



# ***The Next Reproductive Revolution***

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## *Disclosure*

- ◆ Will not be promoting unlabeled/unapproved uses of drugs, devices, products, protocols, or therapeutic strategies.
- ◆ Serves on Illumina's external bioethics advisory board.

# *The First (?) Reproductive Revolution*



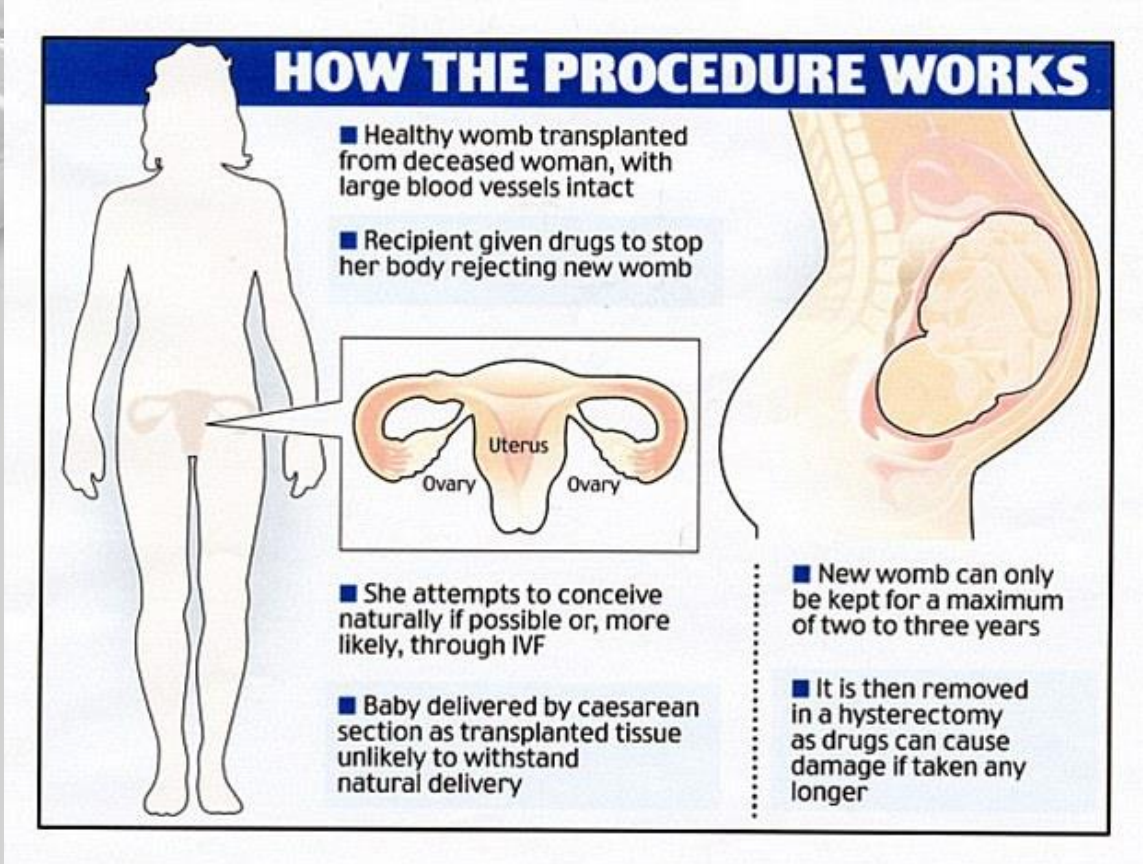
*Enrique Rottenberg LA HISTORIA DE UN HUEVO / THE HISTORY OF AN EGG (2017)*

## *“Old School” New School Reproduction*

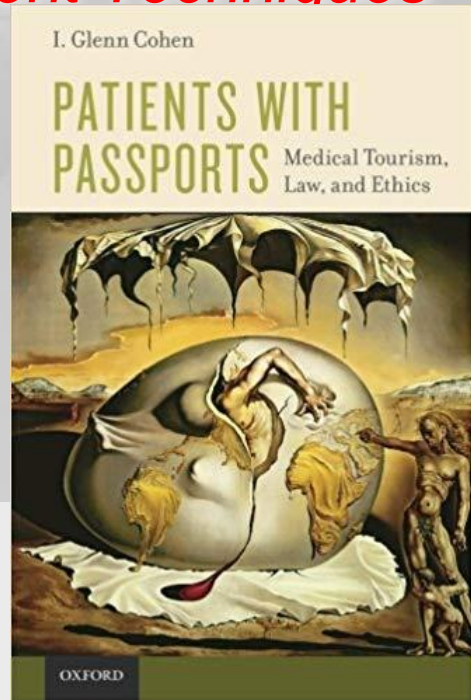
- ◆ Artificial Insemination (AI)
- ◆ In Vitro Fertilization (IVF)
- ◆ Preimplantation Genetic Diagnosis (PGD)
- ◆ Surrogacy (Traditional vs. Gestational)



