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Cord Blood Banking: an OB's Perspective

BY JORDAN H. PERLOW, MD

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Bone marrow and peripheral blood have been the traditional source of stem cells. But now the transplantation of hematopoietic stem cells from umbilical cord blood is becoming the preferred treatment for more and more malignant, benign, and inherited disorders. We obstetricians are uniquely positioned to collect these potentially life-saving cells for this purpose every time we deliver a baby. So it's prudent and practical for us to learn about this vital medical technology and to educate our patients as well. Moreover, the direct marketing of cord blood banking services to our patients requires that we stay up-to-date on the scientific advances in this area and the potential conflicts and dilemmas they pose for our patients.

The use of bone marrow—the traditional source of these stem cells—has been fraught with drawbacks, primarily relating to the limited availability of such cells. In fact, for the 7,000 patients seeking allogeneic bone marrow stem cells annually in the United States, the search for an appropriate matched donor can prove difficult at best. Overall, only 25% will find a suitable match, with ethnic minority patients at greatest risk of failing to be appropriately matched.[1] The average time span from the search for a bone marrow donor to transplant exceeds 4 months. During that waiting time, patients with these serious illnesses may significantly deteriorate, become unsuitable for transplantation, and ultimately succumb to their disease. In fact, some 9,000 Americans die each year waiting for a stem cell transplant; sadly, one third of them are children. Umbilical cord blood may hold the remedy to this tragedy.

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The premise behind cord blood banking

Umbilical cord blood banking consists of the collection, processing, and cryopreservation of the remaining blood within the umbilical and placental circulation following the birth of a child and typically prior to

TABLE 1

Diseases potentially treatable with umbilical cord blood stem cell transplants

Acute leukemias
Acute biphenotypic leukemia
Acute lymphoblastic leukemia
Acute myelogenous leukemia
Acute undifferentiated leukemia

Chronic leukemias
Chronic lymphocytic leukemia
Chronic myelogenous leukemia
Juvenile chronic myelogenous leukemia
Juvenile myelomonocytic leukemia

Myelodysplastic syndromes
Chronic myelomonocytic leukemia
Refractory anemia
Refractory anemia with excess blasts
Refractory anemia with ringed sideroblasts

Stem cell disorders
Fanconi's anemia
Paroxysmal nocturnal hemoglobinuria
Severe aplastic anemia

Myeloproliferative disorders
Acute myelofibrosis
Agnogenic myeloid metaplasia (myelofibrosis)
Essential thrombocythemia
Polycythemia vera

Lymphoproliferative disorders
Hodgkin's disease
Non-Hodgkin's lymphoma
Prolymphocytic leukemia

Phagocyte disorders
Chediak-Higashi syndrome
Chronic granulomatous disease
Neutrophil actin deficiency
Reticular dysgenesis

Liposomal storage diseases
Adrenoleukodystrophy
Gaucher's disease
Hunter's syndrome
Hurler's syndrome
Krabbe disease
Maroteaux-Lamy syndrome
Metachromatic leukodystrophy
Morquio's syndrome
Mucolipidosis II (I-cell disease)
Mucopolysaccharidoses
Niemann-Pick disease
Sanfilippo's syndrome
Scheie's syndrome
Sly syndrome, ß-glucuronidase deficiency
Wolman disease

Other malignancies
Breast cancer
Ewing sarcoma
Neuroblastoma
Renal cell carcinoma

Histiocytic disorders
Familial erythrophagocytic lymphohistiocytosis
Hemophagocytosis
Histiocytosis-X

Inherited erythrocyte abnormalities
Beta thalassemia major
Pure red cell aplasia
Sickle cell disease

Congenital (inherited) immune system disorders
Absence of T & B Cells SCID
Absence of T Cells, Normal B Cell SCID
Ataxia-telangiectasia
Bare lymphocyte syndrome
Common variable immunodeficiency
DiGeorge syndrome
Kostmann syndrome
Leukocyte adhesion deficiency
Omenn's syndrome
SCID with adenosine deaminase deficiency
Severe combined immunodeficiency disease (SCID)
Wiskott-Aldrich syndrome
X-linked lymphoproliferative disorder

Other inherited disorders
Cartilage-hair hypoplasia
Glanzmann's thrombasthenia
Lesch-Nyhan syndrome
Osteopetrosis

Platelet abnormalities
Amegakaryocytosis
Congenital thrombocytopenia

Plasma cell disorders
Multiple myeloma
Plasma cell leukemia
Waldenström's macroglobulinemia

SCID—severe combined immunodeficiency disease

placental delivery. Within this "leftover" blood, traditionally discarded with the placenta as medical waste, lies a rich source of hematopoietic stem cells; undifferentiated cells that have the capacity to differentiate into the various components of the hematologic and immune systems. These pluripotent stem cells can differentiate to form lymphoid precursors, which then produce B-lymphocytes, T-lymphocytes, natural killer cells, and plasma cells, as well as myeloid stem cells that give rise to the erythrocytes, platelets, neutrophils, monocytes, eosinophils, basophils, and macrophages.

