Cbr CENTER FOR
REGENERATIVE MEDICINE

BACKROUNDER:

Newborn Stem Cells from Cord Blood and the Brain:

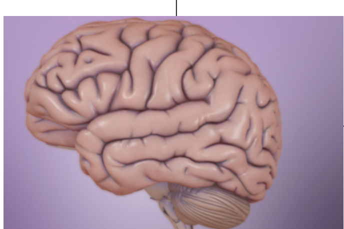
Repairing Injury and Improving Function

Introduction

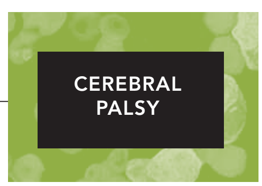
WITH ONGOING DEVELOPMENTS IN SCIENCE, researchers estimate that 1 in every 3 people may benefit from regenerative medicine therapy.[1,2]

Newborn stem cells from cord blood have distinct advantages over other sources of stem cells: they're younger, more prolific, and haven't been exposed to chemicals or viruses in the environment that can alter cell structure and function.[3,4] They've also demonstrated the ability to migrate into the brain, repair damage and induce healing.[5] Researchers currently are applying cord blood stem cells to several forms of brain injury which remain potentially debilitating, have no cure, and present extremely limited treatment options.

Unmet Treatment Needs



Traumatic brain injury ("TBI") is a devastating event for an estimated 1.4 million Americans annually,[6] resulting in about 50,000 deaths and 90,000 life-long injuries with substantial loss of function.[7] Current TBI treatment is insufficient, with the end result being significant motor, cognitive and social impairment.



Cerebral palsy is a broad term referring to neurological disorders affecting body movement and muscle coordination. The cause varies from case to case and can include oxygen-depriving (hypoxic) injury to the brain, traumatic injury, infection and stroke. Affects two million children and adults in the United States, with an additional 10,000 babies and infants diagnosed with the condition annually.[8] There is currently no cure for cerebral palsy and no standard therapy.

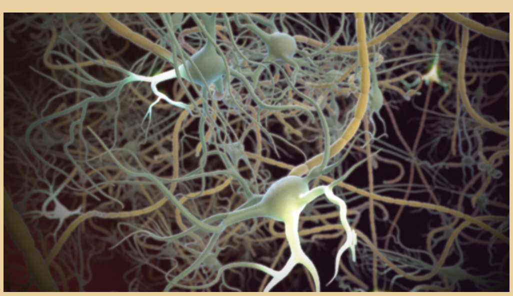
Stroke. Over four million individuals in the U.S. are living with a neurological impairment due to stroke.[9] Since the brain is extremely sensitive to oxygen deprivation, some degree of tissue death from stroke is likely.[1]

Healing Potential of Newborn Stem Cells

Until recently, no therapeutic intervention has demonstrated the ability to affect the underlying pathological processes in the brain through salvage, support, repair or replacement at the tissue or cellular level.[10]

However, a growing body of literature now demonstrates that newborn stem cells from cord blood travel into the brain, activate other cells within the brain (endogenous cells), and promote the healing of neurological problems and injuries, repairing damaged nerve and brain tissue.[5,11,12] In addition, cord blood is easily accessible and contains powerfully diverse and versatile populations of stem cells[13] and embryonic-like stem cells[14] which are able to differentiate into a variety of cell types.

While the exact mechanism of action is not yet clear, current observations in the treatment of children with genetic diseases of the brain (e.g. Hurler syndrome, Krabbe disease) with donor stem cells demonstrate that cord blood stem cells are able to travel to the brain, even when injected in the blood, and differentiate into various types of neural cells including neurons and oligodendrocytes (cells that create myelin)[15]. In certain cases, the cord blood stem cells have been shown to prevent neurological deterioration and even cause cognitive improvement.[16]

