

Yoga and Meditation as a Therapeutic Intervention in Oxidative Stress and Oxidative DNA Damage to Paternal Genome

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DESCRIPTION

Reactive Oxygen Species (ROS) regulate several physiological functions and play key role in several biological functions. Humans now live in a sea of free radicals with ever increasing exposure to both exogenous and endogenous source of free radicals (electromagnetic radiation, persistence organic pollutants, insecticides, pesticides, high temperature, psychological stress, smoking, excess alcohol consumption, sedentary life style, varicocele, infection and inflammation). Studies from our laboratory on normozoospermic infertile men and couples with idiopathic RSA and couples with more than 2 children with congenital malformations with unexplained aetiology has shown that systemic and testicular oxidative stress and oxidative damage to sperm DNA is the underlying aetiology in all these disorders believed to be idiopathic. Oxidative stress damages all biomolecules like proteins, lipids and carbohydrates and even mt and nuclear DNA. Free radicals are generated as byproducts of mt oxidative phosphorylation and thus target the mt which are both the source and target of free radicals. Supraphysiological free radical levels damage the mt which produce less ATP and more free radicals. Free radicals target both somatic and germ cells but the sperm a highly polarized cell is most vulnerable to oxidative stress by virtue of it losing majority of cytosolic antioxidants during spermiogenesis and being very rich in polyunsaturated fatty acids. Being transcriptionally and translationally inert it has only limited DNA damage detection and repair mechanism. Thus it is most vulnerable to oxidative damage and depends largely on the oocyte post fertilization to remove the damage as it only has OGG1 but lacks APE and XRCC1. However in contrast oocyte has very low levels of OGG1 but has APE and XRCC1 thus both work in concert to repair the DNA damage. This can have serious consequences causing pre and post implantation losses, congenital malformations and even childhood cancers.

Thus every effort should be made to prevent oxidative stress in testicular and epididymal tissue, since in majority of cases oxidative stress is caused by a host of modifiable factors (smoking, sedentary lifestyle, excess alcohol intake, obesity) simple changes in social habits and adoption of healthy lifestyle can prevent OS and DNA damage. Delaying marriage and having children at an older age may compound the problem further as sperm tends to accumulate damage and has more denovo germ line mutations due to more cell divisions and also because of accumulation of oxidative DNA lesions. Thus in studies from our lab have shown that sporadic cancers like Retinoblastoma usually affect the last born child when the paternal age is beyond 35 years. Recent studies from our lab have also documented that meditation and yoga are highly effective in reducing OS and DNA damage and thereby the mutagenic load carried by sperm DNA. Childhood cancer appears to be an ever growing disease and a leading cause of death worldwide. Oxidative stress (OS) also targets the telomeric DNA accelerating its shortening further compounding the genome instability and may also cause premature aging of the testis. Shorter telomeres may affect spermatogenesis and such men may manifest with oligozoospermia or azoospermia.

CONCLUSION

Meditation/yoga-based lifestyle intervention might result in decline in free radical levels in blood and lower seminal oxidative stress; reduce oxidative damage to both mitochondrial and nuclear genome which culminates in lower mutagenic load in DNA. Decline in oxidative damage in sperm may aid couples opting for assisted conception to conceive spontaneously and may reduce number of couples experiencing pre and post implantation losses, recurrent spontaneous abortion or having children with congenital malformations/cancer.

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