State of Fertility in X and Y Chromosomes Variations Individuals

What You Should Know in 2025

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26 July 2025 Atlanta

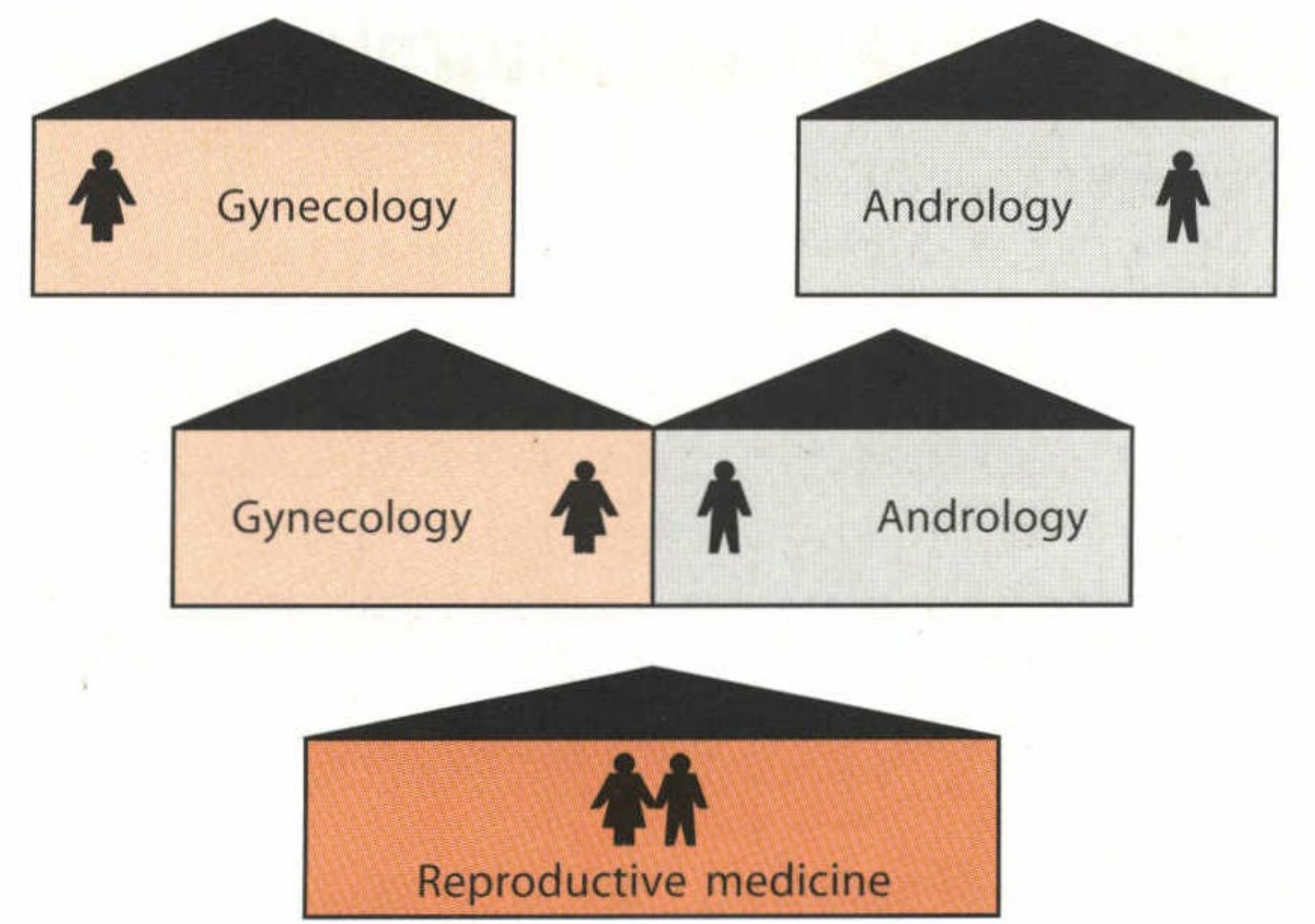
Disclosures

- Active Patent: **5/294,154 | 9865-185**
- **METHOD OF PRODUCING IN VITRO**
- **TESTICULAR CONSTRUCTS AND USES THEREOF**

Application AU2019200730A events
Priority claimed from US201161492151P
2019-02-04
Application filed by Inguran LLC
2019-02-04
Priority to AU2019200730A
2019-02-21
Publication of AU2019200730A1
2021-08-12
Application granted
2021-08-12
Publication of AU2019200730B2
Status
Active
2032-06-01
Anticipated expiration

Objectives

- Infertility in general population (Male & Female)
- Fertility in Klinefelter syndrome
- Fertility in Triple X syndrome
- Current clinical options to treat infertility
- Future options to treat infertility


Gynecology
Andrology
Gynecology
Andrology
Reproductive medicine

Terminology

Fertility refers to the capability to **conceive or induce a pregnancy**.

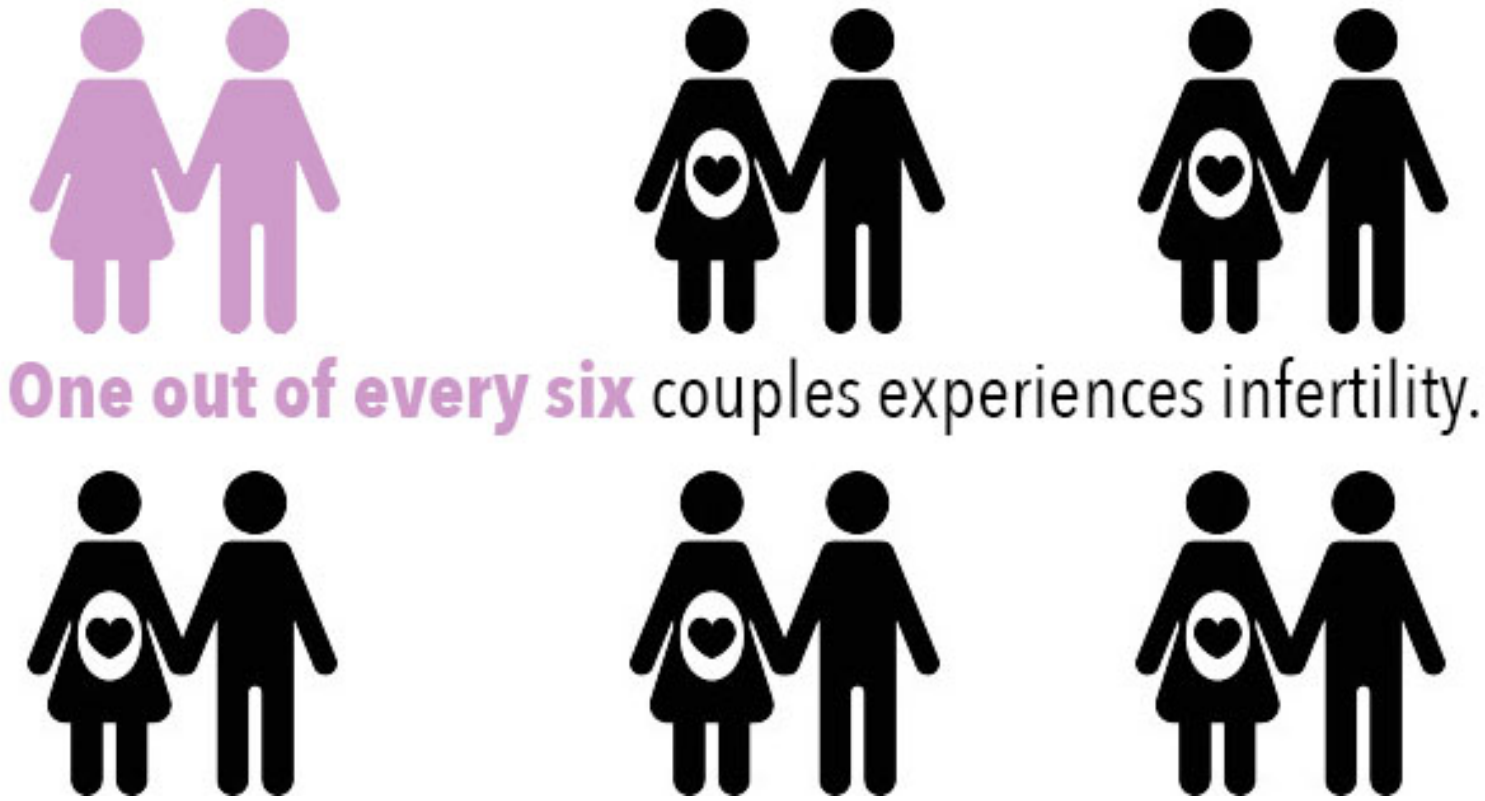
Fecundity refers to the probability of producing a **live birth** arising from a given menstrual cycle.

Infertility is the term used when a couple **fails** to induce a pregnancy within **one year** of regular unprotected intercourse.

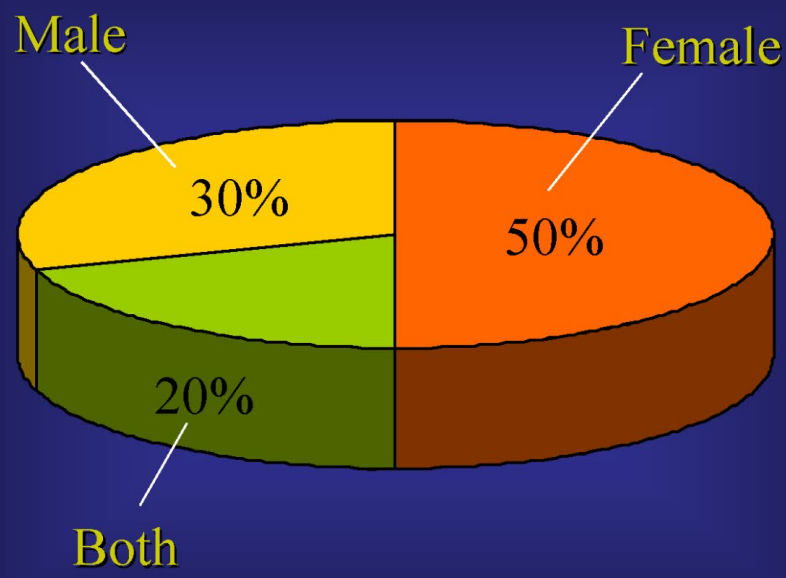
Primary infertility defines the condition when **no pregnancy at all** has been Achieved.

Secondary infertility means **no further** pregnancies have occurred. The term infertile can be applied to both men and women.

Infertility Prevalence

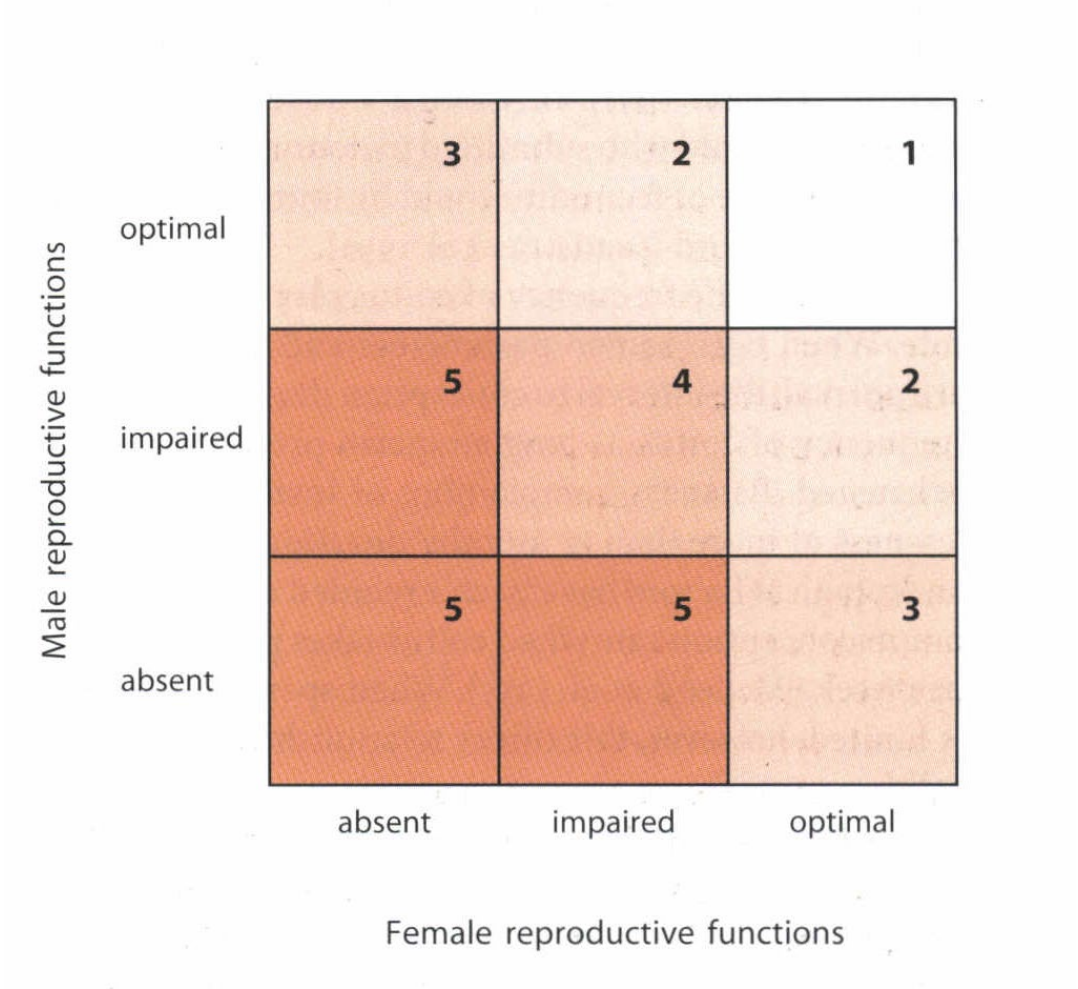


The Infertility Problem

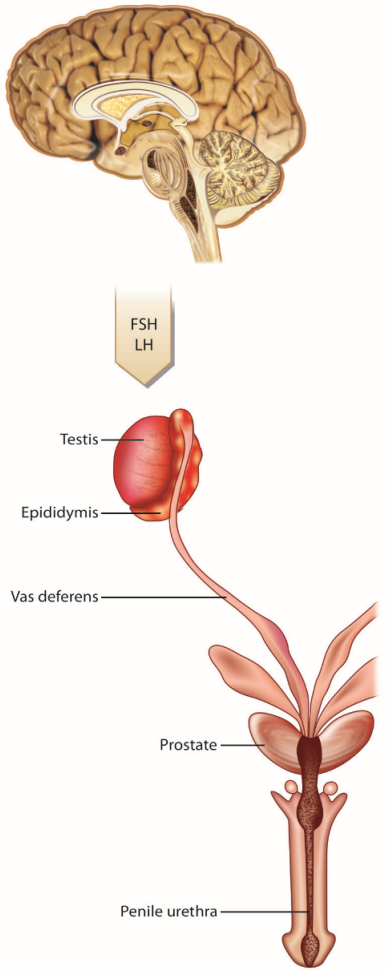


Affects 6-8 million couples in US (NSFG 2002, NICHD)

