Yoga, Meditation, and Acupuncture for Male Reproductive Health

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Key Points

- Male factor infertility is a complex disorder and an etiology is not known in about 70% of the cases; 15–20% of men with non obstructive azoopsermia and severe oligozoopsermia harbor genetic abnormalities.
- Unexplained infertility is on the increase. Such cases have high seminal oxidative stress and DNA damage. DNA damage is the major cause of defective sperm function. Oxidative damage to DNA and accumulation of oxidized DNA adducts like 8-OHdG are mutagenic and also adversely impact sperm epigenome and thus increase genetic and epigenetic disease burden in the offspring.
- Acupuncture, has been shown to mitigate any imbalances in the flow of vital energy or blockage of Qi energy and circulation of blood flow essential for health.
- Yoga is a profound science of inner well-being. It effectively decreases both oxidative stress and nuclear and mitochondrial DNA damage. It upregulates expression of DNA repair, cell cycle control, anti-inflammatory genes and modulates the immune response. It promotes neuroplasticity by upregulating expression of BDNF, DHEA, serotonin, melatonin and thus reduces severity of depression, stress and anxiety. It upregulates activity and levels of telomerase and slows the rate of testicular aging. It may thus reduce the number of couples who need assisted conception.
- Yoga thus improves mitochondrial and nuclear genomic integrity and thus the health trajectory of the offspring and may also reduce the risk of infertile men developing gonadal and extragonadal tumors.

48.1 Introduction

Health, the optimal goal for all people, is particularly challenging as it not only demands due concern early in life but is also sustained across an individual's lifespan. It has been largely recognized in recent years that there is a complex interplay between the occurrences of chronic diseases among reproductive-age individuals. The association between health and the fertility spectrum has gained significant speculation. The exact pathophysiology of the association between the chronic complex lifestyle disorders and fecundity, defined as biological capacity to reproduce regardless of pregnancy intention, has not been delineated yet. It has been observed that reproductive-age individuals who are affected by chronic diseases may experience impairments in fecundity, such as decline in semen quality, infertility, pregnancy loss, and increased incidence of congenital malformations, adversely affecting the health of the future progeny [13, 15, 34]. Derangements in fertility have been associated with a strong psychosomatic component and have been associated with a social stigma in certain societies. An enigma sill remains of whether the occurrence of chronic diseases and impaired fecundity share any similar or distinct etiology and what the effects are on the pregnancy outcomes and offspring health.

48.2 Background

There has been an increasing interest in the wide arena of research exploring the association between infertility and the development of complex chronic diseases and mortality. Infertility is found to be negatively associated with the interpersonal, sexual and psychosocial well-being of an individual. Diagnosis of infertility not only culminates in the distressing symptoms of anxiety and depression but also exerts detrimental effects on the patient's quality of life. To add to the complexity, it is now established that the impairments in fecundity (decline in semen quality, infertility, endometriosis, polycystic ovarian disease) have been greatly

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linked with diseases originating later in the life, such as adult onset carcinomas, cardiovascular diseases, and impending morbidity and mortality [15, 32, 33, 74]. The evolving body of clinical and epidemiologic data supporting an association between fecundity and life course health has prompted a call to incorporate fecundity into general health screening [14, 15, 69, 88]. Infertility has stepped up the ladder to be considered as a complex chronic lifestyle condition. There is growing evidence that lifestyle choices account for the overall quality of health and life (QoL) reflecting many potential lifestyle risks widely associated with alterations of the reproductive function up to infertility. Lifestyle factors can be modified to enhance overall wellbeing, and they are ultimately under one's own control [70]. It has been witnessed that there has been a phenomenal increase in the incidence of complex lifestyle diseases, such as depression, cardiovascular diseases (CVD), diabetes mellitus (DM), cancer, arthritis, infertility, recurrent spontaneous, and implantation failures in the past decade [26–29, 31, 41, 85].

