CATALYSTS FOR BETTER HEALTH CARE

MEDICAL TISSUE BANKS BRING MULTIPLE BENEFITS TO COUNTRIES

BY GLYN O. PHILLIPS AND JORGE MORALES

For millions of injured and disabled people around the world, the treatment brings a new quality of life.

Called tissue grafting or transplantation, it relies on the use of sterilized bone, skin, and other tissues to heal serious injuries, wounds, and sickness. Prime beneficiaries include severe burn victims, and men, women, and children suffering from crippling diseases, birth defects, and blindness.

Long applied in plastic and orthopaedic surgery, tissue grafting once relied only on using a patient's own tissues, known as an *autograft*. But now tissues from human or animal donors *(allograft)* are used for transplantation. This new form of tissue grafting has made big strides over the past decade. An expanding number of facilities today prepare the valuable tissues to the high-quality standards demanded in medical care. Dozens of such new tissue banks have opened in Asia, Latin America, Europe, and North America.

A productive channel of progress has been an IAEA-supported technical cooperation programme. Through it, experts have worked together behind the scenes to help national health authorities establish tissue banks, train associated staff, and develop standards and regulatory guides. The IAEA accordingly has gained more experience and success than any other international organization in supporting the establishment of tissue banks for medical use in developing countries.

Increasingly for quality and cost reasons, the technology of irradiation is used to sterilize tissues for medical care. *(See box, page 19).* The IAEA, through its technical cooperation channels, assists national atomic energy authorities to safely and productively employ radiation technology. An interregional programme on radiation and tissue banking, initiated over a decade ago, today extends to 30 countries.

Measuring Impacts. As experience has been gained through the IAEA programme, the growth and output of tissue banks have been exponential. To the year 2001, participating countries have produced and used more than 220,000 allografts (donated tissues) for medical care. *(See box, page 18).*

The grafts are valued at US$51.8 million, based on the mean tissue bank prices in the USA and Europe. This is far higher than the total expenditure associated with the IAEA programme, which through 2001 amounted to $6.3 million, including training costs of about $2 million.

Countries have realized other savings by avoiding the costly importation of grafts. In Mexico, for example, a $400 graft imported from the USA actually costs the patient at least $3000, due to value added taxes, import fees, and other charges. Elsewhere, costs can be higher. Importing a massive bone graft from the USA into the Republic of Korea, for example, can cost up to $10,000. In Sri Lanka, which established a tissue bank with the IAEA's support, more than $200,000 is saved annually in tissue importation costs

Alongside cost benefits, another outcome is the exposure of surgeons in developing countries to newer methods of using allografts through the IAEA Programme. This has helped to create a positive change in their approach to surgical treatment in their countries.

In Argentina, a network of tissue banks, associated medical centers, and radiation authorities has been established over the past decade. The National Atomic Energy Commission (CNEA) works closely with the Ministry of Health, operating and regulating a Center for Radiation Sterilization and Training. The Center serves a series of skin and bone tissue banks nationally which, in turn, supply hospitals and clinics.

Industrialized countries have benefitted as well, through a type of reverse educational transfer stimulated by participating experts and institutes. The use of

Prof. Phillips, a consultant to the IAEA on the tissue bank programme, is Chairman of Research Transfer Ltd, United Kingdom. Mr. Morales is the Interregional Projects Manager, Director's Office, IAEA Department of Technical Cooperation.

FACTS & FIGURES

Through the IAEA-supported radiation and tissue bank programme, 30 countries around the world have made considerable progress in improving their health care capabilities.

■ Production of Tissues, 1988-2001: A total of 222,580 tissues in 16 countries, valued at $51.8 million. Includes 96,645 skin and amnion tissues, 69,195 cancellous bone; 8588 massive bone allografts; and 50,278 other types, including pig skin, demineralized bone; tendon, ligaments, and fascia.

■ New Tissue Banks in Latin America, 1993-2001: The IAEA supported the formation of seven tissue banks and trained 66 doctors, tissue bank operators, and nurses through national and regional courses and fellowship training. All told, 37 new tissue banks have started up since 1993 in Argentina (11); Brazil (6); Chile (4); Cuba (10); Mexico (4); Peru (1); and Uruguay (1).

