

Review Article

Human tissue banking in Bangladesh: hope for the patients of massive burns, surgical wound and bone associated complications

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Abstract: Each year throughout Bangladesh, thousands of people suffering from massive burns and surgical wounds require amniotic grafts for transplantation. Additionally, the stricken persons of the country have to embrace bone associated disability for the whole life due to traumatic complications need bone graft to treat. As a result, these two problems are the largest financial burden as this situation not only affect the family of patients but also cripple down national economy. However, institute of tissue banking in Bangladesh has undertaken the service program on the processing, preservation and clinical applications of amnion membrane and bone graft for rehabilitative surgery. Importantly, in recent years, this institute has started cranial bone autograft processing and transplantation. In accidental cases such as head injury, it is difficult to provide suitable cranial bone allograft according to demand. In this situation, injured cranial bone of the patient is being transported to the lab of the institute, where the scientist, tissue banker and medic work together immediately to process the cranial bone and sterilize by gamma radiation; and after quality assurance, the processed cranial bone autograft is being supplied for replacement surgery. The use of irradiated amnion and bone allografts and cranial bone autograft in reconstructive surgery restore normalcy to lives of many patients from disabilities. This tissue bank is based on finding and obtaining qualified donors from the community and a demand for tissue grafts from the hospitals. Although growing needs for tissue transplantation but raw and processed tissue grafts preservation and banking braces enormous logistical limitations. The only human tissue bank in Bangladesh, however, ensures the availability of tissue allografts of high quality and acceptability to the recipients for rehabilitative surgery for a decade, regardless patients' socio-economic status.

Keywords: Tissue banking, Bangladesh, amniotic graft, bone graft, cranial bone autograft

Introduction

Processing and transplantations of bone tissue and amniotic membrane allografts in reconstructive surgery are well-established and clinically accepted globally [1]. Realizing the importance of tissue banking and adequate reports on successful allografting, numerous tissue banks have been established around the world in past few decades [2-6]. In late 1985, Bangladesh atomic energy commission in Dhaka started the research and development for the setting up of a tissue bank by preserving fresh amnion/fetal membranes by lyophilisation and then sterilizing by gamma irradiation [7]. The bank has been established under the umbrella of IAEA health care program (CRP 4158/RB)

concentrating the processing of amnion, bone and soft tissues allografts, as well as bone xenografts. The IAEA have provided financial, technical, as well as training support for tissue bank staffs. Since its establishment, this tissue banking institute follows the guidelines of the IAEA and European association of tissue banks. However, after a long negotiation between scientist, medic, politicians, tissue bankers, and social religious representatives; the Human Organ/Tissue Donation and Transplantation Act, 1999: Govt. of Bangladesh has approved the lawful, ethical and legal permission for procurement of tissues from living donors as well as from deceased ones [8]. In 2017, the act has been updated by the approval of "Transplantation of Human Organs Act-2017". Tissue bank-

