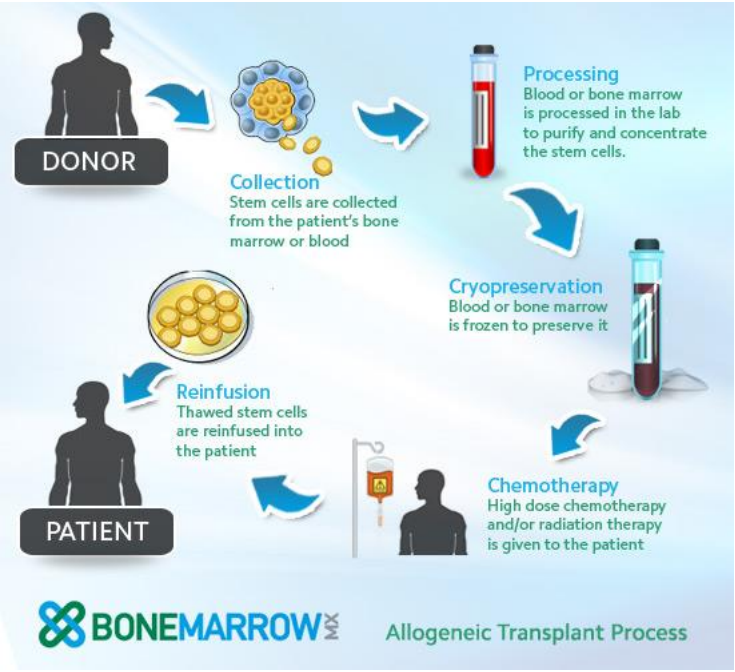
The Sanctimonious Science of Saviors

By Zaed Hindi

The infamous dictator Pol Pot once said, "Better to kill an innocent by mistake than spare an enemy by mistake." Unfortunately, this all-or-nothing mindset is also that of many modern-day cancer treatments. In our modern world, one of the worst parts about chemotherapy and radiation is that they destroy not just the cancerous cells, but also every other type of rapidly-dividing cell. Such cell types destroyed by these agents include your immune cells – the cells that, as their name implies, are responsible for your body's immunity. Likewise, it accounts for why children recovering from conditions such as Ewing sarcoma or glioblastoma must stay in the hospital for an extended period. Their immune response is virtually non-existent at this time and, as such, they must remain in as sterile of an environment as possible. Luckily, there is a way to repopulate these missing cells and essentially re-grow one's immune response – transplantation of hematopoietic stem cells (HSCs). Normally, this is done via a process called *allogenic stem cell transplantation* – infusing stem cells from a compatible donor into the hollow space (referred to as the medullary cavity) of a patient's bones.

Unfortunately, finding such a donor is usually very difficult, even within a family. Only about 30% of those in need of HSC transplants actually have a sibling with an identical copy of the Human Leukocyte Antigen (HLA) gene complex. This is important because this complex is a collection of nine genes that encodes the proteins responsible for our adaptive immunity. [1] Without these genes being the same, the proteins they encode will recognize the body's cells as intruders or invaders. This can result in a complication known as graft vs. host disease (GvHD), in which the donated HSCs, having developed into immune proteins, attack the recipient's own tissues. [2]

Figure 1: A graphical depiction of the process of allogenic stem cell transplantation.



This problem stumped medical researchers for over two decades until, in 2000, translational researcher Yury Verlinsky and his team discovered a way around it. It all began with a 12-year-old girl who had been previously diagnosed with Fanconi anemia, a rare genetic disorder which disrupts the body's ability to appropriately respond to DNA damage and often leads to a rapidly-growing form of leukemia. In an attempt to save her life, her parents first underwent *in vitro* fertilization to create multiple embryos. Then,

Verlinsky and his colleagues used a technique called preimplantation genetic diagnosis (PGD) to select an embryo with the same HLA patterning as the anemic child. After nine months, the baby's cord blood was harvested from the placenta and umbilical cord for use in the ill sibling's bone marrow transplant, and young Adam Nash became the first known "savior sibling" born in the United States for the good of his sister Molly. [3]

The procedure that was used by Verlinsky and his team, which is clinically known as PGD/HLA tissue typing, is highly applicable to a wide variety of medical conditions. As long as it can be shown to successfully and safely restore a patient's immune response, PGD/HLA tissue typing may be used for treating various metabolic disorders, immunodeficiencies, hematologic diseases, malignancies, and even a handful of particularly nasty viral infections. To replenish or enhance the recipient sibling's supply of HSCs, they may be taken from the "savior sibling" by way of the placenta/cord blood supply, bone marrow, or – in extremely advanced cases involving organ failure – one or more organs.

However, the moral and ethical implications of having a child with such an intent in mind have also been scrutinized by both the public and bioethicists alike. As exemplified in the 2004 Jodi Picoult book *My Sister's Keeper* (and its subsequent 2009 film adaptation), concerns exist for the autonomy of the savior sibling whilst still respecting the right to life possessed by the recipient sibling. Often, the train of thought regarding this perspective is that, in conceiving a savior sibling, said child is being used as a means to an end – namely to save the life of a sibling – and that their own individual humanity is being overlooked in the process. [4] This is definitely not a baseless ethical concern, nor is it new, with the philosophical basis of this issue having been debated widely since the late 18th century. Although still a hotly-contested topic, what is apparent is the following. While there are certainly social dimensions that may prevent us from doing all that is ethically conceivable in such a case (i.e. being part of a family unit or even simply being human), it may be best to look at these kinds of cases from both a positive and negative perspective. In other words, weighing the pros and cons of the action can help us determine which approach is stronger and, in turn, determine the best course of action.

It is clear that stem cell therapy truly has vast potential in the field of medicine and regenerative therapy. With increases in funding and research, we may be ever closer to the day we come to rely on a balance of both chemicals and stem cells in helping restore patients' immune systems – killing the bad while encouraging the flourishing of the good. That being said, we must always remember that these stem cells originate from a fellow human being and do our best to keep ourselves, both as scientists and ambassadors of science, from becoming inhuman in the name of our fellow man.

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