Interdependence of male and female reproductive functions



Classification of causes of the male infertility



PRE-TESTICULAR

- Congenital
  - Kallman syndrome
  - Laurence-Moon-Bardet-Biedl syndrome
  - Prader-Willi syndrome
- Acquired
  - Hypopituitarism
    - Tumor
    - Ischemia
    - Post-surgical
    - Radiation
  - Endocrinopathy
    - Hyperprolactinemia
    - Exogenous testosterone
    - Excess estrogen
- Idiopathic

TESTICULAR

- Congenital
  - Chromosomal abnormalities
    - Klinefelter syndrome
    - Y-chromosome microdeletions
  - Noonan syndrome
  - Cryptorchidism
- Acquired
  - Varicocele
  - Torsion
  - Orchitis
  - Gonadotoxins: radiation, chemotherapy and heat
- Idiopathic

POST-TESTICULAR

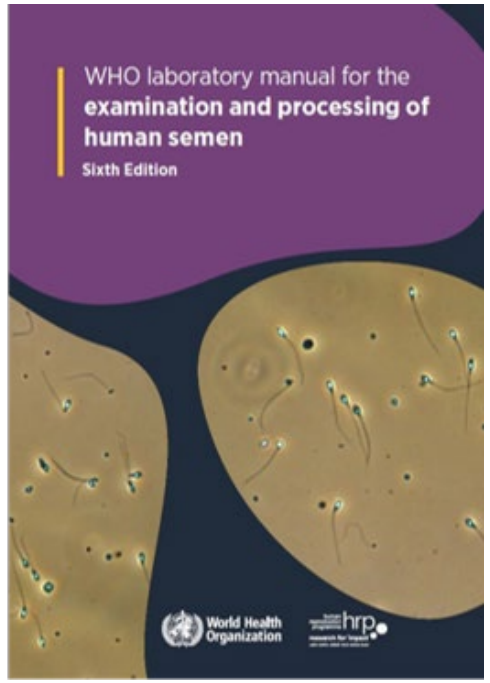
- Congenital
  - CBAVD/cystic fibrosis
  - Utricular/müllerian duct cysts
  - Atresia/stenosis of the ejaculatory ducts
- Acquired
  - Anatomic obstruction
    - Ejaculatory ducts
    - Vas deferens
  - Retrograde ejaculation
  - Penile deformities
  - Erectile dysfunction
  - Failure of emission/ejaculation
- Idiopathic

Distribution of Diagnostic Categories

Category	N	%
Varicocele	629	26.4
Infectious	72	3.0
Hormonal	54	2.3
Ejaculatory dysfunction	28	1.2
Systemic diseases	11	0.4
Idiopathic	289	12.1
Immunologic	54	2.3
Obstruction	359	15.1
Cancer	11	0.5
Cryptorchidism	342	14.3
Genetic	189	7.9
Testicular failure	345	14.5
TOTAL	2,383	100.0

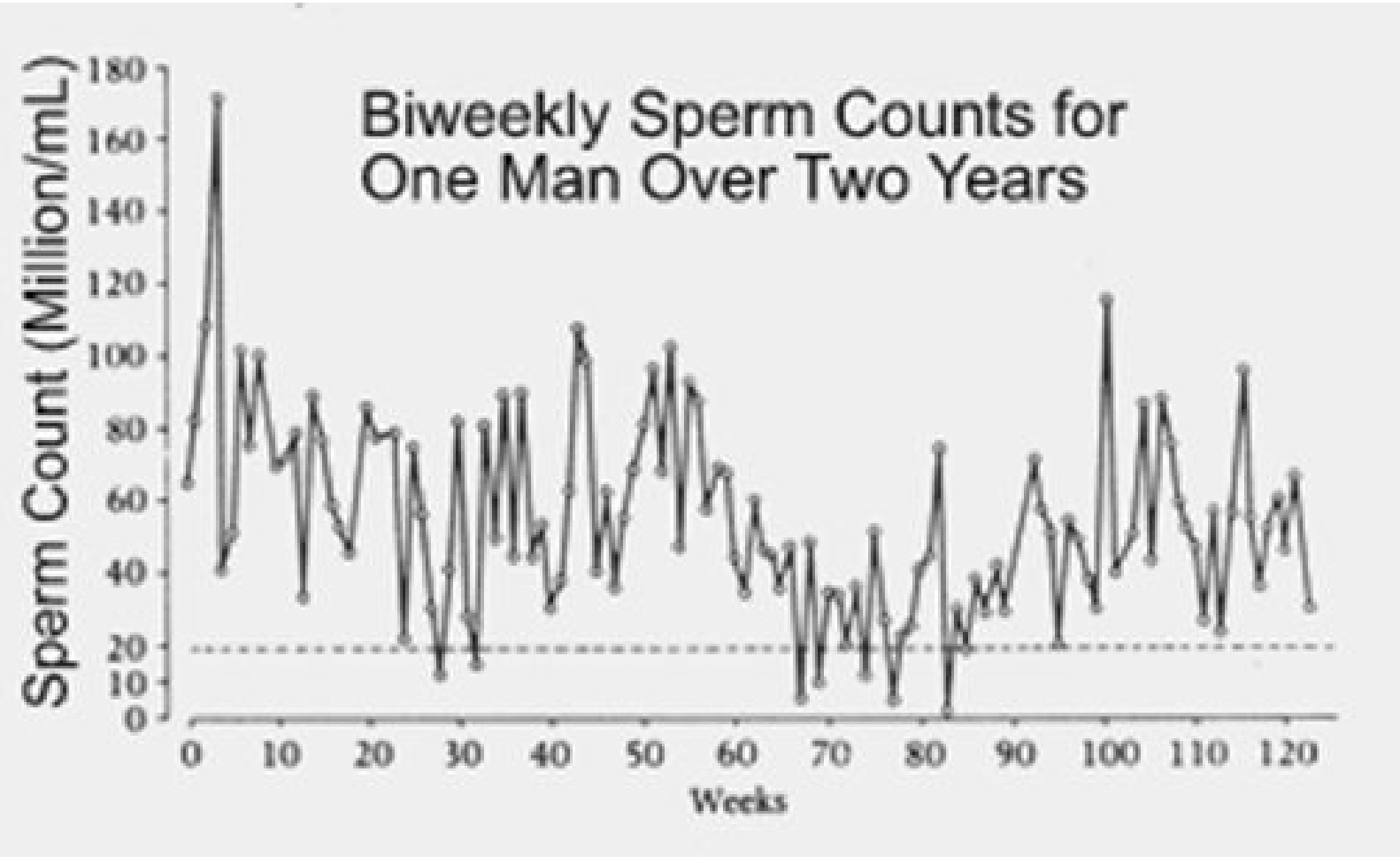
Semen Analysis

- **2-3 days of abstinence**
- **Collection technique**
- Note: SA best performed in andrology lab; If abnormal **always repeat**

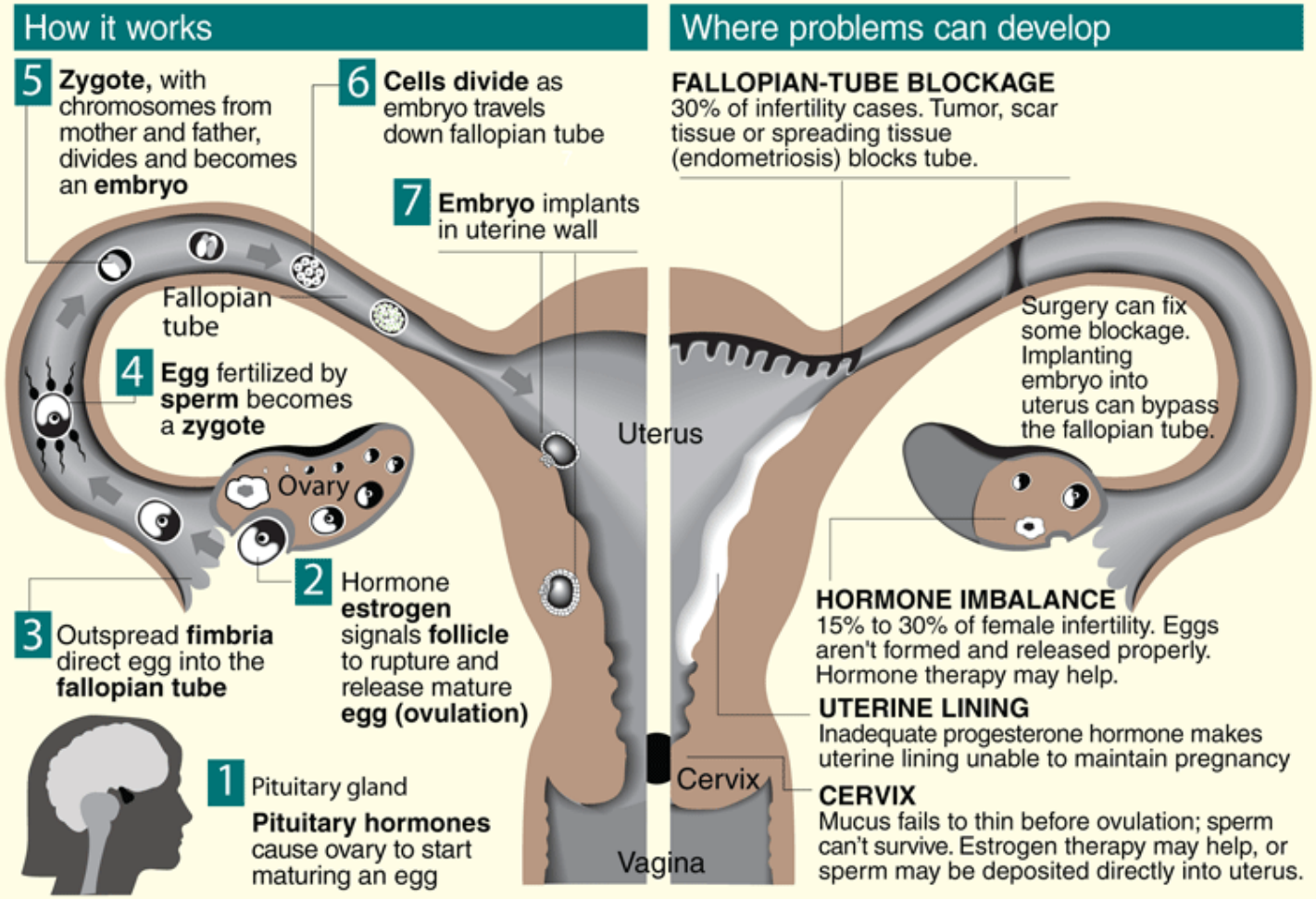


Semen parameter	WHO 1980	WHO 1987	WHO 1992	WHO 1999	WHO 2010[1]	WHO 2021
Volume (mL)	ND	≥2	≥2	≥2	1.5	1.4
Sperm concentration ($x10^6$/mL)	20-200	≥20	≥20	≥20	15	16
Total sperm number ($x10^6$)	ND	≥40	≥40	≥40	39	39
Total motility (%)	≥60	≥50	≥50	≥50	40	42
Progressive motility (%)[2]	≥2[3]	≥25	≥25 (grade a)	≥25 (grade a)	32 (a+b)	30
Vitality (%)	ND	≥50	≥75	≥75	58	54
Normal morphology (%)	80.5	≥50	≥30	(14)	4	4

Sperm count vary over time



THE FEMALE FERTILITY CYCLE



MCT
SOURCES: "ABCs of the Human Body," "Mayo Clinic Family Health Book,"

Common Causes Female Infertility

Ovulation Disorders Causes:

- Aging
- Diminished ovarian reserve
- Premature ovarian failure
- Endocrine disorders (as PCOS)

Tubal Causes:

- Pelvic inflammatory disease
- Tubal Surgery
- Previous ectopic pregnancy
- Salpingectomy

Uterine/Cervical Causes:

- Congenital uterine anomaly
- Fibroids
- Endometriosis
- Poor cervical mucus quantity/quality
- Infection

