Seminal Hypo-and Hypervolemia

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This is an update of Rajasingam S. Jeyendran, Milica Ivanovic, Seminal Hypo- and Hypervolemia, Editor(s): Michael K. Skinner, Encyclopedia of Reproduction (Second Edition), Academic Press, 2018, Pages 70–72, ISBN 9780128151457, https://doi.org/10.1016/B978-0-12-801238-3.64838-9.

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Abstract

Semen volume refers to the quantity of ejaculate produced and is necessary in transporting sperm to or near the cervix during coitus. An abnormal volume may help to identify why a couple has failed to conceive. The semen volume is also important to calculate the total number of sperm in the ejaculate. For clinical interpretation ejaculate volume is classified as: Aspermia and Anejaculate if no ejaculate following orgasm; Hypovolemia if the ejaculate is 0.5 mL or less; Hypervolemia if the ejaculate is more than 6.0 mL. It should be emphasized that the measurement of semen volume is an essential part of routine semen analysis since it may help to identify and correct fertility impairing pathology.

Key Points

- Aspermia and Anejaculate: no ejaculate following orgasm.
- In Aspermia/Anejaculate, voided urine sample following masturbation must be evaluated for the presence of fresh sperm to rule out the retrograde semen flow.
- Hypovolemia if the ejaculate is 0.5 mL or less.
- Artifactual, behavioral, biological, psychogenic, and pathologic etiologies cause hypovolemia.
- Hypervolemia if the ejaculate is more than 6.0 mL and Hypervolemia has a minimal or no effect on spermatozoon fertilizing potential.

Introduction

Semen volume refers to the quantity of ejaculate volume which produced by male partner. The semen volume is also important to calculate the total number of sperm in seminal fluid analysis and identify the pathologies related to spermatogenesis and sperm transport. For clinical interpretation ejaculate volume is classified as: Aspermia and Anejaculate if no ejaculate following orgasm; Hypovolemia if the ejaculate is 0.5 mL or less; Hypervolemia if the ejaculate is more than 6.0 mL.

Semen volume is the quantity of ejaculate produced and represents the sum of secretions from the accessory sex glands (seminal fluid) as well as sperm and other cellular components. Seminal fluid is comprised mainly of secretions by the seminal vesicles and prostate gland, with a small amount from the bulbourethral glands and epididymis. The seminal vesicles contribute approximately 75% of the ejaculate volume; the prostate provides another 20% and the remaining secretions, spermatozoa, and non-sperm cells make up approximately 5% of the ejaculate. During ejaculation, the

bulbourethral gland secretions are emitted first, representing a small drop of fluid. Subsequently, the prostatic secretions as well as the majority of the spermatozoa are ejaculated, followed by the seminal vesicle secretions. By obtaining a "split ejaculate" (collecting the first and subsequent fractions of an ejaculate in two different containers), these secretions can be roughly separated.

An adequate volume of ejaculate during coitus is necessary to transport the spermatozoa to or near the cervix. An abnormal volume may help indicate why a couple has failed to conceive and thus recording the ejaculate volume is an important component of a semen analysis report. Similarly, the total volume of semen is used to calculate the total number of sperm in the ejaculate.

Even if the sperm concentration and motility are well within the acceptable limits, given the nature and consistency of the ejaculate especially if it is viscous, it can be difficult to measure the semen volume accurately. A precise measurement by weighing the sample and then calculating the volume from the weight is advocated by WHO laboratory manual for the examination and processing of human semen (WHO, 2021). However, for Practical reasons we recommend the semen volume to be measured to the nearest 0.1 mL with a graduated pipette, centrifuge tube, or syringe.

For clinical interpretation, one needs to define what constitutes an abnormal ejaculate volume. WHO (2021) laboratory manual provides a lower reference value of 1.4 mL based on3589 fertile men from 13 countries, 6 continents (Asia, Americas, Europe, Africa, Oceania). Jeyendran (2000) recommended that the ejaculate volume be classified as:

- Aspermia and Anejaculate: no ejaculate following orgasm.
- Hypovolemia if the ejaculate is 0.5 mL or less.
- Hypervolemia if the ejaculate is more than 6.0 mL.