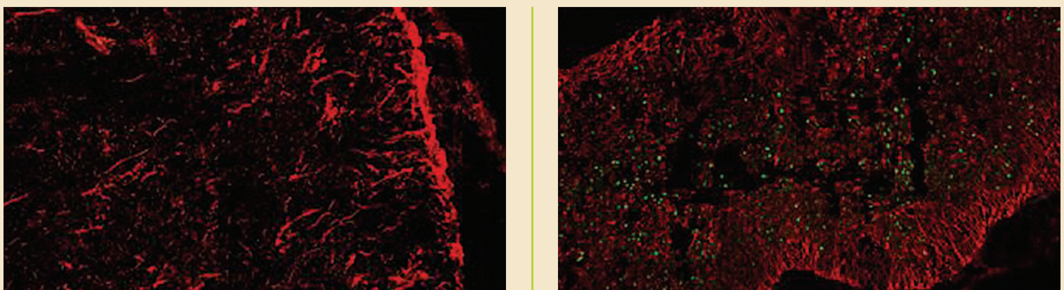


Given these newfound regenerative abilities and the complexities involved in harvesting human neural cells, many researchers consider newborn stem cells from cord blood a promising therapeutic strategy to regenerate nerve tissue and facilitate brain repair.

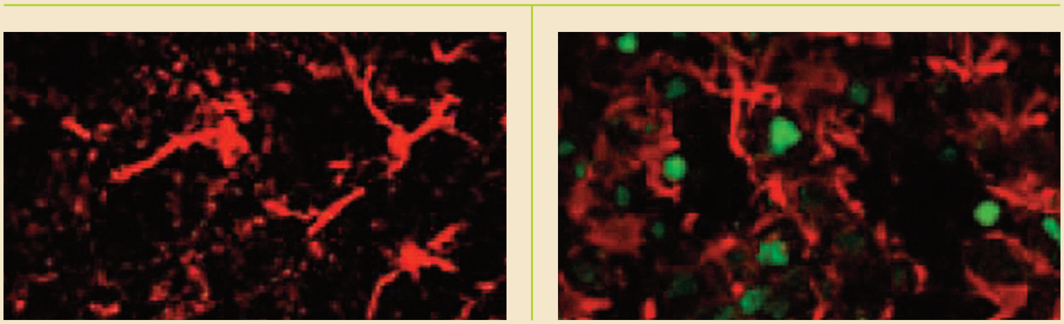
Preclinical Research Summary

Laboratory research has shown that newborn stem cells found in cord blood have the ability to differentiate into neural-like cells,[17,18] and stem cells that secrete therapeutic factors which may help to repair brain damage.[19,20]

Other preclinical studies have shown that newborn stem cells from cord blood injected peripherally into animal models of various neurological disorders **preferentially migrate to the damaged area of the brain and significantly improve motor and neurological function.**[5,11,12]



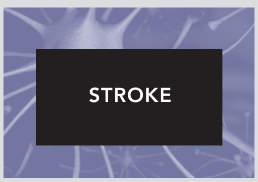
IN ANIMAL STUDIES, newborn stem cells from cord blood demonstrate an ability to cross the blood-brain barrier and migrate to damaged tissue to induce healing. The top left-hand photo represents normal, healthy tissue in a rat's brain and shows no evidence of cord blood stem cell migration even after being infused with human cord blood stem cells. The top right-hand photo represents damaged rat brain tissue with the green dots showing where the newborn stem cells from cord bood migrated in an effort to induce healing. Below, close-up detail of both slides.[5]



Implications for Treating Brain Injury

The results have led many researchers to suggest that the infusion of cord blood stem cells can alleviate damage to brain tissue, reduce muscle tightness, and improve gait and mobility-related symptoms in humans.[5,11,12] Among key preclinical findings:

Traumatic Brain Injury: Researchers studying cord blood use in TBI have found that newborn stem cells from cord blood migrate to the injured brain, express neural and other key cell traits, and significantly reduce functional neurological deficits after severe traumatic brain injury.[10,11]



Stroke: Multiple preclinical studies have shown that newborn stem cells from cord blood improve functional recovery and behavioral performance after a stroke with no adverse effects.[12,21,22,23] Significantly, unlike current pharmacological interventions that require treatment in the first few hours after stroke,[1] CB stem cell therapies are still effective up to 48 hours after the stroke. Beneficial effects are observed whether or not the stem cells reach the brain (probably through the release of growth and repair factors triggered by oxygen loss).