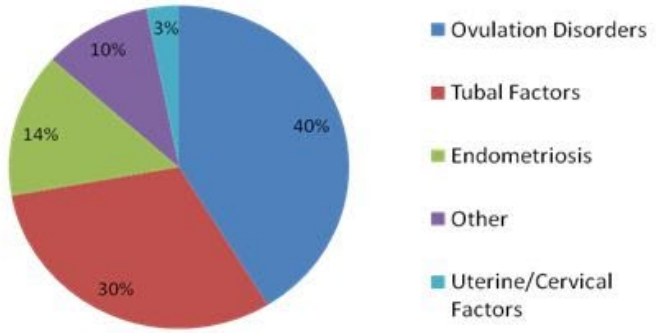
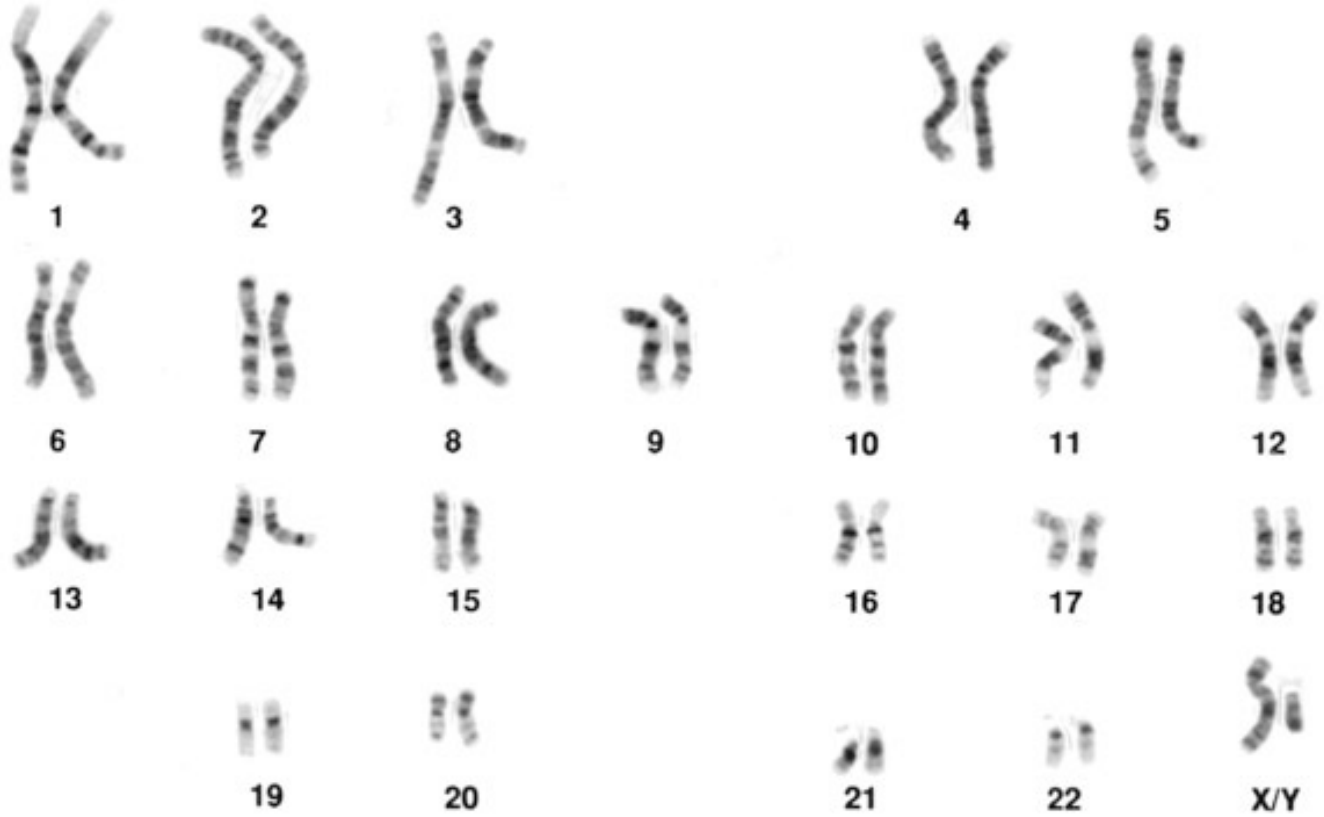


TABLE 4.14 Incidences of Selected Chromosomal Abnormalities in Live-Born Infants

Abnormality	Incidence in Live Births
Autosomal trisomies Trisomy 21 (Down syndrome)	1:650 to 1:1,000
Trisomy 13 (Patau syndrome)	1:4,000 to 1:10,000
Trisomy 18 (Edwards syndrome)	1:3,500 to 1:7,500
Sex chromosome disorders 45,X (Turner syndrome)	1:2,500 to 1:8,000 females
47,XXX (triple X)	1:850 to 1:1,250 females
47,XXY (Klinefelter syndrome)	1:500 to 1:1,000 males
47,XYY (Jacobs syndrome)	1:840 to 1:1,000 males
Structural abnormalities	
Rearrangements (e.g., translocations, deletions)	~1:440 live births

Note: Based on statistics from surveys in different populations and not age adjusted. Data prior to use of prenatal diagnosis and selective termination of pregnancies became widespread.



Normal Karyotype

Male

Klinefelter Syndrome (KS)

- First described in 1942 as an "endocrine disorder"
- Extra-X chromosome identified in 1959; re-classified as "chromosomal disorder"

Harry F. Kleinfelter, MD

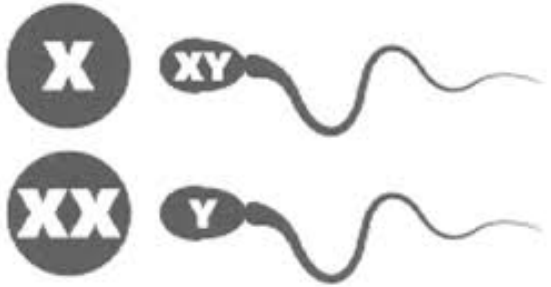
KS Prevalence

- 1 in 500 men

- Most common sex chromosome disorder in men
- Most common genetics cause of male infertility

Error in Cell Division

- Usually, a random error
- Either the egg or the sperm can have an imbalance in number of chromosomes



KS Variability!

- 47,XXY } 80-90% of KS patients

- Extra X chromosomes
  (48,XXXY, 49XXXXY etc.)
- Mosaicism (46,XY/47,XXY)
- Structurally abnormal X chromosome

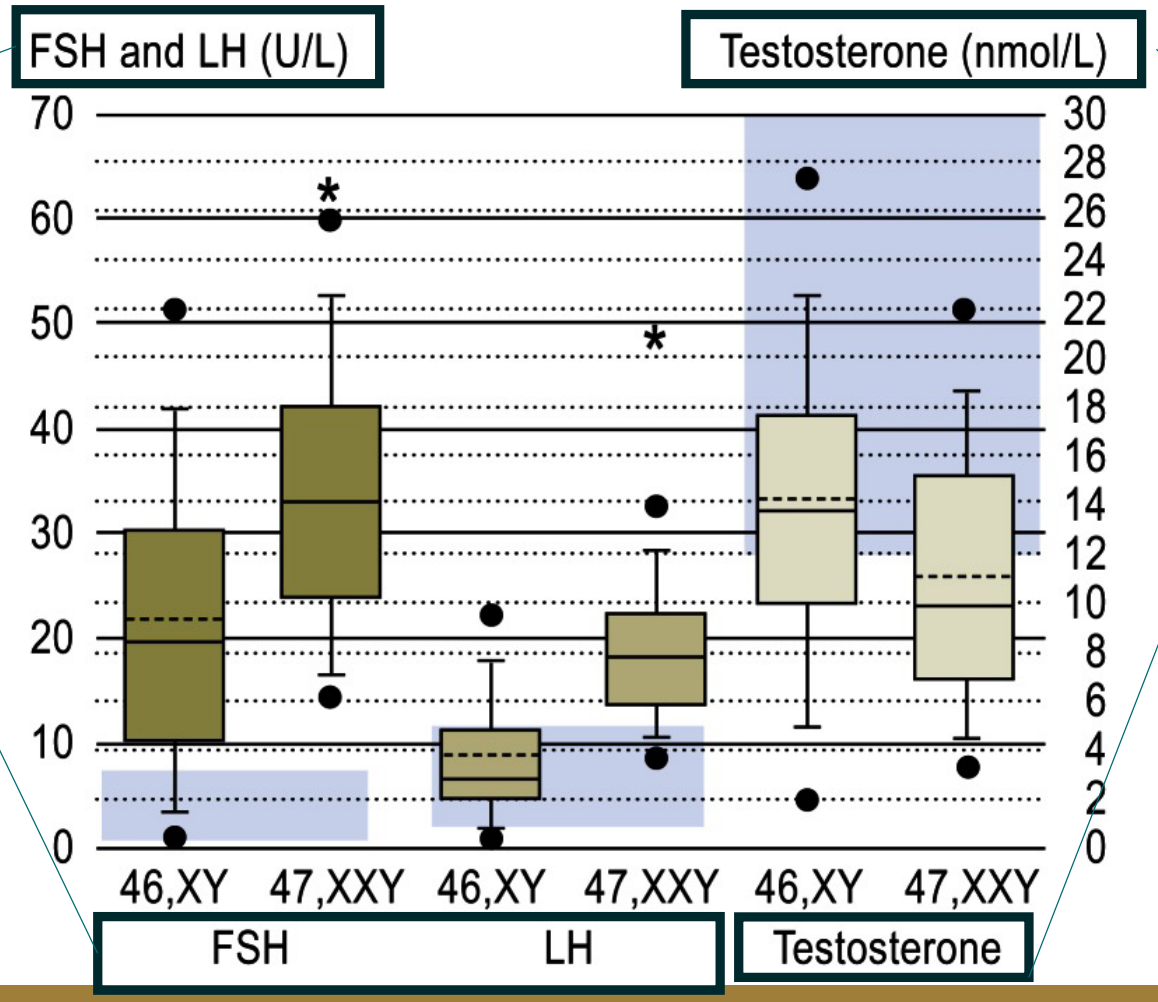
} 10-20% of KS patients

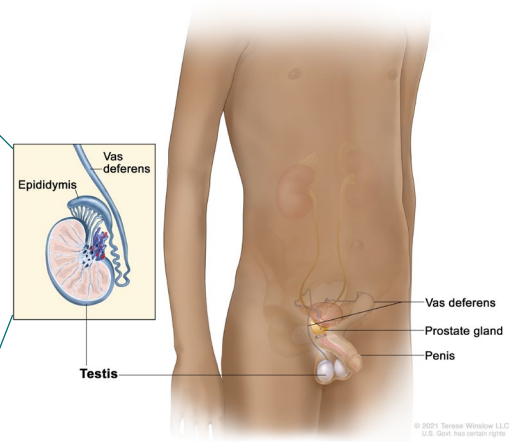
- The “classic” KS patient is….not so classic

Testosterone (T) Production

- T levels are normal in infants and pre-pubertal boys
- Most boys initiate puberty normally, but might fail to progress
- T levels rise in early puberty, plateau in the low-normal range in mid-puberty, then decline

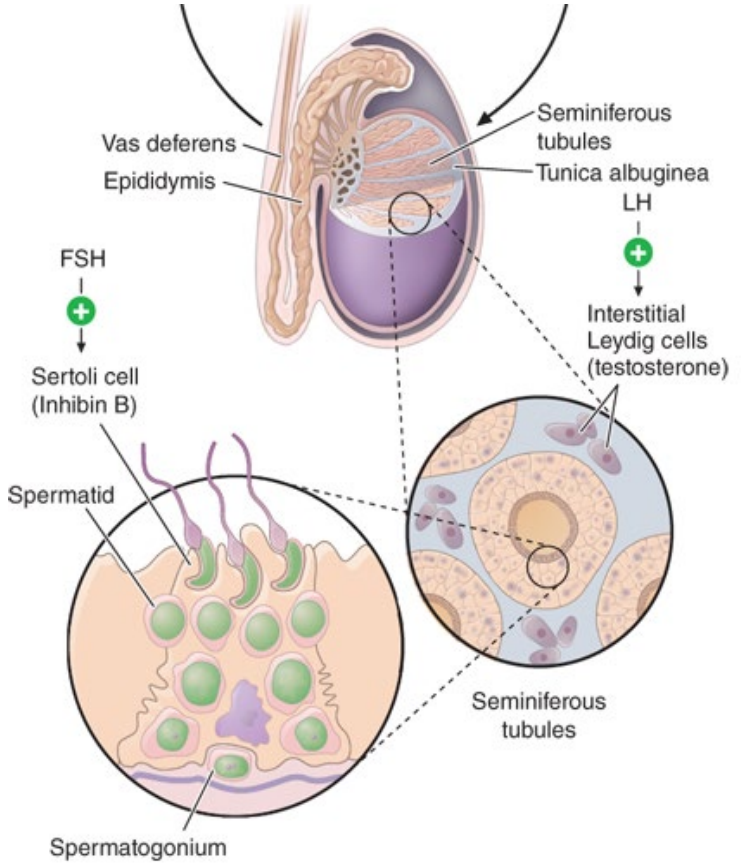
Hormone Levels





Eberhard Nieschlag 2013

Sperm Production

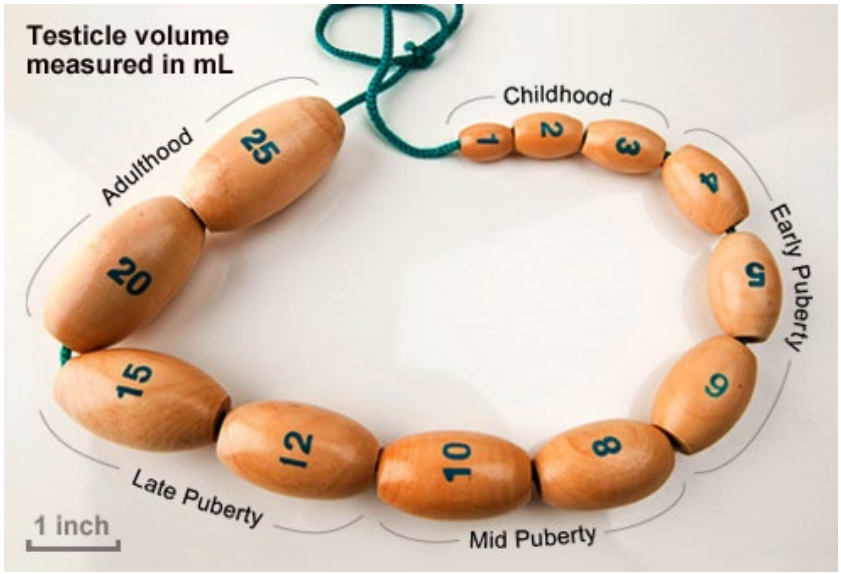


- Klinefelter syndrome
  - Germ cells do not progress normally to produce sperm
  - Seminiferous tubes become scarred
  - Rare areas of sperm production are possible