For more than a decade, banked cord blood stem cells have been used to treat thousands of people worldwide with more than 45 different malignant and nonmalignant diseases and to treat patients with severe combined immunodeficiency syndrome through gene therapy techniques (Table 1).[2-7] In my view, appreciating the advantages of cord blood stem cells over bone marrow stem cells (Table 2) casts each delivery we attend in a new light. It

becomes a unique and potentially life-saving opportunity to facilitate the banking of cord blood.[8]

The premise for banking cord blood is the fact that cord blood stem cells are the progenitor cells that can reconstitute the blood and immune systems. These cells are particularly abundant in cord blood—with concentrations nearly 10 times greater than that found in bone marrow—and are more proliferative. Unlike the risks inherent in bone marrow transplants, they can be collected safely without maternal or neonatal risk following delivery.[8-10] When infused, cord blood stem cells migrate to the bone marrow where they engraft and develop into the cell lines of blood and immune system components mentioned above. Thus, conditions whose pathophysiology emanates from abnormal cells originating from hematopoietic stem cells may benefit from therapy with stem cells from banked umbilical cord blood. This applies whether they're malignant (leukemia) or nonmalignant (sickle cell anemia) conditions, or diseases (solid tumors) whose treatment (chemotherapy and/or radiation) destroys the patient's healthy marrow stem cells and thus requires "rescue therapy" with stem cell transplantation.

Acceptability and advantages reported in the literature

A growing body of research on the clinical outcomes of patients treated with cord blood stem cells suggests not only the acceptability of this approach for both adult and pediatric patients, but the significant advantages to using stem cells from cord blood compared to bone marrow. Primary among these are the significantly lower risks of a serious complication of allogeneic stem cell transplantation known as graft-versus-host disease (GVHD). This condition, resulting from an unfavorable reaction of T cells in the graft to Human Leukocyte Antigens (HLAs) in the recipient, is a leading cause of morbidity and mortality among stem-cell transplant patients. Studies also suggest significant advantages to receiving stem cells from a related donor, particularly if the source of these cells is umbilical cord blood.

TABLE 2

Advantages of cord blood stem cells over bone marrow

Significantly reduced risk of graft-versus-host disease
Greater immunological naiveté
Painless, noninvasive, risk-free retrieval
Essentially unlimited supply
Technically simple collection process
Immediate availability for clinical use
Superior proliferative capacity
Significantly lower cost
Lower risk of infectious complications
Greater HLA mismatch tolerance

HLA—human leukocyte antigen

The first transplant of stem cells from cord blood took place 14 years ago in Paris. A 5-year-old child suffering with Fanconi's anemia was transplanted with stem cells using cord blood that had been banked from his newborn sister, who was HLA identical.[11] Several years later, in 1991, the successful treatment of a patient with cord blood stem cells for juvenile chronic myelogenous leukemia represented the first use of this cord blood-derived therapy for malignant disease. Since then, the use of cord blood stem cells has risen dramatically. It's estimated that more than 3,000 patients have now been treated with cord blood stem cells—and 400 to 500 new patients receive treatment annually.

In a large study of 562 patients who received unrelated cord blood transplants, Rubinstein and colleagues concluded that cord blood banking was a useful source of allogeneic hematopoietic stem cells for these patients, who did not have a related histocompatible donor.[4] They noted acceptable rates of engraftment and survival. An accompanying editorial pointed out that the results confirmed previous work, indicating that reproducible stem-cell engraftment can be achieved in patients with neoplastic disease using stem cells derived from cord blood.[12] Furthermore, the editorial continued, the reduced risk of GVHD with cord blood allows an increase in the permissible degree of histoincompatibility between the donor and the recipient.[12] HLA-typing for histocompatibility is the method of determining whether a collection of stem cells is suitable for transplantation into another person. The HLA system has been used for this purpose. There are six major antigens of this type and a match of five or six of the six is considered optimal, with a high likelihood of

