



Semen Parameters: A Review

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Abstract

The World Health Organization (WHO) provides guidelines for assessing the various semen variables. Semen analysis is one of the most important predictive values of male infertility. Semen consists of spermatozoa suspended in a fluid medium referred to as seminal plasma. This review describe Semen parameters which include appearance (color), volume, pH, motility, morphology, viability, concentration, liquefaction, viscosity, presence of WBC and fructose level. These parameters have been found to be important determinant of functional competence of the spermatozoa. More than 90% of male infertility cases are due to low sperm counts, poor sperm quality and sperm abnormalities caused by a range of factors, including congenital birth defects, diseases, chemical exposure, and lifestyle/habits. Others includes environmental pollutants, exposure to high heat for prolonged periods, heavy use of alcohol, marijuana, or cocaine, smoking, hormone deficiency, infections of the testes or epididymis, older age, previous chemotherapy, previous scarring due to infection, trauma, or surgery, radiation exposure, retrograde ejaculation, use of prescribed drugs.

Key words: Semen parameters, pH, motility, spermatozoa, sperm morphology and fructose.

INTRODUCTION

Semen consists of spermatozoa suspended in a liquid medium referred to as seminal plasma. The seminal plasma component of semen provides nutrients and protection to spermatozoa in the female reproductive tract as it protects spermatozoa from the acidic environment and possible DNA damage. Seminal plasma is composed of fluids secreted by the testes, epididymis, seminal vesicles, prostate, and bulbourethral (Cowper's) glands. The fluid secreted by the seminal vesicles makes up the large portion of the seminal plasma and is high in fructose which provides the necessary energy for normal sperm function. Secretions from the prostate contain lipids, citric acid, proteolytic enzymes, zinc, and acid phosphatase, while the fluid secreted by the bulbourethral glands functions as a lubricant for the urethra. The testes contribute to the composition of semen by producing millions of spermatozoa (Stefan *et al.*, 2013).

Semen has two major quantifiable attributes, the total number of spermatozoa; this reflects sperm production by the testes and the patency of the

post-testicular duct system, the total fluid volume contributed by the various accessory glands: this reflects the secretory activity of the glands. The nature of the spermatozoa (vitality, motility and morphology) and the composition of seminal fluid are also important for sperm function (WHO, 2010).

MATERIALS AND METHODS

Detailed literature search of previous studies published until July, 2017 was performed using the Pub Med, Medline, and Science Direct databases. The search was strictly limited to full articles in English and studies related to human's semen parameters.

RESULTS

Review of literature through electronic search of databases produces a total of 101 articles, including both review and original research articles. Thorough screening resulted in the selection of 61 article which are mostly related to different studies on human sperm parameters and semen analysis.

Further thorough screening leads to the final adoption of 23 articles which were mainly related to sperm parameters and semen analysis.

Semen analysis

A semen analysis is the examination of a male's ejaculate, performed to determine if the cause of a couple's infertility is attributed to the male's inability to fertilize the ovum. It is also used to confirm the absence of sperm following vasectomy. A semen analysis is the examination of freshly ejaculated seminal fluid. Seminal fluid is a viscous, turbid fluid produced mainly from secretions of the seminal vesicles (45-80% of volume) and prostate gland (15-30% of the volume). About 1% of the total volume is spermatozoa and testicular fluid produced by the testes (WHO, 2010).

Semen samples are collected by masturbation which is more preferred compared to coitus interruptus, and the use of condom, this emphasizes the fact that the semen sample needs to be complete, i.e. all the ejaculate is collected, including the first, sperm-rich portion, and any loss of any fraction of the sample should be reported by the subject. It should also be noted whether the sample is complete or incomplete (WHO, 2010).

Semen analysis is one of the most important predictive values of male infertility, WHO suggested that male problem may be present in as many as 43% of couples (Yuki *et al.*, 2003). Analysis should be performed on multiple ejaculates before characterizing a man as fertile or infertile due to the large variation in sperm parameters within-subject (Ashok and Tamer, 2011).