These lifestyle disorders have become fast growing epidemics and a bane of modern society. The surge of these various lifestyle disorders demands an active interplay of various lifestyle modifications as well as adoption of various complementary and alternative medicine (CAM) approaches as an adjunct to modern medicine therapies [51, 53]. In industrialized nations, decreasing the number of people affected by infertility has become a top priority for many health organizations [48]. Furthermore, various recent studies and reviews have suggested that a male's reproductive and general health are largely intertwined. These disorders have a strong psychosomatic component and need to be approached and managed using a mind body intervention. Thus, a holistic approach to male factor infertility and in management of infertile couples is the need of the hour. This chapter intends to portray a descriptive outline of the interventions adopted for the management of male factor infertility. We aim to highlight the adoption of integrative medicine (IM) approaches, which represent a cusp of both CAM and conventional modern medicine.

48.3 Mind Body Interventions (MBI) and Integrative Health for Male Infertility

As infertility has a strong psychosomatic component, an integral component in its management should include the adoption of a holistic and complementary approach. Also, a majority of couples with a long duration of infertility experience high levels of stress and anxiety as compared to their fertile counterparts. Advent of mind–body practices along with various lifestyle interventions and adoption of a healthy and holistic lifestyle has been shown to improve a healthy biological profile of an individual, along with positive alterations in the stress-related physiological and psychosomatic processes implicated in the occurrence of disease.

Mind–body interventions (MBIs), widely known as mind–body medicine, have been mainly centered to "focus on the interactions among the brain, mind, body, and behavior, and on the powerful ways in which emotional, mental, social, spiritual, and behavioral factors can directly affect health" as described by the National Center for Complementary and Alternative Medicine. Diverse techniques have been ascribed to the MBIs, which include yoga, meditation, tai chi, qigong, bio-feedback, progressive muscle relaxation, guided imagery, hypnosis, and deep breathing exercises. The percentage of people now adopting MBI has increased substantially around the globe and a growing body of research has now resulted in evidence based integration into clinical practice [9]. Though all the practices may vary, they do share similarities, especially in the health sector as an integral component of integrative medicine. While many MBIs, such as hypnosis and muscle relaxation, have long standing legacies, many MBIs, such as yoga, tai chi and qigong, have spiritual traditions associated with them.

MBIs involve regulation of the mind's attention processes to impact the body's physiology [9]. These interventions have proven to be effective in reducing the symptoms and improving quality of life, and research has begun to examine the impact of these therapies on biological processes, including inflammation, oxidative stress, gene expression, and epigenetic modifications [8, 9, 30].

48.4 Yoga Based Lifestyle Intervention

There is a growing interest worldwide for modification of lifestyle factors, as well as holistic, complementary, and alternative approaches to treat male infertility. Yoga, essentially described as a psychosomatic–spiritual discipline, is aimed at achieving union and harmony between our mind, body, and soul and brings balance to all aspects of one's being from physical, mental, emotional to the spiritual spectrum. This ancient Indian discipline includes all aspects of an individual from health to self-realization. It is described as the ultimate union of one's own consciousness with the universal consciousness for attaining a super conscious state "*Samadhi*". It caters to self-management of life, and includes regulation of diet, mental attitude, and the practice of specific techniques, such as asanas (postures), breathing practices (pranayamas), and meditation, to attain the highest level of consciousness. Therapeutic yoga is defined as the application of these yoga postures and practice to the treatment of health conditions and involves instruction in yogic practices and teachings to prevent, reduce or alleviate pain, suffering, and limitations of a disease. Yoga was described as

"meditation in motion" by Khalsa et al., in 2009 [55]. Yogic practices have been seen to enhance flexibility, muscular strength, stamina, and endurance, improve respiratory and cardiovascular function, reduce stress, anxiety, depression, and chronic pain, hasten recovery from addictions, improve sleep pattern, and enhance overall well-being and quality of life. Various randomized controlled trials have been previously conducted citing the significant positive impact of yoga in the management of several diseases, such as bronchial asthma, cardiovascular disorders, diabetes mellitus, attention deficit hyperactivity disorders, depression [86], aging [85] primary open angle glaucoma [24, 66], infertility [23], implantation failure [27], autoimmune arthritis, and rheumatoid arthritis [41].

