Y-CHROMOSOME DELETIONS

Ycm

A family of genetic disorders caused by missing gene(s) in the Y chromosome.

Diagnosis  Male

Related Diagnoses:
Azoospermia  Oligozoospermia  Oligoasthenoteratozoospermia  Gonadal dysgenesis

About Y-chromosome deletions

Structural rearrangements of the Y chromosome (Pic. 1), including deletions (Pic. 2) (a part of a chromosome or a sequence of DNA is lost during DNA replication), ring chromosomes (Pic. 3) (a chromosome whose arms have fused together to form a ring) and isochromosomes (Pic. 4) (an unbalanced structural abnormality in which the arms of the chromosome are mirror images of each other) may lead to different phenotypes. Yp (short arm) deletions including SRY gene directly affect testis differentiation leading to streak gonads and a female phenotype, whereas deletions of the long arm, specially involving the Azoospermia Factor regions AZFa, AZFb and AZFc on Yq11 lead to male infertility.

Many men with Y chromosome microdeletions (YCM) exhibit no symptoms and lead normal lives. However, YCM is also known to be present in a significant number of men with reduced fertility. The mechanism of mutation is not different for Y-chromosome microdeletion. However, the ability to repair it differs from other chromosomes. The human Y chromosome is passed directly from father to son, and is not protected against accumulating copying errors, whereas other chromosomes are error corrected by recombining genetic information from mother and father. This may leave natural selection as the primary repair mechanism for the Y chromosome.

Y chromosome microdeletion is currently diagnosed by extracting DNA from leukocytes in a man’s blood sample, mixing it with some of the about 300 known genetic markers. Present diagnostic techniques can only discover certain types of deletions and mutations on a chromosome and give therefore no complete picture of genetic causes of infertility. They can only demonstrate the presence of some defects, but not the absence of any possible genetic defect on the chromosome.

The gold standard test for genetic mutation, namely complete DNA sequencing of a patient’s Y chromosome, is still far too expensive for use in epidemiologic research or even clinical diagnostics.

Most genes involved in Y chromosome deletions are expressed specifically in the testes during spermatogenesis, but do not appear to be essential for fertilization or embryogenesis; thus, these deletions does not seem to adversely affect the fertilization results in men whose sperm was obtained by testicular sperm extraction (TESE). Thus, subjects with mixed gonadal dysgenesis (a rare disorder of sex development in humans associated with sex chromosome aneuploidy and mosaicism of the Y chromosome) may also benefit from procedures such as TESE followed by in vitro fertilization with intracytoplasmic sperm injection (ICSI).

Thereby, patients with a 45,X/46,XY karyotype (Pic. 5) or its variants reared as males who have Y microdeletions may, by means of assisted reproductive technologies, generate not only male offspring with sterility, but also individuals who are carriers of an unstable Y chromosome that may originate mosaicism with a 45,X cell line in the early stages of embryonic development leading to various anomalous phenotypes.

Associated disease

- azoospermia
disorders of sex development (DSD)

Complications

- infertility
- 46, XY complete gonadal dysgenesis

Risk factors

There are no significant risk factor which could be related to Y chromosome microdeletions.

Impact on fertility

Microdeletions in the Y chromosome have been found at a much higher rate in infertile men than in fertile controls and the correlation found may still go up as improved genetic testing techniques for the Y chromosome are developed.

Men with reduced sperm production (in up to 20% of men with reduced sperm count, some form of YCM has been detected) varies from oligozoospermia, significant lack of sperm, or azoospermia, complete lack of sperm.

Much study has been focused upon the "azoospermia factor locus" (AZF). A specific partial deletion of AZFc called gr/gr deletion is significantly associated with male infertility.

Prevention

There is no prevention for this condition.

Symptoms

- infertility
- secondary sex characteristics do not develop (small testes, undescended testes)

Therapies

Self therapy

There is no alternative therapy of Y chromosome microdeletions.

Conventional medicine

Pharmacotherapy

No pharmacotherapy can be used to treat Y chromosome microdeletions.

Surgical therapy

There is no surgical therapy which can improve this condition.

Assisted reproduction

If conservative medical treatments fail to achieve a full term pregnancy, the physician may suggest the
Patient undergo in vitro fertilization (IVF). IVF and related ART techniques generally start with stimulating the ovaries to increase egg production. After stimulation, the physician surgically extracts one or more eggs from the ovary, and unites them with sperm in a laboratory setting, with the intent of producing one or more embryos. Fertilization takes place outside the body, and the fertilized egg is reinserted into the woman's reproductive tract, in a procedure called embryo transfer.

Intracytoplasmic sperm injection (ICSI) is beneficial in the case of male factor infertility where sperm counts are very low or failed fertilization occurred with previous IVF attempt(s). The ICSI procedure involves a single sperm carefully injected into the center of an egg using a microneedle. With ICSI, only one sperm per egg is needed. Men who ejaculate low or no sperm because of a genetic condition that prevents their sperm being released, require some form of surgical sperm retrieval to enable ICSI to take place. Epididymal sperm obtained by microsurgical aspiration (MESA) or percutaneous sperm aspiration (PESA) and testicular sperm obtained by surgical excision (TESE) or percutaneous aspiration (PESA) are used in ICSI treatment. Alternatively, the retrieved sperm can be cryopreserved for use in future sperm injection attempts. If all efforts to extract vital sperm cells fails, then donated ones may be recommended.