Wikstrom et al, 2007

Testicular Size

- Boys with KS have smaller testes compared to their peers
- Testicular growth briefly increases after the onset of puberty to mid-puberty, then declines



Puberty: A Critical Time

- Decline in testicular function begins shortly after entering puberty
- This is the time to consider testosterone therapy
- This is also the time to think about fertility preservation

Testosterone Therapy (TRT)

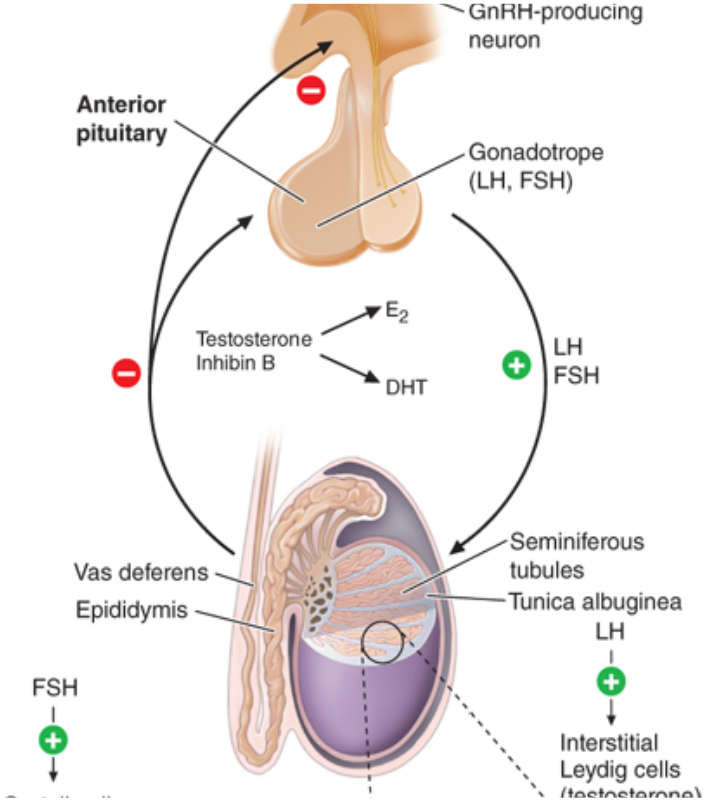
- Testosterone supplementation is helpful because testosterone plays many important roles:
  - Promotes growth
  - Increases muscle mass
  - Preserves bone density
  - Allows development of secondary sexual characteristics
  - Has positive psychological benefits
  - May increase libido and improve erection function

Testosterone therapy does not improve spermatogenesis and should not used by men of reproductive age

Male Contraception

Options

- Use non-testosterone based hormone therapies
  - hCG
  - Clomiphene citrate
  - Anastrazole/Letrozole
- Nasal Testosterone



Nasal Gel Testosterone

One pump (5.5 mg) in each nostril 3 times daily, for a total daily dose of 33 mg

Each dose should be taken 6 to 8 hours apart: once in the morning, once in the afternoon, once in the evening

Natesto appears to increase testosterone while maintaining semen parameters in a majority of men.

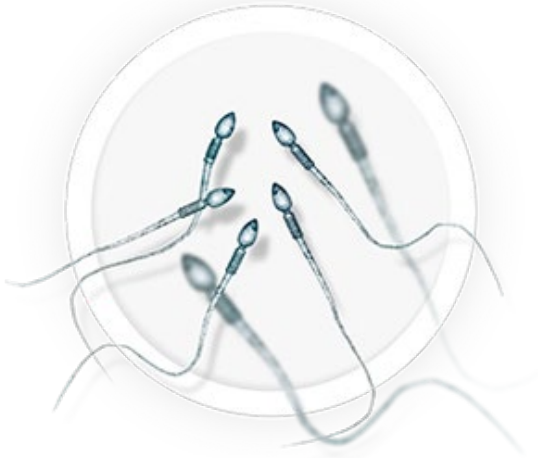
Clinical Trial > J Urol. 2020 Sep;204(3):557-563. doi: 10.1097/JU.0000000000001078.
Epub 2020 Apr 15.

Effect of Natesto on Reproductive Hormones, Semen Parameters and Hypogonadal Symptoms: A Single Center, Open Label, Single Arm Trial

Ranjith Ramasamy [1], Thomas A Masterson [1], Jordan C Best [1], Joshua Bitran [1], Emad Ibrahim [1], Manuel Molina [1], Ursula B Kaiser [2], Feng Miao [3], Isildinha M Reis [3 4]

Affiliations + expand

PMID: 32294396 DOI: 10.1097/JU.0000000000001078



Received: 16 March 2022 | Revised: 7 April 2022 | Accepted: 18 April 2022
DOI: 10.1111/and.14453

ORIGINAL ARTICLE

ANDROLOGIA WILEY

Direct conversion from long-acting testosterone replacement therapy to Natesto allows for spermatogenesis resumption: Proof of concept

Parviz K. Kavoussi | Graham L. Machen | Shu-Hung Chen | Melissa S. Gilkey | Justin Chen | Yazan Hamzeh | Kenneth I. Aston | Shahryar K. Kavoussi

Sunday, July 27

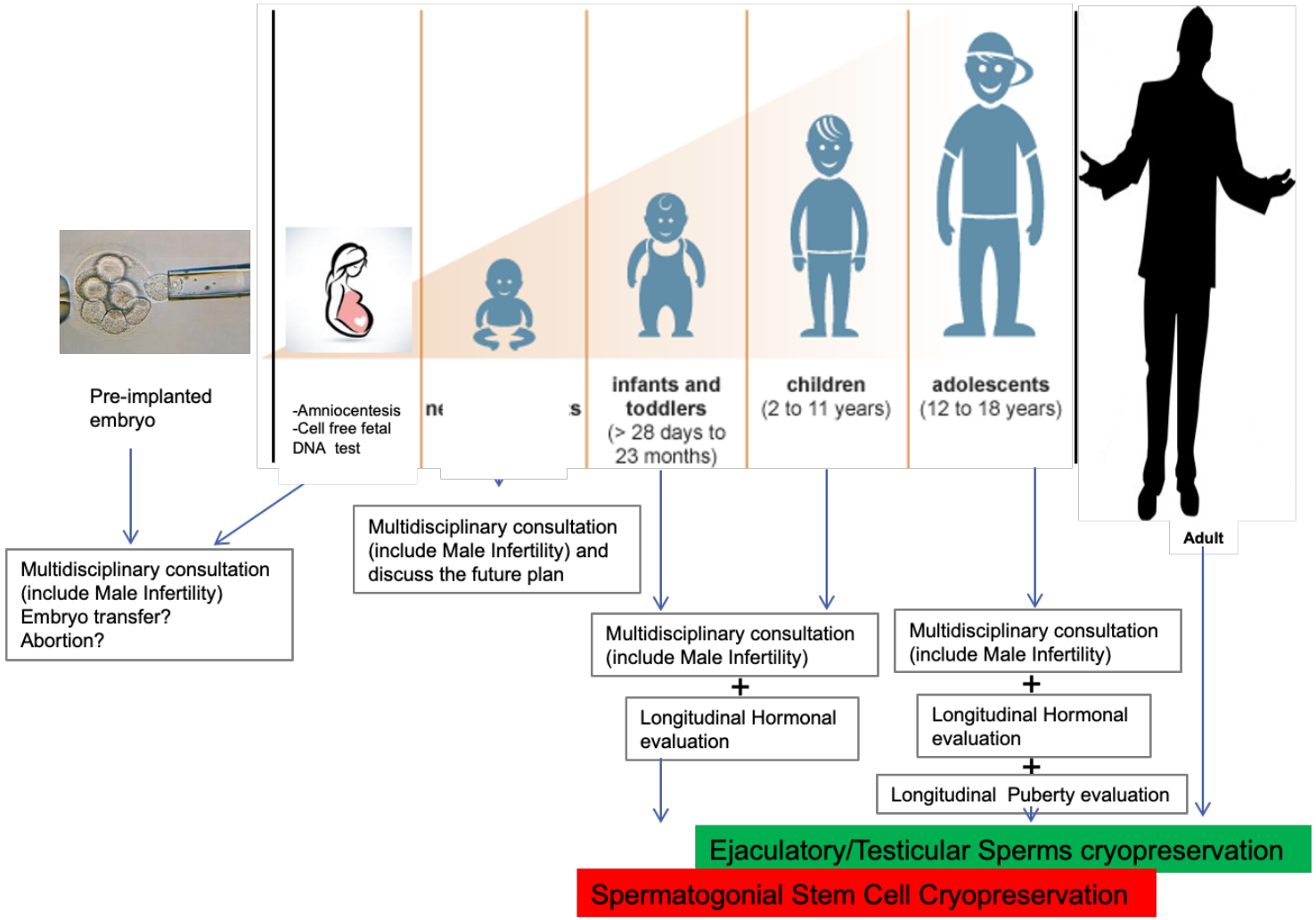
7:30-9am – Breakfast Buffet

8:30-3pm – Childcare

–

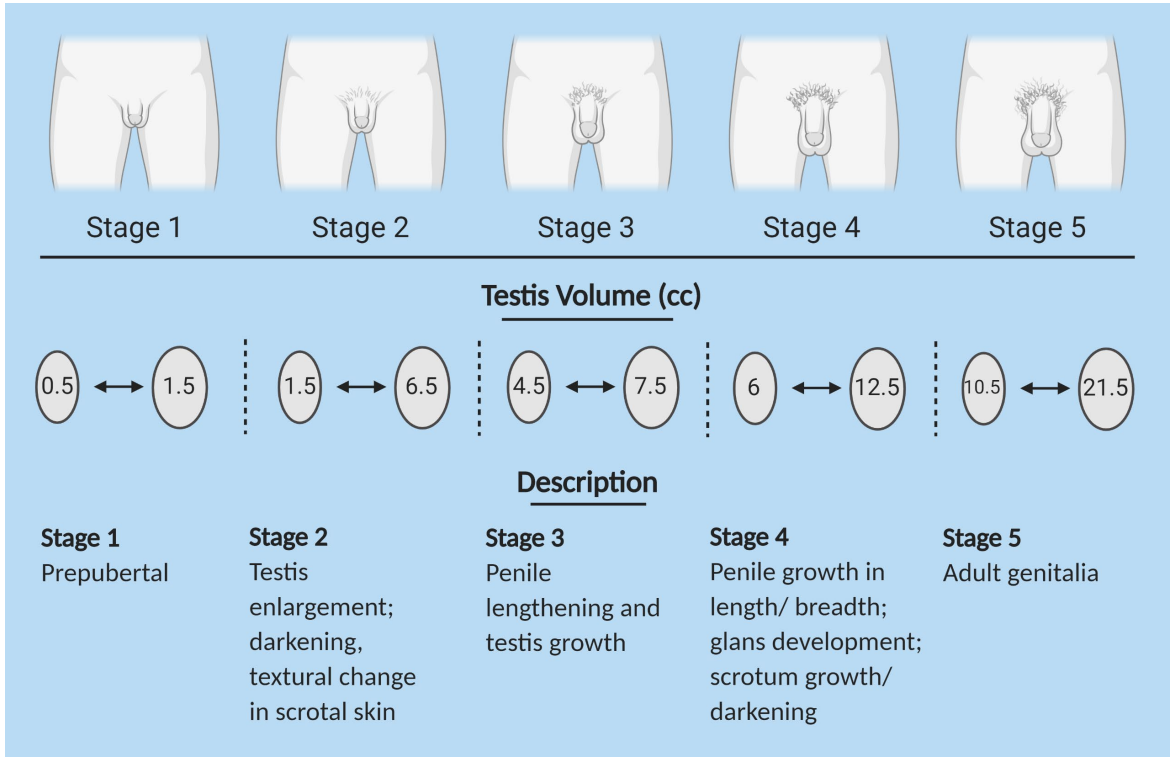
Room	9-10am Session 7	10-11am Session 8	11am-12pm Session 9	12-1:30pm Lunch and Poster Session	1:45-3pm Session 10
Emory Amphitheater (Live Streamed & Recorded) **	Unpacking Social and Emotional Challenges for Teens/Young Adults with X/Y Variations Caitlin Middleton Kate Deer Rebecca Wilson	Eval and Treatment Of ADHD & Anxiety In Children Caitlin Middleton Ciara Gurley	Understanding X and Y Variations: Genetic Diagnosis, Terminology & Next Steps Planning Susan Howell Kayla Molison		Support Groups by Genetic Signature
Oak Amphitheater	Supporting Academic and Social-Emotional Education of Students with X&Y Chromosome Variations Amy Talboy Catherine Trapani	Testosterone Treatment Options in Klinefelter Syndrome Hooman Sadri	What Adults with X/Y Variations Want Parents and Others to Know Panel Discussion Mod. by Sharron Close		Support Groups by Genetic Signature
Azalea	Tips for Staying Healthy for Teens and Adults with X and Y Chromosome Variations Maria Vogiatzi	X/Y Chromosome Variations and Autism: Insights from Large Scale Population Research Matthew Oetjens	Promoting physical activity in Children with XXY T. Zachary Huit		Support Groups by Genetic Signature
Mt. Laurel	Disclosing the Diagnosis- Panel Discussion Mod. by Susan Howell	Unassigned	Unassigned		Support Groups by Genetic Signature
Hickory	Unassigned	Unassigned	Unassigned		Support Groups by Genetic Signature
Dogwood	Unassigned	Unassigned	Unassigned		Support Groups by