TABLE 3

Private and public umbilical cord blood banking options*

Private options

Company	Phone	Web address	Successful transplant(s)	Samples stored	Price: initial banking cost/ yearly storage fee
California Cryobank	800-400-3430	http://www.cryobank.com	0	5,000+	$1,015/$115
Cord Blood Registry	888-267-3256	http://www.cordblood.com	28	60,000+	$1,740/$95
CorCell	888-326-7235	http://www.corcell.com	21	8,000+	$1,750/$95
Cryo-Cell	800-786-7235	http://www.cryo-cell.com	5	70,000+	$1,110/$115
Cryobanks Intl.	800-869-8608	http://www.cryo-intl.com	12	8,000+	$1,299/$95
LifebankUSA	877-543-3226	http://www.lifebankusa.com	11	20,000+	$1,395/$95
ViaCord	800-998-4226	http://www.viacord.com	11	50,000+	$1,650/$125

*Data accurate as of July 2004.

Selected public options

Company	Phone	Web address	Where collected
Cryobanks Intl.	800-869-8608	http://www.cryo-intl.com	Samples from all states accepted; Registration by 35 weeks required
Life South Community Blood Centers	352-334-1000	http://www.lifesouth.org	Local Florida and Alabama hospitals only
Alberta Cord Blood Bank	780-492-2673	http://www.acbb.ca/	Collections throughout Canada
Red Cross Blood Services, San Diego	858-514-1664	http://www.redcross.org	Collections at Palomar Hospital only
StemCyte Inc.	626-821-9860	http://www.stemcyteinc.com	Collections at Southern California hospitals
University of Colorado	303-372-2673		Collections at Denver area hospitals
Bonfils Cord Blood Services	303-363-2350		Collections at selected Colorado hospitals only
Hawaii Cord Blood Bank	808-983-2265		Collections at selected island hospitals

successful engraftment and survival. However, even with lesser degrees of matching, successful transplants of stem cells from cord blood have occurred.[3]

Laughlin and colleagues recently reported on 68 adults suffering from life-threatening hematologic disorders who received stem cells from banked cord blood from unrelated donors.[3] After undergoing intensive chemotherapy or total-body irradiation, all patients received transplants of HLA-mismatched cord blood. The vast majority of patients were HLA mismatched for at least two or more HLA antigens. The incidence of severe GVHD was low, neutrophil engraftment was 90%, and survival rates were encouraging, given the life-threatening nature of these disorders. The authors concluded that HLA-mismatched cord blood from unrelated donors can restore hematopoiesis in adults undergoing myeloablative therapy and is associated with acceptable rates of GVHD. This study and others suggest that even with the relatively small sample volume of banked cord blood, successful stem cell transplantation can take place in adults.

Studies of children have consistently shown the acceptability and advantages of using cord blood. Kurtzberg studied 25 patients, primarily children receiving cord blood from unrelated donors who were partially HLA mismatched. Excellent engraftment was noted, as was minimal risk for severe GVHD.[13] Other researchers reported the outcomes for 113 children requiring stem cell transplants for a variety of serious illnesses.[14] All

What is cord blood?

Umbilical cord blood, also known as placental blood, is blood that flows in the circulation of a developing fetus in the uterus. After the baby's birth, the left-over blood in the umbilical cord and placenta—which is a rich source of stem cells—is often discarded as biologic waste.

What are hematopoietic stem cells?

These stem cells are "progenitor" or immature unspecialized cells of the hematopoietic system that have the potential to later develop into more specialized cells—in fact to differentiate into all of the components of the blood and immune systems. During the 1980s, researchers found that cells in cord blood were similar to the hematopoietic stem cells found only in bone marrow.

What is stem cell preservation?

Stem cell preservation consists of collecting the aforementioned "leftover" umbilical cord blood from the placenta and umbilical cord after the baby is delivered and the cord is cut—which poses no risk to either the newborn or the mother. This blood containing the stem cells is then sent to the "bank," which processes the sample and ultimately preserves the cells by freezing them in liquid nitrogen.

Who should consider umbilical cord blood banking?

