

Viral menace to male infertility: Effects and risks of viral infections on the sperm

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Introduction

In male infertility, mumps (MuV), human immunodeficiency viruses (HIVs), adeno-associated virus (AAV), cytomegalovirus (HCMV), human papillomavirus (HPV), herpes simplex viruses (HSV), and Zika virus (ZIKV), are well-considered as risk-factor virals. It seems that in a delicate condition, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease 2019 (COVID-19) entail risks as well. At present, screening is only performed in the evaluation of HIV, hepatitis B virus (HBV), and hepatitis C virus (HCV) for assisted reproduction techniques.

The negative influence of HPV, and ZIKV in mouse testicular functions,^{1,2} abortion rate, fertilization, and sperm parameters is demonstrable.³

The partners and new-borns are at risk of spreading horizontal or vertical dissemination.⁴ We confer the main viruses and their effects on fertility and the male reproductive system.

Sexually transmitted diseases (STDs) are stigmatized worldwide for problems in the economy, community, and health. STDs endure pregnancy complications and infertility⁵ in 15% of reproductive-age couples and 50% of infertile male cases. The male reproductive system (MRS) is impaired due to inflammatory conditions of the testis and epididymis comparatively to accessory glands.⁶ The impairment includes decreased motility, moderate sperm count and sperm death, production of icing inflammatory cytokines, and despairing male fertility.⁷ Some mechanisms include:

- 1) Systemic acute or chronic infections⁸
- 2) Orchitis⁹
- 3) Urethral infections and male glands take part in male reproduction and fertility with a negative part⁸

Forward motility is low when HBV or HCV is found in semen¹⁰ and also because of the **rate of occurrence** of sperm aneuploidy and DNA fragmentation.¹¹

SARS – CoV was a health epidemic in 2003 as the Middle East Respiratory Syndrome Corona Virus (MERS - CoV) in 2012¹² and COVID-19 in 2019.¹³ For SARS-CoV and SARS-CoV-2 we have the identical human cell receptor, angiotensin-converting enzyme 2 (ACE2), but MERS CoV marches to a different tune because of a receptor called dipeptidyl peptidase 4.¹⁴ Cells with ACE2 receptors in dissimilar issues or other parts of the body can be affected,¹⁵ as well as, the lungs, intestine, kidney, testis, etc.^{15,16}

We have to clarify the **capacity** of viruses to pass on vertically from the mothers to their neonates and vice versa.

On viruses and assisted reproduction

Found below are some of the viruses and the sperm infections they cause.

Hepatitis B virus

The harmful spermatozoa of the HBV infection can cause male infertility. Lorusso et al.¹⁰ established that sperm parameters (concentration, motility, morphology, viability) are notably enhanced in HBV seropositive patients. Kang et al.¹⁷ manifested in vitro studies that revealed that HBV can persuade oxidative stress in sperm cells, as displayed by phosphatidylserine externalization, caspase activation, or DNA fragmentation. Qian et al.¹⁸ demonstrated that quantitative real-time polymerase chain reaction (PCR) can inspect the viral load in the semen of HBV-infected patients during assisted reproduction. With fluorescence in situ hybridization (FISH), Huang et al.¹⁹ proved that HBV DNA can be unified into the sperm chromosomes of HBV carriers and can vertically transmit via the germ cells.

Mumps virus

Acute orchitis in post-pubertal years can lead to male infertility.²⁰ Most are unilateral. Bilateral symbolize roughly 15% of the cases and can contribute to testicular atrophy-related subfertility and infertility.²¹ The MuV infection can increase testicular temperature,²² lessen testosterone production, and break apart the Leydig cell's function.²³

Hepatitis C virus

The reduced motility and abnormal morphology of sperm have been linked to HCV infection.^{10,24,25} Levy et al. (2002) showed changes in 30% of HCV-infected males before antiviral treatment. Also, mitochondrial membrane potential, chromatin compaction, and DNA fragmentation notably change in these patients.⁸ Through in vitro fertilization (IVF) procedures, HCV transmission is possible via semen.²⁶ Sperm washing moderates the viral load in semen and the risk of transmission.²⁷ A new sperm-washing device with a double tube can be used for separating non-infected sperm.²⁸