■ Participating Countries. *In Asia and the Pacific region,* they include Australia, Bangladesh, China, India, Indonesia, Japan, Republic of Korea, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, Thailand and Viet Nam. *In Latin America:* Argentina, Brazil, Chile, Cuba, Mexico, Peru and Uruguay. *In Africa and the Middle East:* Algeria, Jordan, Libya, Zambia and Iraq. *In Europe:* Greece, Poland, Turkey, Russia, Slovakia and Ukraine. Additionally, experts from Australia, Europe, Japan, and the United States have assisted the IAEA interregional programme.

tissue grafts in industrialized countries has become routine, with more than 750,000 being used annually in the USA alone. At least half of these grafts are either sterilized or decontaminated using radiation technology. Worldwide, a conservative estimate is that about 600,000 tissue grafts in industrialized countries are sterilized annually using radiation.

Educational & Technical Initiatives. Through a series of initiatives, the IAEA programme has assisted countries in developing educational programmes in tissue banking, and in harmonizing standards and guidelines.

In the educational arena, a distance learning programme on tissue banking was set up in cooperation with the National University of Singapore (NUS). *(See box, page 20).* International experts reviewed the IAEA/NUS Curriculum, including its introduction of new scientific principles. The material is now available in published form in English, Spanish and Korean. The cost to the IAEA was $16,000. Singapore donated 200,000 Singapore dollars for the English version and the Republic of Korea contributed $45,000 for the Korean version.

A recent global training initiative will place all activities within an interregional and regional structure. It provides a unified objective, management and evaluation system for all activities under the IAEA programme.

These and other steps are designed to broaden both technical and public knowledge and awareness of the benefits of radi-

SAVING LIVES IN LIMA

Emma Castro of Peru's atomic energy institute knows about saving lives — and the importance of being prepared to do it. When a New Year's fireworks celebration ran out of control in January 2002, sparks ignited fires in a busy commercial plaza in the city center. Nearly 400 people died in the tragic blaze and hundreds more were seriously burned and injured. Eight Lima hospitals and clinics suddenly were faced with saving the lives of severely burned men, women and children.

Fortunately authorities were ready to respond to the emergency.

Working with staff at Peru's medical tissue bank in Lima, Emma and her colleagues worked long hours to prepare, sterilize, and supply the tissue dressings that physicians needed for skin graft treatment of serious burn victims, whose lives hung in the balance. More than 1600 dressings were sterilized and supplied to Lima surgeons.

The efforts helped save the lives of 63 patients who otherwise might not have survived the Lima fire.

Peru's tissue bank is one of seven set up since the early 1990s in Latin America with the IAEA's support, and one of 37 overall in the region. The banks sterilize tissues using radiation technology, working in cooperation with national atomic energy authorities. Irradiation is widely used worldwide for the sterilization of medical tissues and supplies.

"Everyone is now more aware of the reasons why we need tissue banks and irradiation technology," says Emma. "Together they save lives."

RADIATION & TISSUE BANKING: WHAT IS IT?

Tissue banks are medical facilities that procure, store, and supply human and/or animal tissues for use in orthopaedic or plastic surgery. The banks operate in accordance with national laws, regulations, and ethical requirements. Each country specifies, for example, whether and how human tissues can be retrieved and donated. In all cases, it is necessary to rigorously check donor medical records and serological testing to make sure that no infection is in the tissues that might be transmitted to the recipient.

Once tissues have been received, the staff of the tissue bank enter into a strict processing regime. This requires cleaning the tissue, cutting it into surgically useful shapes, packaging, and finally sterilization of the packaged tissue.

Radiation Sterilization. Irradiation involves exposing materials to controlled doses of radiation for a specified time inside a shielded facility. The technology eliminates bacteria that cause infections and has become the preferred method for sterilizing most tissues used medically. One advantage is that it can be performed in the final packaging thus eliminating the danger of recontamination. Secondly, no heat is generated, so the biological properties of the tissues are preserved. Thirdly, no residues are left and there is not need for a quarantine period. The end result is that sterility can be assured, and recontamination prevented.

The most widely used tissue is musculo-skeletal, including bone, skin, tendons, and cartilage. When there is bone loss, either by disease or trauma, it must be replaced. This can be done in one way by drawing from existing body structures (called an *autograft*). This is very successful, but often there is not sufficient bone to repair the damage, particularly in children. In such cases, physicians use bone from a donor *(allograft)* via the tissue bank.

For bone grafts, the procedures used are straightforward but the healing processes are quite remarkable. If bone is packed tightly with surgical expertise into a cavity in the bone, it acts as a scaffold on which new bone can grow. This process can prevent the loss of limbs due to cancer or heal injuries from an accident.

