Low hypo-osmotic swelling tests correlate with low percent motility and age of the male

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Summary

Purpose: To determine if sperm motility and hypo-osmotic swelling (HOS) test scores are associated. Furthermore the study would determine if the chance of having a subnormal HOS test increases as motility levels decrease. Finally the study would determine if age, motility, and HOS test scores are independent factors or if they interact. *Materials and Methods:* A retrospective analysis of males of all ages with a normal sperm concentration of > 20 x 10^6/ml is presented. Males were evaluated separately according to age (< 40 vs ≥ 40 years) for percent progressive motility and HOS test scores. The percent motility was assessed according to percentage in deciles. *Results:* A significantly higher percentage of males with low motility have low (< 50%) HOS test scores irrespective of age. The odds ratio of males < 40 years having an abnormal HOS test score is 6.73 times higher and is 8.23 times higher for males ≥ 40 years. As age increases, there is a significantly larger proportion of males with abnormal HOS test scores (6% to 13%). *Conclusions:* Factors that cause an abnormality in the functional integrity of the sperm membrane, as evidenced by a low HOS test score, can also have a negative effect on motility.

Key words: Hypo-osmotic swelling test; Sperm motility; Age.

Introduction

Low motility is a well-known factor associated with male subfertility [1]. A low hypo-osmotic swelling (HOS) test score (< 50%) is a less known factor associated with male subfertility [2]. However, when the HOS test is abnormal, it predicts male subfertility better than motile density or morphology [3].

The HOS test abnormality is interesting because it is unique among male factor issues in that a low level allows normal fertilization but impairs implantation of the embryos [4]. The objective of the study was to determine if there is an association with strictly low motility in the presence of adequate sperm concentration with subnormal HOS test scores.

There were three questions hoped to be answered by this study:

Question 1 – Are sperm motility and HOS scores associated?

Question 2 – Does the chance of having a subnormal HOS test increase as the motility levels decrease?

Question 3 – Are age, motility, and HOS independent factors or do they interact?

Materials and Methods

Only males with a sperm concentration of ≥ 20 x 10^6/ml were chosen. Males with normal (≥ 50%) or subnormal (< 50%) motility percentages were determined.

From these motility groups, the percentage of males with HOS tests < 50% would be determined. Evaluation would be further subdivided by age of the male (< 40 vs ≥ 40 years). Percentage of low HOS scores were determined according to 10% deciles in the low motility group.

Results

Question 1 – Are sperm motility and HOS scores associated?

The correlation of abnormal HOS scores and low motility is shown in Table 1. Only 2.9% (78/2659) of males < 40 years with normal motility had abnormal HOS test scores vs 16.9% (128/757) of men with low percentage motility ($p < 0.001$, chi-square analysis). Similarly a significantly larger proportion of males ≥ 40 years had abnormal HOS test scores when the motility was < 50% (31.6%) vs when the motility was ≥ 50 (5.3%).

The odds ratio in men < 40 years for having abnormal HOS in the presence vs absence of low motility was 6.73 (95% confidence interval, 5.01, 9.04 ($p < 0.001$). Thus the odds of a male < 40 years having an abnormal HOS test score were 6.73 times higher for males with low motility than for males with normal motility. For men ≥ 40 years, the odds ratio was 8.23 (95% confidence interval 6.03, 11.23, $p < 0.001$).

Question 2 – Does the chance of having a subnormal HOS test increase as the motility percentage decreases?

Table 2 lists the number and percentage of abnormal HOS tests in males with diminished motility according to deciles of motility. Table 2 indicates that the rates of abnormal HOS tests increases as the motility rates

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Table 1. — *Correlation of abnormal HOS scores and low motility*.

	Abnormal HOS (< 50%)	Normal HOS (≥ 50%)	Total
Men < 40 years of age			
Normal motility ≥ 50%	78 (2.9%)	2581 (97.1%)	2659
Abnormal motility (< 50%)	128 (16.9%)	629 (83.1%)	757
Odds-ratio 6.73, 95% confidence interval (5.01, 9.04), $p < 0.001$, chi-square analysis.			
Men ≥ 40 years of age			
Normal motility ≥ 50%	66 (5.3%)	1168 (94.7%)	1234
Abnormal motility (< 50%)	161 (31.6%)	346 (68.2%)	507
Odds-ratio 8.23 (95% confidence interval (6.03, 11.23), $p < 0.001$, chi-square analysis.			