48.4.1 Yoga: The Historic Outlook

Yoga, originating as early as 3000 BC with roots in Indian philosophy, is now regarded in the Western world as a form of Complementary and Alternative Medicine (CAM) by the National Institutes of health. The word "yoga" is derived from a Sanskrit root "yuj" meaning "yoking" or "joining" and acts as means or techniques that transform one's consciousness to attain liberation (*moksha*) from karma [7]. Yoga philosophy and practice was systemized by Patanjali in the classic text "*Yoga Sutras"* (300–200 BC). It is considered to be the most authoritative text on yoga and defines the purpose of yoga as knowledge of the true "Self" (self-realization) and outlined an eightfold path to awareness and enlightenment of self, called *"ashtanga"* [59, 63].

Yoga (*ashtanga*), depicted metaphorically as a tree, comprises eight aspects or "limbs" representing the ethical principles of leading a purposeful life [62] (Fig. 48.1). They channelize an individual to ethical conduct, self-discipline, and attention toward one's health. The yogic limbs are connected to the whole similar to the way bodily limbs are connected to each other. On a whole, these eight limbs can be conceptualized as methods that aid in the regulation of thoughts, emotions, and behaviors, thus increasing an individual's well-being. If one yogic limb is pulled off, the others will naturally come in the same way as when someone pulls the body by a leg and no stages are achieved in succession [49].

Though any of the eight limbs may be used separately, the physical postures and breathing exercises prepare the mind and body for meditation and spiritual development [19]. Different yogic disciplines based on Patanjali's eight limbs have been developed, with their own technique for preventing and treating disease [90].

48.4.2 Physiological and Psychological Effects of Yoga

There is a dearth of studies which have employed an integrated yoga course (yoga of transformation) or practices of hatha, sahaj, and sudarshan kriya yoga with asanas, pranayama, and meditation, which included dhyana, transcendental, omkar, and amrita meditation. Transcendental meditation (TM) involves the mind doing well on a series of words (called a mantra) [11].

The coordinative interactions between the hypothalamo–pituitary–adrenal (HPA) axis, central nervous system (CNS), autonomic nervous system (ANS), limbic system, and immune system maintain hormonal homeostasis [10, 37]. Increasing research in this naïve field has suggested numerous beneficial effects of yoga interventions on a myriad of changes in psychological health. Two pathways can be hypothesized for the mechanism of action of yoga: (i) vagal stimulation and (ii) parasympathetic activation and HPA axis modification [71]. Yoga and meditation are a package of mind–body based practices, which exert their beneficial effects through both '*Top down'* and '*Bottom up*' approaches in contrast to the classical psychotherapeutic approaches involving cognitive strategies [39, 82]. Yoga encompassing meditation affects an individual's affective/cognitive state affecting the activity of brain regions, including the orbitofrontal cortex, amygdala, hippocampus, and somatosensory cortex. This exerts beneficial effects in

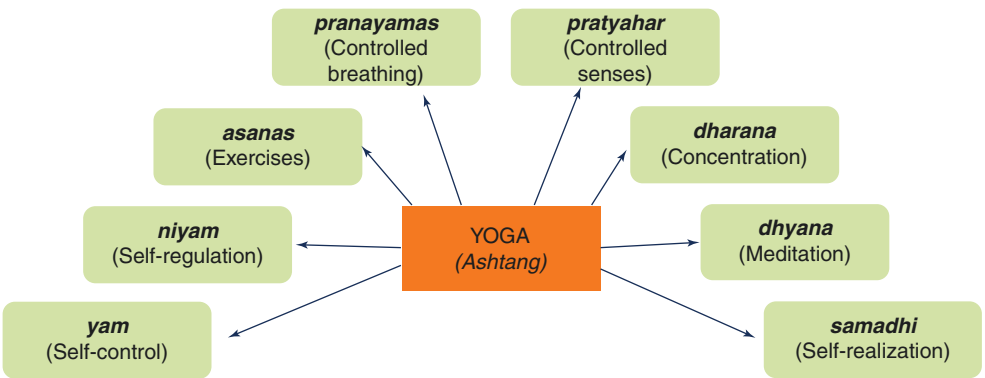

Fig. 48.1 The Yoga "Ashtang"

