Autologous Umbilical Cord Blood Stem Cell Therapy for Regenerative Medicine Applications

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BACKGROUND:

For the past twenty years, hematopoietic stem cells found in umbilical cord blood (UCB) have been used in transplant to treat malignancies, blood disorders, and genetic diseases by regenerating the blood and immune system. Stem cells are now being researched for regenerative medicine applications to repair damaged or diseased non-hematopoietic tissues. Recently it was observed that UCB contains a heterogeneous population of pluripotent stem cells with the ability to differentiate into numerous cell types outside of the hematopoietic lineage. This suggests that UCB stem cells may have regenerative medicine potential for the treatment of a variety of conditions including, cardiovascular, ophthalmic, neurological, and endocrine disorders. Autologous cell sources, such as family banked UCB, are preferred in regenerative medicine treatments as they do not have immune complications or require intensive conditioning regimens.

OBJECTIVE:

To assess the indications, viability, and CD34+ cell counts of UCB units released by one private (family) cord blood bank for autologous use in regenerative medicine applications.

METHODS:

UCB was collected from the placenta of consenting mothers who elected to family bank. The UCB was then transported to Cord Blood Registry (CBR)'s processing facility in Tucson, AZ. The whole blood product was processed to separate the mononucleated cell fraction from the red blood cells and other non-engrafting cells. The processed cord blood was then stored in vapor-phase liquid nitrogen dewars at -195˚ C until requested for use. Prior to release, viability and percent CD34+ (or CFU) content were assessed by the treating institution. Infusions were performed under research protocols at major medical institutions, including Duke University and the University of Florida at Gainesville.

RESULTS:

Through April 30 of 2008, CBR released 70 UCB units for transplant. 23 (32.9%) units were used for autologous regenerative medicine therapies including: cerebral palsy (15), brain injury (3), type 1 diabetes (4), and a rare immune disorder (1). The 23 UCB units were stored a mean of 37.9 months prior to use, the mean CD34+ cell count was 0.58% and mean viability was 94.4%.

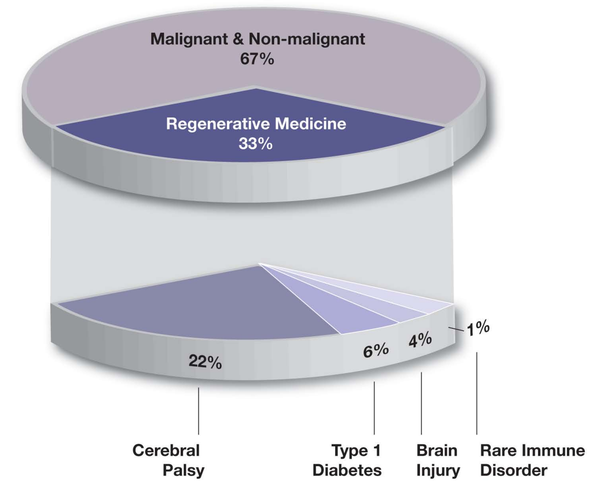
Autologous Cord Blood Units Released for Regenerative Medicine

Infusion Number	Infusion Indication	Date of Use	Time Stored (months)	Cord Blood Volume Collected (mL)	Post Thaw Viability	Total CD34+ Cells (% of total)
1	Anoxic Brain Injury	2/15/2005	5	25	92.00%	0.22%
2	Traumatic Brain Injury	4/12/2005	19	54	92.00%	0.27%
3	Cerebral Palsy	10/11/2005	35	45	91.00%	0.74%
4	Cerebral Palsy	9/19/2006	40	39	99.00%	CFU*
5	Cerebral Palsy	1/9/2007	42	34	88.00%	0.89%
6	Diabetes I	3/1/2007	27	170	99.00%	0.47%
7	Rare Immune Disorder	4/30/2007	69	83	82.00%	0.97%
8	Cerebral Palsy	5/15/2007	10	23	91.00%	0.17%
9	Diabetes I	5/17/2007	24	62	99.00%	CFU*
10	Diabetes I	7/20/2007	95	95	97.00%	CFU*
11	Cerebral Palsy	7/24/2007	18	49	99.00%	0.67%
12	Cerebral Palsy	8/28/2007	7	58	98.00%	0.40%
13	Cerebral Palsy	10/23/2007	32	55	98.00%	0.40%
14	Cerebral Palsy	10/23/2007	36	87	99.00%	0.21%
15	Cerebral Palsy	12/4/2007	20	27	72.00%	1.02%
16	Cerebral Palsy	1/15/2008	51	60	99.00%	0.51%
17	Cerebral Palsy	1/22/2008	22	65	90.00%	0.38%
18	Diabetes I	2/8/2008	105	98	95.00%	CFU*
19	Nonspecific Brain Injury	2/26/2008	34	54	99.00%	0.52%
20	Cerebral Palsy	3/18/2008	20	59	97.00%	0.34%
21	Cerebral Palsy	3/25/2008	39	14	99.00%	1.35%
22	Cerebral Palsy	4/8/2008	24	63	97.00%	0.81%
23	Cerebral Palsy	4/15/2008	98	75	98.00%	0.66%
AVERAGES			**37.9**	**60.6**	**94.35%**	**0.58%**

*Colony forming unit (CFU) reported from transplant hospital instead of percent CD34.

Indications for Umbilical Cord Blood Unit Release

(% of Total Released)



CONCLUSION:

UCB is increasingly being utilized as a source of stem cells for treatment of a wide range of disorders. The safety and availability of autologous UCB units and their capacity to differentiate into a variety of non-hematopoietic cell types makes them an attractive source for regenerative medicine. These data support that emerging therapies utilizing autologous cord blood stem cells appear to represent a significant and growing percentage of all treatments facilitated by a family cord blood bank. Family banks are providing a valuable resource in finding patients with stored autologous cord blood enabling researchers to use cord blood in clinical trials for regenerative medicine. Further analysis is needed to assess the outcomes.