

Impact of Oxidative Stress, Antioxidant Enzymes, and Trace Elements in Determining IVF Treatment Cycles

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Abstract

Infertility is a complex reproductive disorder influenced by multiple biochemical and physiological factors, with in vitro fertilization (IVF) being a widely used assisted reproductive technique. The present study was conducted to evaluate the relationship between oxidative stress, antioxidant enzyme activity, trace element levels, and IVF outcomes. This observational study included patients undergoing IVF treatment, and follicular fluid and blood samples were collected during oocyte retrieval. IVF outcome parameters, including fertilization rate and cleavage rate, were assessed along with embryo development characteristics. The results demonstrated that fertilization rate ($65.19 \pm 1.81\%$) and cleavage rate ($62.78 \pm 1.85\%$) were significantly higher in embryo transfer (ET) done groups compared to ET not done groups ($p < 0.001$). However, no significant difference was observed between IVF positive and IVF negative groups for fertilization and cleavage rates. Analysis of trace elements indicated no significant association of blood cadmium ($0.1261 \pm 0.02 \mu\text{g/dL}$) and lead ($3.66 \pm 0.26 \mu\text{g/dL}$) levels with reproductive outcomes. Serum copper levels also did not show statistically significant variation, although slightly higher values were observed in reproductive impairment cases. Follicular fluid zinc levels ($0.43 \pm 0.02 \text{ mg/L}$) showed a positive trend with fertilization efficiency, though not statistically significant ($p = 0.0632$). Elevated antioxidant enzyme activity, including superoxide dismutase and glutathione-S-transferase, was observed in cases with poor ovarian response, suggesting a compensatory mechanism against oxidative stress. Increased oxidative stress was associated with poor embryo morphology, delayed cleavage, and higher fragmentation rates. Thus, oxidative stress and follicular biochemical environment play an important role in IVF outcomes, while trace elements such as zinc may contribute to improved fertilization efficiency.

Keywords

IVF Outcome, Oxidative Stress, Antioxidant Enzymes, Trace Elements, Fertilization Rate.