

Sperm Vacuoles and Reproductive Outcome

Adriana Fortunato¹ and Elisabetta Tosti^{2*}

¹IDF Center, Naples, Italy

²Stazione Zoologica, Naples, Italy

Editorial

It is estimated that the male factor contributes to half of the infertility in couples attending for assisted reproductive techniques (ART). Therefore the semen analysis remains the starting point to evaluate main causes of infertility and in case of oligospermic semen the assessment of sperm morphology may help to choose the best spermatozoon to use for the intracytoplasmic sperm injection (ICSI).

In order to select the ideal spermatozoon and enhance the chance of pregnancy, in recent years most of the IVF centers have started to perform MSOME, i.e., the motile sperm organelle morphology examination followed by IMSI, the intracytoplasmic morphologically selected sperm injection in the oocytes [1].

Clinical significance of sperm anomalies is a matter of debate. Many studies demonstrate that an accurate evaluation of sperm anomalies plays a crucial role in determining the male fertility potential and the decision for the treatment of patients in IVF programs [2].

However contrasting data show that bad sperm morphology is a parameter differently associated to the chance of pregnancy outcome [3-6].

By examining organelles at the high MSOME magnification (>5000 X), a special attention was paid on the vacuoles in the sperm head. These appear to be small malformations considered to be an alteration of the sperm cell structure and believed to exert an adverse impact on the following embryo development. At the optical microscope, vacuoles appear as small holes, but ultrastructural studies showed that they are abnormal nuclear concavities covered by the acrosome and the plasma and acrosomal membranes [7] (Figure 1).



Figure 1: Representative image of a human sperm population showing normal morphology >4% and 60% of differently vacuolated heads. Magnification 1000X.

Some studies describe a nuclear origin and account for a pathological role of vacuoles [8] starting from previous findings that higher percentage of vacuoles was reported in sperm head of infertile men [9]. Following studies reported that vacuoles exert a negative impact on the sperm functionality associating them with either DNA fragmentation [10] or an impaired DNA packaging and failure of chromatin condensation [7,11,12]. These hypotheses were supported by clinical studies that correlated sperm vacuoles to a decrease in the fertilization rate and failed pregnancies, further encouraging the application of MSOME, as a tool that may enhance the ART success and even proposing a cut off value for vacuoles estimation [13,14].

In this line, in IVF centers the use of IMSI has been increased in order to exclude the injection of sperm bearing vacuoles especially in cases of couples who experienced recurrent implantation failures and pregnancy loss [15,16].

Contrasting data are more recently revising the pathological role of vacuoles. Starting from the observations that a significant decrease of vacuole numbers was found following acrosome reaction [17,18]. It was hypothesized an acrosomal origin and a physiological role of these organelles [19].

The fact that MSOME had no impact on early embryo development [20], and that no correlation was found between vacuoles, sperm DNA packaging and structure, corroborated the idea that vacuoles are not negative parameters and therefore should be not used as a predictive factor of sperm quality. On the other hand it has also been claimed that IMSI is time consuming technique that may also induce oocyte aging as an additional disadvantage [21,22]. In support of this new scenario it is speculated that vacuoles are pre-existing structures and that cannot be modified by environmental conditions [23-25]. In our recent study [26] we have shown that vacuoles in sperm head are not related to abnormal head morphology and do not affect live birth rate, confirming previous findings that vacuoles are physiological features not altering sperm functionality.

Conclusion

It is well known the paternal effect that influences embryo development since a poor sperm quality may lead to poor blastocyst formation [27-29].

It is clear that whatever technique leads to ameliorate fertilization success and pregnancy outcome is worth to be applied in the IVF routine practice. This was the case of IMSI that providing a deep evaluation of

*Corresponding author: Elisabetta Tosti, Stazione Zoologica Anton Dohrn, Villa Comunale 80121, Napoli, Italy, Tel: +390815833288; E-mail: tosti@szn.it

Received November 23, 2015; Accepted November 25, 2015; Published November 30, 2015

Citation: Fortunato A, Tosti E (2015) Sperm Vacuoles and Reproductive Outcome. JFIV Reprod Med Genet 3: e118. doi:10.4172/2375-4508.1000e118

Copyright: © 2015 Fortunato A, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

the fine sperm morphology was included in the treatments of infertile couples; nonetheless contrasting data exist in literature on the real advantages of using IMSI to increase the pregnancy rate.

At present, major question addresses if the presence of vacuoles in the sperm heads may be considered a diagnostic tool to explain idiopathic infertility [23].

Due to different clinical results reported in above mentioned studies, the pros and cons of potential interaction between sperm vacuoles occurrence and fertilization success deserve further investigations and statistical support in order to render ART techniques effective and safe at the same time.

