

A paternal influence on the embryonic capacity for implantation observed in a surrogate motherhood program

Abstract

Objective: We evaluated the influence of semen quality on the outcome of a surrogate motherhood program (SMP).

Design: Thirty two couples (group A) with normal semen parameters (i.e., sperm concentration, % motile sperms, and % morphologically normal sperms) of semen analysis participated in our SMP. Another group of 28 couples (group B) with an abnormal value in at least one semen parameter was also included in this SMP-study.

Materials and methods: All female partners underwent ovarian stimulation and semen samples were collected from the male partners. These women asked to participate in our SMP because of a history of hysterectomy or the presence of malignant hypertension, sickle cell anemia, chronic renal failure, or liver insufficiency (among others). ICSI techniques were performed in all mature oocytes of each couple of groups A and B. One surrogate woman underwent transfer of two embryos generated from each couple of groups A and B. Thus 32 surrogate women received embryos from the group A and 28 surrogate women received embryos from the group B. In addition, 31 couples (group C) with normal semen parameters participated in our SMP asking additionally for donor oocytes. Another group of 26 couples (group D) with an abnormal value in at least one parameter of semen analysis was also included in this SMP-study asking additionally for donor oocytes.

Results: The % fertilized oocytes (at 18hours post-ICSI), the % cleaved oocytes (at 36hours post-ICSI), and the % 8-12-cell stage embryos (at 72hours post-ICSI) were significantly lower ($P < 0.05$; Chi square test) in group B than in group A and in group D than in group C. The proportion of [the pregnant surrogate women] to [the total number of the surrogate women who underwent embryo transfer] was significantly lower in group B (8/28) than in group A (14/32) ($P < 0.05$; Chi square test) and in group D (8/26) than in group C (14/31).

Conclusion: Couples requesting to participate in an SMP with at least one abnormal semen parameter have worse prognosis to achieve pregnancy suggesting that paternal factors affect detrimentally the outcome of SMP. Paternal factors affecting the last events of the fertilization process (such as oocyte activating factor, reproducing element of the centrosome, among others) and early embryonic development or embryonic capacity for implantation (i.e. paternal DNA fragmentation, sperm nuclear proteins, paternal chromosomal aberrations, among others) may be the connective links between decreased semen quality and less optimal outcome in an SMP.

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I Giakoumakis,¹ D Daphnis,¹ E Vlachopoulou,² K Zotos,² G Daligkaros,² N Sofikitis²

¹Mediterranean Fertility Center & Genetic Services, Greece

²Department of Urology, Ioannina University School of Medicine, Greece

Correspondence: Ioannis Giakoumakis, OB-GYN, Clinical Director of Mediterranean Fertility Institute (Surrogacy, Egg Donation, In Vitro Fertilization Program), Alexandra General Hospital in Athens, 24 Zimvrakakidon St., Chania, Greece, Email igiakoumakis@ivfgreece.com

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Introduction

Previous studies from Janny and Menezo have provided evidence for a strong paternal effect on human preimplantation embryo development and blastocyst formation.¹ The studies by Janny and Menezo have been confirmed by other groups:

“Post-fertilization effects of chronic renal failure in male rats”.²

In fact fertilization rate, cleavage rate, blastocyst development rate, and live birth rate are significantly smaller after IVF methods using spermatozoa from rats with chronic renal failure compared with healthy rats. The initial study by Janny and Menezo has been

further confirmed by an additional report which shows that effects of primary testicular damage on sperm DNA may cause oxidative status and embryonic and foetal development if there is fertilization.³ In fact fertilization rate, cleavage rate, blastocyst development rate, and live birth rate are significantly smaller after IVF methods using spermatozoa from rats with varicoceles compared with healthy rats. An additional confirmation was published in rabbits with varicocele where it revealed a detrimental effect of left varicocele in the reproductive capacity of the early haploid male gamete.⁴ In fact ooplasmic injections (ICSI) of round spermatid nuclei from rabbits with primary testicular damage are significantly smaller compared with healthy rabbits (Table 1).

Table 1 Functions of the centrosome

Function	Responsible element	Inheritance mode
Intrinsic		
Reproducing element	Unknown	Paternal
Microtubule organizer	Unknown γ-tubulin binding protein	Paternal
Microtubule nucleation peripheral	Tubulin, probably in the 25S "γ-some"	Largely maternal, Perhaps secondarily derived from function number
Peripheral		
Nuclear association and nuclear(karyogamy)	Gene products of various mutants, including mutations in motor proteins	2
Configurational destruction	Affected and effected by MTs and MFs, including both cell cycial shape changes and antiperpendicular separation	2,3
Cendtrosome destruction	Absence of duplication of reproducing elements results in centrosome destruction	Absence of 1
The cell's pacemaker orchestrator of the cell cycle's regulation	Arrangement of kinases, cyclins, phosphatase	2
Centriole assembly and axoneme excision	Involoves centrin and microtubule assembly, and excision is included by the binding of calcium ions to centrin	2
Cell body organizer	Perhaps derived from microtubules	2

Suggestion

Our suggestion is that the mission of the male gamete is not only to fertilize the oocyte but the male gamete contributes with factors important for the early embryonic development and embryonic capacity for implantation.