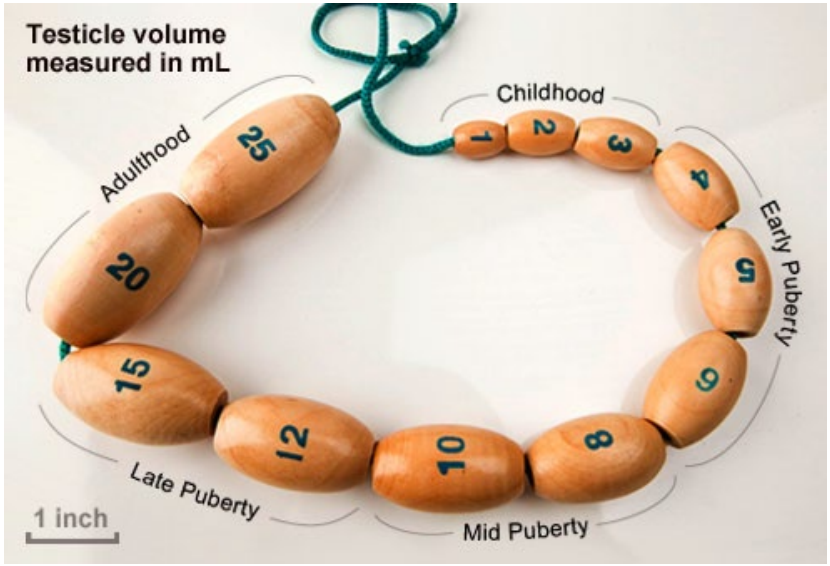
Fertility Preservation Consultation & Services



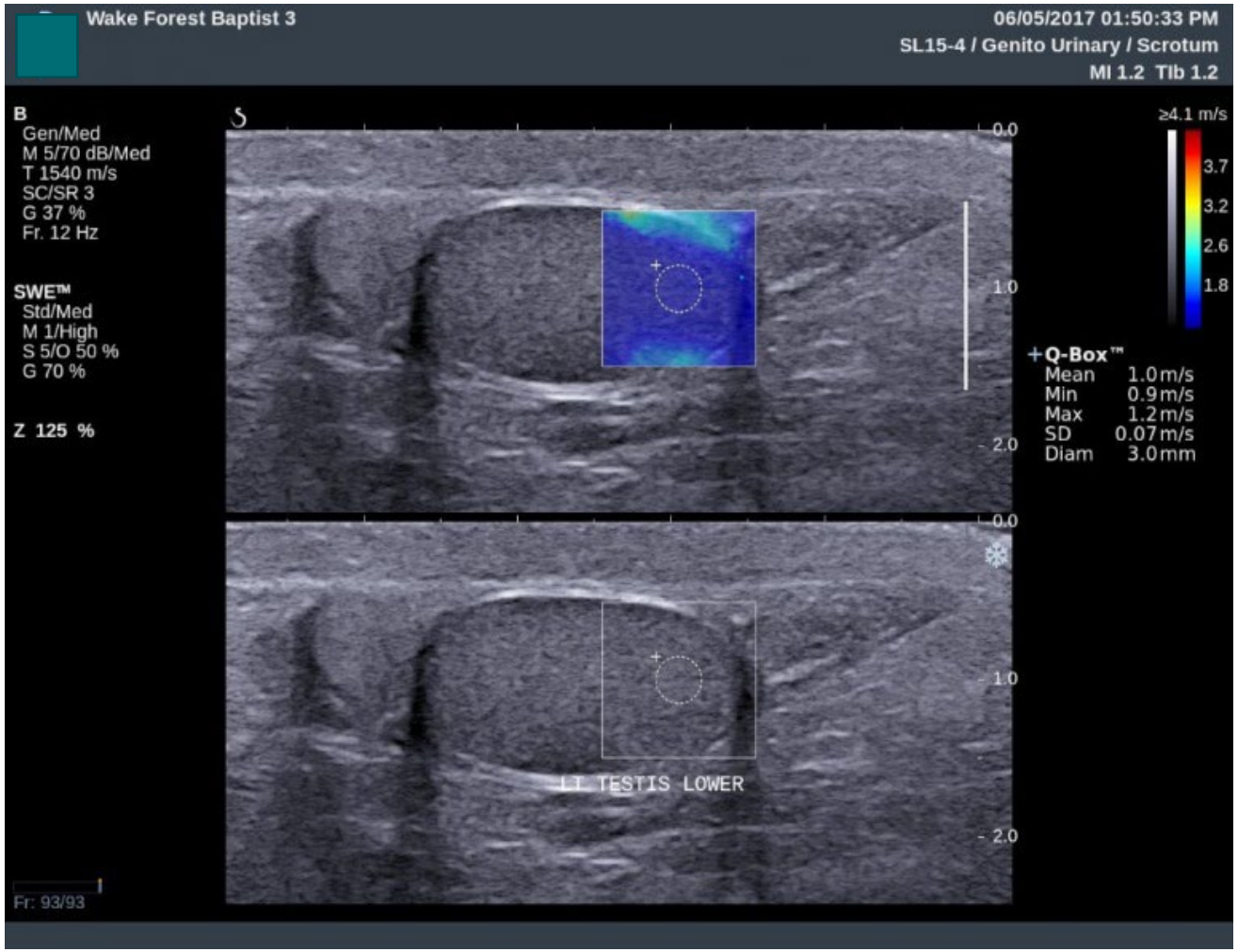
Physical Exam (sexual maturity)

Tanner Staging



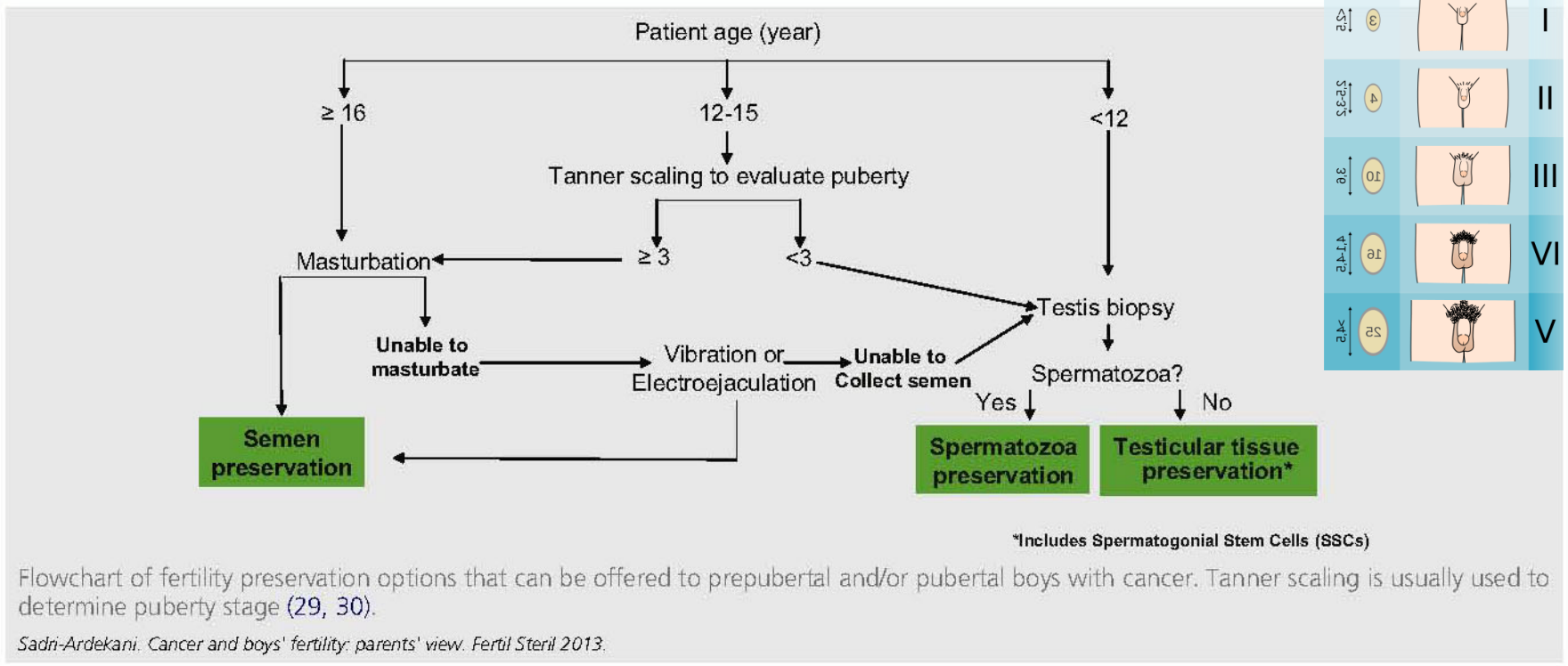


Special Elastography Ultrasound (stiffness; Fibrosis)



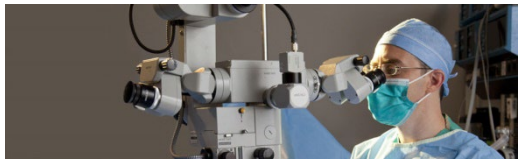
One Step Encounter Fertility Preservation

FIGURE 1



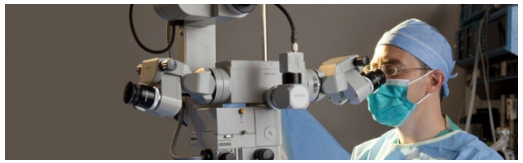
Flowchart of fertility preservation options that can be offered to prepubertal and/or pubertal boys with cancer. Tanner scaling is usually used to determine puberty stage (29, 30).

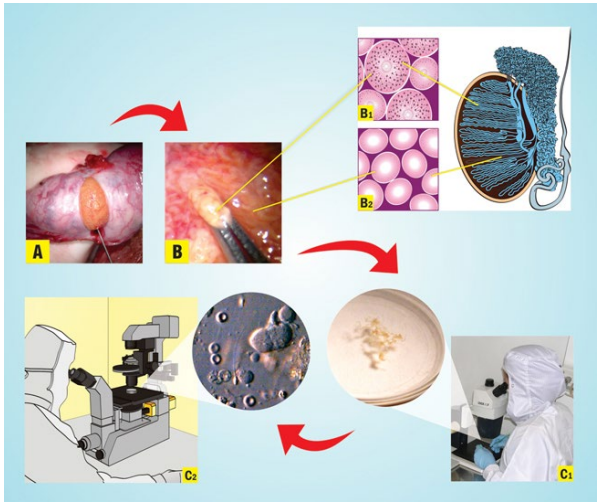
Sadri-Ardekani. Cancer and boys' fertility: parents' view. Fertil Steril 2013.

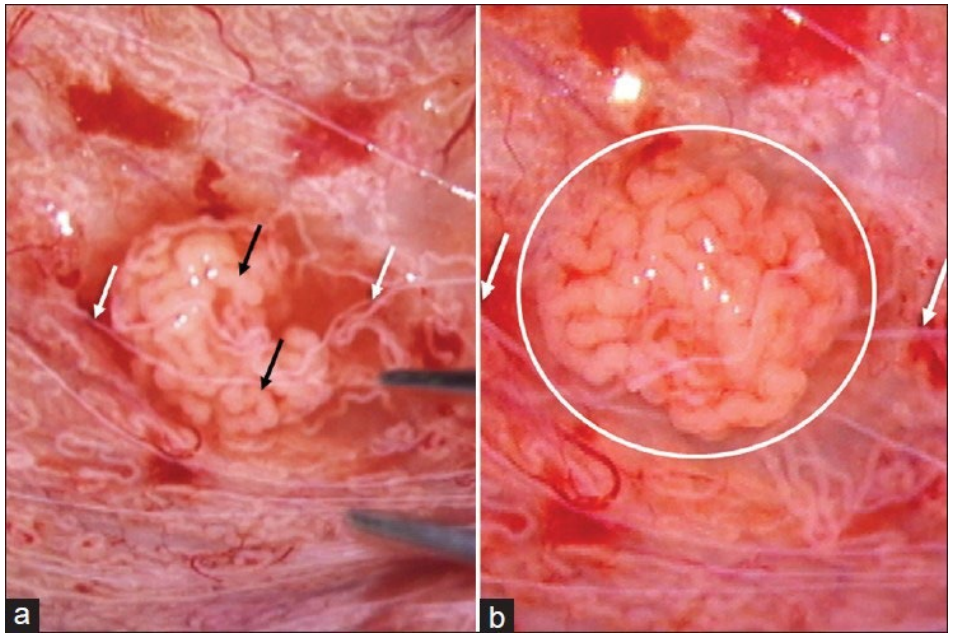


Sadri-Ardekani et al, *Fertility and Sterility 2013*

Microscopic Testicular Sperm Extraction (mTESE)