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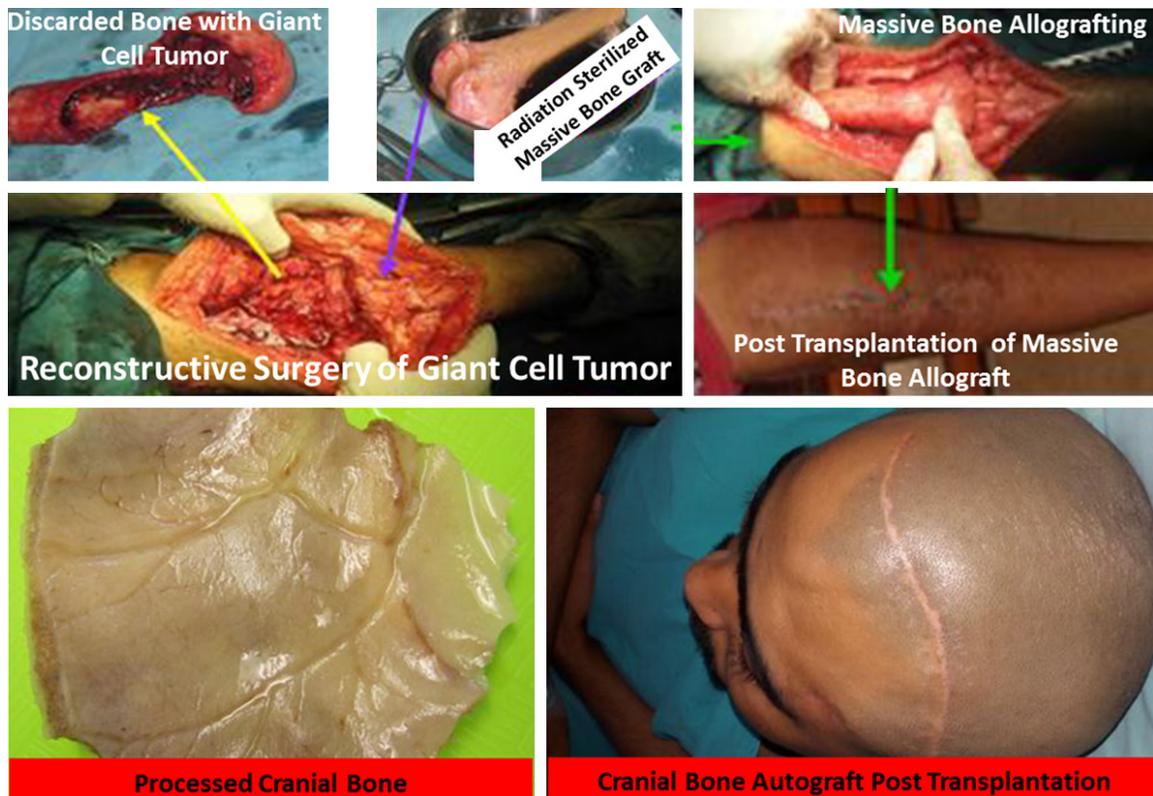


Figure 1. Massive bone allografting for giant cell tumor surgery and recovery. Processed cranial bone autograft and the post re-transplanted outcome.

ing activities include to treat degenerative bone diseases, congenital deformities, bone fractures, gap non-union from traumatic accidents, dental defects, different type of burns, acid violence, leprotic ulcer, bedsore, traumatic open wound, diabetic wound etc. Several hospitals and clinics throughout the country are currently involved in tissue procurement and grafting though some of intricate ethical problems (ideological, cultural, psychological, and religious) and conflicts stay behind this field. Since 90% of the Bangladeshis are Muslims, peoples have a religious fear for donating and taking deceased biomaterials. Cultural factors also play a major role in the disparities in access to cadaveric organ and tissue procurement in Bangladesh. However, now, tissue allograft transplantation acquired recognition from clinic and supervision and administration from government.

Tissue banking activities, services and achievement

Currently in Bangladesh, approximately 109 hospitals/clinics and 300 surgeons/physicians

have collaborated for utilization of radiation sterilized tissue allografts. For the procurement of tissues, donors are assessed as previously described by Akhtar et al., 2016 for both amniotic sac and bone tissues [7]. A written consent of the living donor is also taken. Surgically discarded raw bones were retrieved from living donor undergoing orthopedic surgery such as excised femoral head in fracture neck of femur in replacement hemiarthroplasty or in total hip replacement, rejected bone slides from total knee replacement operation, corrective osteotomy and primary traumatic limb amputation etc. Amniotic sacs were mainly recovered from vaginal and caesarean sections deliveries. Immediately after delivery amnion including chorion were kept in a freezer (-40°C) in the operation theatre. During transportation within short range, tissues were placed in a cool box filled with ice slabs and for long specially insulated transport box tightly packed with dry ice was used. Initial bio-burden of raw tissues was analyzed and the tissues were placed in the quarantine deep freezer at -40°C till the result obtained. Human femoral heads and patellar bone of femoral condyles were used for lyphi-

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Figure 2. Processing and application of amniotic membrane, bone chips and demineralized bone granules.