More than 90% of male infertility cases are due to low sperm counts and poor sperm quality. Sperm abnormalities can be caused by a range of factors, including congenital birth defects, disease, chemical exposure and lifestyle / habits. Environmental pollutants, exposure to high heat

for prolonged periods, heavy use of alcohol, marijuana, or cocaine, smoking, hormone deficiency or taking too much of a hormonal related substances, impotence, infections of the testes or epididymis, old age, previous chemotherapy, previous scarring due to infection, trauma or surgery, radiation exposure, retrograde ejaculation, use of contraindicating prescribed drugs, such as cimetidine, spironolactone and nitrofurantoin can also resulted in sperm abnormality (Kishore *et al.*, 2011).

Semen parameters

The semen parameters are one of the most important predictive values in fertilization and pregnancy rates in *in-vitro* fertilization and embryo transfer (Moazzam *et al.*, 2015). Semen parameters are considered in different ways on the basis of the clinical settings such as part of infertility investigation or follow-up of infertility treatment, selection for appropriate method of assisted reproduction, in reproductive toxicology, or in contraception studies (Trine *et al.*, 2006). Data's indicated that there are minor variations in semen parameters between men in different geographic areas and even between samples from the same individual, seasonal variation in semen parameters have been reported in both fertile and infertile men (Ashok and Tamer, 2011).

Semen parameters including appearance (color), volume, pH, motility, morphology, viability, concentration, liquefaction and presence of WBC have been found to be important determinant of functional competence of the spermatozoa (Ugwuja *et al.*, 2008).

Colour

A normal liquefied semen sample is homogeneous, grey-opalescent in appearance. It may also appear less opaque if the sperm concentration is very low

PARAMETERS	REFERENCE RANGE
Volume	1.5-5.0 ml.
Color	homogeneous, grey-opalescent appearance
Liquefaction	30-60 minutes
Viscosity	30-60 minutes
PH	7.2-8.0.
Seminal fructose (_mol/ejaculate)	>13umol/l
Sperm concentration:	≥ to 20 million per ml.
Motility:	≥ to 40%
Morphology	≥50% normal sperm.
White blood cells	< 1 million per ml.
Viability	≥ 75%.

(Arvind *et al.*, 2012)

; the colour may appear red-brown when red blood cells are present (haemospermia), or yellowish in a subject with jaundice or taking certain vitamins or drugs (WHO, 2010).

Haemospermia

This is the presence of blood in the semen. The prevalence of haemospermia remains unknown but it may be the first striking factor of other urological disease. Haemospermia can occur in male of any age, but more common among young men of between 30 - 40years old, its cause is usually benign. Haemospermia is usually associated with inflammatory condition of the seminal vesicle or prostate, it is self-limiting and resolves within 1-2 months. If persist beyond two months, further investigation is required to determine the real cause (Matters *et al.*, 2017; Ahmad and Krishnan, 2007).

Semen volume

Semen is measured to rule out the possibility of inflammation or blockage. Low semen volume is characteristic of obstruction of the ejaculatory duct or Congenital Bilateral Absence of the Vas Deferens (CBAVD), a condition in which the seminal vesicles are also poorly developed. High semen volume may indicate inflammation of accessory glands (Sasikala *et al.*, 2014).

Absence of any semen volume after orgasm, termed aspermia, occurs in patients with diabetic neuropathy, following the intake of sympatholytic drugs and following surgical procedures that damage the sympathetic nervous plexus or resection of the prostate. In some of these cases, there may be retrograde flow of the semen into the bladder, and the examination of the post ejaculatory urine should be conducted. Hypospermia (semen volume <0.5 mL), could be due to the loss of a portion of the ejaculate during collection, short abstinence period or incomplete orgasm (Ashok and Tamer, 2011).

