Medical Electronic Systems
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SQA: DETERMINING % NORMAL MORPHOLOGY

Background:

Semen analysis is commonly performed as part of an infertility work-up based on the knowledge that male infertility is a contributing factor in 40-50% of all infertility cases. A comprehensive semen work-up includes an assessment of the sperm quality and quantity. The three basic measures of sperm quality for the initial semen analysis are total sperm concentration, motility and morphology.

The automated SQA-V, manufactured by Medical Electronic Systems (MES), objectively and rapidly evaluates the basic three semen variables according to WHO'99 4th ed. manual requirements [1] in approximately 75-seconds.

The basic technology behind the SQA-V is the: (1) Measurement of light absorption by sperm cells to determine **SPERM CONCENTRATION,** (2) Processing of electrical signals generated by motile sperm cells moving through a light path, creating interruptions in the beam to determine **MOTILITY** and (3) Analysis of the correlation between motility, functional sperm concentration and progressive motility to **NORMAL MORPHOLOGY**. All of this information is analyzed and proprietary algorithms translate the information into test results.

Construction of the SQA-V Morphology Algorithm:

The morphology algorithm used in the SQA-V was developed based on (1) Extensive manual and automated studies validating both the relationship between the methods (manual and automated testing) and the correlation of % normal morphology to sperm motility and (2) A thorough review of publications that established a correlation between % morphologically normal spermatozoa and motility.

- **MES Studies Correlating Sperm Morphology to Motility**:

Manual (microscopic) morphology testing was conducted by preparing stained slides according to WHO'99 4th edition guidelines[1] and assessing morphology according to WHO 3rd [2] and WHO 4th [1] edition criteria. In parallel, the same semen samples were analyzed using the SQA. The SQA analog signals associated with motility were recorded. The SQA-V proprietary morphology algorithm was then constructed based on mathematical formulas reflecting the relationship between automated progressive motility and manual normal morphology. The SQA morphology was then extensively tested against manual morphology to determine the correlation between the two methods.

- **Publications Correlating Sperm Morphology to Motility:**

J. Parinaud et al.[3] examined semen samples using CASA and found a high correlation between the percentage of morphologically normal forms and progressive motility. In addition, specific abnormalities such as acrosome defects were inversely correlated with progressive motility. This was also true of spermatozoa treated with Percoll. It was concluded that sperm defects are often linked together, reflecting spermatogenesis and/or epididymal dysfunctions.

G. Haidl et al.[4] evaluated sperm morphology under the microscope using special staining techniques. A significant correlation between the morphology of sperm midpieces/tails and motility/progressive motility was found.

Swatowski D, et al.[5] analyzed the semen samples from men of childless couples. The study showed that an increase in sperm density resulted in less pathological forms and higher sperm motility. Conversely, the study revealed that an increase in the percentage of pathological forms resulted in a decrease in motility.

Mitchell JA, et al.[6] determined that progressive motility develops as the morphology and the metabolic machinery of the spermatozoa mature. They found that spermatozoa morphological abnormalities exhibit varying motility patterns and velocity.

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B. Rao, et al.[7] studied the relationship of lipid peroxidization in human spermatozoa to motility and morphology. A strong correlation was shown between lipid peroxidization and motility and abnormalities of the spermatozoa midpiece. The results suggest that poor motility is linked with membrane fragility.

Centola GM, et al.[8] determined that the % rapid motile sperm and straightline velocity, as well as the % of tail defects, immature sperm, and tapered sperm of andrology patients showed significant seasonal variation.

Baker HWG, et al.[9] demonstrated that increases in sperm concentration, total sperm number, motility and motility index were accompanied by decline in sperm cells with large and small heads.

Medical Electronic Systems in conjunction with the Fertility Department of Rambam Medical Center, Haifa, Israel found a high level of correlation (r = 0.83) between % normal morphology and % progressive motility.

- **Publications Correlating Sperm Morphology to Motility on the SQA:**

G. Schieferstein [10] compared the SQA data with results of conventional analysis to verify the diagnostic validity of the SQA sperm motility index (SMI). A close correlation was found between results obtained by the SQA and conventional analysis and the correlation to sperm morphology was highly significant.

R. C. Johnston et al.[11] compared SQA data to the microscope and to computer assisted semen analysis (CASA) technology. It was shown that the SQA reflects different semen characteristics including morphology. The authors assumed that morphology might be influenced by sperm cell movement. A correlation between motility and morphology measured on the SQA was noted.

Mahmoud AMA, et al.[12] investigated to value of the SQA to predict assisted reproduction outcomes. A significant positive correlation was established between the % of spermatozoa with normal morphology and the SQA parameter SMI (sperm motility index). The study concluded that the SQAII was a valuable tool for rapid screening of semen quality.

Zavos PM, et al.[13] determined that the SQA parameter SMI (Sperm Motility Index) incorporates various sperm parameters including morphology and the acrosomal status of motile spermatozoa. It was suggested that the pattern of moving sperm was affected by the morphology of the sperm cell.

Ramos E[14] studied the value of reporting Functional Sperm Concentration (FSC or TFSC) as an additional important variable in semen analysis. FSC (the concentration of motile spermatozoa with normal morphology) was significantly correlated with the SQA parameter (SMI).

P. Gyorgy, K. Zsolt[15] stated that basic semen parameters could be accurately measured by the SQA. The parameter FSC (Functional Sperm Concentration) was characterized as an inestimable benefit of the SQA which could assist physicians to determine appropriate treatment.

Akashi, T. et al.[16] analyzed 105 fresh semen samples and demonstrated a significant correlation (p < 0.0001) between normal morphology reported by the SQA-V and manual results.

Fuse, HA. et al.[17] demonstrated a significant correlation between normal morphology assessed by the SQA and the microscope for 207 infertile patients.

Agarwal and Sharma[18] compared normal morphology assessed by the SQA-V to the microscope using two independent operators. It was found that the SQA-V showed high sensitivity for accurately detecting abnormal morphology and the SQA-V results indicated greater precision and speed compared to manual microscopic method for determining percent normal morphology. It was concluded that the SQA-V is useful as a screening tool for distinguishing between samples with normal versus abnormal morphology.

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