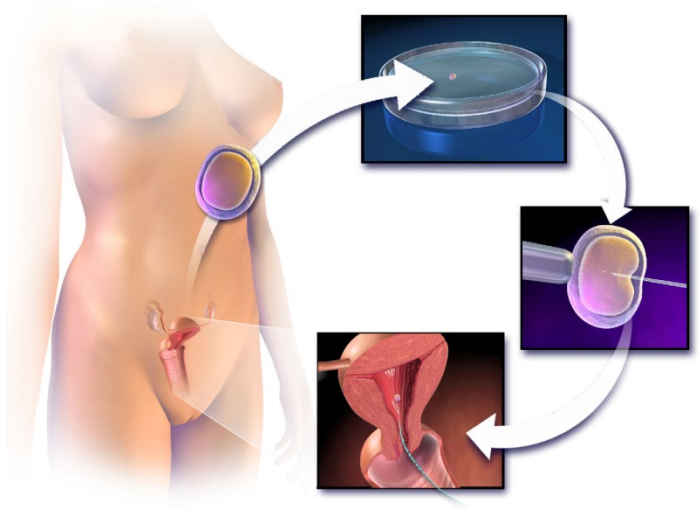




Clinical Andrology 2011, EAU/ESAU Course Guidelines; Edited by L BjÖrndahl, A Giwercman, H Tournaye and W Weidner

Medical and Surgical Management of Male Infertility 2014; Edited by Rizk, Aziz & Agarwal

In Vitro Fertilization (IVF) using stored sperms



Intra-cytoplasmic sperm injection (ICSI)

April 1991- Jan 1992

Overall Sperm Retrieval : 44%
Overall Live Birth Rate per ICSI cycle: 43%

Clinical Andrology 2011, EAU/ESAU Course Guidelines; Edited by L BjÖrndahl, A Giwercman, H Tournaye and W Weidner

Medical and Surgical Management of Male Infertility 2014; Edited by Rizk, Aziz & Agarwal

Corona et al 2017, HRU

Pre-Implantation Genetic Diagnosis (PGD)

(Fresh) mTESE
(at least 70% chance of finding sperm)

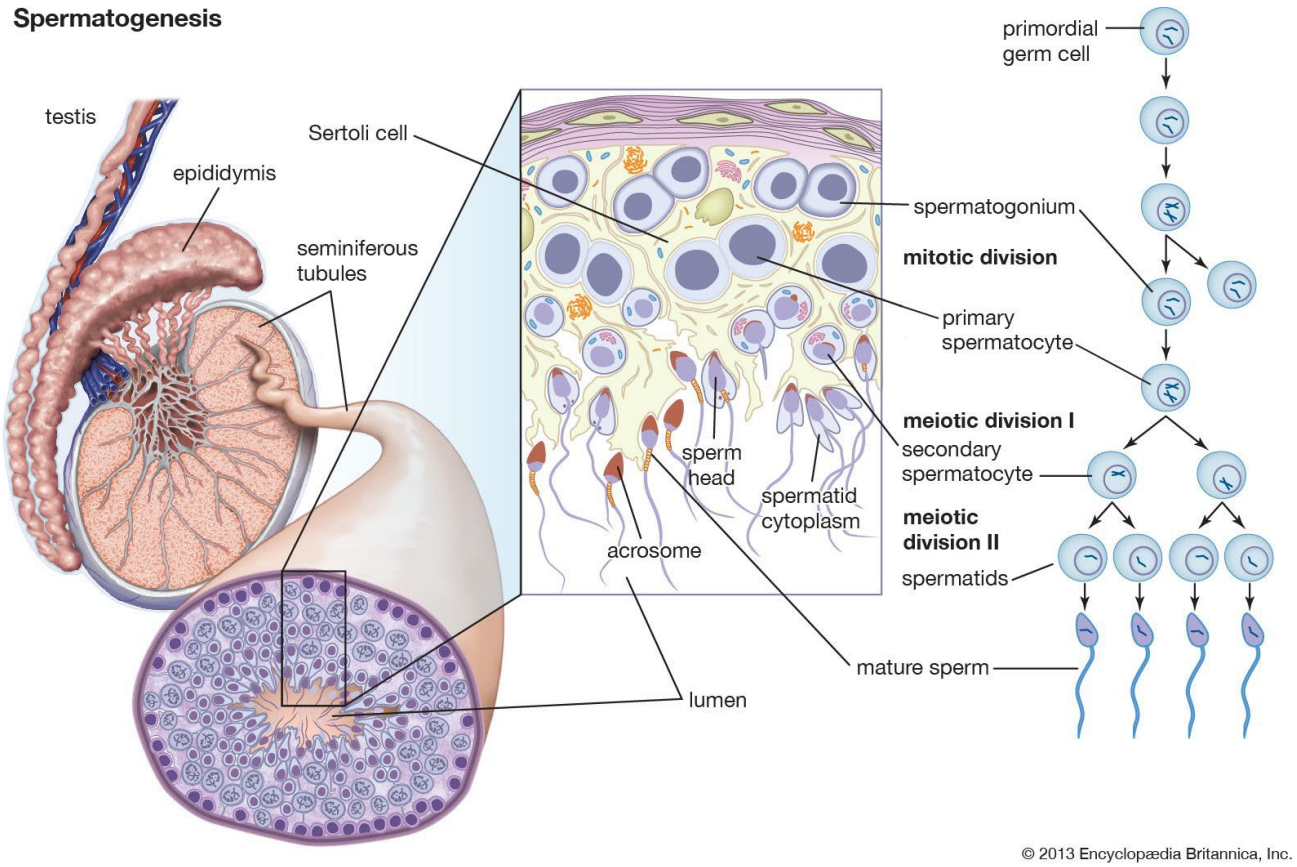
↘

ICSI/PGTA

↘

Pregnancy (70% per Embryo Transfer if partner is <35 yr old)

From Spermatogonia Stem Cell to Sperm



Human Reproduction Update, Vol.26, No.1, pp. 58–72, 2020
Advance Access Publication on December 10, 2019 doi:10.1093/humupd/dmz038

human reproduction update

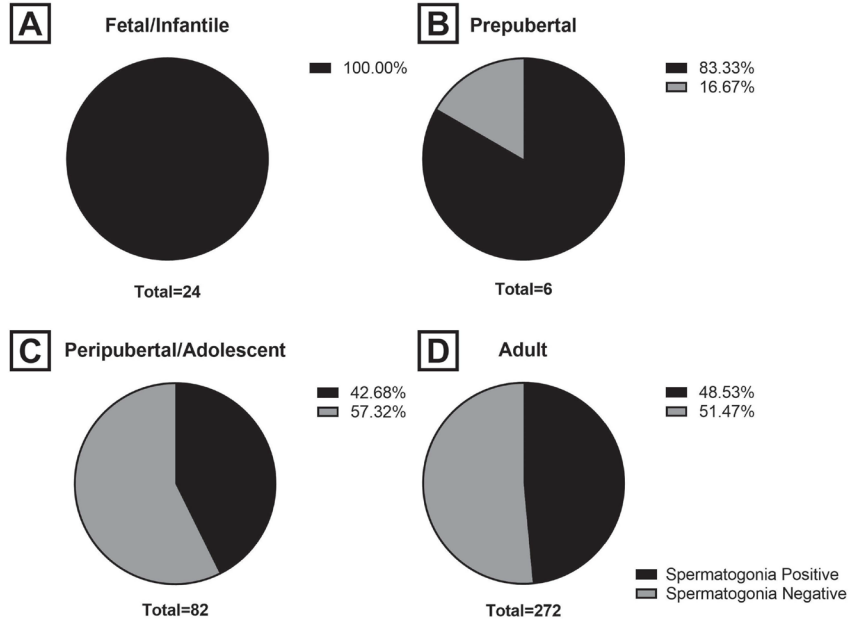
Age-related presence of spermatogonia in patients with Klinefelter syndrome: a systematic review and meta-analysis

Nicholas A. Deebel[1,2], Guillermo Galdon[2], Nima Pourhabibi Zarandi[2], Kimberly Stogner-Underwood[3], Stuart Howards[1], James Lovato[4], Stanley Kogan[1,2], Anthony Atala[1,2], Yanhe Lue[5], and Hooman Sadri-Ardekani[1,2,*]

[1]Department of Urology, Wake Forest University School of Medicine, Winston-Salem, NC, USA. [2]Wake Forest Institute for Regenerative Medicine, Wake Forest University School of Medicine, Winston-Salem, NC, USA. [3]Department of Pathology, Wake Forest University School of Medicine, Winston-Salem, NC, USA. [4]Department of Biostatistics and Data Science, Wake Forest University School of Medicine, Winston-Salem, NC, USA. [5]Division of Endocrinology, Department of Medicine, Los Angeles Biomedical Research Institute and Harbor-UCLA Medical Center, Torrance, CA, USA

*Correspondence address. 391 Technology Way (WFIRM), Winston-Salem, NC 27101, USA. Tel: +1 336-713-1493; Fax: +1 336-713-5754; E-mail: hsadri@wakehealth.edu orcid.org/0000-0003-4377-4404

Submitted on June 4, 2019; resubmitted on September 15, 2019; editorial decision on September 30, 2019



Atrium Health Wake Forest Baptist

Wake Forest® School of Medicine

ORIGINAL ARTICLE: ANDROLOGY

Check for updates

Morphometric and immunohistochemical analysis as a method to identify undifferentiated spermatogonial cells in adult subjects with Klinefelter syndrome: cohort study

Nicholas A. Deebel, M.D.,[a,b] Haleh Soltanghoraee, M.D.,[c,d] Aaron William Bradshaw, M.D.,[a,b] Omar Abdelaal, M.D.,[b,e] Karl Reynolds, B.S.,[b] Stuart Howards, M.D.,[a] Stanley Kogan, M.D.,[a,b] Mohammad Reza Sadeghi, Ph.D.,[c,d] Anthony Atala, M.D.,[a,b] Kimberly Stogner-Underwood, M.D.,[a,e] and Hooman Sadri-Ardekani, M.D., Ph.D.[a,b,f]

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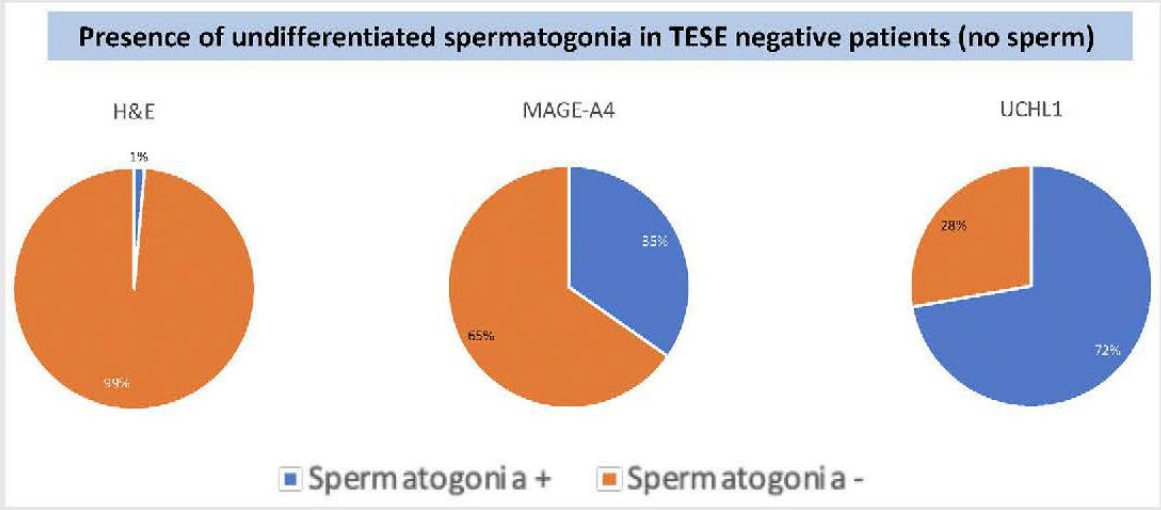
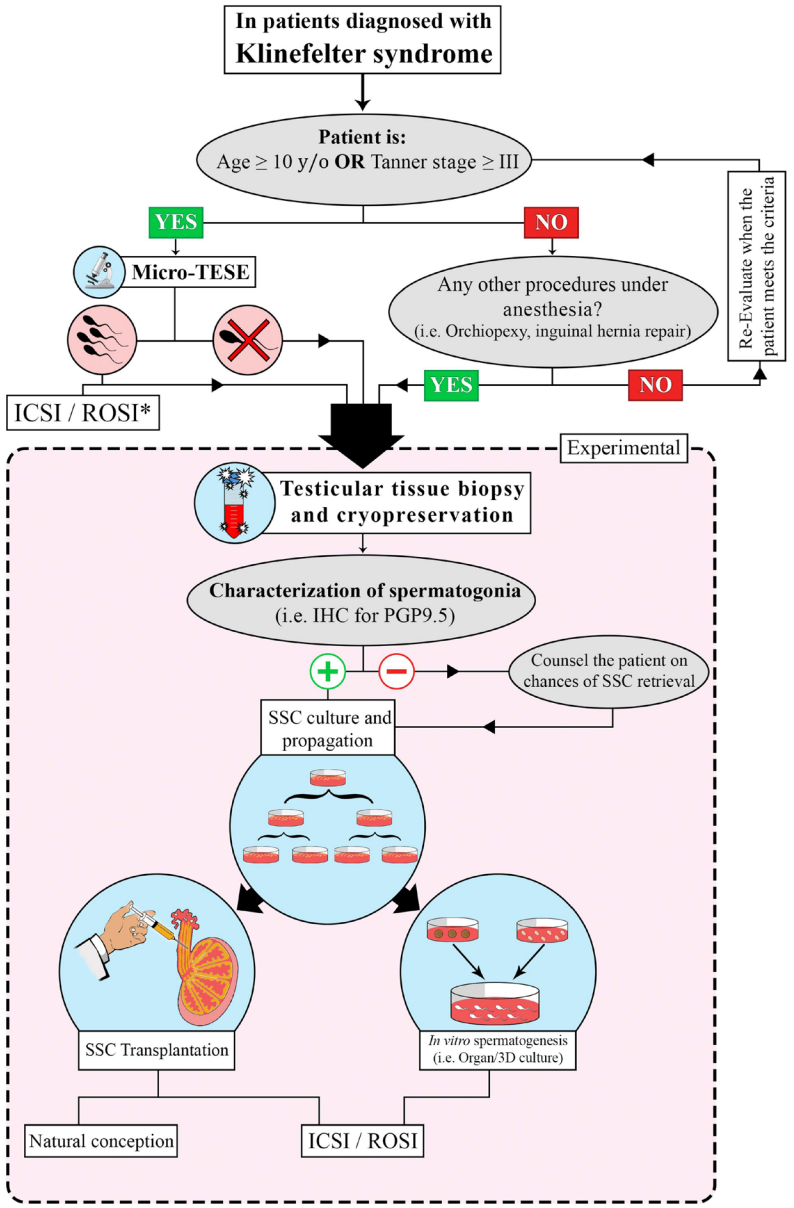
Fertil Steril. 2022 Nov;118(5):864-873



The chance of finding undifferentiated spermatogonia cells in testicular sperm extraction negative (TESE-negative) subjects, detected by hematoxylin and eosin (H & E), UCHL1, or MAGE-A4 staining in histology samples from TESE procedures.

