The Use of Human Umbilical Cord Blood for Wound Healing, Burns, and Brain Injury in Combat Zones

Alluru S. Reddi, MD, PhD; CAPT Norman Ende, MC USNR (Ret.)†*

Cell-based therapy for patients with wounds, burns, and neurological injury due to trauma is receiving great attention among scientists and clinicians. Bone marrow is considered one of the rich sources of stem cells. However, human umbilical cord blood (HUCB) is being increasingly used as an alternative source of stem cells for treatment of a variety of diseases. The umbilical cord supplies nutrients and oxygen from mother to the fetus. The cord blood for preservation and subsequent use is the one that is obtained from the umbilical cord after birth. HUCB, once thought to be a medical waste, is currently considered a valuable source of stem cells.[1] Thus, HUCB remains an alternative to bone marrow transplantation in clinical practice.[2] In this editorial, we will focus on the potential use of HUCB for emergent treatment of wounds, including burns and traumatic brain injury (TBI), with emphasis on U.S. soldiers.

IMPORTANCE OF HUCB TRANSFUSION

HUCB is a rich source of hematopoietic progenitor cells that differentiate into not only erythroid, myeloid, and lymphoid cells but also nonhematopoietic cells such as epithelial, endothelial, and mesenchymal progenitor cells.[2,3] HUCB-derived lymphocytes are immunologically naïve and produce only a few activating cytokines. A number of studies have shown that HUCB cells have the potential to differentiate into keratinocytes, osteoblasts, chondroblasts, adipocytes, hematopoietic cells, and neural cells including astrocytes and neurons that express neurofilament, various neurotransmitter phenotypes, cardiomyocytes, insulin-producing islet cells, and muscle cells.[2,3] Thus, HUCB transfusion can be used as another modality of stem cell therapy to prevent or treat a variety of diseases, including wounds, burns, and brain and spinal cord injuries.

HUCB, WOUNDS, AND BONE NONUNION

There is evidence that HUCB cells can improve wound healing[4] and traumatic bone injury.[5] Valbonesi et al[6] used HUCB-derived CD34+ cells to treat skin wounds that were refractory to conventional treatment for 1 year, including surgery. After 3–4 cord blood applications, wound healing was observed in 2 patients. There was no graft vs. host disease during 3–7 months follow-up. Also, percutaneous transplantation of HUCB-derived mesenchymal cells into patients with traumatic bone injury was more effective in bone union than in traditional treatment.[5] Thus, HUCB cells can improve wound and bone healing in humans.

HUCB AND BURNS

Since HUCB contains mesenchymal progenitor cells, it can be used to treat cutaneous burns. Indeed, it was found that amniotic membrane of the HUCB-derived stem cells has been used to treat partial thickness and full thickness burns as well as chronic diabetic wounds.[4,7]

TBI IN WARS

Susan Okie, a contributing editor of the New England Journal of Medicine, discussed extensively on TBIs that U.S. soldiers experienced during Iraq and Afghanistan wars.[8] TBIs, caused mostly by improvised explosive devices, are classified as mild, moderate, and severe. At Walter Reed Army Medical Center in Washington DC, from all soldiers treated for blast explosion between June 2003 and February 2005, 59% were found to have TBI. It appears that those injured in blasts were significantly more likely to have a skull fracture, seizure, and lower extremity amputation than those not injured in blasts. The most debilitating features in survivors of TBI are motor and cognitive dysfunctions. Several symptoms such as headaches and sleep disturbances are commonly observed in these patients. Cognitive changes such as disturbances in attention, memory, depression, anxiety, and mood changes are frequent in severe TBI. To date, there is no effective treatment to improve or totally abolish these changes except for long-term rehabilitation and other necessary medical care. Thus, TBI impairs the quality of life for these injured soldiers.

HYPOTHESIS

We hypothesize that transfusion of HUCB may improve functional recovery in survivors afflicted with wounds, cutaneous burns, and TBI. This hypothesis is based on the evidence that HUCB-derived stem cells are useful in the repair of wounds, burns, and TBI. It is of interest to note that a 37-year-old female recovered her sensation and hip and thigh movement 41 days after receiving intrathecally 1 million HUCB cells each for 2 times.[9] Although no other such case reports have been reported in humans, a large number

*Department of Medicine, UMDNJ-New Jersey Medical School, 185 South Orange Avenue, Newark, NJ 07103.

†Department of Pathology and Laboratory Medicine, UMDNJ-New Jersey Medical School, 185 South Orange Avenue, Newark, NJ 07103.