I personally believe you should inform all prospective parents of their options for "banking" their baby's umbilical cord blood for potential future use as stem-cell therapy. This opportunity is limited—obviously it will no longer exist once a baby is delivered—so it gives the couple a chance to determine if any relatives who currently have a disease might wish to pursue cord blood stem cell therapy. Parents should also find out about any family history of disease that may increase the risk for other family members. For patients like these, private cord blood banking may offer an opportunity to store the potential cure of these diseases. Some patients may choose to bank cord blood in the absence of "risk factors," given the small but potential need for these cells in the future.

How likely is it that families of patients with no history of disease will ever need stored stem cells?

It's estimated that the likelihood that a need for cord blood stem cells will arise within a family is no more than 1/1,500 Another option is to consider public banking of cord blood as a way to help others with serious diseases find a cure. This is available at no cost to the patient through Cryobank International (1-800-869-8608; www.cryo-intl.com).

How are stem cells currently being used to fight diseases, including cancer?

More than 3,000 patients with at least 45 diseases have now been treated using cord blood stem cells. These include malignant diseases like leukemia and lymphoma, as well as neuroblastoma and retinoblastoma. An important—and less well recognized—fact is that a multitude of nonmalignant diseases are also being treated using cord blood. These are primarily inherited disorders of the blood and immune systems and genetic diseases affecting metabolism in many ways. These therapies using cord blood stem cells are not "experimental" but are considered "mainstream" approaches to treatment.[1,2]

What are the possibilities for the future?

Promising research is ongoing into using cord blood to treat such diseases as stroke, Alzheimer's, multiple sclerosis, lupus, diabetes, and other autoimmune diseases. These future opportunities for treating such serious illnesses are based on the plasticity of cord blood stem cells, and the potential for them to be directed into other cell types, such as nerve, heart, liver,

stem cell donors were HLA-identical siblings, but the patients who received stem cells from cord blood were half as likely as those receiving bone marrow transplants to develop GVHD. In another study, which looked specifically at stem cell transplantation to treat pediatric leukemia, children who received HLA-mismatched cord blood from an unrelated donor also had a lower risk of GVHD than recipients of HLA-mismatched *marrow* from an unrelated donor.[15] These findings speak to the preference and benefits of using unrelated or related cord blood stem cells, if available, rather than unrelated or related bone marrow, in the event a stem cell transplant becomes necessary.

In an important study, Gluckman and colleagues addressed the issue of "order of preference" of cord blood sources.[16] They obtained and reviewed information on 143 cord blood stem cell transplants, giving attention to the source of the stem cells. It turned out that 78 cord blood recipients were related to the donor, while 65 other recipients were not. Patients in both groups were being treated for a variety of diseases, both malignant and nonmalignant. Gluckman found that patients who received their cord blood from a relative were significantly less likely to develop severe GVHD and were more than twice as likely to be alive 1 year later. The researchers noted significantly worse outcomes for the group receiving cord blood from unrelated donors—even in the group with no HLA mismatches—again suggesting the benefits of receiving

stem cells from a related source, if available.

Patient options and counseling

Patients may decide to bank their child's umbilical cord blood privately or publically—in those communities that offer it. But because private cord blood banks can be pricey—their services ranging from roughly $300 to $1,500 initially, with subsequent ongoing annual storage fees of $50 to $100—encourage patients to research their various options (Table 3).The Internet is a good place for them to start gathering information to discuss with you. Patients considering private umbilical cord blood banking shouldn't shy away from questioning prospective cord blood banks about the number of successful transplants they've performed, if they are accredited by the American Academy of Blood Banks for stem cell storage, and how long they've been in business. The issue of whether a cord blood bank has had stored samples used in successful transplants is significant—as it serves to validate the methodology of that bank's collection, processing, and preservation techniques.

Although for several years the marketing of private cord blood banking was aimed at motivating parents to store their child's cord blood in the event *that child* should develop a pediatric leukemia, it is more appropriate that patients approach the option of cord blood banking as a potential "family resource," where cord blood stem cells serve to treat diseases that occur among *family members*, including parents and siblings. In fact, using a child's own blood stem cells may not be preferable when treating blood malignancies, as a lack of graft versus leukemic effect may diminish the likelihood of successful treatment.

How likely is a person ever to need a stem cell transplant? Estimates have varied considerably, ranging from one in 1,000 to one in 200,000 for use by age 18.[17-19] The chance that a banked umbilical cord blood sample would be used for anyone within a family has been calculated at one in 1,400. Given these odds, the question is whether we should encourage patients to

Answering patients' questions about cord blood banking (*cont.*)

and pancreas cells, or the ability of the body to direct cord blood stem cells to damaged or diseased organs where a therapeutic reparative process will occur.

