Chapter

The Effects of Bisphenols on Semen Quality

Bisphenols

Parichehr Nouri and Ali Olfati

Abstract

Both the animals and humans with generalized lipodystrophy develop signs of infertility syndrome in the absence of semen health. Infertility is defined as not being able to get pregnant (conceive) after one year (or longer) of unprotected sex. The treatment of disease is usually expensive. Their expertise and experience provide the most current knowledge to promote future research. Dietary habits need to be altered, for most of world people. Therefore, the conclusions and recommendations from the part of this chapters will provide a basis for change. We welcome your offers and criticisms for book improvement in next editions. Bisphenol has been used since the 1950s, in food packaging, industrial materials, dental sealants, and personal hygiene products. Everyone is exposed to Bisphenol through the skin, inhalation, and digestive system. Bisphenol disrupts endocrine pathways because it has weak estrogenic, antiandrogenic, and antithyroid activities. Known endocrine disruptor bisphenol A (BPA) has been shown to be a reproductive toxicant in animal models. This book chapter the current epidemiological literature on fertility outcomes associated with Bisphenol exposure. It also provides relevant resources for health care providers who are in a unique position to provide guidance in reducing exposure to this endocrine-disrupting chemical.

Keywords: Semen, Bishphenol A, Infertility, Regenerative medicine

1. Introduction

Semen is the result of secretions from different parts of the ducts and glands, so that the secretions Ferrous seminiferous tubules 5%, seminal vesicle secretions 70%, and prostate secretions 25% make it [1].

Semen is examined macroscopically and microscopically:

a. Macroscopic features include:

1. Appearance: Semen has a whitish gray appearance. Red or brown color indicates blood in the semen, and yellow color indicates some vitamins, drugs or hepatitis, and indicates abnormality.

2. Liquefaction: Liquidation is a natural process in the consistency of semen that changes from a semi-liquid to a liquid state.

3. Viscosity: The viscosity can be checked by inserting a glass rod into the sample and observing its elongation after gently removing the rod.

4. Volume: The volume of human semen is at least 1.5 ml, which is measured through a graduated pipette with a sensitivity of 0.1 ml. The volume of semen is mainly due to the secretions of the prostate glands and seminal vesicles and a small amount is due to the secretions of the bulbo urethral glands and the epididymes.

5. PH: The acidity of semen reflects the balance between the acidity of different secretions of the gonads. The agreed threshold for minimum semen acidity is 7.2.

b. Microscopic features include:

1. Aggregation: Attachment of immobile sperm to each other or to mucosal masses, non-sperm cells or cell debris, as Non-specific adhesion is considered.

2. Agglutination: Refers to the attachment of motile sperm to the head to head, tail to tail, or other states they are stuck together.

3. Motility: Number of repetitions usually Depending on the volume of semen, it is defined between 2 to 3 times.

4. Vitality: In general, the percentage of live sperm is higher than motile sperm. Minimum sperm viability (health of sperm membrane) (58%) Is obtained by multiplying the total number of sperm in the percentage of healthy sperm.

5. Concentration: The number of sperm in the semen is calculated using the sperm concentration. Sperm concentration refers to the number of sperm per unit volume of semen.

2. Semen quality health

There is ample evidence in the world that global sperm quality has declined over the past few decades [2]. The probable cause of global decreased semen quality may be environmental and / or occupational and lifestyle factors [3, 4]. Lifestyle factors associated with male infertility include: smoking, alcohol consumption, recreational drugs, stress, obesity, paternal age, diet, and coffee consumption. Other factors include: testicular heat stress, cycling, lack of sleep, and cell phone magnetic waves [5].

2.1 Smoking

Research has reported that sperm concentrations in men who smoke are 17–13% lower than in men who do not smoke. [6]. In addition, smoking has a negative relationship with sperm motility, sperm morphology and sperm count. Decreased semen quality is more common in men who smoke more than 20 cigarettes a day, or on average 10–20 cigarettes a day, than in men who smoke 1–10 cigarettes a day. The effect size is larger in infertile men than in the general population [7]. In addition to the detrimental effect on male fertility, smoking is responsible for DNA damage, aneuploidy and mutations in sperm [8].

2.2 Alcohol

A meta-analysis of 16,395 men showed that alcohol consumption had a detrimental effect on sperm morphology and semen volume [9]. Alcohol canimpair the process of production and maturation and morphological development of spermatozoa [10]. Spermatogenesis appears to decrease with increasing alcohol consumption [11]. Complete or partial cessation of spermatogenesis and Sertoli cell-only syndrome is much more common among heavy drinkers than non-drinkers [12].

