Discuss the role of semen analysis in diagnosing male infertility.

Alexandra Hopkins - 21305919

By definition, Male infertility is the inability to conceive after at least 1 year of unprotected intercourse with a fertile female, it is common for both partners to contribute to fertility issues however it is believed to be solely the male in around 20% of cases. Infertility in men can be caused by several things, for example, testicular cancer/infections, undescended testicles, or injury to them. Certain medicines may also decrease fertility including, anabolic steroids, sulfasalazine (used to treat Crohn's disease) and males undergoing chemotherapy may expect to see a severe reduction in their sperm count. However, the most common cause of infertility in men is having poor quality semen or abnormal semen, this is why semen analysis plays a vital role in diagnosing male infertility. Having abnormal semen could mean a few things, such as, having a low sperm count, having sperm with little movement, and having too much sperm of an abnormal shape. What is semen? As shown in figure 1 semen is a viscous fluid made up of spermatozoa (5%) and seminal fluid (95%) this fluid contains secretions from male reproductive organs.

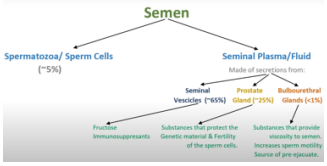

Figure 1. composition of semen (2021)

Volume	≥ 1.5 mL
pH	≥ 7.2
Sperm concentration	≥ 15 million spermatozoa/mL
Total sperm count	≥ 39 million spermatozoa/ejaculate
Progressive motility	≥ 32%
Total (progressive + non-progressive) motility	≥ 40%
Morphology	≥ 4% normal forms
Vitality	≥ 58% living spermatozoa

Figure 2. WHO semen sample criteria (2013)

Semen is analysed following The World Health Organisations guidelines as shows above, these guidelines were altered in 2010 as we are seeing a reduction in sperm quality.

Pre-analysis the patient's information is recorded, and a sample is collected and received, it is important that the patient abstained from ejaculation for at least 48 hours before the sample is collected however the abstinence should not exceed 14 days, this includes involuntary ejaculation. The sample is then collected, most patients will just ejaculate into the sample cup however, in some rare cases the patient may have a blockage, this could be due to a vasectomy or even sexually transmitted infections such as chlamydia. This means the patient would have to undergo a surgical sperm extraction (PESA or TESA) this procedure is done under local anaesthetic and involves a fine syringe being inserted into the epididymis of the testicle to extract the sperm. The sample is then weighed to calculate the volume and then left for 30 minutes in order for liquefaction to occur. Liquefaction is the process in which gel like semen becomes watery due to enzyme activity, this process is crucial when it comes to fertility as is allows movement of the sperm to the fertilization site, a longer liquefaction time may be an indication of infection such as protasis (inflammation of the prostate gland) or Spermatocystitis (usually caused by a bacterial infection, this is when the seminal vesicles become inflamed).

A wet mount slide is prepared, and the semen is ready to undergo analysis. The microscopic appearance is first assessed as well as the concentration and motility, the sperm motility is the ability of the sperm to move efficiently. The PH is then tested, it should fall between 7.2-7.8, a lower PH may indicate obstruction whereas a higher PH is a sign of infection or dysfunction of an accessory gland. Sperm vitality is then assessed and at least 58% of sperm should be living. The sperm morphology is then studied based on the WHO criteria as shown in figure 3 below.

	WHO (2nd edition) [16]	WHO (3rd edition) [17]	Strict criteria [1,13,18,23]
Head	Regular oval Length 3–5 µm, width 2–3 µm Acrosome > 1/3 size of head	Smooth oval Length 4–5 µm, width 2.5–3.5 µm Acrosome 40–70% of head	Smooth and perfect oval 4–6 µm × 2.4–3.5 µm Well-defined acrosome (40–70% of sperm head)
Midpiece	Straight, regular Width < 1 µm, length 5–7 µm	Slender, regular Width < 1 µm, length 1.5 × head size	No midpiece defects Slender, regular Width < 1 µm, length 1.5 × head size
Tail	Slender, uncoiled 45 µm long	Slender, uncoiled 45 µm long	No tail defects Uniform size, 10 × head length, 45 µm long
Cytoplasmic droplets	< ½ the head size	< ½ size of the head	No cytoplasmic droplets > ½ size of the head
Vacuoles	Not stated	< 20% of head	Up to 4
General	If in doubt = normal	Borderline = abnormal	Borderline = abnormal