Table 2. — *HOS scores according to age and low motility divided into deciles*.

Men < 40 years of age % motility	Abnormal HOS % motility	Normal HOS	Total
40 - 49%	49 (10.6%)	413 (89.4%)	462
30 - 39%	40 (22.1%)	141 (77.9%)	181
20 - 29%	20 (29.0%)	49 (71.0%)	69
< 20%	19 (42.2%)	26 (57.8%)	45
Chi-square = 44.20, df = 3, $p < 0.0001$.			
Men ≥ 40 years of age			
40 - 49%	46 (17.7%)	214 (82.3%)	260
30 - 39%	44 (34.6%)	83 (65.4%)	127
20 - 29%	31 (45.6%)	37 (54.4%)	68
< 20%	40 (76.9%)	12 (23.1%)	52
Chi-square = 79.19, df = 3, $p < 0.0001$.			

decrease in those males with abnormal motility in both age groups ($p < 0.0001$, chi-square analysis).

Question 3 – Are age, motility, and HOS independent factors or do they interact?

To answer this question, one can consider a saturated log linear model with three factors: age (< 40, ≥ 40) motility status (normal 40 - 49%, 30 - 39%, 20 - 29%, < 20%), and HOS (normal, abnormal). A saturated model allows for the testing of interaction between the factors. In this model, there was no significant three-way interaction between HOS scores, motility, and age. There was a significant two-way interaction between HOS and age. There was a significant two-way interaction between HOS and low motility for both age groups. As age increases, the HOS abnormality increases significantly from 6% to 13%.

Discussion

There is evidence that the HOS abnormality may be caused by the presence of a toxic protein, as evidenced by correction of the HOS abnormality by the protein digestive enzyme chymotrypsin [5-7]. Not only does the chymotrypsin improve the HOS score, but also allows improvement of pregnancy rates approaching normal [5-7].

Based on these data, it would appear that this toxic protein adversely also affects the motility in some but not in all males with low HOS test scores. These data confirm previous studies suggesting that the HOS abnormality increases with advancing age of the male [8].

Thus these data suggest that factors that can cause a functional impairment of the sperm membrane leading to low HOS test scores may also adversely affect motility.

References

[1] Check J.H.: "The infertile male - Diagnosis". *Clin. Exp. Obstet. Gynecol.*, 2006, *33,* 133.
[2] Check J.H., Epstein R., Nowroozi K., Shanis B.S., Wu C.H., Bollendorf A.: "The hypo osmotic swelling test as a useful adjunct to the semen analysis to predict fertility potential". *Fertil. Steril.*, 1989, *52,* 159.
[3] Kiefer D., Check J.H., Katsoff D.: "The value of motile density, strict morphology, and the hypoosmotic swelling test in in vitro fertilization embryo transfer". *Arch. Androl.,* 1996, *37,* 57.
[4] Check J.H., Katsoff D., Check M.L.: "Some semen abnormalities may cause infertility by impairing implantation rather than fertilization". *Med. Hypoth.,* 2001, *56,* 653.
[5] Katsoff D., Check J.H.: "Two methods of achieving pregnancies despite subnormal hypo-osmotic swelling test scores". *Fertil. Steril.*, 1997, *68*, 549.
[6] Check M.L., Katsoff D., Check J.H., Summers-Chase D.: "Effect of treating sperm with low hypo-osmotic swelling test scores with chymotrypsin on pregnancy rates after conventional in vitro fertilization-embryo transfer". *Fertil. Steril.*, 2004, *82,* 741.
[7] Bollendorf A., Check D., Check J.H., Hourani W., McMonagle K.: "A comparison of the efficacy of treating sperm with low hypo-osmotic swelling test scores with chymotrypsin followed by intrauterine insemination vs in vitro fertilization with intracytoplasmic sperm injection". *Clin. Exp. Obstet. Gynecol.*, 2011, *38,* 24.
[8] Check J.H.: "Leveling the playing field for grandfather's sperm". *Fertil. Steril.*, 2009, *92*, e29.

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