My Sister’s Keeper

Science Background Talk
Outline

- Acute promyelocytic leukemia (APL)
- APL Treatment
- “Savior Siblings”
- *In vitro* fertilization (IVF)
- Pre-implantation Genetic Diagnosis (PGD)
- Risks of donating a kidney
Acute promyelocytic leukemia (APL)

- APL is a rare type of acute myeloid leukemia (AML)
- APL is caused by translocation between chromosomes 15 and 17
- This leads to a deficiency of mature myelocytes and excess of immature promyelocytes

APL Symptoms

- Fatigue, weakness, shortness of breath
  - From anemia (low red blood cells)
- Easy bruising and bleeding
  - From thrombocytopenia (low platelets)
- Fever and infection
  - From the lack of normal white blood cells
- Abdominal discomfort
  - Due to the enlargement of spleen
APL Treatment

- **Initial treatment** includes:
  - Chemotherapy + ATRA (all-trans retionnic acid)
  - This induces remission in 80-90% of patients

- After there are signs of remission, need to undergo **consolidation therapy** to “consolidate” the remission
  - This often includes two more courses of ATRA and chemotherapy

- After consolidation therapy, undergo **maintenance therapy** for at least one year
APL Treatment

- Bone marrow, peripheral blood, and umbilical cord transplants
  - These transplants restore lost blood cells thereby allowing doctors to use higher doses of chemo and radiation to fight the cancer

http://www.chop.edu/export/system/galleries/images/hospital/conditions/bone-marrow-transplant-125422.gif
Savior Siblings

- The creation of a genetically matched human being in order to be the savior of a sick child in need of a donor
  - Since savior siblings are genetically designed, they are sometimes called “designer babies”
Role of “Savior Siblings” (SS)

- SS can donate **umbilical cord blood stem cells** at birth
- Later in life, SS can donate **bone marrow**
  - Donor receives Growth Hormone injections for 3 days prior to bone marrow donation
  - After donation, donors may feel stiff, sore, tired for 2-3 days and may not fully recover strength for 3-4 weeks
- SS can also be a potential **organ donor**
Real “Savior Siblings”

- **Nash Family (USA)**
  - 6 year old daughter had Fanconi’s anemia
  - A “savior” son was born as a donor for sister

- **British Hashmi Family (U.K.)**
  - Son had hereditary Beta Thalassanemia
  - After the family appealed, the UK’s HFEA (Human Fertilisation and Embryology Authority) allowed use of PGD/IVF to create a Savior Sibling

- **Whitaker Family (U.K.)**
  - 3 year old son had Diamond-Blackfan anemia from nonhereditary genetic mutation
  - The UK’s HFEA denied the use PGD so the family went to Chicago to create a Savior Sibling
Designing a “Savior Sibling”

- Kate needs a perfect HLA embryo match in order to receive cord blood
  - HLA: Human Leukocyte Antigen

- Design a Savior Sibling using:
  - *In vitro* fertilization (IVF)
  - Pre-Implantation Genetic Diagnosis (PGD)
IVF

- IVF is a method of assisted reproduction.
- In IVF, sperm and egg are combined and fertilized *in vitro* ("in glass").
- Then 2-4 of the resulting embryos are transferred to women’s uterus for implantation.

[Image source](http://www.scientificamerican.com/media/inline/blog/Image/in-vitro-fertilization.jpg)
PGD

- PGD involves the screening of early embryos for selection of ‘healthy’ embryo
- To screen embryos, a single cell is removed from 8-cell embryos for genetic testing
- The selected embryo is then implanted into mother’s uterus with IVF and the remaining embryos are rejected

Embryo Biopsy

http://www.ivf-amman.com/images/IVF/embryo.jpg
Embryo Biopsy

http://www.nature.com/nrg/journal/v3/n12/images/nrg953-f1.jpg
Risks of Donating a Kidney

- 3-5 day hospitalization
- 2-3 months recovery time
- No pregnancy complications
- Long term side effects include:
  - Slight chance of high blood pressure, and excess protein in urine
  - Remaining kidney will grow to compensate
  - Up to a 1% chance that remaining kidney will fail
  - Must avoid certain pain medications (ex. Ibuprofen)
Works Referenced