reducing psychological stress, decreased sympathetic activity, increased parasympathetic autonomic nervous system (ANS) tone, decreased production of inflammatory cytokines, and enhanced sensitivity to glucocorticoids produced via HPA signaling [17, 39]. Studies now support the belief that yoga techniques improve physical and mental health through downregulation of the HPA axis and the sympathetic nervous system, stress reduction, and immune modulation. Controlled breathing and various physical postures and asanas exert influences via '*Bottom Up*' mechanisms. It is seen to directly affect physiology by causing musculoskeletal exertion, improving cardiovagal tone causing downstream effects on HPA activity, maintaining sympathetic and parasympathetic balance, immune functions, and alleviating the mood. Yogic practices condition the limbic system, which regulates the homeostatic mechanisms through the ANS-endocrine modulation [44]. Higher cortical centers of the brain responsible for cognition and emotion directly affect the hypothalamo–pituitary–gonadal (HPG) axis and reproduction. Spermatogenesis, a highly regulated process encompassing a transition of the primordial germ cells to differentiate into the mature sperm, is tightly regulated by the HPG axis, which is further influenced by higher cortical centers, including the limbic system. These are also seen to be influenced by changes taking place in other systems of the body, including disturbances in metabolic and immune responses [26]. Optimum functioning and regulation of the higher cortical centers of the brain are thus fundamental for the regulation of the HPA, HPG axis, as well as autonomic and immune systems [39, 68]. Any perturbation in the mind, body, and psychological states causes imbalances in reproductive organs resulting in disordered spermatogenesis, poor spermatozoal structure and function. Reduction in stress and improvement in immune functions has been observed with regular practice of sudarshan kriya and rhythmic breathing processes in pranayam [56].

Thus, owing to the ability of yoga and meditation to address both mind and body, it works through a well-defined psychoneuroendocrine pathway that then affects a wide range of processes from basic metabolism, epigenetics, DNA repair, oxidative bioprocesses to aging, maintenance of vital organ systems, subjective well-being, and reproductive health.

Overwhelming psychological stress and anxiety have contributed to the pathogenesis of many chronic diseases and to decreased quality of life. The advent of non-pharmacologic treatment modalities like yoga and meditation are one of the promising modalities for opting to relieve stress and anxiety. Various biochemical markers can be used to quantify psychological stress, such as cortisol, β-endorphins, IL-6, and TNF-α. Regular adoption of yoga and meditation in our lifestyle has been seen to improve various cardinal biomarkers, facilitate immunomodulation, regulate the activity of various neurotransmitters, neuromodulators, and gene expression [17, 22, 52, 56, 81, 85]; (Fig. 48.2).

Tolahunase et al. [86] reported a decrease in clinical severity in major depressive disorder patients along with an associated increase in neuroplasticity with a brief yoga and