In his own laboratory study of analyzing ejaculates from 5077 male spouses of infertile couples who presented them to ascertain their fertility potential 727 (14.3%) had 1.4 mL or less. A deeper review of the results revealed a wider distribution within this group; 2 men produced no ejaculate and 134 (2.6%) men produced 0.5 mL or less.

It is generally thought that the seminal plasma is supportive to spermatozoa rather than being essential for their function, but the biochemical analysis of the seminal plasma can be useful for diagnostic purposes. Individual components of seminal plasma are more than likely not essential for sperm function so that they are not useful as fertility indicators but only to assess the reason if the semen volume is affected.

Outline

Semen volume may identify fertility impairing pathology of the male. Below describes causes for alterations in seminal fluid volume. Some aren't necessarily associated with abnormal pathologies and rather artifactual.

Aspermia and Anejaculate

This condition is defined as the absence of an antegrade ejaculate following orgasm or a very small semen volume (less than 0.1 mL) following ejaculation (Kamischke and Nieschlag 1999; Mieusset *et al.*, 2017). In this situation, voided urine sample following masturbation must be evaluated for the presence of fresh sperm. If spermatozoa are present, then retrograde semen flow back into the bladder has occurred and the condition is referred to as retrograde flow of semen (commonly and erroneously referred to as: "retrograde ejaculation").

Normally, the involuntary urethral sphincter at bladder neck is closed during ejaculation to prevent retrograde semen flow into the bladder. If the sphincter fails to contract for whatever reason, the ejaculate may flow back into the bladder rather than proceed through the urethra. The following underlying causes can produce this condition:

- Transurethral or open surgical resection of the bladder neck or prostate
- Bilateral sympathectomy
- Bilateral retroperitoneal lymphadenectomy
- Extensive pelvic surgery (particularly proctectomy and colectomy)
- Diabetic visceral neuropathy
- Antihypertensive drugs that block sympathetic tone (e.g. Prazosin)
- Spinal cord injury

Hypovolemia

The hypovolemia is clinically relevant since it may affect fertility of the male. It is often due to factors that can be broadly classified into artifactual, behavioral, biological, psychogenic, and pathologic causes (Roberts and Jarvi, 2009).

Note: Hypovolemia has a minimal or no effect on spermatozoon fertilizing potential.

Artifactual Causes

The sexual stimulatory signals are modulated from higher brain centers, and therefore semen quality and quantity depend in part on the degree of psychological arousal (Jeyendran, 2023).

Studies have demonstrated that collection of semen during actual coitus (using a seminal pouch) yields higher ejaculate quality and quantity than that obtained through masturbation in the laboratory environment (Zavos and Goodpasture, 1989).

An insufficient period of sexual abstinence between ejaculations will influence the ejaculate volume.

WHO (2021) reference value for semen volume is based on 2–7 days of sexual abstinence based on 3589 fertile men, but it is generally recommended the ejaculate be collected after 2–3 days of sexual abstinence or sexual abstinence period corresponding to the couple's usual coital frequency (Jeyendran, 2003). Hanson *et al.* (2018) based on systematic review of 28 publications concluded that there was a strong correlation between greater than 5 days of sexual abstinence and increased semen volume. Results from 3274 men who presented them to ascertain their fertility potential, is detailed below. A linear increase in semen volume was observed between days 1–5 of sexual abstinence period (Correlation coefficient = 0.904); any abstinence period beyond 5 days showed no difference in the ejaculate volume.

Days of Abstinence	*1*	*2*	*3*	*4*	*5*
Mean ± CI[a]	1.81 ± 0.3	2.72 ± 0.1	3.03 ± 0.1	3.32 ± 0.2	3.54 ± 0.2
Number of patients	45	980	1561	298	390

[a]CI: 95% confidence interval

Based on the above data, we suggest 5 day abstinence period for everyone as a universal criteria.

Container for Sample Collection

Manual masturbation is by far the most common method used in the collection of semen for analysis. Incomplete collection (partially missing the container) or spillage following sample collection will affect the semen volume determination. Each semen jar should have a wide opening with a minimum diameter of about 5 cm to prevent the incomplete collection of samples (Jequier, 2011).

In Jeyendran's laboratory study of analyzing ejaculates from 2305 men who presented them to ascertain their fertility potential 173 (7.5%) indicated that they partially missed the collection into the specimen container. This underscores the significance of ensuring complete sample collection for accurate analysis.

