Cord Blood: from Garbage to Life-Saving Source

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Cord blood (CB) which was wasted along with placenta and umbilical cord, has been used to save life since Dr. Gluckmann treated Fanconi anemia patient using CB from his sister (1). Since then, the trials for storage of wasted CB have been performed and many CB banks have been established over the world. I would overview the impact of CB in the field of life science in terms of banking, clinical application, research tool, and particularly governance program for CB. Also, the other authors in this issue would describe the current status and perspectives of usefulness of CB on the point of clinical and research field of hematopoietic and non-hematopoietic stem cells.

Cord bloods have been preserved in the liquid nitrogen (LN₂) tanks for long-term storage. A lot of research works have been done to preserve the quality of CB during long-term storage, particularly in terms of processing and cryopreservation. I would describe the generally accepted methods in the world as well as our country for banking CBs (2). Collected CBs in the bags are transported to the CB banks in the room temperature and processed within 24~48 hours after collection, because the viability of CB would be maintained effectively in the room temperature rather than 4°C and before 48 hours rather than after 48 hours after collection. To reduce the volume for long-term storage in the LN₂ tanks, the mononuclear cells (MNCs) are separated from whole CB with density-gradient method using starch or Ficoll-Hypaque followed by centrifugation and removal of red blood cells including plasma. The separated MNCs are mixed with 10% dimethylsulfoxide (DMSO) which is cryoprotectant, and adjusted to the volume of 25 ml with dextran. The processed CB would be put

in the controlled rate freezer for decreasing temperature to -90°C and then stored in -196°C LN₂ tank.

In the clinical fields, CB has been widely used as an alternative source of hematopoietic stem cell transplantation (HSCT) and the clinical results of cord blood transplantation (CBT) are comparative to bone marrow transplantation (BMT) (3). At beginning, CBT has been available only for children because cell doses in the stored CB are limited. However, a lot of experimental and clinical studies have been tried to overcome this disadvantage of CB in the transplantation settings. Many investigators tried to expand CB in the ex-vivo conditions to increase the number and function of hematopoietic progenitor cells (4). Even they could expand CB by using several cytokines including stem cell factor, FLT3, interleukin 6, the clinical data of stem cell transplantation (SCT) using expanded CB was not successful. Others have tried to change the stem cell niche environment such as enhancing homing potential of infused CB (5). However, so far, SCT using double unit CB has been clinically accepted to overcome the barrier of low cell dose of CB. CBT has been widely performed in adults as well as children since Dr. Wagner performed successful double CBT (6). The clinical results of CBT using single or double units are also comparative. By the favor of these experimental and clinical trials, more than 10,000 patients including children and adults have had chances to receive CBT so far.

CB also has been used as an important source for stem cell research because non-hematopoietic stem cells as well as hematopoietic stem cells (HSCs) have been demonstrated in CB. Mesenchymal stem cells (MSCs), one of the non-HSC, which derived from CB have been revealed to have an ability of immune regulator as well as multilineage differentiation potential to osteoblast, chondrocyte, adipocyte, cardiomyocyte, hepatocyte, neuroglial cells (7). Clinical trials using CB-derived MSC also have been performed. In the field of HSCT, MSCs usually introduced to enhance engraftment of infused CB and suppress immune responses

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such as graft versus host disease following CBT (8). Cell therapies using MSCs also has been tried for tissue repair and regeneration in the various clinical settings such as myocardial infarction, ischemic disease, and various degenerative diseases of cartilage and nerve (7). The following non-HSCs in CB also have been isolated and characterized: endothelial progenitor cells, unrestricted somatic stem cells, embryonic-like stem cells, multilineage progenitor cells, and neuronal progenitor cells (9). These non-HSCs are also under investigations for cell based therapies.

Because CB has been used as an important source for life-saving as well as human tissue regeneration, wasted CB has to be recycled and governed strictly. At first step, the ethical consideration for using wasted product and quality control of stored CB should be warranted. The international standard for CB collection, processing, cryopreservation, and other things regarding CB banking has been released and revised by Foundation for the Accreditation of Cellular Therapy (FACT) (10). Most of CB banks in the world perform their CB works by referring to this guideline. In Korea, our own guideline for CB banking program which based on the FACT standard, was also released by Ministry of Health, Welfare and Family on August, 2005 (11). The public CB banks in the world share their CB data to provide more chances to transplantation candidates. They organized the international networking system, namely NetCORD and currently 31 CB banks in the world are participated, of which 10 banks were FACT accredited and 21 not accredited. Their inventory has currently about 200,000 units of CB and has released over 8,000 units of CB for SCT to children as well as adults. In Korea, networking system of 7 public CB banks as KoreaCORD has been started since 2008. We, in KoreaCORD inventory, have about 20,000 units of CB and have released above 350 units of CB mostly to the children. However, since any CB banks did not get FACT accreditation, we are just preparing our own nationwide inspection system for public CB banks as well as private CB banks even before joining NetCORD and FACT accreditation system. I strongly suggest that a statute law such as "Stem Cell Act 2005" in USA would be necessary to expand public CB banks nationwide and govern them effectively. Therefore, we, in Korea, made draft law regarding "Governance and Promotion of Research for CB" by the committee members of the Korean Society of Blood and Marrow Transplantation (11). We submitted the draft law to the National Assembly, which is now open for discussion, and hopefully anticipate passing this plenary session of National Assembly.

In conclusion, CB has proven evidences for reconstitution of hematopoiesis and also an infinite potency for tissue repair and regeneration. Therefore, CB should be

governed thoroughly and utilized continuously for the clinical and research works.

Potential Conflict of Interest

The authors have no conflicting financial interest.

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