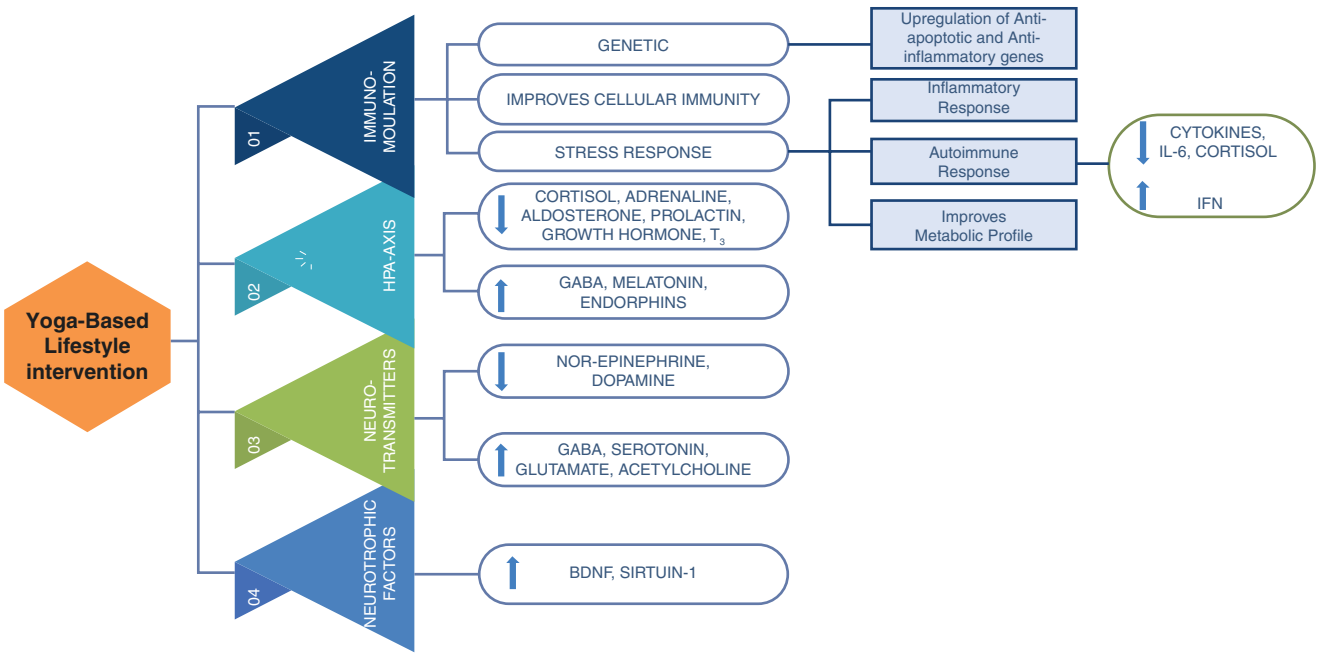

Fig. 48.2 The physiological basis of Yoga: effects of Yoga on regulation of hormones and neurotransmitters which effect physiological and psychological functions. HPA hypothalamo-pitutitary adrenal axis, T3 triiodothyronine, GABA gamma amino butyric acid, IL-6 interleukin-6, IFN interferon, BDNF brain derived neurotrophic factor

meditation based lifestyle intervention. This randomized controlled trial conducted in our laboratory documented an increase in the levels of DHEAS, sirtuin 1, telomerase activity, and a decrease in the levels of cortisol and interleukin 6 in addition to a significant decline in ODD and maintenance of oxidative eustress. Yoga thus acts as an important component of mind–body medicine that helps to improve overall health and has significant beneficial effects in male factor infertility.

48.4.3 Effect of Yoga on Oxidative Stress, Genomic Integrity, and Telomere Dynamics

Regular practice and adoption of yoga and meditation training as a part of one's lifestyle has been seen to exert a range of salubrious effects, including decline in oxidative stress, improved genomic integrity and semen quality, telomere regulation, and sperm transcript normalization [28, 30, 31, 57, 74]. Oxidative stress in the male germ line, thought to be produced by a host of intrinsic and extrinsic factors, affects male fertility and exerts a detrimental impact upon normal embryonic development. Spermatozoa are vulnerable to oxidative attack due to an abundance of polyunsaturated fatty acids in the sperm plasma membrane. Impending oxidative attack on the sperm is detrimental to the sperm nuclear and mitochondrial genomes [4, 5]. ROS metabolites attack the DNA bases (particularly guanine) and phosphodiester backbones, thus destabilizing the structure and inducing DNA fragmentation [5, 27, 67]. The accumulation of the harmful mutagenic base adduct due to the self-perpetuating lipid peroxidation cascade affects sperm plasma membrane fluidity, resulting in loss of sperm motility and ensues oxidative DNA damage ([2], Aitken & De Iuliis. 2010, [3, 5, 12]).

Previous studies from our laboratory have reported a rapid, significant decline in seminal oxidative stress even within 10 days of practice of yoga and meditation [28, 31, 57]. A minimal nonsignificant improvement in DNA fragmentation index (DFI) was observed by [28, 31] in male partners of couples with recurrent implantation failure in IVF cycles with a brief yoga-based lifestyle intervention for 21 days. A significant improvement in progressive motility and sperm count (taken at two separate intervals) has been found in primary infertility patients who experienced failed implantation in IVF cycles [28]. Significant improvement in DNA integrity was observed in another study on male infertility patients after following yoga-based intervention for 6 months. Sperm DNA damage is not only an underlying etiology of poor implantation and pregnancy rates but also affects the health of offspring and may also result in *denovo* mutations in the male germ line and post fertilization and a higher rate of post-zygotic mutations. A decline in DFI was accompanied by a decline in the levels of oxidative DNA base adduct 8-OHdG, which induces mutations and epimutations [23, 57, 74] and an increase in total antioxidant capacity (TAC) levels in seminal plasma [58, 74]. The decline in levels of this oxidative DNA adduct is important to assess the levels of oxidative DNA damage, and as this product is highly mutagenic, it can be the cause of infertility, post implantation losses, congenital malformations, and even childhood cancers.

