

Umbilical Cord Blood Donation: An Evolving Lifeline for the Stem Cell Field

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The fact that stem cells hold increasingly apparent and still untapped potential for the treatment of a multitude of genetic diseases is undisputed; however, the sources from which pluripotent isoforms are harvested, specifically embryonic, carry significant ethical considerations that have hampered their wide-spread adoption in the clinic. Adult stem cells negate this problem, but are often invasively attained and limited in their potency to produce the various cell types needed to treat complex diseases, whilst induced pluripotent stem cells, despite their impressive innovation, are not (as of yet) a scalable option for the healthcare industry. Could umbilical cord blood banking be meeting some of these challenges head on?

Cord blood can be collected and stored from the placenta and umbilical cord following the birth of a new-born. It is replete with haematopoietic stem cells, identifying it as potential aid in the fight against various immune deficiencies, genetic conditions, metabolic disorders, and cancers. There are currently 37,000 people in the UK requiring a stem cell transplant,¹ but around 70% of patients requiring one do not have a matching donor in their own family;² importantly, cord blood-sourced stem cells somewhat bypass this problem due to having less stringent human leukocyte antigen matching and lower graft-versus-host disease burden.³ This is especially important for non-Caucasian recipients for which finding a suitable match can be desperately hard.¹ Additionally, cord blood collection represents a steady and scalable source of stem cells that could feasibly improve the current long waiting times for patients.

Umbilical cord blood donation is still a relatively young field, beginning with the first donation in

1989 for the treatment of a child with Fanconi's Anaemia.⁴ This related donation was quickly followed by the first unrelated donor cord blood transplant in 1990, this time for the treatment of a four-year-old boy with T-cell leukaemia.⁵ The advantages cord blood donation offered over conventional stem cell sources in regard to compatibility between donor and host could not be ignored, leading to increased practice in clinics across the USA and UK throughout the 1990s and into the 21st century.⁵ The charity sector, including UK-based Anthony Nolan, have taken notice.

Anthony Nolan puts considerable effort into providing support across the entire stem cell spectrum (primary research, matching of donor/recipients, offering support and information for patients), and cord blood donation is no exception. The charity has identified four major hospitals in the UK in which child birth numbers and ethnic diversity are high, and that serve as a primary source of cord blood: King's College Hospital,

London; Saint Mary's Hospital, Manchester; Leicester Royal Infirmary; and Leicester General Hospital. The straight-forward process likely puts mothers' minds at ease, as the cord is clamped as normal following vaginal or caesarean delivery before being taken, together with the placenta, to a separate room for blood extraction. The blood is transferred to a cell therapy centre, assessed for transplant suitability, and then frozen for as long as 25 years or until the cells are matched and needed.⁶ The efficiency and simplicity of the charity's pipeline sets a sterling example for other bodies to follow suit.

Both the NHS and Anthony Nolan openly share first-hand accounts and testimonies of the life-saving opportunities cord blood donation has offered to young patients. The former promotes the story of a child who was diagnosed with the rare and life-threatening disease Hurler's syndrome,⁷ a condition characterised by accumulation of toxic sulfate compounds in the body that results in severe organ failure.⁸ Following the child's diagnosis at 9 months old and initiation of enzyme replacement therapy, their immediate family were screened for bone marrow transplant suitability but to no avail. A match was found through stem cell registries in a cord blood unit in Germany, leading to a successful transplant within weeks. The likelihood that this patient would not have survived into adulthood without an available donated cord blood sample adds weight to the importance of Anthony Nolan's objective, and would undoubtedly resound with mothers contemplating donation of their own cord blood and tissue for charitable purposes.

Complimentary to donative purposes, a growing sentiment to which cord blood collection is undoubtedly tied is the idea of investing in one's child's future, a haematological insurance policy should genetic predispositions manifest as disease later in life. This 'banking' of cord blood is increasingly common, with some 27,028 blood and tissue units being banked privately in the UK in 2018.⁹ The British Broadcasting Corporation (BBC) recently published an article discussing the case of a mother harbouring a mutation in breast cancer susceptibility gene *BRCA1* who pre-emptively paid to bank her newly born son's cord blood and tissue.⁹ "I've got no control over whether I've passed a faulty gene to them but I feel like I've got a little bit of control now if something was to happen," explained Rosaira Tormey from Sheffield. This outlook is not unanimously supported however, with some claiming that private banks are

monetising parent concerns that are not being properly discussed with qualified specialists in regard to accurate disease prediction, or even cell utility.¹⁰ Italy and France have both banned private cord-blood banking, and bodies such as the American Academy of Pediatrics (AAP)¹⁰ and the Royal College of Obstetricians and Gynaecologists⁹ have both expressed concern over private, but not public, cord blood donation.

Whilst admittedly there are ethical concerns in the UK around the idea of private banking as opposed to public donations to charities or other NHS-affiliated stem-cell banks, there is regardless a clear change in public perception towards making the most of something that for decades we had discarded. Donor suitability, host rejection, and a limited pool have long been issues facing the public stem cell donation sector, therefore it is not entirely surprising that we are witnessing increased interest in capitalising on cord blood as an elixir for tackling a multitude of pathologies. It is perhaps more surprising that it did not happen sooner.

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