High semen volume may reflect active exudation in cases of active inflammation of the accessory organs (WHO, 2010).

Semen liquefaction

Human semen coagulates spontaneously after ejaculation and consequently liquefies within 5-20 minutes under normal physiological conditions. Although the mechanism is not fully understood, the process of semen coagulation/liquefaction is believed to be regulated through a series of enzymes, mainly proteases, and inhibitory factors. Subsequent liquefaction of coagulum within minutes (~5-20

min after ejaculation) allows for a progressive release of motile spermatozoa (WHO, 2010).

Liquefaction is achieved through a stepwise proteolytic cleavage of the gel proteins semenogelin I and II (SgI and -II) into soluble proteins, followed by their peptidic fragmentation. These peptides are eventually degraded into their constituent amino acid residues (Nashmail *et al.*, 2017)

Viscosity

The viscosity of the semen sample can be measured using a plastic disposable pipette with a diameter of ± 1.5 mm by gently aspirating the semen sample and later allowing it to drop by gravity. A normal sample leaves the pipette in small discrete drops (Stefan *et al.*, 2013). There are many known causes of seminal hyper viscosity (SHV) as well as several hypothesized contributors and associated factors, although the exact cause of abnormal semen viscosity after coagulation and liquefaction is unclear. Seminal hyper viscosity is mostly attributed to male accessory gland infection, increased levels of leukocytes and inflammation, as well as dysfunction of the sex glands or even the immune system, while these hypotheses are generally accepted by clinicians, conflicting scientific evidence have been reported in the literature (Stefan *et al.*, 2013). Semen usually loses its viscosity during the liquefaction process, both in vitro and in vivo (in the female reproductive tract). However, in the event that semen retains some of the viscous characteristics, it can be identified and is regarded as hyper viscous. Hyper viscous seminal fluid has been shown to have a negative impact on sperm motility and semen quality and contributes to a poor outcome with in vitro fertilization. SHV is likely caused by infection, inflammation, dysfunction of the male sex glands, and diseases that directly impact male fertility. While these conditions are related to SHV, hyper viscous seminal fluid results in a negative impact on fertility through its role in the female genital tract. The various causes of hyper viscosity contribute to male subfertility outside the scope of SHV (Sandro *et al.*, 2011). The thread lengths of the semen drops can be measured on a centimeter scale in order to determine the grade of viscosity. Men whose semen has a thread length between 2cm and 4cm are diagnosed with mild SHV; a thread length between 4cm and 6cm is labeled as moderate SHV and a thread length greater than 6cm is diagnosed as severe SHV (Stefan *et al.*, 2013).

Semen pH

pH is used as a scale to indicate how acidic or basic (alkaline) a solution is. It ranges from 0 to 14, meaning that anything with a pH of 7 is neutral, anything above 7 is basic and anything below 7 is acidic. So as the pH number goes down, acidity increases, and vice versa (Zhou *et al.*, 2015). According to the World Health Organization (WHO), the average pH of semen should range between 7.2 and 8. This is just slightly basic, making it the perfect protective environment for sperm. If semen has a pH below 7, it is acidic. This could impair chances of conception and can be a sign of a blockage of seminal vesicles. If semen has a pH above 8 (basic), this can impair sperm motility and can be a sign of an infection (Zhou *et al.*, 2015).

Human semen pH often focuses on clinical cases. It has been reported that semen pH is lower than 7.2 in patients with oligospermia or/and asthenospermia. Deviation from the range may be an indication of inflammation of the male accessory sex organs or chronic disease of the prostate gland and seminal vesicles (Zhou *et al.*, 2015).

Prostatic secretion is acidic while seminal vesicles fluid is alkaline. Acidic ejaculate may be associated with the blockage of the seminal vesicles. Alkaline ejaculate is usually associated with infections that can impair fertilization *in vitro* and *in vivo*. In general a pH value outside the range is harmful to spermatozoa (Sasikala *et al.*, 2014).

