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Case Report Open Access

The Chernobyl and It's Long Term Consequence: Clinical Cases of Leukemia

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Abstract

The Chernobyl accident that occurred 30 years ago was one of the worst nuclear disasters ever. Although it's effects have been the subject of several articles, the role of its repercussions in the etiology of hematological disorders is not clearly revealed. Studies have shown a causal relationship between radiation exposure and the incidence of thyroid cancers but in the case of acute lymphoblastic leukemia a correlation could not have been made. However, due to its increasing incidence, there seems to be differences between adult and in utero exposure. Through its geographical position, Romania was affected especially in the North East region. We present the case of acute lymphoblastic leukemia of a patient from Iasi with exposure during pregnancy, post-partum period and the effects on her and the fetus.

Keywords: Chernobyl; Acute lymphoblastic leukemia; Adult exposure; In utero exposure

Introduction

The accident occurred on April 26th 1986 at the power plant in Chernobyl (Ukraine). It was the largest nuclear accident of the 20th century. The resulting steam explosion and fires released radioactive emissions made of a wide spectrum of aerosols, fuel and mineral particles, organic compounds and various entrapped radioactive cores [1].

It led to major consequences in the immediate post-accident period, mostly in medical, radiological, ecological and socio-economic fields [2]. The Chernobyl accident was a unique event given its location at about 20 km south of the border with Belarus and 130 km north from Kiew (therefore close to the Ukrainian border with Russia), but also the meteorological characteristics of the region (winds, cloudiness, temperature and precipitations) that led to the ground contamination of the North-East Europe.

Besides Ukraine, Belarus and Russia that were the most affected, the radionuclear contamination spread to Romania, Germany, Austria and even to the Northern countries (Norway, Finland and Sweden) [1].

In our country, a Romanian Environmental Protection Agency (A.N.P.M.) measured radioactivity of atmospheric aerosols, deposition, surface water, soil and vegetation spontaneous, reveal areas of low contamination (west of Timisoara, Arad, Oradea, Satu Mare) and areas with higher values of radioactive contamination (Parâng Fundata Babele, Ceahlău, Tg. Mureș, Gheorghieni, Iași Tulcea, Buzău, St. George, southern Subcarpathians, Bucharest, Pitești, Tg. Jiu, and Turnu Severin).

A variety of radioisotopes including Iodine (^{131}I), Cesium (^{137}Cs, ^{134}Cs), and Strontium (^{90}Sr) were released from the damaged reactor vessel at different times after the destruction, contaminating soil, vegetation and ground water [3]. Most of those radioisotopes have decayed by now, but the attention should still be centered on ^{137}Cs and ^{90}Sr, especially in the proximity of the former power plant [1].

Effects of ^{131}I (T1/2=8 days) radioactivity on the human body were first observed and studied in the Chernobyl Forum report of 2005, led by International Atomic Energy Agency (A.I.E.A.) and World Health Organization (WHO), attributed 56 direct deaths (47 workers and nine children with thyroid cancer) and estimated that of the approximately 9,000 people highly exposed 6.6 million could die from a cancer.

^{137}Cs (T1/2=30 years) can be set to level radioactive mioartrotendinos, where its emitting radiation can generate various forms of tumor.

^{90}Sr (T1/2=28.90 years) can be engaged by the similarity radioactive electromagnetic element similar to that in bone metabolism.

There were several deaths reported in the following months after the explosion among firemen and employees, primarily caused by myelosupression. There is no indication of a direct effect of Chernobyl accident on the risk of leukemia among children and adults exposed in the contaminated area, but the available data have relied on registries. It is considered that if there was the same impact as in other types of malignancy (such as thyroid cancer in children) it would have been demonstrated already.

However, leukemia has the highest radiation-related risk especially for exposed children, this increased risk being observed in various studies. Leukemia is also cited to be the first malignancy linked to radiation after atomic bomb explosions. Those aspects are seen in the first 2-5 years after exposure [4].

As for in-utero exposure, the hypothesis that low dose fetal irradiation affect further hematopoietic processes is based mainly on biologic assumptions about external radiation in general and not on the results of studies about the nuclear accident in Chernobyl [5]. The suggestion that leukemia risks are higher in persons exposed in-utero remains anyway.

