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·Original Article·

Seminal characteristics and sexual behavior in men of different age groups: is there an aging effect?

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Abstract

Aim: To assess the seminal characteristics as well as the sexual behavior of men of various age groups to establish the presence of an aging effect on those characteristics. **Methods:** Semen samples were collected from men (n = 792) undergoing *in vitro* fertilization or intrauterine insemination in cases of female factor infertility only. Samples were collected using a seminal collection device at intercourse and evaluated manually according to World Health Organization (WHO) standards. Men were divided into four groups according to their ages: (i) 20–30, (ii) 31–40, (iii) 41–50 and (iv) 51–60 years, and their seminal characteristics and responses to a sexual behavior questionnaire were compared. **Results:** The data showed statistically significant differences in the seminal characteristics tested, most notably in the sperm concentration, motility, grade of motility, hypo-osmotic swelling and normal sperm morphology. Furthermore, the decline in normal sperm morphology with age was more pronounced when using strict criteria rather than WHO standards. There were also differences in total sperm count, total motile sperm and total functional sperm fraction (assessed by both WHO and strict criteria). Significant differences were also observed in the sexual behavior patterns in older men in terms of the number of years they have been trying to conceive, sexual frequency and sexual satisfaction. **Conclusion:** The data clearly illustrate an aging effect on semen characteristics and sexual behavior in men as they age. It is suggested that the aging effect be taken into consideration when proposing normal standard values for semen characteristics in routine semen analysis as outlined by WHO standards. *(Asian J Androl 2006 May; 8: 337–341)*

Keywords: seminal parameters; male; aging effect; fertility; sexual behavior; semen quality; male factor infertility

1 Introduction

It has been established that aging in women significantly reduces the potential to produce oocytes and achieve conception. Female fecundity starts to decline after 30 years of age and is more pronounced after 40 years of age, thereby making maternal age the main limiting factor in the treatment of infertility [1, 2]. However, very little data show similar trends in men, possibly because of the fact that spermatogenesis can continue throughout life. It has been shown that in bulls, spermatozoal production increases from puberty to sexual maturity and declines again in older men [3]. Also, young rats show higher sexual frequency and number of erections than middle-aged rats. Such decline was correlated to decline in sex hormones [4].

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Older men have been shown to have decreased sexual frequency [5], ejaculate volume [5, 6], motility [5–7] and normal morphology [6] as compared to younger men. However, in a study comparing seminal characteristics of proven fertile fathers aged 60-88 years and those aged 24-37 years, the older men showed higher sperm density and lower sperm motility with no difference in seminal volume and normal sperm morphology [7].

Changes in the biochemistry of human semen have been reported with aging, showing decreases in the concentrations of fructose [7], kallikrein and prostate specific antigen (PSA), and elevated liquefaction times [8]. These alterations could cause age-related declines in sperm motility and fertilizing ability.

Ford *et al.* [9] showed that increasing paternal age is associated with delayed conception in a large population of fertile couples. Watanabe *et al.* [10] showed a negative correlation between the fertilization rate in an oocyte donor program and paternal age. The fertilization rate was lower for men over 39 years of age (51.3%) compared to those younger than 39 years (60.2%). Recently, it has also been shown that both paternal and maternal aging has a deleterious effect on *in vitro* fertilization (IVF) and gamete intrafallopian tube transfer (GIFT) outcomes [11].

On a structural level, advanced age has been associated with an increase in sperm double stranded DNA damage [12]. Genetic disease has been shown be positively associated with increasing paternal age and this could be a result of an increase in sperm genetic abnormalities [13]. Furthermore, an increase in aneuploid sperm has been reported for oligoasthenozoospermic men when compared to fertile controls [14]. However, the aneuploidy rate for men under 30 years of age was not significantly different from men over 60 years [13].

The aim of the present study was to assess the seminal characteristics as well as the sexual behavior of men of various age groups to establish the presence of an aging effect on those characteristics.