Y chromosome microdeletion can be diagnosed before the child is born. There is PGS/PGD which allows studying the DNA of eggs or embryos and select those that carry certain damaging characteristics. It is useful when there are previous chromosomal or genetic disorders in the family, within the context of in vitro fertilization programs.

Find more about related issues

Diagnoses

Azoospermia
Complete absence of sperm in the ejaculate of a man.
Learn more at: www.fertilitypedia.org/therapy/diag/azoospermia

Oligozoospermia
Semen with a low concentration of sperm and is a common finding in male infertility.
Learn more at: www.fertilitypedia.org/therapy/diag/oligozoospermia

Oligoasthenoteratozoospermia
Male fertility diagnosis defined as a combination of low sperm concentration, reduced motility and abnormal sperm morphology in the ejaculate.
Learn more at: www.fertilitypedia.org/therapy/diag/oligoasthenoteratozoospermia

Gonadal dysgenesis
Any congenital developmental disorder of the reproductive system characterized by a progressive loss of germ cells on the developing gonads.
Learn more at: www.fertilitypedia.org/therapy/diag/gonadal-dysgenesis

Organs

Testes
Male gonads which produce both sperm and androgens, such as testosterone, and are active throughout the reproductive lifespan of the male.
Learn more at: www.fertilitypedia.org/edu/organs/testes

Reproductive cells

Sperm
A male reproductive cell which is able to fertilize the counterpart female gamete - the oocyte.
Learn more at: www.fertilitypedia.org/edu/reproductive-cells/sperm
Biological control

Follicle-stimulating hormone
FSH is a hormone secreted by the anterior pituitary gland. It regulates the development, growth, pubertal matur and reproductive functions of the body.
Learn more at: www.fertilipedia.org/edu/biological-control/follicle-stimulating-hormone

Testosterone
Steroid hormone produced primarily in the testes of the male; responsible for the development of secondary sex characteristics in the male.
Learn more at: www.fertilipedia.org/edu/biological-control/testosterone

Reproductive functions

Fertilization
The fusion of an ovum with a sperm to initiate the development of a new individual organism.
Learn more at: www.fertilipedia.org/edu/reproductive-functions/fertilization

Spermatogenesis
Process in which spermatozoa are produced from male primordial germ cells in testicles by way of mitosis and meiosis.
Learn more at: www.fertilipedia.org/edu/reproductive-functions/spermatogenesis

Symptoms

Absence of sperm in ejaculate
The medical condition of a man whose semen contains no sperm.
Learn more at: www.fertilipedia.org/edu/symptoms/absence-of-sperm-in-ejaculate

Infertility
The failure to achieve a clinical pregnancy after 12 months or more of regular unprotected sexual intercourse.
Learn more at: www.fertilipedia.org/edu/symptoms/infertility

Small testes
Abnormally small testicular volume.
Learn more at: www.fertilipedia.org/edu/symptoms/small-testes

Undescended testes
The absence of one or both testes from the scrotum.
Learn more at: www.fertilipedia.org/edu/symptoms/undescended-testes

Therapies

ICSI
A micromanipulative fertilization technique in which a single sperm is injected directly into an egg.
Learn more at: www.fertilipedia.org/edu/therapies/icsi

MESA
A microsurgical procedure to harvest sperm from the single epididymal tubule (epididymis), used in the case of obstructive azoospermia.
Learn more at: www.fertilipedia.org/edu/therapies/mesa

Micro TESE
Microsurgical method used to identify areas of sperm production within the testes with the aid of optical magnification.
Learn more at: www.fertilipedia.org/edu/therapies/micro-tese
PESA
Sperm aspiration procedure in which a needle is inserted into the epididymis in order to retrieve sperm.
Learn more at: www.fertilitypedia.org/edu/therapies/pesa

Preimplantation genetic diagnosis
Technology that allows couples with a family history of monogenic disorders, x-linked diseases and chromosomal abnormality to have a healthy baby.
Learn more at: www.fertilitypedia.org/edu/therapies/preimplantation-genetic-diagnosis

Preimplantation genetic screening
The term PGS is used to denote procedures that do not look for a specific disease but to identify embryos at risk of de-novo occurring aneuploidies
Learn more at: www.fertilitypedia.org/edu/therapies/preimplantation-genetic-screening

Sperm donation
The procedure in which a man (sperm donor) provides his sperm for fertility treatment.
Learn more at: www.fertilitypedia.org/edu/therapies/sperm-donation

TESE
Removal of a small portion of testicular tissue in order to extract a few viable sperm.
Learn more at: www.fertilitypedia.org/edu/therapies/tese

Gallery

Pic
Ideogram of human Y chromosome.

Pic
Deletion on a chromosome.

Before deletion
After deletion
**Pic**
Formation of a ring chromosome.

**Pic**
 Isochromosome in which the arms are mirror copies of each other.

**Pic**
Loss of one arm and duplication of the other.

**Pic**
Human karyotype with 22 pairs of autosomes and 1 pair of heterosomes.

**Sources**

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