Various antioxidant formulations are being prescribed for the current alleviation of the burden of overwhelming oxidative stress and its detrimental effects on genomic integrity and telomere dynamics [75]. Antioxidants cause improvement in sperm motility or concentration, but only a few have been implicated to impact the nuclear DNA damage at therapeutic doses [1, 64, 77]. Furthermore, the ideal balance of the redox system necessary for optimal sperm function is not known, and overconsumption of antioxidants may result in 'reductive stress' that could cause detrimental effects on human health and wellbeing [12, 28, 30, 31, 45]. Apart from causing untoward reductive stress, unregulated and unsupervised administration of the antioxidants has also been associated with impairment of mitochondrial activity, decreased permeability of the blood–brain barrier, and suppression of endothelial cell proliferation. Yoga and meditation interventions significantly impact free radical levels and also cause a collateral increase in antioxidant levels and decrease in inflammatory cytokines [28, 31, 40, 43, 74] as documented by an increase in total antioxidant capacity [58, 74]. They have been documented to regulate rather than simply scavenge reactive oxygen species. Indiscriminate use of antioxidants causes very low levels of free radicals, resulting in impaired sperm function and several redox sensitive metabolic reactions. Yoga and meditation mediated ROS regulation alleviates and reverses stress-causing processes.

Some of the important biomarkers of cellular and testicular aging affected by a yoga-based lifestyle are the telomeres [6, 46], activity of the related telomerase enzyme [60, 61], and the expression of telomere-related genes [20, 21, 35]. Telomere is a complex trait highly affected by the OS, which is the prime cause of rapid telomere attrition, genomic instability, and testicular aging. OS is associated with shorter telomeres predisposing to genome instability as well as genome wide hypomethylation and unmasking of repetitive elements [12, 27]. Telomere length is seen to shorten incrementally during cellular division and in response to cellular damage associated with various stressors. Thus, telomere length is counted as a crucial indicator of cellular aging, physiological and psychological stress ([20, 21, 87]; Conklin et al. [21]). Shorter telomeres are potentially associated with an increasing number of degenerative and age-associated disorders, infertility, cancers, etc. [73, 83, 92]. The regulation and maintenance of these highly conserved hexameric

repeats and optimum telomere length is done by a complex network of molecular components referred to as the '*telomere interactome'*. The telomerase enzyme is the key component of this interactome [20, 21, 76, 93]. Telomere length and telomerase activity have been shown to be highly sensitive to a range of psychosocial and behavioral factors. Telomerase activity is not only seen to predict cell survival but also to facilitate the actions of BDNF [38]. Studies from our laboratory have shown a significant increase in telomerase activity and a serotonin DHEA, BDNF mediated decrease in severity of clinical depression [86]. An increase in melatonin levels regulates the circadian rhythm and improves mitochondrial integrity, as the highest subcelluar concentration of melatonin is in the mitochondria. This improves mitochondrial integrity and reduces free radical production and increases ATP production. Though mild OS exerts beneficial effects in the maintenance of telomere length, low and high OS is associated with shorter telomeres and genomic instability [65]. YBLI has been shown to exercise beneficial effects in decline in OS and ODD as well as upregulation in the telomerase activity. An increase in telomerase activity with decline in OS and ODD and an increase in total antioxidant capacity were observed by Kumar et al. [58] following a brief yoga intervention for 21 days. There is significant decline in OS and ODD mainly due to improvement in mitochondrial integrity as seen by increased COX II activity [85]. This thus suggests that though psychosocial stressors and their biochemical consequences have the potential to cause telomere erosion, the resilience and adoption of yoga and meditation might offer some level of protection against such degradation. Yoga can aid in reducing the rate of biological as well as testicular aging. Age associated accumulation of mitochondrial mutations and associated high free radical levels predispose to genome hypermutability and genomic instability and might predispose to cancer [25].

