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Abstract

The cause of the death due to the atomic-bomb radiation is yet unknown definitely and the same can be said of shock brought about by the atomic-bomb. It cannot be said with certainty that infection of pathogenic bacteria concerns in the mortality, for even minor injuries did not often escape bacterial invasion from any part of the whole body. In this case the progress was same to a symptom of agranulocytosis, namely collapse, chill, fever, red throat or ulcerative stomatitis and from the reason of the heavily infected tonsils, although cultures were not made, there are reasons to consider it as agranulocytosis angina. The interpretation of the histologic changes observed in this patient, is rendered difficult not only by the factor of infection, but by the possible influence of one damaged organ upon another. From the histological changes there were the destruction of the epithelium of the gastro-intestinal organs, the atrophy of the testis and the necrosis of the tonsils, but the most noteworthy was the changes in the bone-marrow. The hyperplasia of the reticulum cells, the disappearance of the hematopoetic foci, and the great quantity of mitotic figures in the myeloid cells observed in this case are found in many of the atomic-bomb victims died approximately one month after the exposure. This is a case of the death caused by aplastic anemia with infective complication or in other words symptomatic agranulocytosis caused by the atomic-bomb radiation with sepsis.

Pathological Studies on an Atomic-Bomb Radiation Case

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The patient was a 17-year-old student, who was at that time in Hiroshima for a college entrance examination. He was inside a building located approximately 1,000 meters from the hypocenter and lost consciousness, but a slight excoriation of the scalp was the only external injury. A few days later he suffered from anorexia but gradually recovered. However, on August 25 depilation was noted and later on August 30 he began to suffer with a fever, accompanied by petechia, sore throat, diarrhea, nausea and vomiting.

He was admitted to the Okayama University Hospital on September 2, when there were petechiae over the entire body but particularly predominant on the face. The pharynx was swollen, necrotic, ulcerated and coated. At the time, there was a marked decrease in the red blood count, but the hemoglobin was recorded at 65%. Leukopenia (1150 per cu mm) in the form of agranulocytosis was marked and the blood sedimentation rate increased to 123 mm per hour or 160 mm per two hours. Sub-cutaneous injection of *Lock's* solution (600 cc), blood transfusion (50 cc), and intravenous injection of 5% neo-disseptal (20 cc) were made daily.

Laboratory Examination

The urine examination made on September 4 was positive for albumin, urobilin and urochromogen. Bleeding time was 32 minutes. The hematological examination revealed that the white blood cell count was 675, the red cell count of 3,760,000, and hemoglobin was 70%. The analysis of leucocytes showed neutrophile as 34%, lymphocyte as 58%, and monocyte as 8%.

Progress in the Hospital

The temperature fluctuated between 39 and 40 degree Centi-

grade and the pulse between 130 and 160. He was given 600 cc of *Lock's* solution, vitamin C, cardiac tonics and blood transfusion of 20 cc to 50 cc on four occasions. At approximately 6 a.m. on September 7 dyspnea appeared and radial pulse became unpalpable. He died at 7.15 a.m. in collapse.

Finding at Autopsy

Gross Notes

There were petechiae of the skin, pleura, mucous membrane of the stomach and intestine, and the pelvis of the kidney. The scalp was depilated. Dark brown papule, thought to be an anthrax, was found on the zygomatic region. Subcutaneous fat tissues were generally poor in development. Muscles of the skeleton were red and dry. The peritoneal cavity was also dry. Abnormal fluid was not seen in the pleural cavity, but about 10 cc of fluid yellowish in color was found in the cardiac cavity.