lized cancellous bone allografts. Pasteurized cancellous human bones were the raw materials for producing demineralized bone granules. From deep-frozen (-80°C) cortical bones, massive bone allografts were prepared. Irradiations (25 kGy) of the massive bones were done under frozen condition. After irradiation, the massive bones were preserved at -80°C . **Figure 1** shows the application of massive bone allografting and cranial bone autografting. Refrigeration plus steam disinfection and medium pressure repetitive saline flow plus irradiation technologies were used to process of autologous skull bone prior to re-implantation. However, the success of the tissue banking and transplantation efforts also depends at three preservation points: biopreservation (the time period before transporting of tissue from the donor clinic) of tissues during procurement and transport (preservation during transport from donor clinic to tissue processing lab), biobanking (post processing storage for short and long term), and other steps of the delivery chain in order to meet grafting demands in the desired quality. Regarding the importance of preservation and

banking in adequate temperature, the human tissue banking institute of Bangladesh has received relatively little attention from funding agencies, the research community, and the general public in terms of long term banking.

Last 10 years (2007 to 2016), approximately six thousand bones and eight thousand amniotic sacs were collected from tissue donors. During this period, eighty thousand cubic centimeter bone allografts and thirty five thousand pieces of amniotic membrane allografts were processed and supplied to different hospitals throughout the country on the basis of demand. The outcomes of the concerted efforts of tissue banking professionals and physicians were the restoration of health and hope of five thousands patients during these years. For instance, in 2008 bone allograft were provided for 76 giant cell tumour patients, 18 aneurysmal bone cyst, 13 simple bone cyst, 19 fibrous dysplasia, 27 gap non-union, 66 bone fracture, two spinal fusion/scoliosis, and three osteomyelitis patients [8]. **Figure 2** represents the use of amniotic membrane graft and demineralized bone

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granules for oral and maxillofacial surgery; and clinical use of bone chips. Last three years from 2015 to 2017, sixty seven cranial bones were processed in this institute and successfully transplanted. These patients are now in observation. This human tissue bank is a unique place in Bangladesh for research and development which is directly related to human health. Researchers are working to understand and develop new regenerative rehabilitation therapies for a wide range of anomalies, including burns, wounds, bone associated dysfunctions, rely on donated tissues and cells for their investigations. The working teams of this institute always encourage and welcome students' regardless country to investigate the clinical potentials of medically discarded biomaterials such as amniotic fluid, synovial fluid, umbilical cord blood, amniotic membrane, and bone. Recently, this institute has given the priority to advance research on biomedical engineering and regenerative medicine.

Basically, tissue banking is a practice of collecting human cadaver and discarded tissue, their processing and preservation for clinical use and research for short and long term as well. In regard to good human tissue banking services, existence of interaction between public, health care personnel and the tissue bankers is obvious to increase and facilitate the tissue donation, collection, processing, preservation and also the clinical acceptance of tissue graft. In Bangladesh, tissue banking is steered by this institute, which has already set up a well public awareness strategy to communicate with professionals and mass peoples through organizing seminars/presentations on tissue banking, displaying posters in conferences, publishing newsletter/leaflets, establishing personal contact, negotiation and collaboration with other national/international organ transplant groups/organizations, and meeting with higher authority. Moreover, the ethics, moral principles, and legal aspects regarding human tissue banking always be disseminated enormously to the general public of the country as they could be more conscious and interested to tissue donation thereby more people will contribute to alleviate sufferings and more lives will save. However, rapid advancement in biomedical sector in last few decade, the idea and working areas of tissue banking is not limited to bone and amniotic membrane banking. So, we have to pay our

emphasis on the identification and improvement of new allograft products and allograft substitute from non-human origin to deliver better service to the receivers. We are also working on the development of allograft substitute suitable for transplantation based therapy but still we have a very long way to go. We are always looking for collaboration with international scientist from the fields of Bio-engineered skin and bone development related research group.

Conclusion

Tissue preservation (pre and post processing) has profound effect on grafting and preclinical biomedical research. Preserving tissues during procurement, transportation, processing, long term post processing storage, and other steps of the supply chain are still in constrains regard to technical and logistics challenges for maintaining highest quality of graft. Bangladesh still needs IAEA support to fulfill the increasing demand of tissue allografts, as well as research on the effects of preservation and radiation. The biobanking technologies that promise to advance the preservation of a vast array of tissues and address a large breadth of public health needs in future.

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Disclosure of conflict of interest

None.

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