Fructose level

The purpose of the fructose test is to measure the amount of fructose in human semen or seminal plasma. The Fructose test may help in assessing the diagnosis and the management of male infertility, fructose in semen reflects the secretory function of seminal vesicles. Fructose acts as a donor of energy to the spermatozoa, which break it down selectively and convert it into energy. The motility of spermatozoa is very closely connected with fructose break down. Fructose is one of the major energy yielding nutritive substrates present in human seminal fluid, Fructose values which fall below normal values of 1200 - 4500µg/ml may be as a consequence of inflammation in the prostate or seminal vesicles, or structural abnormality of the

seminal vesicles and their ducts (Zahoor *et al.*, 2010).

Sperm motility

Sperm motility is one of the most important parameters in evaluating the fertility potential of semen sample (Singh *et al.*, 2010). Sperm gain motility, after being freed from the seminal clot by the action of proteolytic enzymes secreted by the seminal vesicles following liquefaction of the coagulum, approximately 20-30 minutes after ejaculation. Sperm motility are classified into progressive motility, non-progressive motility and immotile sperms (Stefan *et al.*, 2013).

Progressive motility (PM): Spermatozoa move actively, either linearly or in a large circle, regardless of speed (WHO, 2010). The presence of progressively motile sperm in the ejaculate is critical to ensure adequate sperm transport and fertilization. Sperm motility is considered as compromised if the percentage of forward progressive sperm falls below 50% within 60 min of sample collection (Ashok and Tamer, 2011).

Non-progressive motility (NPM): All other patterns of motility with an absence of progression, e.g. swimming in small circles, the flagella force hardly displacing the head, or when only a flagella beat can be observed (WHO, 2010).

If movement is slow, not in a straight line, or both, the sperm have would difficulty invading the cervical mucus or penetrating the hard outer shell of the egg and any sperm that move sluggishly may have genetic or other defects that may render them incapable of fertilizing an egg. Poor sperm motility may be associated with DNA fragmentation and may increase the risk of passing on genetic diseases (Moazzam *et al.*, 2015).

Immotility (IM) or Absent of sperm movement: A rapid decline in motility could be due to infection, prostatic function or a disturbed order of emission of fluid from the prostate and seminal, but in any instance one is unable to identify the specific cause. Sperm motility is considered as compromised if the percentage of forward progressive sperm falls below 50% within 60 min of sample collection (Moazzam *et al.*, 2015; WHO, 2010).

Sperm immotility can have several causes such as structural abnormalities of the axoneme, the fibrous sheath and the outer dense fibers.

The outer dense fibers are essential structures for spermatozoa to generate motility, particularly progressive motility and structural shaft defects, or deletions have grave consequences for motility. Among these structural defects, the dysplasia of the fibrous sheath (DFS) is a genetic defect of multigenic nature and spermatozoa of these subjects are not only immotile, but also show distinct morphological abnormalities of the flagellum (Leyla and Gabor, 2015). Moreover, abnormalities of the mitochondrial organization are also a cause of asthenoteratozoospermia. Such mitochondrial defects are not only responsible for the morphological abnormality, but also low sperm motility (Leyla and Gabor, 2015).

Viability

It is clinically important to know whether immotile spermatozoa are alive or dead. Viability results should be assessed in conjunction with motility results from the same semen sample. The presence of a large proportion of vital but immotile cells may be indicative of structural defects in the flagellum; a high percentage of immotile and non-viable cells (necrozoospermia) may indicate epididymal pathology. Live spermatozoa have white or light pink heads and dead spermatozoa have heads that are stained red or dark pink after staining with nigrosine-Eosin (WHO, 2010).

Sperm concentration

Sperm concentration refers to the number of spermatozoa per unit volume of the semen and is an indicator of the number of the spermatozoa ejaculated and the volume of the fluid that dilutes them (Moazzam *et al.*, 2015). This determines the amount of spermatozoa present in the semen sample and is expressed in Sperms/milliliter (mL). It is further sub-divided as follows.