2.3 Recreational drugs

opiates (narcotics), methamphetamines, anabolic–androgenic steroids, Marijuana, and cocaine are examples of illicit drugs thatNegatively affects male fertility. Destructive effects of these drugs is on the hypothalamic–pituitary-gonadal axis, testicular structure and sperm function [13].

2.4 Obesity

Overweight and obesity cause excessive accumulation of fat in the body, which is determined by using the body mass index. Men who are overweight and obese are more likely to have low sperm quality and infertility. A systematic review of 30 studies involving 158,115 men found that paternal obesity was associated with reduced male fertility. Obese men have a higher percentage of sperm with fragmented DNA, mitochondria with low membrane potential, abnormal morphology, and infertility [14].

2.5 Psychological stress

Stress, in all its forms, is detrimental to male reproductive potential. The classical stress response activates the sympathetic nervous system and engages the cytothalamic-pituitary–adrenal (HPA) axis. [15]. The HPA axis and gonadotrophin-inhibitory hormone (GnIH) have an inhibitory effect on testicular Leydig cells and the hypothalamic–pituitary-gonadal axis. This inhibitory effect reduces testosterone levels. This causes changes in the Sertoli cells and the blood-testicular barrier, which eventuallysuppress spermatogenesis [16].

2.6 Advanced paternal age

There is no clear definition ofAdvanced paternal age. Studies have defined this age as between 35 and 50 years with a classification in the age range of 5 years [17]. A meta-analysis of 90 studies involving 93839 participants stated that sperm volume, total sperm count, normal sperm morphology, and progressive sperm motility decreased with age and sperm DNA fragmentation increased with age. However, sperm concentration was not significantly associated with increasing age of men [18].

2.7 Diet

Nutrition and diet have a great impact on sperm quality. Balanced and proper nutrition improves fertility and sperm quality [19].High-fat dairy, coffee, alcohol, sugary drinks, and processed meats are associated with low sperm quality and low fertility. Low-fat dairy products, grains, poultry and fish, vegetables and fruits increase sperm quality [19].

2.8 Other lifestyle risk factor

An important risk factor for male infertility is genital heat stress caused by increased scrotal temperature. Varicocele, exposure to radiant heat, cryptorchidism, and prolonged sitting can all lead to testicular heat stress [20]. Increased scrotal temperature leads to spermatogenicsuppression, sperm DNA damage, oxidative stress andgerm cell apoptosis [21]. Cycling is associated with an increase in testicular temperature [22]. The detrimental effects of sleep disorders on male fertility are likely, as semen volume is lower in patients who have difficulty starting to sleep, such as smokers and alcoholics [23]. Radio frequencies emitted from a mobile phone and exposed to magnetic radiation can have devastating effects on the testicles [24]. A study has shown that exposure to mobile radiation can reduce sperm motility and viability [25], While another study showed that these destructive effects occur only in vitro [26].

The role of environmental pollution is critical because of its impact on sperm quality [27]. Since 1960, the rate of male infertility in industrialized countries has risen from 7–35% [28]. Research has shown with certainty that environmental toxins have a detrimental effect on male fertility in many ways. These toxins reduce the number and function of sperm [29]. The worst toxins that interfere with fertility bisphenol A (BPA), organochlorine compounds (chlorinated pesticides, polychlorinated biphenyls, and dioxins), and organophosphate pesticides and herbicides. However, many other chemicals, metals, and air pollutants seriously damage fertility [29]. In infertile couples, mercury levels were significantly higher than in the control group [30]. There is a significant relationship between blood cadmium levels in men and infertility [31].

3. Bisphnol A

The plastic monomer and plasticizer BPA is one of the chemicals produced worldwide, producing more than 66 million pound a year. [32]. BPA is used in the production of epoxy resins and polycarbonate plastics used in metal cans and in many plastic products, including water pipes, sports safety equipment, dental monomers, toys, spectacle lenses and pipes [33]. Oral exposure to bisphenol A occurs more frequently. Another possible route that exposes humans to bisphenols is by inhalation and through the skin [34].

3.1 Metabolism and toxicokinetics

Bisphenol is metabolized in the liver by uridine 5-disphospho-glucuronyl transferase (UGT), and is catalyzed by glucuronidation (**Figure 1**) [35].

BPA interacts with estrogen receptors due to its phenolic structure and acts as an antagonist and agonist through endocrine receptor-dependent (ER) signaling pathways [36]. Accordingly, BPA appears to play a role in the pathogenesis of endocrine disorders including infertility in both men and women [37].