References

- Setti AS, Paes de Almeida Ferreira Braga D, Iaconelli A Jr, Aoki T, Borges E Jr (2013) Twelve years of MSOME and IMSI: a review. *Reprod Biomed Online* 27: 338-352.
- Menkveld R, Holleboom CA, Rhemrev JP (2011) Measurement and significance of sperm morphology. *Asian J Androl* 13: 59-68.
- Nikoletos N, K pker W, Demirel C, Sch pper B, Blasig C, et al. (1999) Fertilization potential of spermatozoa with abnormal morphology. *Hum Reprod* 14 Suppl 1: 47-70.
- Ruvolo G, Fattouh RR, Bosco L, Brucculeri AM, Cittadini E (2013) New molecular markers for the evaluation of gamete quality. *J Assist Reprod Genet* 30: 207-212.
- Fortunato A, Leo R, Liguori F (2013) Effects of cryostorage on human sperm chromatin integrity. *Zygote* 21: 330-336.
- Fortunato A, Leo R, Casale S, Nacchia G, Liguori F, et al. (2013b) Sperm DNA fragmentation assays correlate with sperm abnormal morphology and the pregnancy outcome. *JFIV Reprod Med Genet* 1: 1.
- Boitrelle F, Ferfour F, Petit JM, Segretain D, Tourain C, et al. (2011) Large human sperm vacuoles observed in motile spermatozoa under high magnification: nuclear thumbprints linked to failure of chromatin condensation. *Hum Reprod* 26: 1650-1658.
- Fekonja N, Štrus J, Tušek Žnidarič M, Knez K, Vrtacnik Bokal E, et al. (2014) Clinical and structural features of sperm head vacuoles in men included in the in vitro fertilization programme. *Biomed Res Int* 2014: 927841.
- Mundy AJ, Ryder TA, Edmonds DK (1994) A quantitative study of sperm head ultrastructure in subfertile males with excess sperm precursors. *Fertil Steril* 61: 751-754.
- Oliveira JB, Cavagna M, Petersen CG, Mauri AL, Massaro FC, et al. (2011) Pregnancy outcomes in women with repeated implantation failures after intracytoplasmic morphologically selected sperm injection (IMSI). *Reprod Biol Endocrinol* 9: 99.
- Perdrix A, Travers A, Chelli MH, Escalier D, Do Rego JL, et al. (2011) Assessment of acrosome and nuclear abnormalities in human spermatozoa with large vacuoles. *Hum Reprod* 26: 47-58.
- Franco JG Jr, Mauri AL, Petersen CG, Massaro FC, Silva LF, et al. (2012) Large nuclear vacuoles are indicative of abnormal chromatin packaging in human spermatozoa. *Int J Androl* 35: 46-51.
- Falagario D, Brucculeri AM, Depalo R, Trerotoli P, Cittadini E, et al. (2012) Sperm head vacuolization affects clinical outcome in ICSI cycle. A proposal of a cut-off value. *J Assist Reprod Genet* 29: 1281-1287.
- Ghazali S, Talebi AR, Khalili MA, Aflatoonian A, Esfandiari N (2015) Large nuclear vacuoles in spermatozoa negatively affect pregnancy rate in IVF cycles. *Iran J Reprod Med* 13: 425-432.
- Antinori M, Licata E, Dani G, Cerusico F, Versaci C, et al. (2008) Intracytoplasmic morphologically selected sperm injection: a prospective randomized trial. *Reprod Biomed Online* 16: 835-841.
- González-Ortega C, Cancino-Villarreal P, Pérez-Torres A, Vargas-Maciel MA, Martínez-Garza SG, et al. (2010) [Intracytoplasmic morphologically selected sperm injection (IMSI) vs intracytoplasmic sperm injection (ICSI) in patients with repeated ICSI failure]. *Ginecol Obstet Mex* 78: 652-659.
- Kacem O, Sifer C, Barraud-Lange V, Ducot B, De Ziegler D, et al. (2010) Sperm nuclear vacuoles, as assessed by motile sperm organellar morphological examination, are mostly of acrosomal origin. *Reprod Biomed Online* 20: 132-137.
- Montjean D, Belloc S, Benkhalifa M, Dalleac A, Mén zo Y (2012) Sperm vacuoles are linked to capacitation and acrosomal status. *Hum Reprod* 27: 2927-2932.
- Tanaka A, Nagayoshi M, Tanaka I, Kusunoki H (2012) Human sperm head vacuoles are physiological structures formed during the sperm development and maturation process. *Fertil Steril* 98: 315-320.
- Mauri AL, Petersen CG, Oliveira JB, Massaro FC, Baruffi RL, et al. (2010) Comparison of day 2 embryo quality after conventional ICSI versus intracytoplasmic morphologically selected sperm injection (IMSI) using sibling oocytes. *Eur J Obstet Gynecol Reprod Biol* 150: 42-46.
- Palermo GD, Hu JC, Rienzi L, Maggiulli R, Takeuchi T, et al. (2011) Thoughts on IMSI. *Biennial Rev Infert* 2: 277-289.
- Tosti E, Menezo Y (2012) IMSI, useful, useless or harmful? *J Fertil In Vitro* 2: e115.
- Gatimel N, Léandri RD, Marino L, Esquerre-Lamare C, Parinaud J2 (2014) Sperm vacuoles cannot help to differentiate fertile men from infertile men with normal sperm parameter values. *Hum Reprod* 29: 2359-2367.
- Neyer A, Vanderzwalmen P, Bach M, Stecher A, Spitzer D, et al. (2013) Sperm head vacuoles are not affected by in-vitro conditions, as analysed by a system of sperm-microcapture channels. *Reprod Biomed Online* 26: 368-377.
- Ebner T, Shebl O, Oppelt P, Mayer RB1 (2014) Some reflections on intracytoplasmic morphologically selected sperm injection. *Int J Fertil Steril* 8: 105-112.
- Fortunato A, Boni R, Leo R, Nacchia G, Liguori F, et al. (2016) Vacuoles in sperm head are not associated with head morphology, DNA damage and reproductive success. *Reprod Biomed Online* (in press) DOI: org/10.1016/j.rbmo.2015.10.009.
- Janny L, Menezo YJ (1994) Evidence for a strong paternal effect on human preimplantation embryo development and blastocyst formation. *Mol Reprod Dev* 38: 36-42.
- Mén zo YJ (2006) Paternal and maternal factors in preimplantation embryogenesis: interaction with the biochemical environment. *Reprod Biomed Online* 12: 616-621.
- Mén zo Y, Dale B (1995) Paternal contribution to successful embryogenesis. *Hum Reprod* 10: 1326-1328.