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Occupational Exposure to Heat and Incidence of Male Infertility in Occupational Drivers

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Abstract: Infertility is a worldwide problem affecting 8-12 percent couples during their reproductive life. The most common causes of infertility are the problems with sperm production and maturation (spermatogenesis). The environment and the socio-economic conditions we live in, affects the sperm quality. To trace back the main cause of male infertility, an attempt was made to get some approximation on the occupation and the environment, that malein-habitat. Only then treatment accuracy can be attained. The study population consist of couples consulted for infertility, below age 40, between the years 2018-2019. Heat exposure is a threatening issue that affects spermatogenesis, causing infertility in drivers. Recommendations are made to tackle this issue.

Keywords: *Infertility, Spermatogenesis, Occupational Drivers*

I. INTRODUCTION

According to the Indian Society of Assisted Reproduction, infertility currently affects about 10 to 14 percent of the Indian population, with higher rates in urban areas where one out of six couples is impacted. Nearly 27.5 million couples actively trying to conceive suffer from infertility in India (Neeta Lal, 2018).

Male infertility refers to a male's inability to cause pregnancy in a fertile female. In humans it accounts for 40–50% of infertility(Brugh & Lipshuitz, 2004). It affects approximately 7% of all men (Lotti & Maggi, 2014). Male infertility is commonly due to deficiencies in the semen, and semen quality is used as a surrogate measure of male fecundity (Cooper et.al, 2009). Semen quality is the measure of the ability of semen to accomplish fertilization. Thus, it is a measure of fertility in a man. It is the sperm in the semen that is of importance. Semen quality involves both sperm quantity and quality. Decreased semen quality is a major factor of male infertility(Philipa D.Darbre, 2015)

Causes of male infertility can be categorised into three headings: pretesticular, testicular and post testicular. Pretesticular include factors that affect the normal hormonal regulation of the testicles (e.g. obesity, low testosterone, medications, steroids, narcotic). Testicular include factors that affect normal sperm production by the testicles (e.g. undescended testicles, cigarette or marijuana smoke, EtOH (Excessive alcohol intake), trauma to the testicles, prior chemotherapy, a history of testicular cancer, genetic factors – Klinefelter syndrome and abnormal Y chromosome, genital infection, prescription drugs). Post testicular include the factors that affect the ability of the sperm to travel from the site of production (testicles) to leave the body to ejaculate (e.g. hernia repair, absent vas deferens, ejaculatory duct abnormalities, vasectomy, genital tract infection, genetic diseases- cystic fibrosis, retrograde ejaculation,erectile dysfunction) (Stanford Health Care n.d.).

The most common causes of infertility are the problems with the production and maturation of sperm. Sperm may be immature or abnormally shaped(teratospermia), unable to move properly(asthenospermia), or be produced in abnormally low numbers(oligospermia) or seemingly not at all (azoospermia)(Stanford Health Care n.d.).

SI NO.	TYPE OF ABNORMALITY	
1	Teratospermia	Abnormal shape.
2	Asthenospermia	Unable to move properly.
3	Oligospermia	Abnormally low in numbers.
4	Azoospermia	No sperm at all.

II. HEAT EXPOSURE

Sperm production in humans and other mammals is dependent on the temperature of the testicles. Sperm is optimally produced when the testicles are 2-4^{o}C below body temperature. The temperature of the testicles is regulated by the scrotum(which expands and contracts to facilitate heat transfer) and heat exchange between blood flowing into the testis via the arteries in the spermatic cord and that flowing out of the testes via veins in the spermatic cord. This results in the pre-cooling of the blood entering the testes (Health Engine, 2009).

In situations of extreme heat, the scrotum's natural cooling mechanisms may be insufficient to prevent a rise in testicular temperature. The increased testicular temperature may affect both the quality and quantity of sperm production(Robert L. et.al, 2007). According to BioNews (2000), if the temperature within the testicles is elevated by only two, three, or four degrees Fahrenheit, both sperm and testosterone production are negatively affected.