As the concentration of BPA in the urine increases, the number of sperm per ejaculation decreases. It also reduces sperm motility and sperm viability [38]. The results of clinical research conducted in recent decades have shown that the destructive effects on the endocrine glands of bisphenol A on male reproductive function, possible mechanisms by which bisphenol A may regulate spermatogenesis, mainly through the hypothalamic–pituitary-gonadal axis Specify to be involved [39]. In rodent models, with the exception of some cases, in vitro exposure to BPA at different doses (largely ranging from2 μg/kg/day to 960 mg BPA/kg body

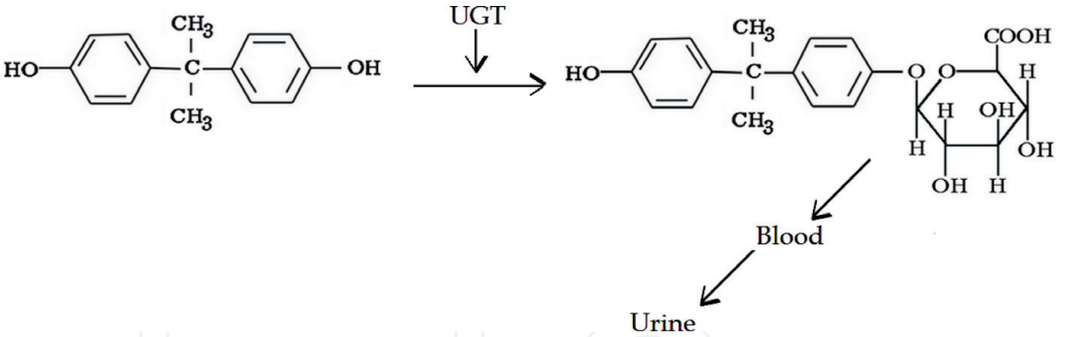

Figure 1.
Structure of bisphenol.

weight/day) and time intervals (from 5 to 84 days) caused a significant reduction in sperm count [40–43], sperm motility [41, 44], normal sperm morphology [42], increase in sperm DNA damage [44], and poor spermatogenesis [45, 46]. In a study adjusted using linear regression of confounders, increased urinary BPA levels were significantly associated with decreased total sperm count, decreased sperm motility, decreased sperm viability, and decreased sperm concentration [47]. BPA can affect sperm density and quality [48].

3.2 Resource review

1. Hatch pollard et al. reported that Higher exposure to BPA was associated with abnormal sperm tail morphology in their prospective, pre-conception cohort [49].

2. Ghada ali omran et al. reported that Total BPA levels were negatively associated with semen quality and antioxidant levels, and positively correlated with DNA damage, especially with multiple semen profile defects, alongside seminal-plasma lipid peroxidation [50].

3. Evdochia Adoamnei et al. showed that BPA exposure may be associated with a reduction in Leydig cell capacity (increased LH levels) and decreased sperm counts in young men [51].

4. Honglei Ji et al. reported that environmental exposure to BPA in a less industrialized area of China, where human urine BPA level is relatively lower, is associated with decreased sperm concentration. Impaired spermatogenesis and sperm movement may explain male subfertility resulting from exposure to BPA, although the biological mechanism is still uncertain and, therefore, needs to be disclosed by future studies [52].

5. Juan li et al. in their study showed that the, testis coefficient, sperm density, sperm activity, sperm survival rate decreased, but the sperm abnormality rate increased with increasing BPA concentrations [53].

6. Chigrinets S.V. et al. showed in their study that BPA in the seminal fluid influences negatively on the quality of the sperm and suppress the level of total testosterone in plasma [54].

7. Knez j et al. found that increased urinary BPA concentrations (5th–95th percentiles 0.3–6.7) ng/mL) were associated with lower sperm count, sperm concentration, and sperm vitality [55].

8. D.pan et al. findings identified that bisphenol A exposure may negatively contribute to the sperm quality in adult mice. Mechanistically, we showed that bisphenol A reduced sperm chromatin integrity along with increased DNA damage, which may be due to poor protamination of spermatozoa [56].

9. Ramy abou ghayda et al. found associations of urinary BPS concentrations with lower ejaculate volume, sperm concentration, total count and motility [57].

10. Alexandra E. Goldstone et al. showed A negative relation between Bisphenol and DNA fragmentation in sole significant finding in adjusted linear regression ($\beta = -0.0544$, $p = 0.035$) and suggestive of less sperm DNA damage [58].

4. Conclusions

In sum, BPA associated to male infertility. Future research will need to expand on these findings to provide a clearer picture of the effects BPAs may have on ovarian development and function, the authors wrote.

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Author details

Parichehr Nouri[1] and Ali Olfati[2*]

1 Departmentof Midwifery, School of Nursing and Midwifery, Kermanshah University of Medical Sciences, Kermanshah, Iran

2 Young Researchers and Elites Club, Kermanshah Branch, Islamic Azad University, Kermanshah, Iran

*Address all correspondence to: aliolfati66@yahoo.com

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