Behavioral Causes

Recreational drugs such as heroin or methadone acting through higher brain centers may indirectly influence semen volume (Nudell *et al.*, 2002).

Semen volume tends to decrease with increasing cigarette consumption (Pasqualotto *et al.*, 2006).

Biological Causes

Patient age appears to affect the semen volume. As men age, the semen volume decreases (Eskenazi *et al.*, 2003). A 50-year-old man may have a 20% less semen volume compared to a 30-year-old man.

Psychogenic Causes

Anorgasmia due to anxiety, stress, disapproval, and embarrassment about masturbation may lead to partial ejaculation. Appropriate counseling or repeat collection on a different day may be advisable (Roberts and Jarvi, 2009).

Under certain emotional stress such as the recent diagnosis of cancer, one may produce poor ejaculate quality prior to semen analysis and cryopreservation.

Pathologic Causes

Hypovolemia without spermatozoa in the semen, and with a pH less than 7.4 could be due to ejaculatory duct obstruction or congenital absence of the seminal vesicles (Roberts and Jarvi, 2009).

Semen chemistries should be investigated. Such symptoms are associated with either partial or complete absence of fructose (produced by the seminal vesicles). However, normal zinc and acid phosphatase content with acidic pH (produced by the prostate gland) should be present.

Hypovolemia with spermatozoa present in semen and with a pH less than 7.4 could be due to obstruction of the seminal vesicular opening by a mucus-like plug, producing a high sperm concentration (Perez-Pelaez *et al.*, 1988).

The obstructing plug may dissolve spontaneously, causing resumption of normal ejaculate volumes; but more often than not the obstacle actually enlarges, causing azoospermia over time.

Stricture of the seminal vesicular duct, probably due to inflammation, may also result in this condition.

Hypovolemia without (or low numbers of) spermatozoa in semen and with pH more than 7.8 could be due to hypoandrogenism leading to impaired spermatogenesis, while some fructose may still be present (Jeyendran, 2000).

Hypovolemia with spermatozoa present in the semen and with a pH greater than 7.8 could be due to a partial or incomplete retrograde flow of semen.

Post ejaculate; voided urine must be examined (Kamischke and Nieschlag, 1999; Mieusset *et al.*, 2017).

This condition may also be due to accessory sex gland impairment caused by inflammation or cancer (especially if the pH is more than 9.0; Jeyendran, 2000).

Other factors that appear to affect ejaculate volume include dietary zinc deficiency (Hunt *et al.*, 1992), HIV −1 infection (Bujan *et al.*, 2007), Klinefelter syndrome (Aksglaede *et al.*, 2009), and certain drugs such as Silodosin and Tamsulosin (Nudell *et al.*, 2002).

Hypervolemia

There is no clear cut point above which the seminal volume becomes pathologic, but the upper limit for normal has been reported to be 6 mL (Eliasson, 1976; Cooke *et al.*, 1995; Jeyendran, 2000; Zhang *et al.*, 2015). The determination of hypervolemia is generally not relevant clinically but should be noted. It is often due to either a long period of sexual abstinence or accessory sex gland fluid overproduction. (In the author's own laboratory experience, 4% of the men produced more than 6 mL; the largest volume measured from a single ejaculate was 15.8 mL.).

Note: Hypervolemia has a minimal or no effect on spermatozoon fertilizing potential.

With the increasing interest in sperm function testing and nearly routine use of intracytoplasmic sperm injection with assisted reproductive technologies, clinicians treating male infertility are sometimes only interested in obtaining sperm from the male rather than identifying or correcting any underlying etiology and pathology. This notion may suggest that the determination of ejaculate volume may no longer be important. It should be emphasized however that the measurement of semen volume is an essential part of routine semen analysis since it may help identify and correct fertility impairing pathology which may allow couples to conceive without resorting to advanced assisted reproductive technologies.

Conclusion

Semen volume is the quantity of semen produced during ejaculation. According to the WHO (2021), the amount of semen ejaculated can range from 1.4 mL to 6.2 mL. The accessory organs of the male reproductive system contribute to greater volume of semen.

We should understand that the measurement of semen volume is an essential part of routine semen analysis since it may help to identify and correct fertility impairing pathology. Proper semen collection method and excluding retrograde flow of semen are important during analysis of semen volume.

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