Case Report

DS, female, 36 years old

Born on July 17, 1965, 5 pregnancies, all natural births. In September 1986 she became pregnant, a boy was born on June 24, 1987, healthy. Her initial diagnosis was Pulmonary Tuberculosis for which she received specific treatment. In August 2001, at Fundeni Hospital she presents generalized lymphadenopathy (later cervical, axillary, and inguinal) with diameters of about 2-5 cm; hypertrophic tonsils; lingual mycosis; hemorrhoids. She was diagnosed with acute lymphoblastic leukemia L2 morphological type, imunotype T/NK +CD19. She followed conventional chemotherapy, protocol ALL 16 VCR+FRB+L-aspartate+PRALx6 weeks. In August 13 2001, she was rehospitalised at Fundeni Hospital for prophylaxis and treatment of leukemic meningitis. On October 10 2001, she was rehospitalised at Fundeni Hospital, proposed for bone marrow transplantation. In November 7 2001, she had hematopoietic stem cell transplant evaluation. During February-April 2002, a hematopoietic cell transplant was received at the Hematology Clinic in Idar Oberstein, Germany. She performed allogeneic pluripotent stem cells transplant from a sibling, compatibility of almost 100%. Post-transplant complications occurred: chronic graft versus host disease, hypogammaglobulinemia and osteoporosis. Follow polyvalent immunoglobulin specific permanent treatment, pamidronate disodium (APD), pamidronate disodium (Aredia), cyclosporine and prednisolone. She came monthly to Idar Oberstein Hospital in Germany for specialized treatment and specific laboratory tests. Her health improved until May 2005 when it was discovered a relapse, she passed away a few weeks later (May 25, 2005).

SPD, male, 19 years old

He was born on June 24, 1987. On January 13, 2007 he was hospitalised on emergency at Municipal Emergency Hospital in Timişoara accusing dyspnea and asthenia marked. Lymph laterocervical appeared a month ago, which increased in volume and tend to organize in packages node, size 3-4 cm, hard, adherents, spontaneous and painless on palpation. On January 19, 2007 he was diagnosed at Hematology Clinic in Timisoara with acute lymphoblastic leukemia - Price with aberrant expression of B lymphocyte markers; Oral mucositis grade IV; iatrogenic marrow aplasia with severe peripheral pancytopenia. Follow initial cytoreductive chemotherapy of cyclophosphamide and prednisone 5 days without result. Subsequently established Hydroxyurea five days, getting cytoreduction and began phase I of induction chemotherapy according to protocol G-Mall, lasting 20 days during which marrow aplasia occured with peripheral pancytopenia, severe agranulocytosis, fever 39 degrees Celsius, oropharyngeal mucositis grade IV. On day 26 of treatment the control was showing complete remission. Phase II began with a protocol treatment with the mention of a future bone marrow transplant strategies. On April 05, 2007 he was rated by the committee of Hematology for hematopoietic stem cell transplantation indication. There were no donors in the family. Also, an echocardiogram was performed which revealed: mitral stenosis, mitral regurgitation, tricuspid regurgitation grade I and recommended finding a donor and hematopoietic stem cell transplant abroad. On April 18, 2007 he was rehospitalised for consolidation therapy, hospitalization shows deep painful abdomen on palpation in the right hypochondrium. In June 14, 2007 he died in acute cardiorespiratory failure. Status of morbidity which resulted in iatrogenic marrow aplasia death was complicated by basal right acute pneumonia. The onset of acute lymphoblastic leukemia after a long period of Chernobyl wonder about the diagnosis and treatment of these disorders and the onset and exacerbation of evolution similar to the child and mother therapy, including bone marrow transplant customizes each case.

Discussion

After exposure to radiation from atomic bomb explosion, leukemia is the most frequent malignancy, especially for exposed children [6,7]. A number of studies have examined the link between this type of cancer and the radiation emission from Chernobyl. The European Childhood Leukemia-Lymphoma Study (ECLIS) was based on the existing data from cancer registries in Europe, Belarus and Russia and also on the national incidences reported in those countries [8-14].

From the data, ECLIS found no evidence of an increase in the incidence of leukemia in the first 5 years after radiation exposure.

Unfortunately, national studies do not provide evidences in this direction and they are not sufficiently sensitive to detect these changes because of the low incidence of the disease.

Studies conducted in the most contaminated regions found an association between radiation exposure and leukemia risk in Ukraine, Belarus, but not in Russia, and they are not statistically significant [15-17]. A study conducted in Greece reported an increase in infant leukemia among infants who were in utero at the time of Chernobyl accident but those findings were based on a small cohort of 12 patients exposed and 31 unexposed [18]. Other studies conducted in this direction were inconsistent [14].

There were numerous subjects exposed in utero and in early childhood especially in the areas closest to the nuclear accident site, therefore a careful study must be conducted in order to provide important information for radiation protection.

Considering that 30 years have passed since the nuclear accident in Chernobyl, there are no recent studies on the risk of leukemia after adult exposure and the results available from the existing studies are inconclusive [14,19]. Two case-control studies conducted within liquidators of the power plant, one from Belarus, Russia and Baltic countries and the other from Ukraine, used a new approach for individual dose reconstruction [20-22]. They used a questionnaire on the place, time and work condition in the area and the information collected was reviewed and interpreted by expert familiar with the accident using interpolation techniques that can be used to calculate exposure rates. Both these studies found similar results for all leukemia (4.8Gy in the first group and 3.44Gy in the second group). Although these findings are not statistically significant, they are worth studying further.

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