Deebel. Undifferentiated spermatogonia in Klinefelter testes. Fertil Steril 2022.


In patients diagnosed with
Klinefelter syndrome
Patient is:
Age ≥ 10 y/o OR Tanner stage ≥ III
YES
NO
Micro-TESE
Any other procedures under anesthesia?
(i.e. Orchiopexy, inguinal hernia repair)
Re-Evaluate when the patient meets the criteria
YES
NO
ICSI / ROSI*
Experimental
Testicular tissue biopsy and cryopreservation
Characterization of spermatogonia
(i.e. IHC for PGP9.5)
Counsel the patient on chances of SSC retrieval
SSC culture and propagation
SSC Transplantation
In vitro spermatogenesis
(i.e. Organ/3D culture)
Natural conception
ICSI / ROSI

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Institute for Regenerative Medicine

Testicular Tissue Banking

for Fertility Preservation in
Boys and Men at Risk for Infertility

EXPERIMENTAL

IRB approval
March 2013

↓ Good Tissue Practice (GTP) regulations

FDA registration
June/July 2014

First patient recruitment
07/22/2014

↓

221 Patients

Cancer	Bilateral UDT	Klinefelter	Registry	denied

→ **12**

Updated July 25, 2025

Atrium Health

* One subject was Klinefelter and suffered from the cancer too.

Wake Forest School of Medicine

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frontiers | Frontiers in Endocrinology

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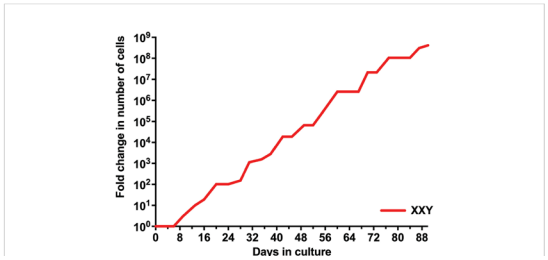
In vitro propagation of XXY human Klinefelter spermatogonial stem cells: A step towards new fertility opportunities

Guillermo Galdon [1,2], Nicholas A. Deebel [1,3]



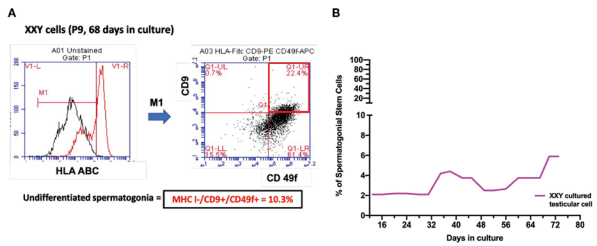


FIGURE 6
(A) Spermatogonial stem cells (SSC) population was estimated by combining HLA-/CD9+/CD49f+ markers on Flow Cytometry analysis. After 68 days in culture and nine passages, the percentage of putative SSC was 10.1% of a 17-year-old KS patient **(B)**. Several time points were analyzed to evaluate the evolution of this population over time in all subject samples in culture. The graph shows the average of the SSCs population during the culture in KS patients **(B)**.

bioengineering

MDPI

Article

In Vitro Generation of Haploid Germ Cells from Human XY and XXY Immature Testes in a 3D Organoid System

Guillermo Galdon [1,2,*], Nima Pourhabibi Zarandi [1,3], Nicholas A. Deebel [1,4], Sue Zhang [1,5], Olivia Cornett [1], Dmitry Lyalin [6,7], Mark J. Pettenati [6], YanHe Lue [8], Christina Wang [8], Ronald Swerdloff [8], Thomas D. Shupe [1], Colin Bishop [1], Kimberly Stogner [1,6], Stanley J. Kogan [1], Stuart Howards [1,4], Anthony Atala [1,4] and Hooman Sadri-Ardekani [1,4,6,*]

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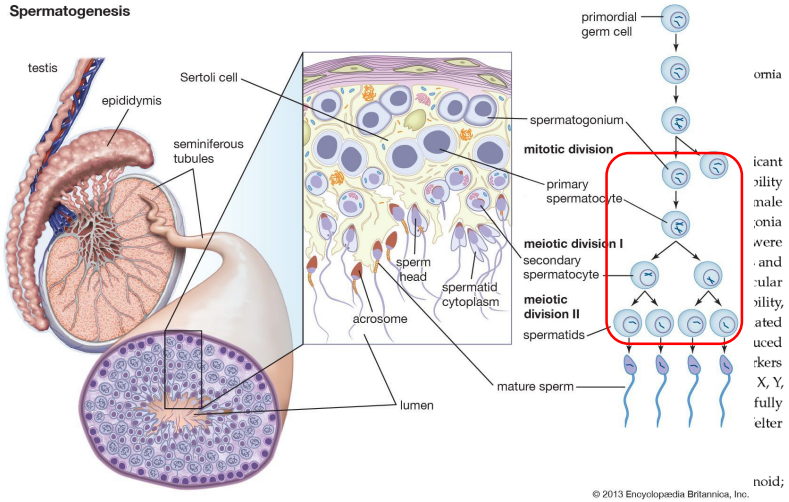
2 Facultad de Medicina, Universidad de Barcelona, 08036 Barcelona, Spain
3 Department of Internal Medicine, University of Pittsburgh Medical Center, Harrisburg, PA 17101, USA
4 Department of Urology, Wake Forest School of Medicine, Winston-Salem, NC 27157, USA



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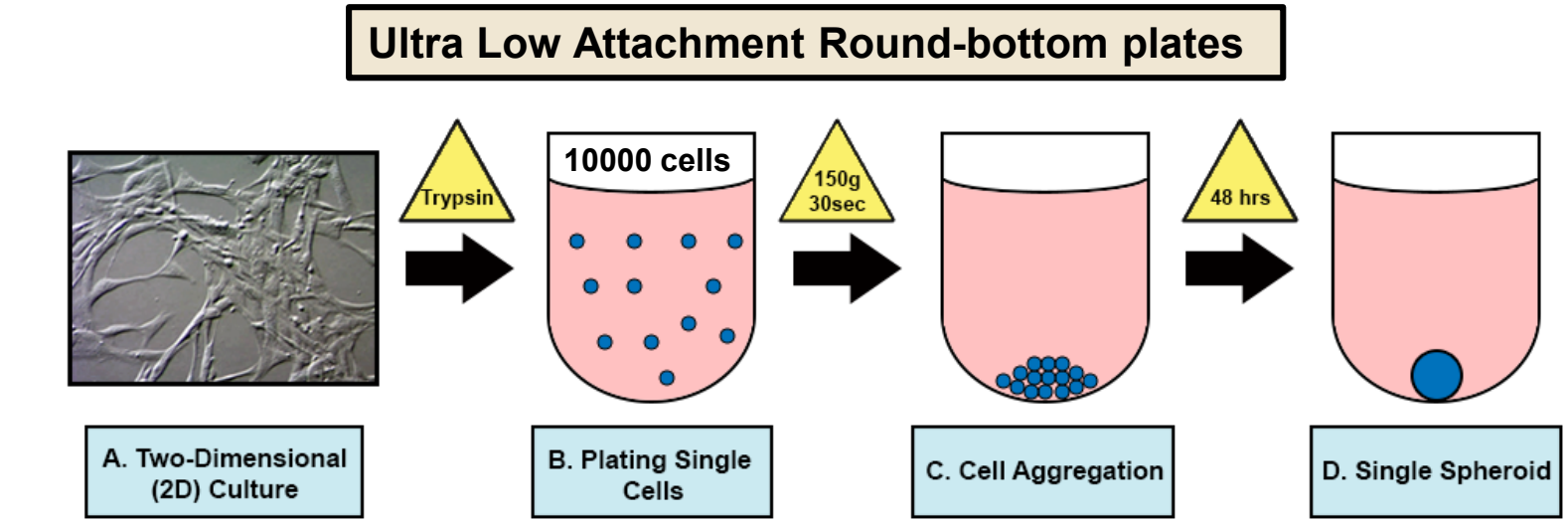
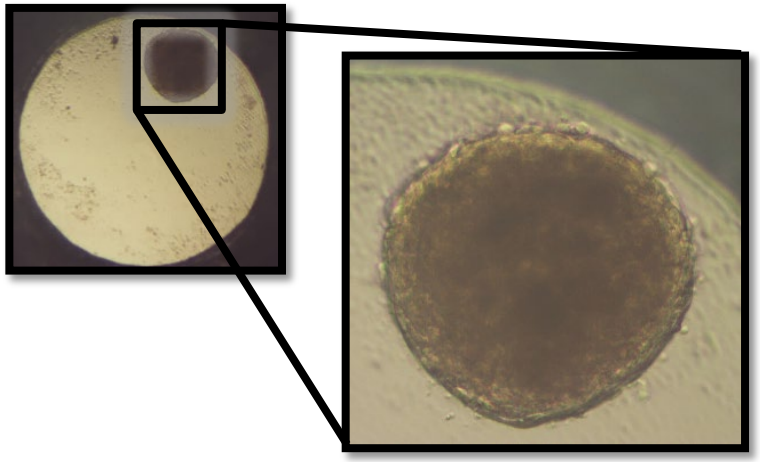
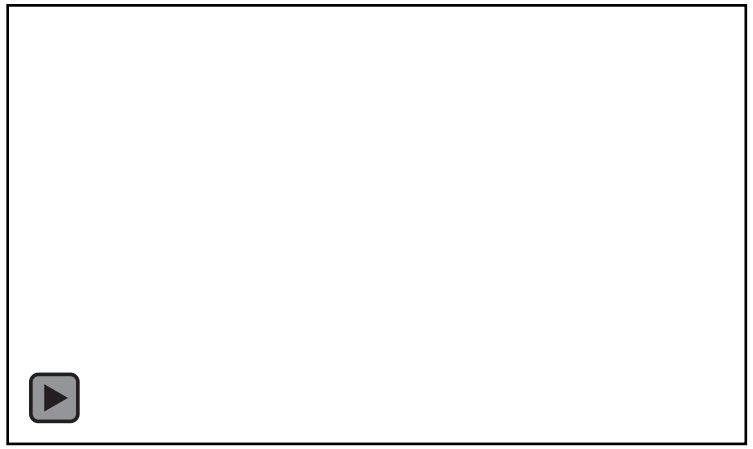
Creating the 3D Organoids (HTO); Methods

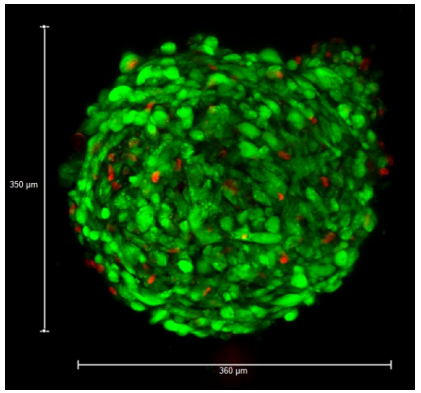




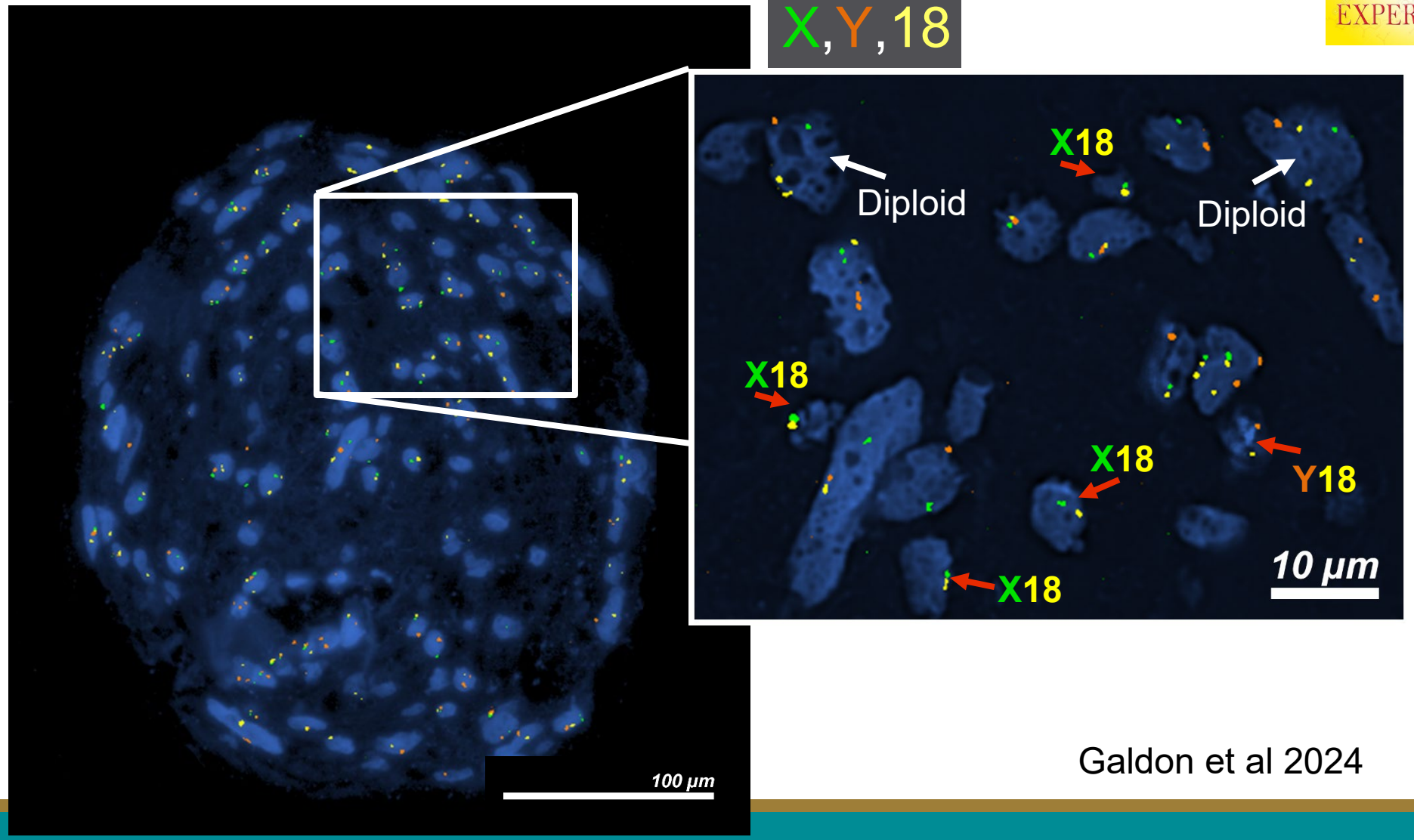


Pendergraft et al 2017
Galdon et al 2024

In Vitro Formed HUMAN Haploid Germ cells; DNA FISH



Human Testicular Organoid (HTO)