A surrogate motherhood program

Considering that young healthy women serve as surrogate mothers it appears that a surrogate motherhood program offers a unique opportunity to appreciate the contribution of paternal factors to the early embryonic development and to the embryonic capacity for implantation.

Objective

Our objective was to evaluate the influence of semen quality on the outcome of a surrogate motherhood program (SMP). Past studies by Schatten et al have demonstrated that the human centrosome is paternally inherited.

Major Contributions of the Male Gamete to the Zygote,

- i. DNA,
- ii. Nuclear Protein Matrix,
- iii. Centrosomic Components,
- iv. Oocyte activating substance.

Participants and methods

This study involves 4 groups:

- i. Group A (n=32): Couples with normal concentration, motility and morphological aspects.
- ii. Group B (n=28): Couples with an abnormal value in at least one of the above parameters.
- iii. Group C (n=31): Couples with normal normal concentration, motility and morphological aspects asking additionally for donor oocytes.
- iv. Group D(n=26): Couples with an abnormal semen parameter asking additionally for donor oocytes.

Embryo transfer

(Table 2) Every surrogate woman underwent transfer up to two embryos generated from groups A, B, C, or D. Within each column, values not sharing the same superscript a or b are statistically significantly different (P<0.05) (Table 3). There is a significant difference in all parameters when comparing Group A VS Group B and Group C VS Group D.

Table 2 Pregnancy in the surrogate motherhood program

Group	Number of women undergone ET	Pregnant women (%)
A	32	14(43%) ^a
B	28	8(28%) ^b
C	31	14(45%) ^a
D	26	8(30%) ^b

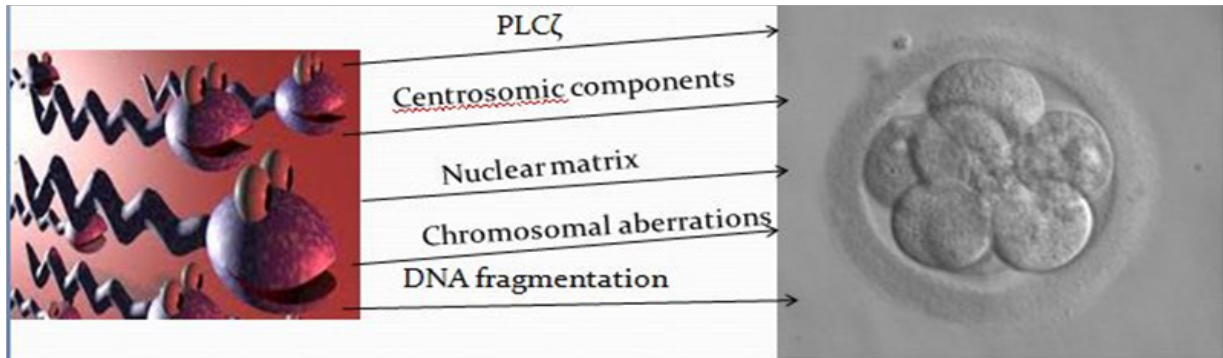
Table 3 Effect of sperm quality on embryonic dynamics

Group	Fertilisation rate	Cleavage rate	8-10 cell stage embryos rate
A	132/221(59.7%) ^a	87/132(65.9%) ^a	64/87(73.5%) ^a
B	98/223(43.9%) ^b	49/98(50.0%) ^b	29/49(59.1%) ^b
C	117/186(62.9%) ^a	79/117(67.5%) ^a	68/79(86.0%) ^a
D	75/156(48.0%) ^b	39/75(52.0%) ^b	28/39(71.7%) ^b

Results

- i. Couples participating in an SMP and use the female partner's oocytes have significantly smaller live birth rate if there is an abnormal value in the normal concentration, motility and morphological aspects.
- ii. Couples participating in an SMP and use donor oocytes have significantly smaller live birth rate if there is an abnormal value in the normal concentration, motility and morphological aspects.

Conclusion



- i. In conclusion increased defects in spermatozoa concerning number, motility and morphology affect detrimentally the above mentioned parameters.
- ii. This will result in a lower probability for optimal embryonic development and capacity for implantation.

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None.

Conflict of interest

The author declares no conflict of interest.

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