The male factor infertility phenotype includes focusing on the next generation as it is associated with attention to the offspring's wellbeing and childhood mortality. Understanding the link between health and disease and infant outcomes is highly relevant for children conceived with infertility treatment received in the course of management of an infertile couple. Establishing the pathophysiology between the disease and fertility impairments remains an enigma and needs to be elucidated. In a collaborative yet unpublished study on the impact of yoga on sperm epigenome in infertile men between our group and Dr. R K Mishra of CCMB, Hyderabad, we found differentially methylated regions on the sperm genome [the technique employed was reduced representation bisulfite sequencing (RRBS)], an upregulation in expression levels of genes of folate membrane transport and folic acid transport, genes for DNA repair and cell cycle control, intrinsic apoptotic signaling pathway in response to oxidative stress, and anti-inflammatory genes. Thus, improving genomic DNA integrity can reduce the incidence of male factor infertility, idiopathic recurrent spontaneous abortions, idiopathic recurrent congenital malformations, and even reduce incidence of denovo germ line mutations, which set the stage for childhood cancers and numerous autosomal dominant disorders. Yoga thus not only promotes health but may prevent onset of age associated complex diseases and also exert a rehabilitative and curative potential.

48.5 Traditional Chinese Medicine: Role of Acupuncture

The use of acupuncture as another component of complementary/alternative medicine (CAM) in health care has been increasing and is also being adopted for the treatment of infertility. The World Health Organization (WHO) thus released a global policy in 2002 to assist the countries practicing these methods in regulating traditional medicine to facilitate safety and effectiveness, improve standardization, and also preserve ancient knowledge and safeguard the rich cultural heritage [50]. Acupuncture was adopted from traditional Chinese medicine (TCM), dating back almost 3000 years, and has become an integral component. Acupuncture practices have now gained immense popularity in the Western world as well [91]. The term acupuncture was essentially coined by Jesuit missionaries from the Latin word 'acus' meaning needle and 'punctura' that refers to pricking [91]. Theories of this ancient Chinese medicine state that there are certain patterns of energy flow (Qi) throughout the body that are vital for the maintenance of optimum health. TCM was greatly influenced by Chinese philosophic systems, such as Confucianism and Taoism. It was in those ancient times when the concepts of channels (meridians) through which the flow of the vital Qi energy flows for the regulation of harmony of the body status emerged [54]. A complete set of 365 acupoints has been described in relation to the respective meridians [47, 89]. In the sixth century, acupuncture spread to neighboring countries, such as Japan and Korea.

A National Institutes of Health interview survey conducted in the United States in 2002 stated that lifetime use of acupuncture had been reported in 4.1% of the respondents. On average, 2.13 million (1.1%) Americans were stated to have recently adopted the use of acupuncture [16]. Seven percent of the adult population was estimated to visit an acupuncture practitioner in the UK [84]. Acupuncture has now become immensely popular in Western medicine in the past decade, while the attempts to merge traditional Chinese and Western medicine have not largely been successful.

The use of acupuncture to treat reproductive disorders has gained significant attention. Various studies of acupuncture treatment have been conducted on male infertility patients.

Significant positive reports from uncontrolled trials on infertile men have shown a positive impact on sperm concentration and motility [72]. Regulations of endocrine status in male infertility by an increase in testosterone and improvement in luteinizing hormone (LH) level have also been reported [42]. These studies have also shown an increase of normally shaped sperm and a significant decrease in the percentage of morphologically abnormal sperm. Some studies also have shown that acupuncture did not trigger subjective behavior alterations or influence sexual behavior [72].

48.6 Physiologic Basis of Acupuncture in Treating Subfertility

The occurrence of infertility as described by theories of TCM is due to disruptions in the vital balance and blockage in the Qi energy and circulation of blood flow essential for health. These disruptions in the flow of energy and imbalances and disturbances, organ deficiencies or any excesses have been cited to be responsible for various disease states in human reproduction, such as infertility, polycystic ovarian diseases, and dysmenorrhea. Acupuncture has been proposed to mitigate any such imbalances in the flow of life force along meridians as a cure to specific diseases.

