Magnetic Field and Medium Viscosity Influence the Kinetics of Oocytes Bound to Nanoparticles

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INTRODUCTION

Assisted reproductive technologies (ARTs) require precise handling of gametes and embryos to preserve their viability. Magnetic manipulation represents a novel strategy based on the conjugation of functionalized magnetic nanoparticles (NPs) to truncated porcine oviductal glycoprotein 1 (pOVGP1t), forming the NPOv complex[1]. This complex binds specifically to the zona pellucida of mature oocytes without internalization, enabling magnetic control[1].

The **objective** was to evaluate the effect of medium viscosity on the displacement of oocyte-NPOv complexes under a low-intensity magnetic field, aiming to better understand oocyte behavior in reproductive-like fluids and to optimize its application in magnetic devices for ARTs.

METHODS

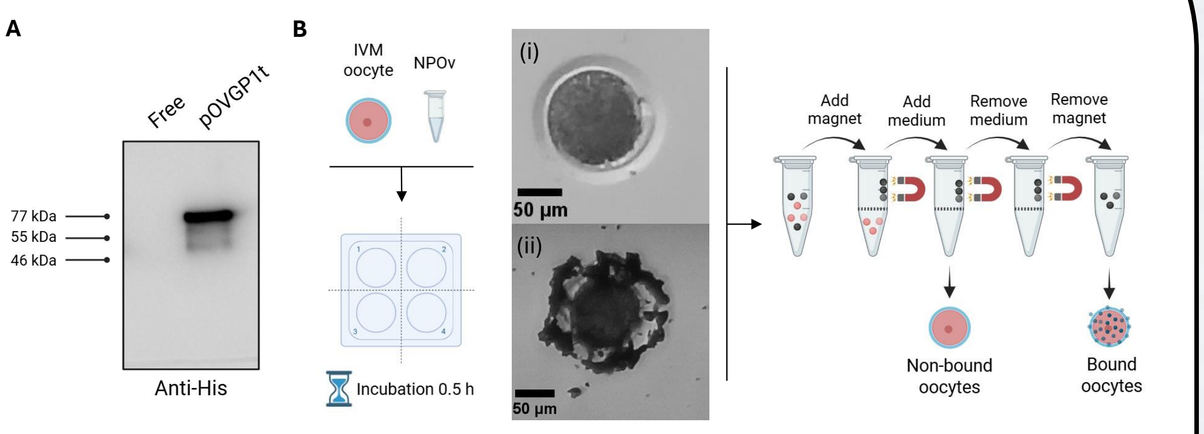

Figure 1. Western blot and incubation of *in vitro* matured porcine oocytes with NPOv. (A) WB: pOVGP1t (~77 kDa) and free protein in wash medium. (B) (i) Decumulated IVM oocyte; (ii) oocyte-NPOv complex. After 30 min of incubation with NPOv, oocytes were magnetically separated. n = 26 oocyte-NPOv complexes.

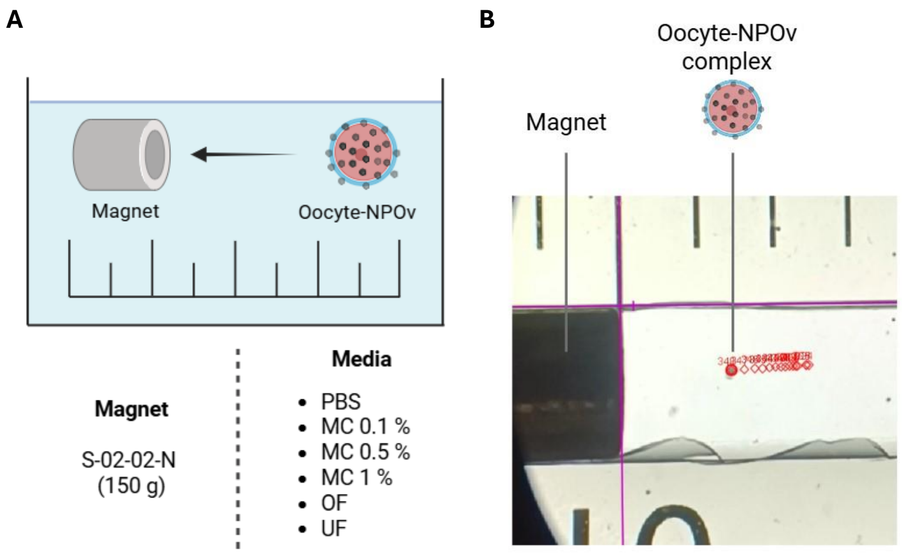

Figure 2. Oocyte-NPOv complex displacement analysis. (A) Setup to assess displacement of oocyte-NPOv complexes under S-02-02-N (magnet150 g holding force) in different media. Media: phosphate-buffered saline (PBS), PBS supplemented with methylcellulose (MC: 0.1%, 0.5%, 1%), uterine fluid (UF) and oviductal fluid (OF). (B) Tracker showing the displacement of an oocyte-NPOv complex.