Polyzoospermia: polyzoospermia may be associated with asthenozoospermia and/or teratozoospermia. Polyzoospermia is considered a pathological finding not only because of an overproduction of spermatozoa, but also for its association with decreased reproductive performance as a result of dysfunctional acrosomal membrane, chromosomal abnormalities and decreased ATP content (Moazzam *et al.*, 2015).

Oligozoospermia: Sperm counts may vary between 10- 20x 10⁶/mL in mild, 5-10 x 10⁶/mL in moderate and < 5 x 10⁶/mL in severe oligozoospermia. Functional disturbances of the testis, e.g endocrine disorders, varicocele and as

well as factors of non-testicular origin, e.g drug toxicity, environmental pollutants, mumps, orchitis, radiation and exposure to chemical products all are involved in the causation of mild and moderate oligozoospermia. Severe oligozoospermia is associated with genetic abnormalities, such as Y chromosome micro deletions. Oligozoospermia is associated with abnormal sperm morphology and decreased sperm motility, hence degrading the semen quality and its fertilization capacity. However, these males to some extent still have the ability to fertilize naturally even in severe oligozoospermic conditions (Moazzam *et al.*, 2015).

Azoospermia: Refers to the total absent of sperm cells in the semen sample, differential diagnosis of azoospermia is based on physical examination of the male, testicular biopsy, endocrine evaluation and genetic screening. Azoospermia is classified into two types, for diagnostic purposes, non-obstructive or secretory resulting as a cause of extreme testicular failure and obstructive or excretory caused by occlusion of the testis, epididymis and excretory ducts, hence preventing the release of spermatozoa in the seminal ejaculate. Micro deletions of the Y chromosome may also be involved in the pathogenesis of azoospermia. Congenital bilateral absence of the vas deferens and the seminal vesicles as a result of cystic fibrosis gene mutation is a special case of azoospermia. In spite of its rarity, this pathology is easily identifiable by the presence of an elevated levels of prostatic biomarkers, absence of seminal vesicle markers, a seminal pH<7.0 and a seminal volume of ≤ 1.0mL (Kolettis *et al.*, 2002).

If azoospermia is detected, the semen analysis must be repeated to rule out iatrogenic cause, such as loss of the sample. Azoospermia is one of the conditions, where chemical analysis of the seminal plasma may be of importance such as fructose, which is normally present in seminal plasma, it originates mainly from the seminal vesicles and absence of fructose in azoospermic patient may be indicative of ductal obstruction (Ashok and Tamer, 2011).

Sperm morphology

Human semen samples contain spermatozoa with different kinds of malformations. Defective spermatogenesis and some epididymis pathologies are commonly associated with an increased percentage of spermatozoa with abnormal shapes.

The morphological defects are usually mixed. Abnormal spermatozoa generally have a lower fertilizing potential, depending on the types of anomalies, and may also have abnormal DNA. Morphological defects have been associated with increased DNA fragmentation, an increased incidence of structural chromosomal aberration, immature chromatin and aneuploidy, emphasis is therefore given to the form of the head, although the sperm tail (midpiece and principal piece) is also considered Rheubert *et al.*, 2012; Franken and Henkel, 2012).

These aberrations are identified through differences in size, structure, or form, and include immature spermatozoa, sperm precursors, and spermatozoa with head, midpiece and tail defects Rheubert *et al.*, 2012).

Head defects: This defect could appear as large or small, tapered, pyriform, round, amorphous, vacuolated (more than two vacuoles or >20% of the head area occupied by unstained vacuolar areas), vacuoles in the post-acrosomal region, small or large acrosomal areas (<40% or >70% of the head area), double heads or any combination of these.

