

RADIATION RESEARCH IN TRANSPLANT SURGERY AND OTHER MEDICAL WORK

The Agency's April symposium in Monaco dealing with cellular proliferation and differentiation will provide much information about the effect of radiation on blood, tissues and diseased parts of the body. Much of the work in this field is connected with surgery, including transplantation of organs, bones and tissues. It is discussed in this article by G. Kozinets, until recently a member of the Agency's Life Sciences Division.

At present, the effects of radiation on the body are widely known. For instance, different doses of radiation cause different reactions in organisms. If these reactions are more pronounced, they are called "X-ray diseases". It is one of the tasks of the Agency to support the radiation protection of people, or, if an incident occurs, to give recommendations for the treatment of victims.

Lately the Section of Radiation Biology has started to orientate itself more towards problems of the haematopoietic (blood-forming) and immune system — the mechanisms by which the human body can resist infection. The reason for this is the fact that the blood-forming tissue is distributed over the whole body, so that even if one part of the body is irradiated, the system will react and the picture of the blood, like a mirror, will reflect whatever changes occurred in the areas where the blood cells are produced. The changes can be used as a biological measure, or dosimeter, if a certain technique is applied, and will thus reflect the dose of radiation received by the body.

Recent tendencies in leukemia, commonly called "blood cancer" are a subject of study. It is known that radiation can cause or provoke the development of leukemia. The scientific activities of the Agency here are not only in support of direct investigations such as effects of irradiation on the haematopoietic tissue, but also in initiating the use of isotopes to gain a better understanding of the metabolism of cells, their life, etc. This knowledge would be very important in connection with people working in the atomic industry, or with isotopes. The Agency held a panel in 1960 on "Effects of Various Types of Ionizing Radiations from Different Sources on the Haematopoietic Tissue", now followed by the Monaco Symposium.

The technical possibilities for transplanting tissue and organs have existed for a long time. The standard of present-day surgery is such that kidneys and hearts, etc. can be transplanted quite easily. The real question for biological science, however, is to find a way for the peaceful coexistence of the transplant with the host body, as well as keeping the transplant viable, and, above all, working.

Cell transplantations (as in blood transfusion) and bone marrow transplantations are well established; but in the case of bone marrow transplantations the immunology problem exists, because with the proliferation of the grafted cells the antibody production is simultaneously started, and thus the rejection reaction starts in the acceptor's body.

In earlier days, immunity was explained to be the reaction of the body to infections. Now, since our knowledge of the function of the living system has improved, we consider the immunological reaction as one of the functions of the body in responding to foreign proteins. If a body receives foreign proteins, cells called lymphocytes will start with the production of antibody, which is actually gamma globulin. Subsequently, several immunological reactions can occur which in scientific language are known under "secondary diseases". The reaction can either be a host-against-transplant or a transplant-against-host reaction.

In both situations, very often both the transplant and the host produce their own antibodies. Here ionizing radiation, which earlier was considered to have a detrimental effect on an organism, by causing X-ray diseases, shows a beneficial effect in connection with immunology, since it decreases the immune response of the body, and, a certain dose level can even eliminate it. Therefore it is possible after radiation incidents to transplant bone marrow cells, as in the Vinca accident. However, what is more important, radiation can also be used theoretically and practically for transplantation. For instance, radiation sources are used to sterilize the biological tissue, whereupon the tissue is much better suited for transplantation. The Agency's activities in this field have been reported at various panels, and at a recent symposium in Budapest, entitled "Radiosterilization of Medical Products".

Biological tissues such as bone, cartilage and vessels are visceral organs and their functions mechanical, so that the reaction of the body to these transplants is not very strong. In case of the more complicated organs, an investigation of the effect of radiation to depress the immune response is a necessity. Replacement surgery is now facing alternatives with regard to organ transplantation. One possibility is to suppress the defence reaction of the host body by using ionizing radiation for a whole-body irradiation, as was done in the South African cases. This method, however, is very risky since the depression of the body's immune reaction leaves the body defenceless against a germ invasion into the organism. The alternative would be to modify the antigen property of the grafted tissue or organ, also by using ionizing radiation. Thus, the irradiated graft being less antigenic, an immune reaction of the body could be avoided or at least lessened. Irradiating biological tissue also serves another purpose; it sterilizes the tissue and therefore makes storage possible, so that it could be available in any time of need.

These are only some of the ways in which radiation contributes to immunology and replacement surgery. They will doubtless take an important place in the programmes of the coming decade in medicine.

Immunological problems in connection with radiation were discussed during a recent Agency panel in Paris, entitled "Radiation and the Control of

the Immune Response", and another panel, planned to be held in Moscow this year on "Current Problems of Bone Marrow Transplantation with Special Emphasis on Their Conservation and Cultures" will go into further detail on the problems. In addition, a Manual on Radiation Haematology is being prepared by the Agency, and many international contributions will be received.

In radiation immunology the Agency is stimulating research along the following lines :

1. Use of radiation sources for sterilization of organs. By this method the usual difficulties arising from the normal sterilization procedures by heat or chemicals, are avoided. This method also gives some hope for use with organs like heart, kidneys and other tissues, since the radiation would also beneficially influence the immune reaction after the transplantation.
2. The application of bone marrow transplantation in persons involved in radiation accidents. More details and a deeper insight into this problem should be made available to physicians working in the atomic industry, and also to general physicians who may be involved in therapy following radiation accidents.
3. Use of radiation for the treatment of leukemia and some kinds of cancer. It is for instance possible to irradiate part of the body of a patient heavily, thus killing most of the cancer cells. To survive, the patient has to be kept in sterile conditions and receive a bone marrow cell transplantation or another tissue transplantation. For this investigation many different combinations of possibilities exist.

The activities of the Agency mainly concentrate on promoting research, collecting data on the practical use of irradiated tissue or organs, and making available the results to its Member States through training courses, study group meetings, panels, etc.