RESULTS

PBS, MC 0.1%, UF and OF showed viscosities comparable to human cervicovaginal fluid[2], while MC 0.5% and MC 1% reproduced higher-viscosity of complex human uterine secretions[3].

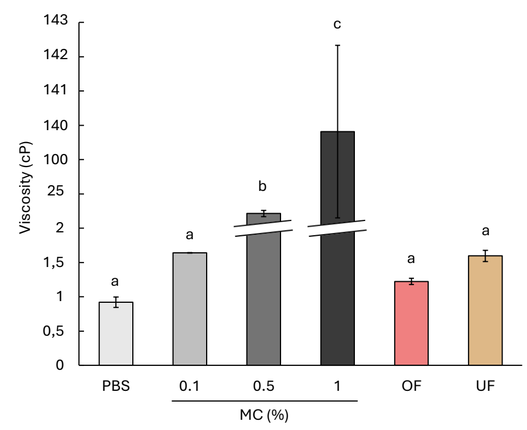

Figure 3. Viscosity of PBS, MC (0.1%, 0.5%, 1%), OF and UF, expressed as mean ± SD (cP). Different letters indicate significant differences ($p < 0.05$; n = 3 replicates). One-way ANOVA and Tukey's test.

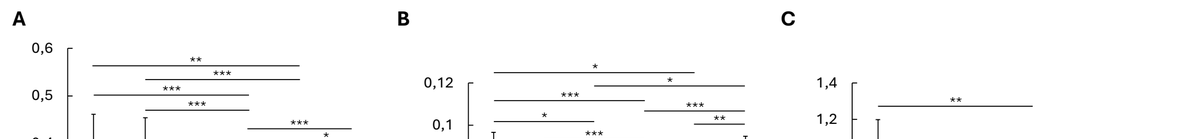

Figure 4. Movement parameters: (A) Distance travelled. (B) Mean velocity. (C) Maximum acceleration. $p < 0.05$ (*), $p < 0.01$ (**), $p < 0.001$ (***); n = 7-9 oocyte-NPOv complexes. One-way ANOVA and Tukey's test.

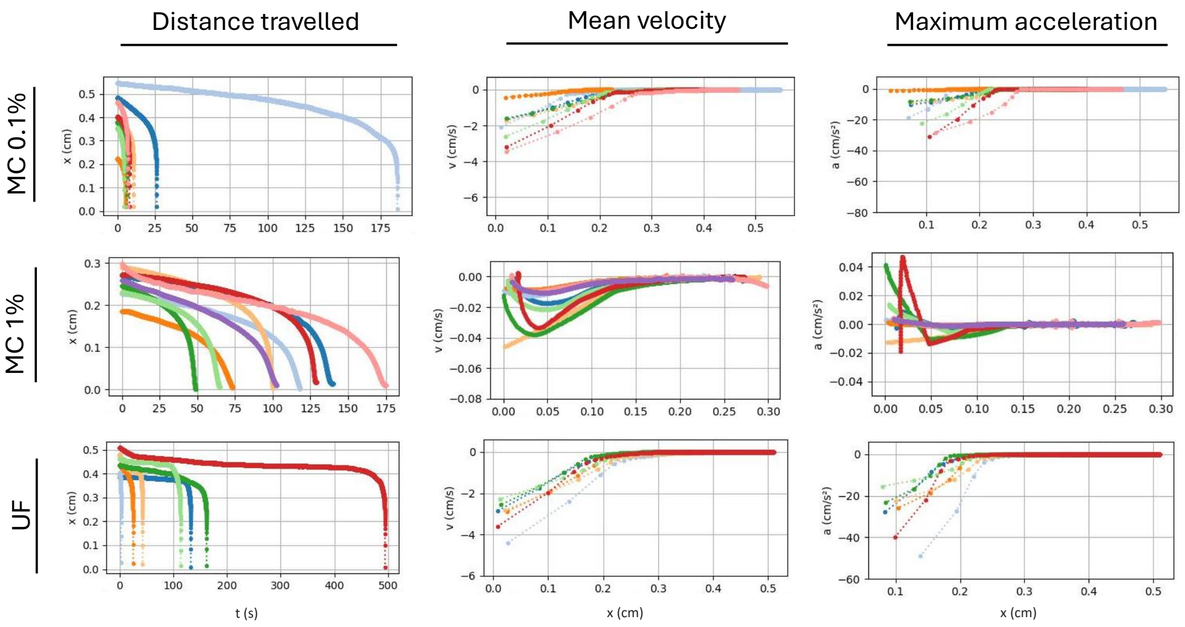

Figure 5. Displacement of oocyte-NPOv complexes in different media. MC 0.1% (n = 10), MC 1% (n = 7) and UF (n = 9). Each line represents an oocyte-NPOv complex.

CONCLUSION

Motion parameters declined progressively with increasing viscosity, confirming an inverse relationship between medium viscosity and magnetic responsiveness. These findings provide key insights for the design of magnetic-based micromanipulation tools for ART applications and microfluidic systems.

REFERENCES

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