CELL BANKS

Life blood

Stem cells from the umbilical cord are among the latest weapons in the fight against leukaemia.

BY MELINDA WENNER MOYER

Breast or bottle? Cloth nappy or disposable? Circumcise or not? Expectant parents face many choices, and now there is another: whether and how to bank the blood from their baby's umbilical cord.

Cord blood, taken from the placenta and umbilical cord immediately after birth, is rich with stem cells that can be used to replace or replenish abnormal cells. In a child with leukaemia, these transplanted cells could replace the diseased blood-forming stem cells killed by radiation or chemotherapy.

Parents who choose to bank their child's cord blood have two options: private banks, which cost upwards of US$3,600 for 20 years of storage[1], or free public banks that make it available to anyone who is a suitable match.

According to Bone Marrow Donors Worldwide in the Netherlands, more than 570,000 cord blood units are kept in public banks, and a 2008 survey found that 780,000 units are stored in 134 private banks[2]. More than 25,000 cord-blood transplants have been performed globally to date.

In the past five years, the scientific consensus has favoured the public banking option, particularly for leukaemia, because people with the disease usually benefit more from others' stem cells than from their own.

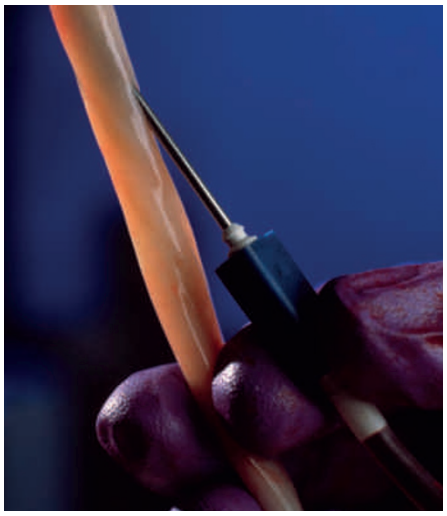
"A child who develops leukaemia has evidence that his or her own immune system has already failed to prevent the leukaemia," says Hildy Dillon, senior vice-president of patient services at the Leukaemia & Lymphoma Society, a non-profit research and advocacy organization based in White Plains, New York. In fact, she says, stem cells from donors sometimes attack the cancer cells in what is known as a helpful 'graft-versus-leukaemia' effect.

UNRELATED BENEFITS

People with leukaemia benefit most from bone-marrow transplants, ideally from immune-matched relatives. But two-thirds of those who need transplants can't find a match, and the search for unrelated matched donors can take months, particularly for people of some ethnic backgrounds[3].

Cord blood from unrelated donors can be an effective alternative. From 2003 to 2008, people with acute myeloid leukaemia who received cord-blood transplants from an unrelated donor had a 39% chance of surviving three years later, compared with 45% after an unrelated bone-marrow transplant and 43% after an unrelated peripheral-blood transplant, according to the US Department of Health and Human Services.

One big advantage of cord blood is that it does not need to be perfectly matched by immune subtype to prevent graft-versus-host disease[3], a condition in which the transplanted cells attack the recipient's tissues. This is because cord stem cells are immature and are enriched with regulatory T cells, a kind of immune cell that suppresses immune responses, says Eliane Gluckman, a haematologist at the Hôpital St Louis in Paris, France, who in 1988 performed the first successful cord-blood transplant for a rare genetic disease[4]. And because cord stem cells are less likely than other stem cells to have been exposed to pathogens, they are less likely to transmit infectious diseases.



Should parents bank their baby's cord blood?

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The main drawback of cord blood cells is that they take longer to engraft than do stem cells from more mature sources. This delay leaves recipients vulnerable to infection.

To limit the window of vulnerability, Marcel van den Brink, an oncologist at the Memorial Sloan-Kettering Cancer Center in New York, and his colleagues are testing a form of interleukin-7, a growth factor secreted by cells in the bone marrow that speeds up T-cell recovery and engraftment[5]. And ProHema, a cell therapy developed by California-based Fate Therapeutics, helps stem cells home to the bone marrow faster, shortening engraftment time.

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But even if engraftment can be accelerated, cord-blood transplants will still face serious limitations. Doctors can extract only a limited number of cells from one umbilical cord — typically less than half the 20 million cells per kilogram of the recipient's body weight usually recommended for adult transplants.

"Cord blood works well, but the problem is the amount per sample that can be collected," says Mahendra Rao, director of the NIH Center for Regenerative Medicine in Bethesda, Maryland. "If we could expand it, pool it or in some other way augment the supply without losing its efficacy or introducing additional problems, there would be a sea change" in the prevalence of this approach, he says.

DOUBLING UP

To address this problem, researchers at the University of Minnesota began combining cord blood from two unrelated donors. Analysing 536 stem-cell transplants for leukaemia conducted between 2001 and 2008, they found that the 128 people with leukaemia who had received double cord-blood transplants were less likely to relapse or develop graft-versus-host disease than those who had received bone-marrow transplants. But the cord-blood recipients were also 2–3 times more likely to die from infection and haemorrhage. Combine these effects, and double cord-blood transplant recipients had a five-year cancer-free survival rate of 51%, similar to those who received bone-marrow or peripheral-blood transplants from relatives or immune-matched non-relatives[6].

The researchers speculate that the unexpectedly low relapse rate may be because having two donors increases the chances of a beneficial graft-versus-leukaemia effect, with one or both sources of cells eliciting the response[6].

Cord blood's future as a viable treatment is likely to depend on more than scientific problem solving. The American Medical Association, the International Federation of Gynecology and Obstetrics, and the UK Royal College of Obstetricians and Gynaecologists have all discouraged private cord-blood banking except in the case of known medical need, noting that public banking is generally more useful. The question is whether these recommendations will reach expectant parents — and whether the parents will heed them. ■

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