2 Materials and methods

2.1 Patient profile

Seven hundred and ninety-two couples undergoing infertility evaluation at our facilities (Andrology Institute of America, Lexington, Kentucky, USA) participated in the current study. Only couples with female factor infertility and no male factor infertility as determined by routine semen analyses were included in the study. Men were divided into four groups according to their ages: (i) 20–30, (ii) 31–40, (iii) 41–50 and (iv) 51–60 years.

2.2 Semen collection and evaluation

All ejaculates were produced during intercourse using Male Factor Pak (ZDL, Lexington, KY, USA) after 3–4 days of abstinence [15, 16]. The experimental protocol of the current study was reviewed and approved by the Institutional Review Board at the Andrology Instiute of America. After semen samples were produced and liquefied (within 15–30 min), each specimen was evaluated manually according to standard procedures recommended by the World Health Organization (WHO) using a phase-contrast microscope [17]. Semen measures included volume, sperm concentration per mL, percentage sperm motility, grade of sperm motility (scale of 0–4) and normal sperm morphology, and hypo-osmotic swelling. Sperm morphology was also assessed using strict criteria [18]. Derivative parameters, such as total motile sperm (TMS, total sperm count × percentage motility), total functional sperm fraction (TFSF; total motile sperm × percentage normal morphology as assessed by WHO guidelines) and the critical total functional sperm fraction (total motile sperm × percentage normal morphology as assessed by strict criteria, as described above) were also calculated.

2.3 Measurement of sexual satisfaction

During the first visit, each couple was asked to complete a questionnaire pertaining to their clinical profile and sexual history in the presence of each other. The requested information included: age of the husband and wife, number of years of marriage, years trying to conceive, sexual frequency per month and sexual satisfaction/rating (0–10; 0 = poor and 10 = extremely satisfactory).

2.4 Statistical evaluation

Men were divided into four groups according to their ages: (i) 20–30, (ii) 31–40, (iii) 41–50 and (iv) 51–60 years, and their seminal characteristics and responses to the sexual behavior questionnaire were compared. The results obtained were analyzed statistically with the use of the unpaired *t*-test, as appropriate. $P < 0.05$ was considered statistically significant.

3 Results

The results obtained in the present study are shown in Tables 1 and 2. The data showed statistically signifi-

cant differences in the seminal characteristics tested, most notably in the sperm concentration, motility, grade of motility, hypo-osmotic swelling and normal sperm morphology. There were also differences in total sperm count, total motile sperm and total functional sperm fraction (as assessed by both WHO and strict criteria). Significant differences were also observed in the sexual behavior patterns of older men in terms of the number of years they have been trying to conceive, sexual frequency and sexual satisfaction.

Most noticeably, there was a significant increase in almost all of the parameters assessed in the 31–40-year age group versus the younger 20–30-year age group, after which there was a significant decrease in the 41–50 and 51–60-year age groups. A marked but not significant increase was noted in the seminal volume in the 31–40-year age group, resulting in corresponding increases in total sperm count, TMS and TFSF. There was a consistent decrease in the percentage normal sperm morphology as assessed by WHO guidelines with increasing age. More noticeably, this decrease in the percentage normal sperm morphology was more pronounced when using strict criteria for morphology evaluation (Figure 1).

Significant differences were also observed in the sexual behavior patterns of older men in terms of the number of years they have been trying to conceive, sexual frequency and sexual satisfaction. There was a significant decline in the sexual frequency of men as age increased (Table 2). Sexual satisfaction rated on a scale of 0–10 showed a significant decline in men over 40 years of age. However, the overall satisfaction in all the age groups remained high despite the decline.

4 Discussion

The data clearly illustrate an effect on semen characteristics and sexual behavior in men as they age. Although semen quality declined with age, in the group of normospermic men, the semen parameters were still above normal levels according to WHO standards. The decline in sperm quality along with the decreasing sexual frequency noted in the present study could cumulatively have a negative effect on fecundity. It is suggested that the aging effect be taken into consideration when proposing normal standard values for semen characteristics in routine semen analysis as outlined by the WHO standards. The cut-off values for normal semen characteristics might be too strict when evaluating older men and, thereby, classifying them as subfertile when in fact their sperm characteristics might be within normal limits for their age group. This will be of significant clinical importance when advising the patient regarding his potential for natural conception prior to pursuing assisted reproductive technologies.