Current Clinical Research with Children

Following the proven benefits of autologous newborn stem cells from cord blood and the established ability of these cells to stimulate brain repair and induce healing in multiple animal models, several clinical trials are evaluating the therapeutic use of autologous newborn stem cells from cord blood for the treatment of traumatic brain injury and cerebral palsy.

Duke University Medical Center

Currently, a team at Duke University Medical Center led by Dr. Joanne Kurtzberg, professor of Pediatrics and Pathology and the program director for Pediatric Blood and Marrow Transplantation, is investigating autologous cord blood stem cell treatment of newborns and young children diagnosed with brain injuries, such as cerebral palsy (CP). This treatment is being studied to determine if an infusion of a child's own cord blood stem cells (i.e., autologous infusion) will improve the condition and reduce the severity of the neurological damage or deficit.

To date, more than 150 children have undergone treatment at Duke as part of this pioneering research for a range of neurological conditions including CP, hydrocephalus, and hypoxic-ischemic encephalopathy (HIE). While the research is ongoing and final conclusions have not been determined, initial observations have shown that intravenous infusions are safe and have been described as "encouraging."

Medical College of Georgia

Medical College of Georgia researchers are conducting the first FDA-approved clinical trial to determine whether an infusion of stem cells from umbilical cord blood can improve the quality of life for children with cerebral palsy. The trial launched in the first half of 2010, utilizing only cord blood processed and stored at Cord Blood Registry to insure study consistency.

University of Texas Houston

Researchers at the University of Texas Houston evaluated the therapeutic benefits of infusing a child's own bone marrow stem cells back into his or her bloodstream following traumatic brain injury (TBI). The primary research objectives – to determine if bone marrow stem cells harvest and whether this autologous transplantation was safe in children after TBI – showed a higher-than-expected survival rate. The secondary objective – to determine if those stem cells improved the child's functional impairment – revealed improved outcomes. University of Texas researchers are now in Phase Two of their research, which focuses on the use of a child's own cord blood stem cells (instead of bone marrow stem cells) following traumatic brain injury.

Key Conclusions

- Researchers are evaluating the ability of newborn stem cells from cord blood to help heal various forms of brain injury, which remain potentially debilitating, have no cure, and present extremely limited treatment options.
- A growing body of literature demonstrates that newborn stem cells from cord blood migrate to the brain, activate other cells within the brain, and induce subsequent healing of neurological problems and injuries.
- Cord blood is easily accessible and contains a powerful, diverse and versatile population of newborn stem cells AND embryonic-like stem cells which are able to differentiate into a variety of cell types.
- Given these newfound regenerative abilities and the complexities involved in harvesting human neural cells, many researchers consider newborn stem cells from cord blood to be a promising therapeutic strategy to regenerate nerve tissue and facilitate brain repair.
- Preclinical studies have shown convincing evidence that infused newborn stem cells from cord blood migrate to the damaged area of the brain, improve motor and neurological function and promote healing. The results may lead many researchers to suggest that the infusion of newborn stem cells from cord blood can alleviate damage to the brain tissue, reduce muscle tightness, and improve gait and mobility-related symptoms in humans.
- Following the proven benefits of autologous newborn stem cells from cord blood and the established ability for these stem cells to stimulate brain repair and induce healing, several clinical trials are evaluating the therapeutic use of autologous newborn stem cells from cord blood for the treatment of traumatic brain injury and cerebral palsy.

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New uses for cord blood stem cells are being discovered rapidly; however, banking cord blood does not guarantee that the cells will provide a cure or be applicable for every situation. Ultimate use will be determined by the treating physician. Use in regenerative medicine is still considered experimental. Medical treatments using cord tissue are still under development.

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