# Borrowed Wombs: Uterus Transplants



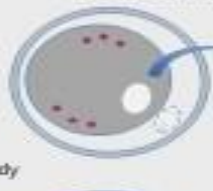
# Three Genetic Parents? Mitochondrial Replacement Techniques



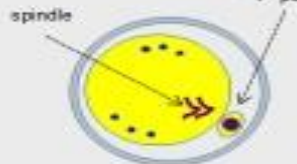
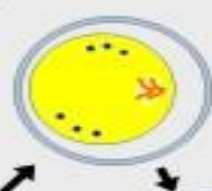
1. Unfertilised patient's egg with abnormal mitochondria



2. Spindle and associated chromosomes removed as karyoplast from patient's egg and fused into "enucleated" donor egg



3. Reconstituted egg is fertilised (by ICSI) with sperm from patient's partner



Unfertilised donated egg with normal mitochondria



Spindle and associated chromosomes removed as karyoplast from donated egg and discarded



4. Cleaving embryo with normal mitochondria and maternal and paternal genome can be transferred to the uterus



The 1<sup>st</sup> polar body is a diploid product of the first meiotic division, which occurs at ovulation. The 2<sup>nd</sup> polar body is a haploid product of the second meiotic division, which occurs on fertilisation (or after activation). The polar bodies fail to persist and do not contribute to the resulting embryo.