Table 1. Seminal characteristics of men of different age groups. Values are expressed as mean ± SD. [a–d]Values with different superscripts are significantly different between columns ($P < 0.05$). TFSF, Total functional sperm fraction = total motile sperm × normal morphology (World Health Organization). Critical TFSF, total functional sperm fraction = total motile sperm × normal morphology (strict criteria).

Parameters	Age groups in years (n)			
	20–30 (n = 168)	31–40 (n = 209)	41–50 (n = 305)	51–60 (n = 110)
Men mean age (years)	26.7 ± 2.8[a]	34.2 ± 3.1[a]	43.8 ± 3.6[a]	55.7 ± 4.1[a]
Women mean age (years)	25.7 ± 2.1[a]	32.0 ± 3.2[a]	40.6 ± 4.7[a]	47.4 ± 5.1[a]
Volume (mL)	3.3 ± 0.5[a]	4.2 ± 0.6[a]	3.1 ± 0.6[a]	2.6 ± 0.8[a]
Concentration (× 10^6/mL)	68.5 ± 6.3[a]	72.5 ± 7.2[a]	61.5 ± 8.3[a]	52.5 ± 9.4[b]
Motility (%)	68.0 ± 5.6[a]	66.1 ± 6.4[a]	57.2 ± 6.8[a]	48.7 ± 7.7[b]
Grade of motility (0–4)	3.6 ± 0.3[a]	3.5 ± 0.3[a,b]	3.1 ± 0.4[a,b]	2.7 ± 0.6[b,c]
Morphology (% normal)	69.7 ± 4.2[a]	65.3 ± 4.7[a]	59.6 ± 5.9[a]	53.4 ± 10.1[b]
Critical morphology (% normal)	12.1 ± 2.1[a]	11.0 ± 1.8[a]	8.2 ± 2.5[b]	5.4 ± 2.3[c]
Hypo-osmotic swelling (%)	75.2 ± 6.3[a]	74.3 ± 7.2[a]	61.2 ± 7.0[b]	49.7 ± 3.6[c]
Total count (× 10^6/mL)	226.1 ± 20.4[a]	304.9 ± 26.7[b]	190.7 ± 22.3[a]	136.5 ± 18.6[c]
Total motile sperm (× 10^6/mL)	153.7[a]	201.5[b]	109.1[c]	66.4[d]
TFSF (× 10^6/mL)	107.1[a]	131.6[a]	65.0[b]	35.5[c]
Critical TFSF (× 10^6/mL)	18.6[a]	22.1[a]	8.9[b]	3.6[c]

Table 2. Sexual behavioral characteristics of males of different age groups. Values are expressed as Mean ± SD. [a–d]Values with different superscripts are significantly different between columns ($P < 0.05$).

Parameters	Age groups in years (n)			
	20–30 (n = 168)	31–40 (n = 209)	41–50 (n = 305)	51–60 (n = 110)
Years trying to conceive	2.0 ± 0.6[a]	3.1 ± 1.1[b]	3.9 ± 1.6[b]	3.6 ± 1.5[b]
Sexual frequency (per month)	13.8 ± 3.1[a]	11.3 ± 4.0[a]	7.4 ± 4.7[b]	4.1 ± 5.2[c]
Sexual satisfaction (0–10)	9.3 ± 0.2[a]	9.2 ± 0.6[a]	8.7 ± 1.1[b]	8.0 ± 1.5[c]

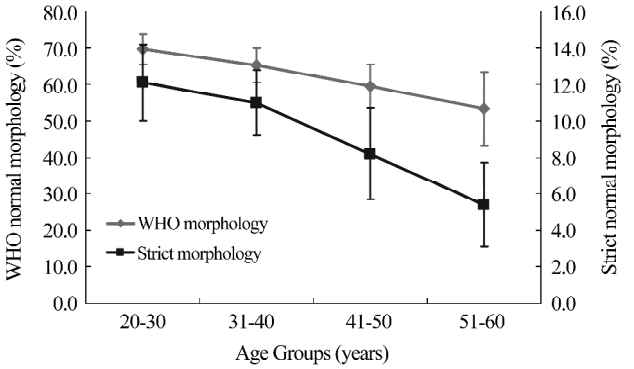

Figure 1. Effect of age on percentage normal morphology as evaluated using the World Health Organization (– ◆ –) and strict criteria (– ■ –).

