beta (which passes through skin but not an aluminum plate) and gamma (which passes through aluminum but not a layer of concrete).¹⁰ The bombs that fell on Palomares were mostly composed of plutonium.¹ Plutonium is an artificial radioactive substance, which does not exist in nature (it is obtained from uranium-238) and emits alpha radiation.¹¹

From the start, both the U.S. and Spanish authorities attempted to make the accident at Palomares go unnoticed. The American government considered their nuclear program top secret, and the Spanish government did not want the incipient tourism of the Spanish coast to be affected.^{5,12}

The first decision facing the scientists who visited the accident scene was whether to evacuate the population. Ultimately, the decision was made not to evacuate so as not to create alarm.¹³ The scientists immediately began to measure the alpha contamination of the area. They prepared an initial dosimetric map of the contaminated areas and fenced in the surrounding areas where bombs 2 and 3 fell.¹³ The strong prevailing wind in Palomares in the days following the

accident dispersed the plutonium contamination to uninhabited areas. Luckily, most of the urban center of Palomares lay outside the areas of greatest contamination.^{14,15}

The next issue for the scientists was to determine what contamination levels were acceptable. This was no easy task because plutonium had been discovered only 26 years before the accident,¹⁶ and cases of poisoning in humans were very scarce.^{17,18} Ultimately, the decision was made to remove the soil that showed radioactivity levels above 60,000 counts or disintegrations per minute (cpm) and the crops with concentrations above 400 cpm.^{1,12} The contaminated soil and crops were placed in 4810 drums and transferred to the nuclear cemetery in Savannah River in South Carolina, US, where they are currently buried.¹

Medical implications. The Indalo Project

Plutonium is a heavy element, which is deposited in the ground.⁴ The element can enter the body through inhalation or gastrointestinally.¹⁹ Once in the body, plutonium has carcinogenic effects on the lungs, bones and liver.²⁰ Eliminating plutonium is very difficult; only 12.7% is eliminated 10 years after entering the body.^{17,18}

Project Indalo was created immediately after the Palomares accident with two objectives: the monitoring of individuals affected by the accident and the environmental monitoring of the air, soils, vegetation and animals.^{5,21} In this article, we only discuss the monitoring of the individuals affected by the accident.

Those responsible for Project Indalo were, on the Spanish side, the pharmacist Emilio Iranzo from the Nuclear Energy Board (*Junta de Energía Nuclear*, JEN) and, on the US side, Dr. Wright H. Langham, Head of the Los Alamos Biomedical Research Laboratory, New Mexico. Dr. Langham was known as "Mr. Plutonium" because he was the highest authority worldwide on the effects of this radioactive substance on living beings.^{17,18} His knowledge came from studies performed on humans who were injected with plutonium without their consent.^{5,22}

A total of 1950 inhabitants of Palomares and its surroundings were analyzed, and 80 individuals with the highest levels of alpha radiation were selected.¹³ These individuals were transferred to Madrid, where 24-h urine tests were performed to indirectly measure the quantity of plutonium stored in the body.¹⁸ Forty-five of these individuals (56%) had positive results but at a level so low that it did not represent a threat to their health, according to the official version.¹³ One year later, the analysis was repeated, and the level of positives had increased to 71%, which indicated that there was further poisoning through inhaling part of the plutonium

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