Galdon et al 2024

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ClinicalTrials.gov

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Record 1 of 1 | Return to Search

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Recruiting

Experimental Round Spermatid Injection (ROSI) to Treat Infertile Couples (ROSI)

ClinicalTrials.gov ID NCT04298255

Sponsor Wake Forest University Health Sciences

Information provided by Wake Forest University Health Sciences (Responsible Party)

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Study Details | Researcher View | No Results Posted | Record History

Ninety babies born after round spermatid injection into oocytes: survey of their development from fertilization to 2 years of age

Atsushi Tanaka, M.D., Ph.D.,[a] Kohta Suzuki, M.D., Ph.D., M.P.H.,[b] Motoi Nagayoshi, M.D.,[a] Akihiro Tanaka, M.B.I.T.,[a] Youichi Takemoto,[a] Seiji Watanabe, Ph.D.,[c] Satoru Takeda, M.D., Ph.D.,[d] Minoru Irahara, M.D., Ph.D.,[e] Naoaki Kuji, M.D., Ph.D.,[f] Zentaro Yamagata, M.D., Ph.D.,[g] and Ryuzo Yanagimachi, Ph.D.[h]

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Objective: To compare physical and cognitive development of babies born after round spermatid injection (ROSI) with those born after natural conception.
Design: Comparison of efficiencies of ROSI and ICSI using testicular spermatozoa, performed in the St. Mother Clinic. Physical and cognitive development of ROSI babies recorded by parents in the government-issued Mother-Child Handbook was checked and verified by attending pediatricians. Data included baby's weight gain and response to parents' voice/gesture.
Setting: Assisted reproduction technology practice.
Patient(s): A total of 721 men participated in ROSI; 90 ROSI babies were followed for 2 years for their physical and cognitive development. Control subjects were 1,818 naturally born babies.
Intervention(s): Surgical retrieval of spermatogenic cells from testes; selection and injection of round spermatids into oocytes; oocyte activation, in vitro culture of fertilized eggs, and embryo transfer to mothers.
Main Outcome Measure(s): Physical and cognitive development of ROSI babies (e.g., body weight increase, response to parents, and understanding and speaking simple language) compared with naturally born babies.
Result(s): Of 90 ROSI babies, three had congenital aberrations at birth, which corrected spontaneously (ventricular septa) or after surgery (cleft lip and omphalocele). Physical and cognitive development of ROSI babies was similar to those of naturally born babies.
Conclusion(s): There were no significant differences between ROSI and naturally conceived babies in either physical or cognitive development during the first 2 years after birth.
Clinical Trial Registration Number: UMIN Clinical Trials Registry UMIN000006117. (Fertil Steril® 2018;110:443–51. Copyright © 2018 The Authors. Published by Elsevier Inc. on behalf of the American Society for Reproductive Medicine. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).)
El resumen está disponible en Español al final del artículo.

Key Words: Assisted fertilization, human egg, physical and cognitive development, round spermatid injection

Discuss: You can discuss this article with its authors and other readers at https://www.fertstertdialog.com/users/16110-fertility-and-sterility/posts/32485-25452

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Atsushi T. has nothing to disclose. K.S. has nothing to disclose. M.M. has nothing to disclose. Akihiro T. has nothing to disclose. Y.T. has nothing to disclose. S.W. has nothing to disclose. S.T. has nothing to disclose. M.I. has nothing to disclose. N.K. has nothing to disclose. Z.Y. has nothing to disclose. R.Y. has nothing to disclose.
A.T. and K.S. should be considered similar in author order.
Reprint requests: Atsushi Tanaka, M.D., Ph.D., Saint Mother Obstetrics and Gynecology Clinic, 4-9-12 Orio Yahatanishi-ku Kitakyushu, Fukuoka, Japan (E-mail: incho@stmother.com).

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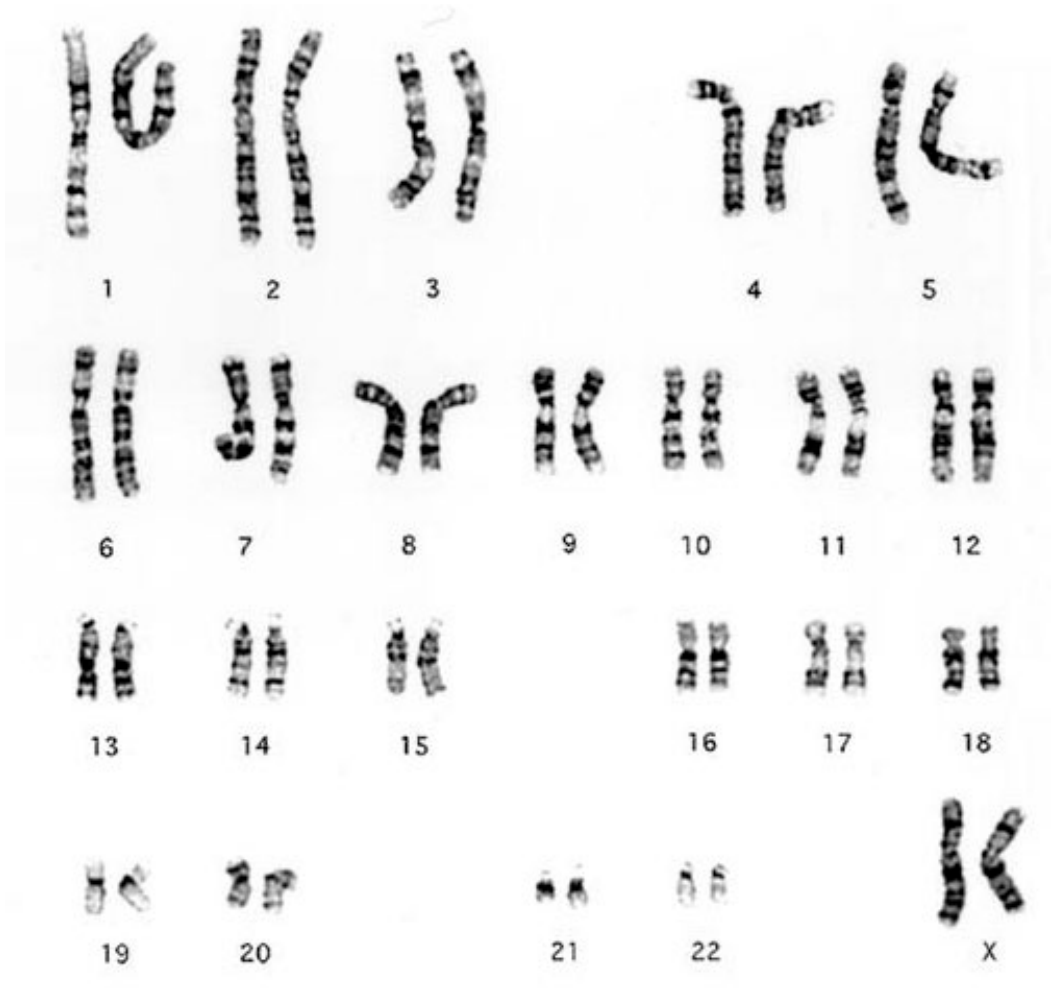
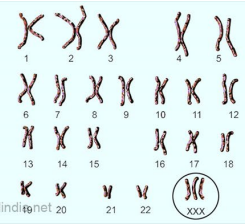


Normal Karyotype

Female



Triple X Syndrome

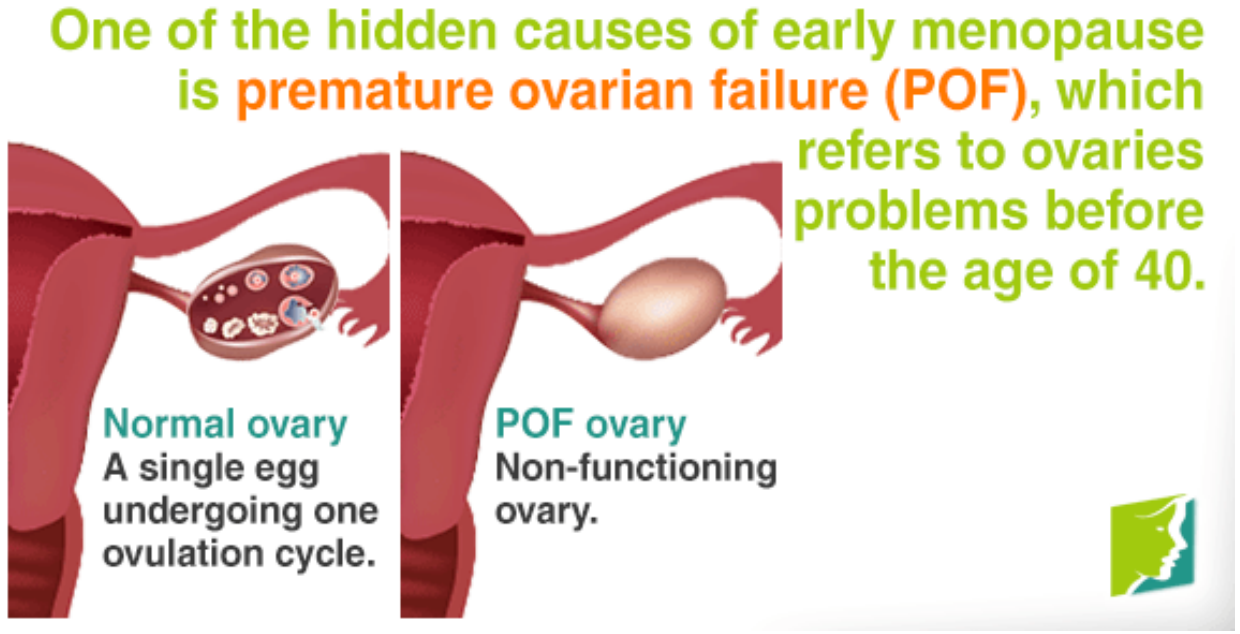
It is a genetic disorder seen in females, characterized by the presence of an extra X chromosome

History

- The first published report of a woman with a 47,XXX karyotype was by Patricia A. Jacobs, in Edinburgh, Scotland in 1959. She was a 35-year-old, 5 ft. 9 in., 128 lb. woman who had premature ovarian failure at age 19; her mother was age 41 and her father was 40 at the time of her conception.
- Occurs more often when older men and women conceive vs. younger couples.

Triple X Syndrome

- One in every 1000 females has an extra X chromosome
- The most common sex chromosome abnormality in females
- Most individuals with 47,XXX are diagnosed **incidentally** on prenatal genetic screening
- The physical phenotype shows earlier growth and longer legs. 47,XXX females have a tendency to be tall, with many reaching the 80th percentile in height by adolescence, but with an average head circumference between the 25th to 35thpercentile
- **Puberty and fertility** are generally in the **normal** range, but **premature ovarian failure** can occur



Premature ovarian failure (POF) is a condition in which the ovarian functions of **hormone production** and **oocyte (egg) development** become impaired before the typical age for menopause.

POF occurs in approximately 1% of all women

Studies on the prevalence of POF in adolescents or adults with trisomy X have not yet been performed

Premature ovarian failure (POF) seems to be somewhat more common than in the general population

Summary

- Infertility is common in general population (15%)
- More than 98% of **Klinefelter** individuals deal with infertility
- Early Fertility Preservation is recommended before long term Testosterone replacement
- Microsurgical Testicular Sperm Extraction (**Micro-TESE**) and Intra Cytoplasmic Sperm Injection (**ICSI**) is the most successful clinical option in Klinefelter syndrome
- **Spermatogonial Stem Cell** Technology is a great hope for the future
- Infertility is not an issue in most of the **Triple X** individuals; however they need a good reproductive health management
- Egg Freezing (Triple X)

- Appointment for initial evaluation and consultation (In Person Only):

336.713.1493

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Winston-Salem, North Carolina
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- Appointment for initial evaluation and consultation (Virtual for Non-NC Residents or In-Person):

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Greensboro, North Carolina
Winston-Salem, North Carolina

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