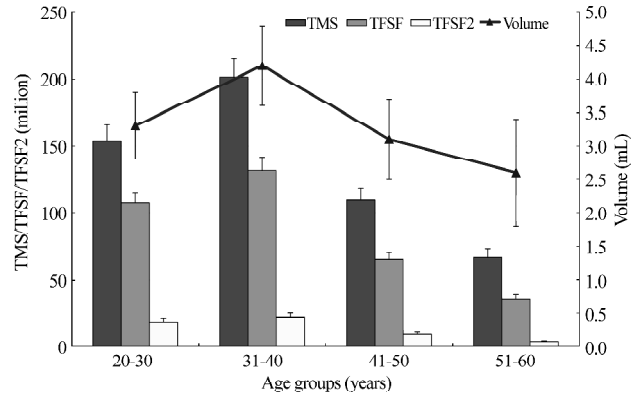

Figure 2. Effect of age on various semen parameters assessed. TMS: total motile sperm = total sperm count × percentage motility; TFSF: total functional sperm fraction = total motile sperm × normal morphology (World Health Organization); TFSF2: total functional sperm fraction = total motile sperm × normal morphology (strict criteria).

Increasing paternal age was associated with delayed conception in fertile couples, especially after the age of 25 years [1]. The published literature suggested various causes for the decline in conception. Johnson *et al.* [19] reported that older men (aged 51–84 years) have significantly reduced testicular weight, length of tubules, volume of seminiferous tubule and daily sperm production, when compared to men between 20 and 29 years of age. They also showed that the daily sperm production per testes was 30% lower in older men [20].

Upon closer inspection of the various sperm characteristics in the current study, we have shown significant differences in almost all the semen parameters tested between each of the age groups. Of interest, there was a significant increase in semen characteristics in patients in the 31–40-year age group as compared to the 20–30-year group, after which the qualitative and quantitative sperm characteristics declined significantly for the 41–50-year and 51–60-year age groups. This trend is also noted by Schwartz *et al.* [21]. However, they found that the only parameter significantly different between the age groups was the percentage normal morphology.

The deficiencies noted in older patients do not affect the ability of sperm to fertilize oocytes *in vitro* [22, 23], presumably because during IVF the number of normal, motile sperm is standardized to eliminate such variations. In addition, subsequent embryo development and implantation was not affected by the age of the man providing the semen sample [22]. In contrast, Watanabe *et al.* [10] showed a negative correlation between the fertilization rate in an oocyte donor program and paternal age. The fertilization rate is lower for men over 39 years of age (51.3%) compared to those below 39 years (60.2%). However, no difference is noted in the clinical pregnancy rate between these two groups. Recently, aging, both paternal and maternal, has been associated with deleterious effects on IVF and GIFT outcomes, as evidenced by pregnancy and live birth rates [11].

The aging effect on men is further demonstrated in sexual behavior patterns in terms of the number of years they have been trying to conceive, sexual frequency and sexual satisfaction. We showed in the present study that sexual frequency declined significantly in each of the age groups tested. Similarly, the degree of sexual satisfaction decreased significantly after 40 years of age. Ford *et al.* [9] adjusted for the age of the woman, and found that the likelihood of conception within 6–12 months was lower in older men.

The data obtained in the present study clearly illustrate an aging effect on semen characteristics and sexual behavior in men as they age. Although semen quality declined with age, in this group of normospermic men, the semen parameters were still above normal levels according to WHO standards. In cases of male factor infertility, this aging effect on semen quantity could be significant enough to impact on sperm function. The decline in sperm quality along with decreasing sexual frequency could have a negative effect on these couples' overall fecundity. Given the results generated in the present study, it is suggested that the aging effect be taken into consideration when proposing normal standard values for semen characteristics during routine semen analysis to standardize the population and to eliminate any bias that might be associated with advanced age.

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