Human immunodeficiency virus

Orchitis and male infertility can be acquired from an HIV infection.²⁹ STDs play a role in the spread of HIV-1. There can be a high level of HIV-1 in seminal cells or seminal fluid that can be sexually transmitted when these patients are under antiretroviral therapy.³⁰ In HIV-positive men who are asymptomatic and have normal semen parameters,³¹ the progression of the disease can change the normal sperm morphology and motility.³² We can use spermatozoa in procedures such as intrauterine insemination, IVF, or intracytoplasmic sperm injection (ICSI).³³

Human papillomavirus

HPV is frequently detected in semen and urethral swabs from asymptomatic men. The data shown is contrasting, and the number of studies is low for HPV infection on sperm parameters.³⁴ We can find **reduced** sperm motility, and **moderate** pH of seminal plasma but some authors **comment that there is** no clinically significant **change** in the parameters.

Herpes simplex virus

In fertile and infertile topics and in semen has been found no difference in the DNA of HSV-1 & 2.³⁵ The HSV DNA in semen can be accountable for some incidents of male infertility such as reduced sperm concentration and motility.³⁵ In vitro incubation had been performed for the HSV-2 virus and had been found that it remains in the seminal fluid.³⁶

Human cytomegalovirus

We can find HCMV DNA with frequency from 8% to 65% of the semen of fertile or infertile HCMV-seropositive patients.^{35,37,38} Improvement is modest, just 5% of seropositive donors³⁹ with no serious object in infertility, semen quality, the functional capacity of sperm, anti-sperm antibodies and seminal white blood cells.^{37,39} In ICSI, we can still have virus transmission even when we use washing procedures for assisted reproduction techniques.³⁶

Adeno-associated virus

On chromosome 19 we can find that the AAVS1 locality is supported by the testis tissue.⁴⁰ Infertile patients have more AAV DNA in semen (20–40%) than normal patients (0–5%) and in couples, 3.8% in semen and endocervical examples.^{41,42} We have identified a small risk of infection by AAV in genital tests.⁴³ In assisted reproduction, we have information about the infection of semen.⁴⁴

Effect of SARS- CoV-2 on male fertility

Based on the fatality rates, men are more exposed to SARS- CoV-2 than women. Academic work in China and Italy has shown this.^{45,46} In the United Kingdom, it has been reported that males represented 60% of the situation.⁴⁷ We must find the problems in the acute or long form of this disease regarding male fertility.

The systemic oxidative stress from SARS-CoV-2 can cause problems with testicular capacity. Hypogonadism has been observed. The angiotensin-converting enzymes 2 (ACE2) receptor is extremely manifested in testicular cells. The ACE2, together with the virus counter enzyme called Spike (S) glycoprotein, enters the virus.^{48,49} A direct invasion can cause direct testicular damage, by immunological or inflammatory reactions. The young male patients and COVID-19 relate to high fever and for this reason, a multidimensional andrological translational research project was suggested.⁵⁰ It is investigated the effect on semen parameters from febrile illnesses such as influenza.⁵¹ A fever episode can improve the sperm DNA fragmentation index together with modification of the nuclear protein mixture of ejaculated spermatozoon.⁵² SARS-CoV-2 may have an influence on the male reproductive organs and male infertility. Furthermore, we have to rate the risk of miscarriages.

Conclusive remarks

Male infertility has numerous pathophysiological mechanisms which can be influenced by infections caused by HBV, HCV, HIV, HPV, and HSV, but not by HCMV and AAV. At the semen level, some pathogens may be the source of untreatable or fatal infections, as

well as, damage sperm parameters and functions. The SARS-CoV-2 virus can cause testicular damage together with infertility and this can be hypothetically explained. In light of these findings, we can state that the sperm alone can pass on the viral infection with an almost identical occurrence rate to sporadic sexual intercourse.

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Conflicts of interest

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