# Observational findings of numerical relationships specifically between Sertoli, early and late germ cells, and spermatozoa, during diagnostic TESA and micro TESA.

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## Abstract

Are there a numerical relationship and interaction between the various testicular reproductive cells such as the Sertoli, germ cells and spermatozoa? The study sought to correlate the numbers of various testicular cells to determine whether some trend could be detected in their relationship to one another. The sample size was n=21 pts for mTESA for negative (late maturation arrest); n=14 mTESE cases positive for spermatozoa; n=19 TESA cases were negative for spermatozoa, and n=19 cases positive for spermatozoa. The duration was from December 2024 -January 2026. The results were statistically treated using the Statistix and MedCalc softwares. There were significant ($p<0.00001$) positive interactions between various reproductive germ cells (RCs) in mTESA and TESA specimen both positive and negative for spermatozoa. In the mTESA positive group, spermatozoa were significantly correlated with RCs and Sertoli cells. While Sertoli cells were significantly correlated with all the RCs ($p<0.0001$) and elongated spermatids ($p=0.0224$).In the mTESA negative group, spermatozoa were significantly correlated with Sertoli cells and primary ($p=0.0118$), and secondary spermatocytes, round and elongated spermatids ($p<0.0001$) but not to spermatogonia. In TESA positive group, spermatozoa were significantly correlated with Sertoli cells ($p=0.0101$) and round spermatids ($p<0.0001$) but not with other cell types ($p>0.05$) while Sertoli cells were significantly correlated with round spermatids ($p=0.0031$) but not with other cell types. In the TESA group negative for spermatozoa there were no correlations whatsoever between all cell types ($p>0.05$). The proportions of spermatozoa and all cell types in the mTESA positive group were significantly different to all cell types ($p<0.0001$) in corresponding negative group except for primary and secondary spermatocytes ($p>0.05$) but in the TESA tissues all cells were significantly ($p<0.0001$) different between the groups positive and negative for spermatozoa. In conclusion positive numerically relationship exists between cells in testicular tissue specimen, which is a novel finding.

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## Introduction

The literature appears well documented about the roles but very little is known about the numerical interactions between the testicular reproductive cells in the human. The relationship between the numbers of Sertoli cells and the numbers of spermatozoa and all types of germ cells, namely spermatogonium, primary and secondary spermatocytes, round and elongated spermatids (collectively referred to as reproductive cells; RCs) present at any given time within the seminiferous tubules has not been well documented. Are there a numerical relationship and interaction between the various testicular reproductive cells such as the Sertoli, germ cells and spermatozoa in the human?

During routine extraction of spermatozoa from testicular biopsies in the human, the general impression is that there appear to be some numerical relationship between the numbers of

Sertoli cells present and the germ cells. A literature search revealed previous studies have demonstrated a correlation between Sertoli cell numbers and spermatid numbers (Orth et al. 1988; Simorangkir et al., 1995; Meachem et al., 1996; Auharek et al., 2011). Sertoli cell number was also closely associated with changes in Leydig cell volume (Rebourcet et al., 2017). This relationship has also been seen during aging in both rats and humans (Neaves et al., 1978; Wang et al., 1993; Chen et al., 1994) suggests a Sertoli cell−regulated change in cell function.

We describe here our observations during routine testicular sperm extraction on the numbers of various germ cells present in the biopsies and their relationship to the numbers of Sertoli cells. When the numbers of Sertoli cells appear increased other cells showed a concomitant increase.

## Materials and methods

The participants were patients for diagnostic micro TESE and TESE of Urology Department in a private hospital in Riyadh, Saudi Arabia. The study design was to correlate the counts of various RCs, Sertoli cells and spermatozoa in positive and negative specimens of micro TESA (mTE) and TESE (TE). TE and mTE specimen were obtained during diagnostic TE and mTE. The sample size was n=21 pts for mTE for negative (late maturation arrest); n=14 mTE cases positive for spermatozoa; n=19 TE cases were negative for spermatozoa, and n=19 cases positive for spermatozoa. The duration was from December 2024 -January 2026.

The biopsied tissue was macerated using two needles of 1ml syringe in Flushing medium (FM). The amounts of cells in the macerated specimen were very large. Therefore, for accuracy the numbers of different types of cells present were counted 20 times per specimen (20 replicates). The cells were counted using an inverted microscope (Nikon Ti). The results were statistically treated using Statistix and MedCalc softwares. The tests applied were correlation studies, comparisons between proportions and interaction were determined using Chi-square tests.

## Results

There were significant ($p<0.00001$) positive (Chi-square) interactions between various RCs in mTE and TE specimen both positive and negative for spermatozoa. There were significant ($p<0.00001$) positive (Chi-square) interactions between various RCs in mTE and TE specimen both positive and negative for spermatozoa.

In the mTE positive group, spermatozoa were significantly correlated with RCs and Sertoli cells and Sertoli cells were significantly correlated with all the RCs ($p<0.0001$) and elongated spermatids ($p=0.0224$). In the mTE negative group, spermatozoa were significantly correlated with Sertoli cells and primary ($p=0.0118$), and secondary spermatocytes, round and elongated spermatids ($p<0.0001$) but not to spermatogonia. In TE positive group, spermatozoa were significantly correlated with Sertoli cells ($p=0.0101$) and round spermatids ($p<0.0001$) but not with other cell types ($p>0.05$) while Sertoli cells were significantly correlated with round spermatids ($p=0.0031$) but not with other cell types.