Foramen ovale was still open about the size of a pencil core. There were necrosis of the tonsils with hyperemia and bleeding in the vicinity. A marked emphysema was found in the lungs. Hemorrhagic erosions were apparent throughout the gastro-intestinal tract especially in the lymph apparatus of the intestine. Solitary follicles of the mucous membrane were noticeably swollen in the vicinity of the cecum. The lymph nodes of the mesenterium were slightly atrophic, soft and congested. The gelatinous appearance of the bone marrow was impressional. The spleen weighed 100 gm. The cut surface was swollen and dark red in appearance. Follicles of the spleen appeared atrophic. Periacinous fatty changes were noted in the liver. Cloudy swellings were found in both kidneys. Petechial bleeding was found in the mucous membrane of the pelvis of the kidneys.

Histological Notes

Heart: The nuclei of the heart muscle cells were generally not sufficiently stained and were varied in size and in amount of chromatin. The small vessels of the interstitium were fairly filled with blood cells.

Gastro-intestinal Tract: The epithelium of the mucous membrane of the stomach was desquamated. The central veins of the small intestinal villi were filled with blood. Mitosis was seen in

the epithelial cell of the appendix, while the lymph apparatus of the appendix were atrophic. Chromosomen-pyknotis and chromosomen-rhexis were seen in the epithelium of the large intestine. The intima of the vessel was separated from the muscle layer in the bleeding foci.

Liver: Pronounced cloudy swelling was seen in the hepatic cells of the periacinous area. Although the nuclei of the hepatic cells became smaller, their chromatin amount diminished and a typical pyknotis was not found. Extensive bleeding was seen in the walls of hepatic veins and some of the intrahepatic veins were involved in phlebitis.

Pancreas: No significant changes were observed.

Spleen: The lymphoid tissue was atrophic and edematous in the central part of the follicles. Hyaline degeneration was seen in the endothelium of the central artery. Amitosis was found in the reticulum cells, which were involved in pyknotis by a strong degeneration.

Kidneys: Cloudy swelling was observed in the epithelium of the convoluted tubuli and their nuclei decreased the chromatin amount in varied degree. The cavity of the *Bowman's* capsule was dilated. Hemorrhagic spots were scattered in the pelvis of the kidneys.

Thymus: Lymphoid cells of the cortex were almost completely gone.

Thyroid Glands: Hypertrophic follicles with a great amount of colloidal substance were observed.

Bladder: No outstanding finding was noted.

Adrenals: The cells of the cortical substance had only vacuolated cytoplasm and a small medullary hemorrhage was found. Localized fatty changes and necrosis were seen in the cortex.

Testis: There was marked diminution of the spermatogonia and standstill of the spermatogenesis.

Tonsils: The surface was necrotic and covered with fibrin and fibrinous substance.

Bone Marrow: The remarkable finding here was the disappearance of hematopoietic foci and the great quantity of mitotic and amitotic figures in the myeloid cells. Moderate hyperplasia of the reticulum cells and plasmacells was observed.

Comment

The cause of the death due to the atomic-bomb radiation is yet unknown definitely and the same can be said of shock brought about by the atomic-bomb. It cannot be said with certainty that infection of pathogenic bacteria concerns in the mortality, for even minor injuries did not often escape bacterial invasion from any part of the whole body. In this case the progress was same to a symptom of agranulocytosis, namely collapse, chill, fever, red throat or ulcerative stomatitis and from the reason of the heavily infected tonsils, although cultures were not made, there are reasons to consider it as agranulocytosis angina.

The interpretation of the histologic changes observed in this patient, is rendered difficult not only by the factor of infection, but by the possible influence of one damaged organ upon another. From the histological changes there were the destruction of the epithelium of the gastro-intestinal organs, the atrophy of the testis and the necrosis of the tonsils, but the most noteworthy was the changes in the bone-marrow. The hyperplasia of the reticulum cells, the disappearance of the hematopoetic foci, and the great quantity of mitotic figures in the myeloid cells observed in this case are found in many of the atomic-bomb victims died approximately one month after the exposure.

This is a case of the death caused by aplastic anemia with infective complication or in other words symptomatic agranulocytosis caused by the atomic-bomb radiation with sepsis.

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