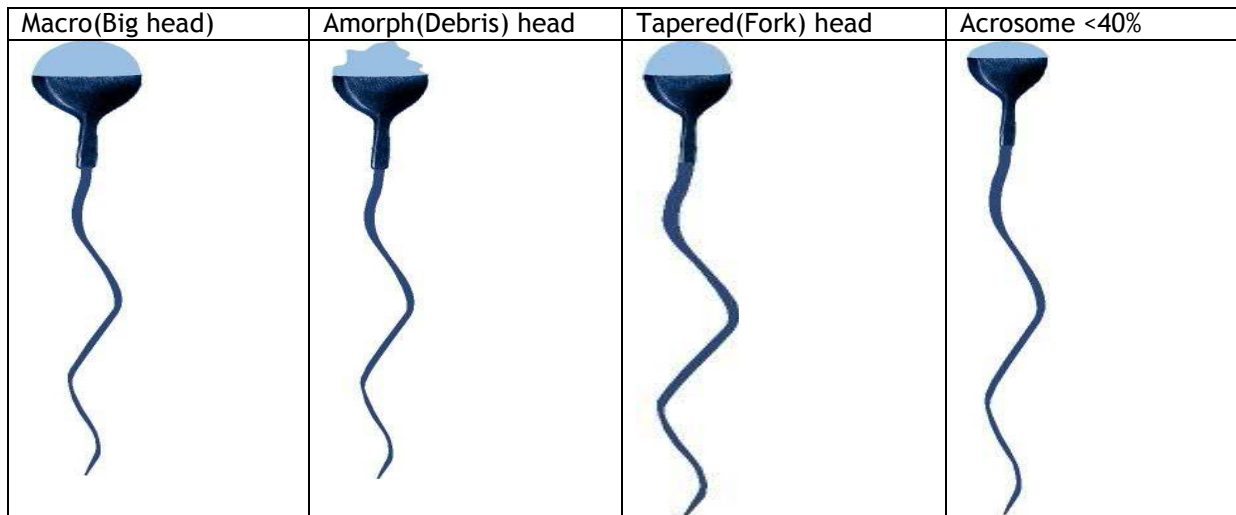


Fig. 1 Abnormal sperm head (Rheubert *et al.*, 2012; Franken and Henkel, 2012).

During spermatogenesis, the acrosome of mature spermatozoa derives from transformations of the Golgi apparatus. In early spermatids, the acrosomal vesicle and granule form inside the Golgi complex that progressively approaches the spermatid nucleus and attaches to it at a site marked by previous changes in the nuclear envelope. Men with acrosome-less spermatozoa are infertile because the sperm are unable to bind to the zona pellucida and subsequently penetrate the oocytes (Rheubert *et al.*, 2012).

Pathology of the sperm head are divided into two globozoospermia i.e. Type I completely lack the acrosome and acrosomal enzymes, whereas Type II contains a conical nucleus (Rheubert *et al.*, 2012; Franken and Henkel, 2012).

Midpiece defects:

The midpiece derives from interaction of centrioles with the spermatid nucleus and

includes; thick insertion, bent, asymmetrical insertions and thin insertion (Franken and Henkel, 2012).

Principal piece defects:

Short, multiple broken, smooth hairpin bends, sharply angulated bends, irregular width, coiled, or any combination of the above mentioned defects. Excess residual cytoplasm (ERC), this is associated with abnormal spermatozoa deduced from a defective spermatogenic process. Spermatozoa characterized by large amounts of irregular stained cytoplasm, one third or more of the sperm head size is often associated with defective midpieces abnormality (WHO, 2010).

These aberrations are also known as tapered forms and their heads are typically narrower and longer than the described limits of normality.