Human skin, which can be preserved and used for the treatment of burns, is widely used. It seals the wound, prevents the loss of fluid and the penetration of infections from outside the body. Another effective wound dressing — introduced through the IAEA radiation and tissue banking programme — is the membrane surrounding the placenta, called *amnion*. It promotes healthy growth of tissue in cases where wounds often are intractable, such as in leprosy or pressure sores that readily affect paraplegics. This method has been particularly successful in Indonesia where thousands of grafts are produced and used annually.

Another widely used tissue is the cornea, which eye surgeons can use for treating blindness and eye disease. Sri Lanka's Eye Bank, for example, has sent more than 36,000 corneas to eye surgeons around the world. With IAEA support, Sri Lanka opened a tissue bank in the 1990s that supplies radiation-sterilized cornea, as well as other types of tisssues, to clinics and medical centres worldwide.

ation sterilized tissue grafts, and to ensure that the same uniform international standards are being used by all countries participating in the IAEA programme. Other key ingredients are:

Preparing a set of international standards for tissue banks. Presently there is a great deal of variation among countries. Experts have reviewed the US and European practice, which now are widely applied, and the proposed standards will ensure compatibility throughout the IAEA programme.

Preparing an international code of practice for the radiation sterilization of biological tissues. No international body has undertaken this important function, which is within the IAEA's technical competence. The first draft of a code now is in review.

Raising public and professional awareness. Limited awareness about tissue banking has been a major obstacle to extending the use of radiation-sterilized grafts in individual countries. Edu-

DISTANCE LEARNING IN TISSUE BANKING

Distance learning is nothing new for tissue bank operators, managers and doctors. The training and educational approach has been used since 1995 by countries participating in the IAEA Radiation and Tissue Banking Programme.

The first steps were initiated in the Asia and Pacific Region, with the support of international experts, the Singapore Government and the National University of Singapore (NUS). They led to the production of the first comprehensive IAEA/NUS Curriculum in radiation and tissue banking. It is now a tangible asset.

The Curriculum, now available in English, Korean and Spanish, is a unique vehicle for training tissue banks operators, managers and doctors worldwide. The University Diploma extends over one year, starting with a two week session at NUS or the University of Buenos Aires in Argentina. It is the first such diploma available anywhere in the world. In the Asia/Pacific, Latin America, Africa and Europe regions, 296 tissue bank operators, managers and doctors have been trained under the IAEA Programme, with 65 trainees graduating from the University of Singapore and 16 from the University of Buenos Aires. All told, trainees from 18 countries have attained the University Diploma level. The costs have been far below comparable university education — $557,117 for all trainees under the IAEA Programme compared to the equivalent cost of $972,000 in the United Kingdom for the same level course, using conventional training methods.

Photo: Studies toward a diploma in tissue banking are offered by the University of Singapore in cooperation with the IAEA. The address is http://citamed.nus.edu.sg/tissuebank/.

cation is needed at all levels. A handbook on public awareness is being prepared to assist workshops and national programmes in conducting campaigns during 2003.

Strategic Partnerships. On this established foundation, strategic partnerships are being formed.

A partnership between the IAEA and the Musculo-skeletal Transplantation Foundation (MTF) in the USA identifies a joint programme of professional and public education. In particular, the MTF will spearhead the training of surgeons in the use of tissue transplants, and the IAEA will coordinate provision of the radiation technology for sterilization of tissues.

Another partnership is being formed with major international professional associations engaged in tissue banking, as a step toward ensuring the maintenance of the highest international standards. The Presidents of these associations have accepted the chairmanship of the Technical Advisory Committee to the IAEA programme. The associations include the American Association of Tissue Banks, the European Association of Tissue Banks, the Asia Pacific Surgical Tissue Banking Association and the newly formed Latin America Association of Tissue Banks.

Another strategic step extends the IAEA's cooperation with the National University of Singapore. The university will serve as the International Centre for Global Internet Delivery of Training of Tissue Banking Operators, Managers and Doctors, using the established IAEA/NUS curriculum. It will feed regional and national centres, with instruction in the relevant language. Teaching material is already available in Spanish, and the University of Buenos Aires in Argentina will play a comparable role to the University of Singapore to cover the Latin America Region, as a regional training centre. Also being set up is a National Training Centre in the Republic of Korea. ❐