When the free flow of the energy is blocked, it can cause deficiency, stagnancy or heat syndrome [94]. Deficiency syndrome blocks and disrupts the sexual and reproductive function both in men and women. The stagnancy syndrome disables the free flow of the energy and blood and restricts it from circulation to the tissues in the reproductive organs. The heat syndrome is connected to inflammation processes that have an impact on semen quality and gynecological infections [94]. The insertion of intramuscular needles and stimulation causes afferent activity in the peripheral nerves. The acupuncture needles are then either stimulated by manual manipulation and/or by electrical stimulation, i.e., electro-acupuncture after insertion at the specific acupoints [80]. The stimulation of these acupuncture points in muscle tissue causes local release of neuropeptides—including neuropeptide Y, substance P, vasointestinal peptide, and calcitonin gene-related peptide—from the peripheral nerve endings. The muscle afferents modulate transmission of signals in the spinal cord and central nervous system [78]. The regulation of the pituitary gland in the CNS may thus modulate the endocrine system [79].

Recent advancements in modern scientific principles led to a better understanding of the underlying physiologic mechanisms of acupuncture. The beneficial effects of acupuncture in the management of infertility may be related to the central sympathetic inhibition modulated by the endorphin system and decrease in the levels of psychological stress. Nevertheless, the underlying mechanism of body acupuncture is still elusive. Most of the patients of male infertility, especially those who are undergoing IVF treatment, are under great levels of psychological stress, which is detrimental for fertility outcomes. Acupuncture exerts both physiologic and psychologic effects, and it may provide an excellent alternative for stress reduction in patients undergoing subfertility treatment ([18]; Yu Ng et al. [91]). Feelings of relaxation were reported by as many as 86% of patients following acupuncture [36]. Acupuncture thus aids in the maintenance of endogenous regulatory systems, including the endocrine system, sympathetic nervous system, and neuroendocrine system. The current data on the use of acupuncture as a component of TCM in Western medicine for the treatment of reproductive dysfunctions has not been well investigated. With sparse literature, only a few clinical studies have been reported. The studies also lack reliability in terms of flaws in poor design and a lack of diagnostic criteria and valid study outcomes measures, thus making the results difficult to interpret [80].

Though acupuncture has been shown to be beneficial for improving semen quality, the evidence in favor of acupuncture is still not compelling. Discrepancies in the effectiveness of acupuncture among the studies conducted so far is one of the factors that make it difficult to draw definite conclusions. Acupuncture treatment has been shown to be a simple, non-invasive modality for male infertile patients opting for either natural fertility or assisted conception to improve semen quality. Further research needs to be conducted to elucidate what stages and times in spermatogenesis are affected by acupuncture and what physiological changes are caused by acupuncture in spermatogenesis.

48.7 Conclusion

Infertility might be the first health crisis faced by an otherwise healthy couple, but they might learn of a lifelong, non-reproductive condition from their clinician. However, less is known about the extent to which fertility status can impact, or act as a marker for, future overall health. Infertility is not necessarily a unique disease of the reproductive axis but is often physiologically or genetically linked with other diseases and conditions. Recent epidemiologic studies demonstrate links between fertility status in both males and females and various somatic diseases and disorders.

With increased attention to infertility, there is increased potential to reach people during their reproductive years; when they are highly motivated to protect their current and future health yet young enough to begin to make changes to their lifestyle/health, which may mitigate later disease risk. Management of infertility with the adoption of lifestyle modifications can be a potential clinical ‘game changer’ and would aim to provide new insights for the diagnosis of chronic diseases and a window into future health.

48.8 Review Criteria

An extensive search of studies was performed to examine the impact of various complementary and alternative therapies in male reproductive health using search engines, such as PubMed, Google Scholar, and Science Direct, for full-text English-language articles. The search was performed between June 2017 and December 2018. Various combinations of the following search items: 'male infertility', 'integrative medicine', 'mind–body interventions', 'yoga', 'meditation', 'acupuncture', 'oxidative stress', 'DNA damage', 'testicular aging', 'testicular cancers', 'ART', 'ICSI', 'antioxidants', 'hypothalamic–pituitary axis', 'hypothalamic–pituitary–gonadal axis', 'psychological stress' as well as the names of specific oxidative stress biomarkers, neuromodulators, and neurotrophic factors. The reference lists of selected articles were searched for further relevant publications. Relevant primary research papers, reviews, and meta-analyses were then classified and analyzed for coherent theoretical explanations. All relevant literature reports were taken into consideration when writing the manuscript.

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