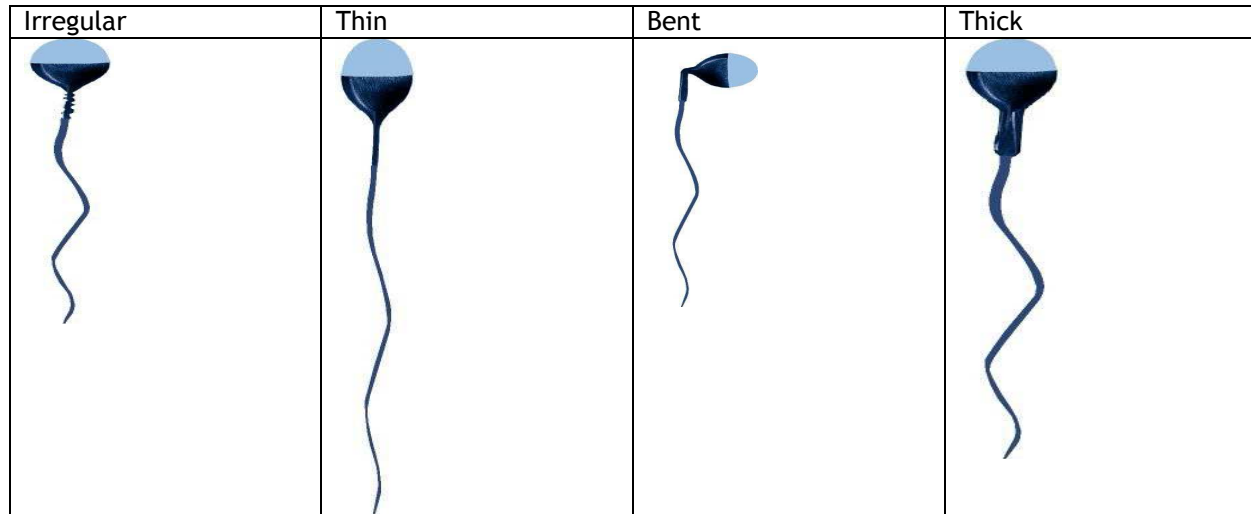


Fig. 2 Abnormal Midpiece defects (Franken and Henkel, 2012)

Amorphous

These abnormalities include all of the above 3 categories. In general, the heads can take any shape or size but are generally non-oval.

Tail aberrations

Tail aberrations could be in the following forms: coiled, duplicated, stumped, or bent more than 90°C (Rheubert *et al.*, 2012; Franken and Henkel, 2012).



Fig. 3 Abnormal sperm tail containing bent, more Stumped, duplicated and coil Rheubert *et al.*, 2012; Franken and Henkel, 2012).

Leucocytospermia:

Leucocytospermia is defined as the present of leucocyte $>1 \times 10^6$ WBC/ml in semen which is correlated negatively with different parameters of sperm function, especially with impaired sperm motility and morphology, acrosomal membrane damage and sperm tail defects. Presence of leucocytes in the epididymis, seminal vesicles, urethra and prostate is a physiological process required for elimination of abnormal germ cells from the seminal ejaculate. High leucocyte content causes an increased generation of toxic metabolites exceeding the neutralizing

capacity of the antioxidants present in the seminal plasma, leading to generation of oxidative stress (Moazzam *et al.*, 2015). Large numbers of contaminating leucocytes are indicative of poor semen quality and have been implicated as a possible cause of male infertility. However, neutrophils and macrophages are the main peroxidase positive cells which are important in the diagnosis, as they are the source of reactive oxygen species by phagocytosis (Samantha *et al.*, 2015). Increased numbers of white blood cells in semen have been associated with deficiencies in sperm function and motility.

Under wet-mount microscopy, leukocytes and immature germ cells appear quite similar and are properly called “round cells.” Unfortunately, many laboratories improperly report all round cells as “white blood cells,” and in men with such findings, the clinician must ensure that the two types of cells are differentiated. Traditional cytologic staining and immunohistochemical techniques have been utilized to distinguish leukocytes from immature germ cells. Men with true pyospermia (>1 million leukocytes/ml) should be specifically evaluated to exclude genital tract infection or inflammation (Samantha *et al.*, 2015)

Genital tract infection is confirmed by the presence of an increased concentration of leukocytes in the semen and has an association with an increased immature germ cell concentration.