In the TE group negative for spermatozoa there were no correlations whatsoever between all cell types ($p>0.05$). The proportions of spermatozoa and all cell types in the mTE positive group were significantly different to all cell types ($p<0.0001$) in corresponding negative group except for primary and secondary spermatocytes ($p>0.05$) but in the TE tissues all cells were significantly ($p<0.0001$) different between the groups positive and negative for spermatozoa.

## Discussion

A positive numerically interactive relationship exists between cells in human testicular specimens, which is a novel finding in the human although it has been reported in rodents as alluded to previously in this report. This novel finding in the human contributes to the advancement of knowledge in the area of spermatogenesis. We now know there is a numerical positive relationship between the various cells within the testicular tubules suggesting mathematical precision in the population size of cells during the spermatogenesis process. This small sample-sized study was performed in patients with pathologies associated with male fertility and therefore caution must be taken in extrapolating

| **Table 1a: Correlation between Sperm and Sertoli cells with other germ cells in TESA specimen positive for sperm** | | | |
|---|---|---|---|
| **TESA Positive for Sperm** | **Correlation studies for positive cases** | | |
| **Parameter 1** | **Parameter 2** | **correlation "r"** | **p value** |
| Sertoli cells | Spermatozoa | 0.1816 | 0.0101 |
| Spermatogonia | Spermatozoa | -0.05434 | 0.4447 |
| Pri spermatocytes | Spermatozoa | -0.005727 | 0.9359 |
| Sec spermatocytes | Spermatozoa | 0.01362 | 0.8482 |
| Round spermatids | Spermatozoa | 0.2966 | 0.0001 |
| Elongated Spermatid | Spermatozoa | -0.03202 | p=0.6526 |
| Spermatogonia | Sertoli | 0.01128 | 0.8740 |
| Pri spermatocytes | Sertoli | 0.03417 | 0.6310 |
| Sec spermatocytes | Sertoli | 0.1148 | 0.1055 |
| Round spermatids | Sertoli | 0.2084 | 0.0031 |
| Elongated Spermatid | Sertoli | -0.04535 | 0.5237 |
| | | | |
| **Table 1b: Correlation between Sertoli cells and germ cells in TESA specimen negative for sperm** | | | |
| **TESA Negative for Sperm** | ***Correlation: Negative Late Maturation** | | |
| **Parameter 1** | **Parameter 2** | **correlation "r"** | **p value** |
| Spermatogonia | Sertoli | -0.03464 | 0.6263 |
| Pri spermatocytes | Sertoli | -1.343E-18 | 1.000 |
| Sec spermatocytes | Sertoli | 0.000 | 1.000 |
| Round spermatids | Sertoli | 0.000 | 1.000 |
| Elongated Spermatid | Sertoli | 0.000 | 1.000 |
| (*Late maturation arrest, no sperm present) | | | |

| **Table 2a: Correlation between spermatozoa and Sertoli cells with other germ cells in micro TESA specimen positive for spermatozoa** | | | |
|---|---|---|---|
| **Micro TESA Sperm** | **Correlation studies for positive cases** | | |
| **Parameter 1** | **Parameter 2** | **correlation "r"** | **p value** |
| Sertoli cells | Spermatozoa | 0.6614 | 0.0001 |
| Spermatogonia | Spermatozoa | 0.3494 | 0.0001 |
| Pri spermatocytes | Spermatozoa | 0.5077 | 0.0001 |
| Sec spermatocytes | Spermatozoa | 0.3494 | 0.0001 |
| Round spermatids | Spermatozoa | 0.7178 | 0.0001 |
| Elongated Spermatid | Spermatozoa | 0.2622 | 0.0001 |
| Spermatogonia | Sertoli | 0.4179 | 0.0001 |
| Pri spermatocytes | Sertoli | 0.6413 | 0.0001 |
| Sec spermatocytes | Sertoli | 0.5946 | 0.0001 |
| Round spermatids | Sertoli | 0.6456 | 0.0001 |
| Elongated Spermatid | Sertoli | 0.1928 | 0.0224 |

| Table 2b: Correlation between spermatozoa and Sertoli cells with other germ cells in micro TESA specimen negative for spermatozoa | | | |
|---|---|---|---|
| **Micro TESA** | ***Correlation: Negative Late Maturation** | | |
| **Parameter 1** | **Parameter 2** | **correlation "r"** | **p value** |
| Spermatogonia | Sertoli | 2.12E-17 | P=1.0000 |
| Pri spermatocytes | Sertoli | 0.1734 | P=0.0118 |
| Sec spermatocytes | Sertoli | 0.3289 | P<0.0001 |
| Round spermatids | Sertoli | 0.5399 | p<0.0001 |
| Elongated Spermatid | Sertoli | 0.2318 | p<0.0001 |
| (*Late maturation arrest, no sperm present) | | | |

this finding to the general normal population. This study must be confirmed by other workers before the present findings can be accepted as factual.

## Conclusion

In conclusion, a positive numerically interactive relationship exists between cells in the humanatesticular specimen, which is a novel finding.

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