Figure 3. strict criteria for sperm morphology 2010

At least 4% of the sperm should have normal morphology, having a high number of abnormal sperm (known as teratozoopermia) can be caused my multiple factors, including, exposure to toxic chemicals, infections, and genetic traits. The semen is also checked for presence of leukocytes, there should be no more than 1 million white blood cells for every millilitre of semen. Excess leukocyte presence in semen is called leukocytospermia and can be cause by urinary tract infections as well as bacteria in the semen. A mixed antiglobulin antibody test (MAR) may also be carried out to detect anti sperm antibodies, anti-sperm antibodies are immune system proteins that destroy sperm cells, they are produced when the immune system mistakes sperm cells for an invader. The semen is also checked for presence of red blood cells as this can affect sperm quality and indicate infection, having excess RBC in the semen is called Hematospermia and can be caused by UTI's, STI's, recent procedures such as vasectomy (cut/tie the two tubes that carry sperm from the testicles) or a cystoscopy (having a cystoscope inserted into the urethra to examine the bladder and urethra for signs of disease etc).

Diagnosing male infertility can be a long process that requires lots of testing, hence why semen analysis plays such a vital role in the diagnosis. The patient may also expect to have a genital examination as well as a general physical examination and must give details about any inherited diseases, chronic illness, injuries and even lifestyle factors, such as smoking, recreational drug use, use of steroids, caffeine, and alcohol intake, as these may affect fertility. Patients can also expect to have their weight recorded, as men that are considered obese are 81% more likely to produce no sperm. If your sperm analysis comes back as abnormal and shows signs of infertility the patient will have to return and keep having their semen analysed over a period of time, this is because sperm counts can fluctuate from one specimen provided to the next, so monitoring it will ensure more accurate results. It is

recommended that the female partner undergo fertility testing as well to rule out any possible contribution.

In conclusion semen analysis is crucial in diagnosing male infertility, it provides us with information about the possible root cause of the infertility which will indicate what further testing needs to be done. Examples of further testing include, scrotal/transrectal ultrasounds, hormonal testing, genetic testing, testicular biopsies and post-ejaculation urinalysis. Semen analysis helps us determine if the sperm have the biological capabilities to fertilize the egg and have a viable pregnancy or if further procedures/medications are needed to assist.

References:

1. Publishing, H.H. (n.d.). Male Infertility. [online] Harvard Health. Available at: https://www.health.harvard.edu/a_to_z/male-infertility-a-to-z
2. Leslie, S.W., Siref, L.E. and Khan, M.A. (2020). Male Infertility. [online] PubMed. Available at: https://www.ncbi.nlm.nih.gov/books/NBK562258/
3. NHS Choices (2019). Causes - Infertility. [online] NHS. Available at: https://www.nhs.uk/conditions/infertility/causes/.
4. (figure 2). Samplaski, M.K. and Sabanegh, E.S. (2013). The semen analysis. [online] Cambridge University Press. Available at: https://www.cambridge.org/core/books/abs/fertility-preservation-in-male-cancer-patients/semen-analysis/10AC95A6C455D9938968DED788C4C8A9
5. (figure 1) www.youtube.com. (n.d.). Semen Analysis Test Lab | Complete Video. [online] Available at: https://www.youtube.com/watch?v=OMRxQgCl6rw.
6. www.youtube.com. (n.d.). Semen Analysis: Boyz Under the Hood. [online] Available at: https://www.youtube.com/watch?v=EmGPXKCexOg
7. fertilitypedia.org. (n.d.). Fertilitypedia - Non-liquefaction of the semen. [online] Available at: https://fertilitypedia.org/edu/symptoms/non-liquefaction-of-the-semen.
8. www.hfea.gov.uk. (n.d.). Surgical sperm extraction | Human Fertilisation and Embryology Authority. [online] Available at: https://www.hfea.gov.uk/treatments/explore-all-treatments/surgical-sperm-extraction/.
9. gpnotebook.com. (n.d.). semen analysis (abnormal pH) - General Practice notebook. [online] Available at: https://gpnotebook.com/simplepage.cfm?ID=-657457077#:~:text=A%20pH%20of%20below%207.0
10. (Figure 3) Centola, G.M. and Jeyendran, R.S. (2009). Strict criteria for sperm morphology. 4th ed. [online] Cambridge University Press. Available at: https://www.cambridge.org/core/books/abs/infertility-in-the-male/strict-criteria-for-sperm-morphology/3225B7966E944A03B55A009F0672877F
11. Healthy Male. (n.d.). How weight can impact male fertility. [online] Available at: https://www.healthymale.org.au/news/obesity-overweight-can-impact-male-fertility#:~:text=Overweight%20men%20are%2011%25%20more