Numerous external factors (for example, posture, clothing, lifestyle, and season) can affect the temperature difference between the body core and the scrotum. Experimental studies in animals and humans have demonstrated the role of exogenous heat exposure in male infertility (MacLeod and Hotchkiss, 1941). Sas and Szollosi (1979) found that 291 (9.4%) of the 2984 patients consulting for infertility in Szeged (Hungary) were professional drivers, whereas this occupation accounted for only 3.8% of the general population in the same catchment area. The incidence of the most severe sperm anomalies (oligoasthenozoospermia and azoospermia) was associated with the hours and the number of years of driving. (Jensen et.al, 2006).

Generally, occupational exposures have been divided into physical (heat and radiation), chemical (solvents and pesticides) and psychological (distress). Too much of driving causes infertility. The problem appears to be a rise in the temperature of the testicles, caused by sitting in the same position for too long (MacLeod & Hotchkiss, 1941).

A. Oxidative Stress

Higher temperatures would lead to an increase of testicular metabolism without a corresponding increase in blood supply, resulting in local hypoxia and deleterious effects for the tissue (Aitken & Roman, 2008). In a study conducted in ruminants, suppression of testicular functions under heat stress led to a decrease in fertility (McDonal et.al, 2004).Oxidative stress is the main factor responsible for damage caused by heat stress.

Oxidative stress is defined as the damage caused to biomolecules by the imbalance between pro-oxidative molecules overlapping anti-oxidative molecules. The increase in reactive oxygen species (ROS) or decrease in antioxidant levels could happen after heat stress. (Halliwell & Gutteridge, 2007).

In a study conducted by Hamilton et.al, 2015, it was found that heat stress is related to decrease in sperm motility, concentration and viability. Poor sperm motility means that the sperm do not swim properly, which can lead to male infertility. Poor sperm motility is also known as asthenozoospermia. (verywellfamily.com, 2019). Structure and function of the sperm membrane are affected by oxidative stress and this compromises fertilization (Flesch & Gadella, 2000).

III. RESEARCH METHODOLOGY

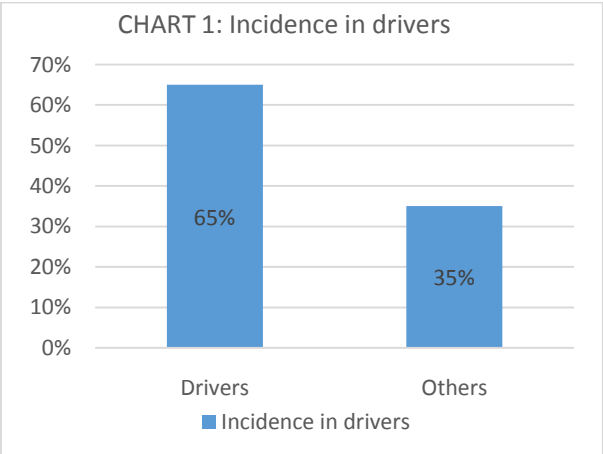
A retrospective cross sectional study was conducted at Janani (Infertility Clinic), Government Homoeopathic Medical Hospital, Thiruvananthapuram, for the collection of data from 2018 – 2019. Males within the age group 25-40 years with a normal fertile female partner were included in the study. This age group was selected as aging contributes to decreased fertility in males. Subjects with a normal female partner would lessen the complications in the study. Male subjects with a history of addiction, suffering from diseases like varicocele, hernia, genetic abnormalities like bilateral small testis or absence of testis etc., were excluded from the study. Subjects with testicular causes were only included.

A number of cases were selected at random, who consulted at the OPD during the year 2018-2019. We identified 120 cases of infertility (n=120) from the Infertility OPD. Of these, after analysing the inclusion and exclusion criteria, and after excluding the female partners with a morbidity, 55 cases were identified for the study (n=55).