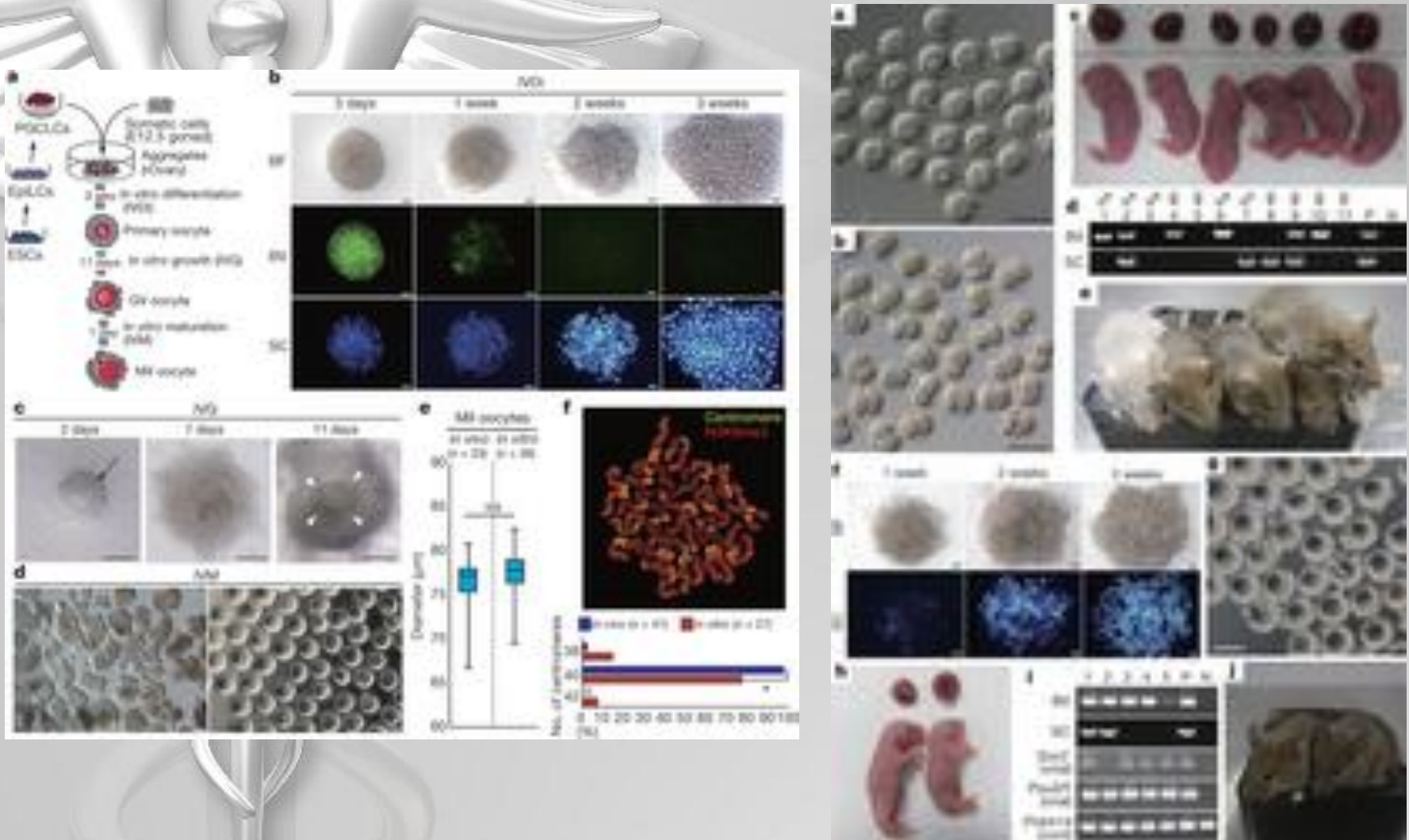
**MST**  
**Maternal spindle transfer**

# *Mitochondrial Replacement Techniques*

- ◆ Legal/Ethical Issues
  - ◆ Crossing the Germ-Line “Red Line”?
  - ◆ Anonymity and Payment of Mitochondrial Donor
  - ◆ Parentage Questions (?)
  - ◆ Sex Selection



# In Vitro Gametogenesis (IVG)

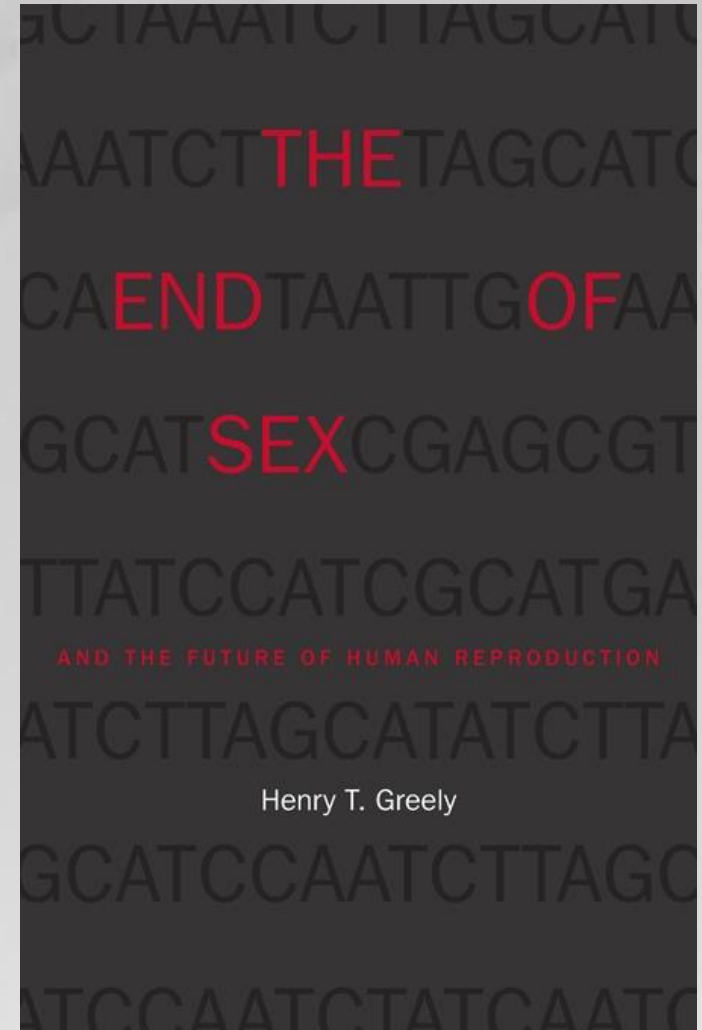


From Hikabe et al, Reconstitution in vitro of the entire cycle of the mouse female germ line, *Nature*, 539, 299-303 (2016)



# *In Vitro Gametogenesis (IVG)*

- ◆ Legal/Ethical Issues
  - ◆ Mass Embryo Creation
  - ◆ Embryo Destruction
  - ◆ Enhancement (+ Gene Editing)
  - ◆ Unauthorized Parenthood
  - ◆ Multiplex + Single Person Parenthood



## *Image Acknowledgements*

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