Can stem cells for one sibling be used for another?
Privately banked stem cells of a family member can be used for other members of the family if the "matching" is acceptable. Fortunately, compared to the traditional source of stem cells—bone marrow—cord blood cells can be used with less precise matching. Receiving stem cells from a relative also confers a greater likelihood of survival and a reduced likelihood of severe transplant-related complications. Mothers, siblings, and other relatives to the newborn contributing the cord blood have all been recipients of cord blood stem cell transplantation.

Can the cells be donated to anyone outside of the family?
Typically, privately banked stem cells are called upon to treat a family member with a known need or who develops a need in the future. Several children have now been treated using their own banked stem cells who had no specific risk factors to begin with—but who later developed unexpected life-threatening diseases that proved treatable with them.

Are any genetic diseases helped by using stem cells?
Yes; in fact, sickle cell anemia is being cured using cord blood stem cell transplantation. Many other inherited diseases have been similarly treated. Fanconi's anemia has been cured with cord blood transplantation and was the very first disease cured using cord blood stem cells in 1988. Rarer diseases, such as severe inborn errors of metabolism, have been treated in this manner (Table 1).

Is collection a difficult process?
No. Collection is relatively straightforward and is done after the infant is delivered and the umbilical cord is cut. It requires about 3 to 5 minutes before the placenta delivers.

If a patient is considering private cord blood banking and trying to choose a company, what questions should she ask?
Some suggested questions are:

1. How long has the company been established and working in the field of cord blood banking and stem cell research and how many samples do they have in storage?
2. Is the facility approved by the American Association of Blood Banks (AABB accreditation)?
3. Has the company had successful cord blood stem cell transplants? This is critical, as a successful transplant essentially validates the companies' methodology and procedures for collection, processing, and storage.

In my opinion, a prospective customer of a private "family" cord blood bank can feel more confident regarding their "investment" if the company is well established (>5 years), has thousands of banked samples, is accredited by the AABB, and is involved in hematopoietic stem cell research with respect to investigating current and future stem cell applications.

pursue private umbilical cord blood banking.

Neither the American College of Obstetricians and Gynecologists (ACOG)[20] nor the American Academy of Pediatrics (AAP)[21,22] recommends routine private umbilical cord blood banking for all patients. However, I believe that only the patient and her family in consultation with their medical care providers can best decide if this is something of value to them. Given the evidence within the literature suggesting significantly improved outcomes for individuals requiring stem cell transplants using related cord blood, I certainly would not discourage a woman from pursuing private cord blood banking if she were so inclined, aware of the costs, potential benefits, and low likelihood for need. Every individual has different priorities, therefore I believe in educating, counseling, and then allowing patients to make an informed decision.

ACOG and AAP have raised a number of important ethical and medical questions pertaining to cord blood banking, including: To whom do the stem cells ultimately belong? What happens if parents disagree on their use? Should cord blood be saved routinely at all deliveries? These questions and other ethical issues need continued discussion as we move forward with the expansion of umbilical cord blood banking opportunities.[23] Some years ago even the *Wall Street Journal* criticized private marketing practices for playing on the emotions of expectant parents.[24] The term "biological insurance" is often used to validate the expense of cord blood banking, and parents are often made to feel inadequate if they choose not to bank cord blood. Unquestionably, parents should not be made to "feel guilty" if they are not interested or able to afford this service. This is a particularly important point, considering the many patients for whom private cord blood banking may not be economically feasible. It is important to point out though, that private cord blood banks are likely to provide free services or banking at substantially reduced costs if a specific need is identified and cord blood is likely to be used for transplantation.

Also in my experience, payors have covered the costs of cord blood banking for patients in whom a stem cell transplant is likely, and physicians become patient advocates in communicating with insurance companies regarding these special needs.