Prostate and epididymis are considered as the major sources of seminal leukocytes, three different types of leukocytes are identified and capable of phagocytizing spermatozoa:

- (i) Polymorphonuclear cells about 10-12 μm in diameter,
- (ii) Large macrophages, about 30 μm which are capable of engulfing numerous spermatozoa
- (iii) Smaller macrophages/monocytes having a 10- 12 μm diameter. Leukocytes present generally in most ejaculates, play an important

role in phagocytic clearance and immune surveillance of abnormal spermatozoa (Samantha *et al.*, 2015).

Laboratory Diagnosis of Semen Parameters

The World Health Organization (WHO) periodically releases manuals for the laboratory examination and processing of human semen. While laboratories use these manuals as a practical guide of standardized methods for performing semen analyses both manual (macroscopic and microscopy) and Computer-aided sperm analysis, clinicians rely on the reference of normal limits for interpreting semen analysis results. The first manual, published in 1980, summarized the clinical experience and research from the previous eighty years with subsequent updates in 1987, 1992, 1999 and 2010 to meet contemporary challenges.

WHO manuals provided substantial improvements on how to assess the seminal parameters. The reference values that were thought to be compatible with normal male fertility have also changed. In its latest fifth edition (WHO, 2010) the semen analysis reference values are markedly lower than those of previous editions. Much debate has taken place thereafter, and a series of reports has questioned the validity of the newly released reference values (Sandro *et al.*, 2014).

Infertility conditions in male subject

Term	Explanation
Aspermia	No semen (no or retrograde ejaculation)
Asthenozoospermia	Percentage of progressively motile (PM) spermatozoa below the lower reference limit
Asthenoteratozoospermia	Percentages of both progressively motile (PM) and morphologically normal spermatozoa below the lower reference limits
Azoospermia	No spermatozoa in the ejaculate (given as the limit of quantification for the assessment method employed)
Cryptozoospermia	Spermatozoa absent from fresh preparations but observed in a centrifuged Pellet (WHO, 2010).
Haemospermia(haematospermia)	Presence of erythrocytes in the ejaculate
Leukospermia (leukocytospermia,pyospermia)	Presence of leukocytes in the ejaculate above the threshold value
Necrozoospermia	Low percentage of live, and high percentage of immotile, spermatozoa in the ejaculate
Normozoospermia	Total number (or concentration, depending on outcome reported) of spermatozoa, and percentages of progressively motile (PM) and morphologically normal spermatozoa, equal to or above the lower reference limits
Oligoasthenozoospermia	Total number (or concentration, depending on outcome reported) of spermatozoa, and percentage of progressively motile (PM) spermatozoa, below the lower reference limits
Oligoasthenoteratozoospermia	Total number (or concentration, depending on outcome reported) of spermatozoa, and percentages of both progressively motile (PM) and morphologically normal spermatozoa, below the lower reference limits
Oligoteratozoospermia	Total number (or concentration, depending on outcome reported) of spermatozoa, and percentage of morphologically normal spermatozoa, below the lower reference limits
Oligozoospermia	Total number (or concentration, depending on outcome reported) of spermatozoa below the lower reference limit
Teratozoospermia	Percentage of morphologically normal spermatozoa below the lower reference limit

(WHO, 2010).

CONCLUSION

The above described semen parameters form the basic requirements of semen analysis, Therefore, more attention should be paid to these parameters to reduce wide variability as decision for treatment options rely more strongly on them while most developing nations depend on semen analysis for infertility diagnosis and treatment as

developed nations are far ahead utilizing cut edge technologies going beyond semen analysis.

Recommendation

All semen specimens collected with the sole purpose of semen analysis, should be examine for the above semen parameters before declaring such subject fertile or non-fertile.

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