IV. RESULTS AND ANALYSIS

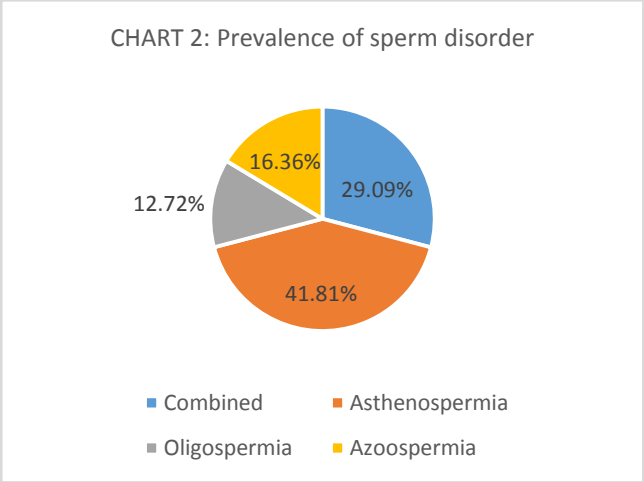
Analysis of the study was done in different ways so as to provide a clear cut conclusion.

Chart 1: Comparison of Incidence of Infertility in Drivers with Other Jobs.



The bar chart is a representation of incidence of infertility in the population. 65% of study population were drivers. Overall it is noteworthy that incidence of infertility rates higher among occupational drivers.

Chart 2: Prevalence of Sperm Disorder.



The pie chart elucidates the prevalence of sperm disorder in occupational drivers. The striking feature of the graph is that Asthenospermia is the prevailing sperm disorder in males. Combined (oligoasthenozoospermia) is the other sperm anomaly that affects males the most. Oligospermia and Azoospermia are the least affected causes.

CONCLUSION AND RECOMMENDATION

The results of this study depicts the incidence of male infertility is more among occupational drivers. Asthenospermia is the most prevailing sperm disorder in drivers, followed by Oligoasthenozoospermia. Decreased sperm motility i.e. Asthenozoospermia is also observed. The association between driving and increase in scrotal temperature indicate a potential exposure of male reproduction to lifestyle factors. The long hours of drive in a single posture leads to increase in scrotal temperature interfering spermatogenesis. Structure and function of sperms get altered compromising fertilization, leading to male infertility. Other exposures include radiation, toxic exposure and jobs with increased exposure to heat (e.g. welding).

A higher level of attention towards environmentalrisk factors in infertility settings might unravel clinical cases that are seldom identified today. Exposure assessment should be made as accurate as possible. In men exposed to very high levels of ambient heat need to be properly ventilated or air conditioned. It is recommended for the long distance drivers to wear loose-fitting clothes and to take regular breaks.

There are references in Ayurveda to treat male infertility. Ayurveda focus on the root cause for infertility, which should be treated correcting diet and regimens. Some of the herbal drugs which mentioned in Ayurvedic texts include:

- Mucuna Pruriens Bak. (Kapikacchu), which increase sperm concentration and motility (Sabnis M., 2006)
- Tribulus terrestris Linn. (Gokshura), which raises testosterone levels. (Sabnis M., 2006)
- Withania somnifera Dunal. (Aswagandha), which enhances spermatogenesis (Lavekar, 2008).
- Asparagus racemosus Willd. (Shatavari), which appears to enhance fertility by reducing oxidative stress (Sabnis M., 2006).

- Glycycrrhiza glabra Linn. (Yashtimadhu), improves semen quality(Lavekar, 2008).

Do's	Don'ts
• Drink milk at night.	• Hot baths.
• Proper sleep at night.	• Stress.
• Proper exercise.	• Alcohol, smoking, drugs.

All you need is a balanced diet, proper lifestyle habits and correct medical assistance. Life style diseases like Diabetes Mellitus, obesity, hypertension etc. to be treated for infertility.

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