The AAP statement, however, specifically says that private cord blood banking "should be considered if there is a family member with a current or potential need to undergo stem cell transplantation." That contingency and the ever-expanding list of conditions being treated with cord blood, heighten the importance of obtaining a thorough family history during the course of prenatal care. Patients themselves may be unaware of the potential importance in volunteering family medical history data. Therefore, I can't overstate the importance of questioning them directly—whether through an interview or survey—to identify family members with dis-

Key points

- Cord blood is a rich source of hematopoietic stem cells: undifferentiated cells that can develop into virtually any type of blood cell in the human body, and which now provide a better alternative to bone marrow transplantation to treat an expanding list of malignant, benign, and inherited disorders.
- The premise for banking cord blood is the fact that cord blood stem cells are the progenitor cells that can reconstitute blood and the immune system. These pluripotent stem cells can differentiate to form lymphoid precursors, which then produce B-lymphocytes, T-lymphocytes, natural killer cells, and plasma cells, as well as myeloid stem cells that give rise to erythrocytes, platelets, neutrophils, monocytes, eosinophils, basophils, and macrophages.
- Because using cord blood stem cells carries a smaller risk of graft-versus-host disease, it allows for a greater degree of histoincompatibility between donor and recipient.

eases that are potentially treatable or curable through the use of cord blood. The opportunity to obtain related cord blood stem cells doesn't often knock twice.

I'd advise patients who anticipate that a child or other family member will need a stem cell transplant to privately bank their child's cord blood. On the other hand, I'd counsel parents who ask about private cord blood banking as a form of "biological insurance" about the small likelihood that they'd ever need it, the costs involved, and the successful outcomes reported with related cord blood, in case a need should one day arise. Also I would present the currently fairly limited options for public donation. Public donation of umbilical cord blood should be without charge to the patient and practitioners are encouraged to learn of the resources within their communities.

With 4 million births per year in the US, a large reservoir of genetically diverse stem cell samples could be collected that would otherwise be discarded. Undeniably, many people would benefit from the availability of these samples, most especially ethnic minorities, given their underrepresentation in bone marrow registries. Cryobanks International (1-800-869-8608; www.cryo-intl.com) will accept public cord blood donations at no cost as long as collection arrangements are made prior to 35 weeks' gestation. Other public cord blood banks accept donations from samples only within affiliated hospitals (Table 3). Ultimately, it is hoped that significant medical advances in transplantation biology will improve outcomes for all patients, whether stem cells are obtained from related or unrelated sources.

The future looks promising

Several favorable new developments are occurring in cord blood banking. As successful engraftment correlates positively with larger numbers of stem cells within a transplanted sample, cord blood stem cell amplification or expansion is an in vitro process that holds great promise.[8] By increasing the numbers of stem cells within a sample, we can anticipate both more successful engraftment and a potentially inexhaustible supply of stem cells from any given sample.[25-27] The availability of greater numbers of stem cells would make possible transplants in larger-sized patients, multiple patients, or the provision of multiple doses for a single patient. At present, cord blood samples are used in their entirety and thus unavailable for subsequent use.

Recently, the first successful autologous cord blood transplants took place (Personal communication; Viacord, Cord Blood Registry, July 2002). These were cases where parents opted for private cord blood banking without any specific family risk factors, and the stem cells were subsequently used to treat unanticipated metastatic retinoblastoma, neuroblastoma, and several cases of severe aplastic anemia.

Expanded uses for cord blood appear to be on the horizon. Promising areas of current research are focusing on the use of cord blood for tissue regeneration, angiogenesis, and gene therapy. Stem cell therapies are being studied for diseases as wide ranging as diabetes, lupus, spinal cord injury, and neurologic disorders as diverse as stroke, multiple sclerosis, Parkinson's, and Alzheimer's.[28-33]

New information on the differentiation plasticity of hematopoietic stem cells raises the probability that these cells may be converted to cell types other than those of the blood and immune systems, such as skeletal muscle, heart, liver, brain, and epithelial tissues.[34,35] Such an accomplishment could replace the need for work with embryonic stem cells for this purpose and eliminate the compelling ethical and moral issues associated with the use or creation of human embryos for this purpose.

Conclusions

Privately banking a baby's cord blood after delivery may not be for every patient, but obstetricians should discuss cord blood banking with parents, or at least provide information. Advise women whose significant family or personal history indicates a potential need for stem cell treatment to seek counseling with medical or surgical specialists on the advisability of cord blood banking for this purpose (see "Answering patients' questions about cord blood banking," page 6). Another option is to contact private cord blood banks for advice and information on whether a particular disease is amenable to stem cell transplantation. Some years ago, it was predicted that "the collection of placental blood will become as usual as it is unusual today."[36] With greater

awareness of the many diseases treatable with stem cells, the superiority of cord blood to other sources, the potential cord blood stem cell breakthroughs of tomorrow, as well as the large untapped supply of these cells, this statement seems truer today than ever before. □

The author has spoken on the topic of cord blood banking and received travel reimbursement and honoraria from Viacell Inc.

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