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Original Research Article

Paternal age and reproductive outcomes in donor intracytoplasmic sperm injection cycles

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ABSTRACT

Background: Advanced paternal age has emerged as a potential contributor to adverse reproductive outcomes, though its role remains less clearly defined than that of maternal age. Donor oocyte intracytoplasmic sperm injection (ICSI) cycles provide an ideal model to study paternal effects by minimizing oocyte-related confounding effect. Objectives were to evaluate the impact of paternal age on clinical pregnancy rate (CPR) and live birth rate (LBR) in donor oocyte ICSI cycles.
Methods: This retrospective observational study analysed 101 donor oocyte ICSI cycles performed at Madras Medical Mission, Chennai from 2020 to 2025. Male participants were stratified into paternal age groups: <40 years, 40-45 years, and >45 years and their outcomes in donor ICSI cycles studied. Recipient female partners ages were between 27 and 45 years. Statistical analysis was performed using chi-square tests, with $p<0.05$ considered significant.
Results: The overall CPR was 51.4%, and the LBR was 34%. A declining trend in CPR and LBR was observed with increasing paternal age; however, these differences were not statistically significant (CPR: p=0.39; LBR: p=0.71). Miscarriage rates were higher in men aged 40 years and above (miscarriage rate p=0.340).
Conclusions: Although advancing paternal age did not significantly affect CPR or LBR in donor oocyte ICSI cycles, a negative trend was observed. These findings highlight the importance of incorporating paternal age into infertility counselling and reinforce the need for larger prospective studies.

Keywords: Paternal age, Donor oocyte, ICSI, Clinical pregnancy rate, Live birth rate

INTRODUCTION

of advanced maternal age on fertility and pregnancy outcomes are well established, the influence of paternal age has received comparatively limited attention.[2] Ageing in men is associated with progressive changes in semen parameters, including reductions in semen volume, sperm concentration, and motility, as well as increased sperm DNA fragmentation and chromosomal abnormalities.[3] Advanced paternal age has been linked to increased risks of de novo mutations, autosomal dominant disorders, neurodevelopmental conditions, and adverse obstetric outcomes.[4] In assisted reproductive technology (ART), particularly ICSI, the impact of paternal age may be underestimated due to laboratory selection of motile spermatozoa. Donor oocyte cycles offer a unique opportunity to study paternal effects independently, as they control for age-related decline in oocyte quality.

Aim

Aim of the study was to evaluate the effect of paternal age on reproductive outcomes in the donor oocyte of ICSI cycles.

METHODS

A retrospective study was conducted at the institute of reproductive medicine, Madras medical mission, Chennai, India from 2020 to 2025. A total of 101 couples who underwent donor oocyte ICSI cycles using self-sperms and healthy donors aged between 23 and 35 years were included. Inclusion criteria included recipients with low ovarian reserve, poor oocyte quality, genetic and chromosomal abnormality, using paternal sperms and failed multiple cycles of ICSI using self-eggs. Exclusion criteria included severe male factor infertility, testicular problems, previous chemotherapy or radiotherapy, cycles with incomplete records, cycles cancelled prior to embryo transfer, and patients who tested positive for HIV, HBsAg, VDRL, CMV, and Treponema pallidum.

Male patients were categorized into three paternal age groups: <40 years, 40-45 years, and >45 years. Recipient female aged between 25 and 45 years. All endometrial preparation were done using oestrogen and the endometrial thickness ranged between 8.1- and 11-mm. Data were analysed using chi-square tests, and a $p<0.05$ was considered statistically significant.

CPR=(Number of pregnancies/Total number of embryo transfers)×100.

RESULTS

Table 1 shows the distribution of participants by paternal age.

Figure 1 shows that there was a declining trend of CPR with rising paternal age. CPR was highest in paternal age <40 years (62.1%). CPR was 44.1% in paternal age group 40 to 45 years and 51.7% in paternal age group >45 years (p=0.329, not statistically significant).

Figure 2 shows that there is a declining trend of LBR with rising paternal age. LBR was highest in paternal age <40 years (72.2%) and lowest in group with age >45 years (60%). LBR was 63.15% in paternal age group 40 to 45 years (p=0.74, not statistically significant).

Figure 3 shows that the miscarriage rate increases with rising paternal age. Miscarriage rate was highest in paternal age >45 years (40%) and lowest in group with age <40 years (27.77%). Miscarriage rate was 36.84% in paternal age group 40 to 45 years (p=0.74, not statistically significant).

Table 1: Number of patients across various age groups, (n=101).

Paternal age groups (in years)	N	Percentage (%)
<40	29	28.7
40 to 45	43	42.5
>45	29	28.7

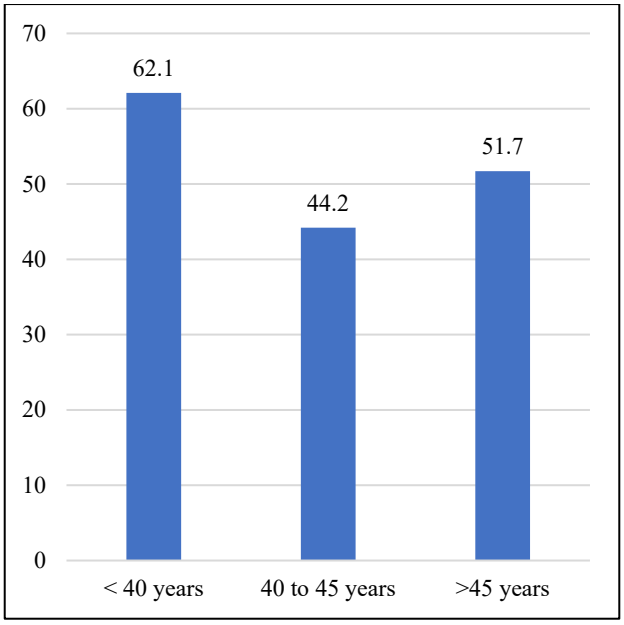

Figure 1: CPR by paternal age group.

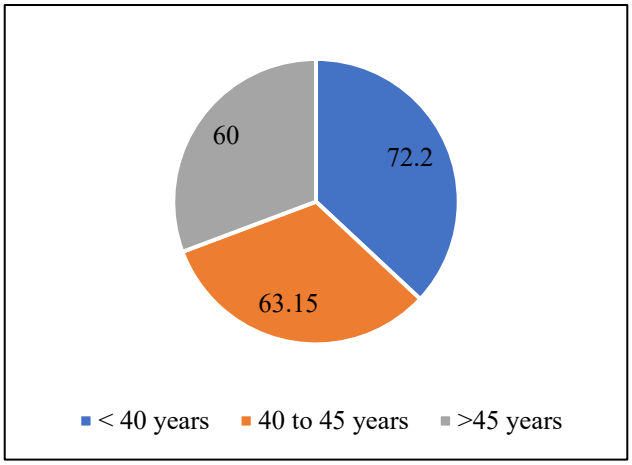

Figure 2: LBR.

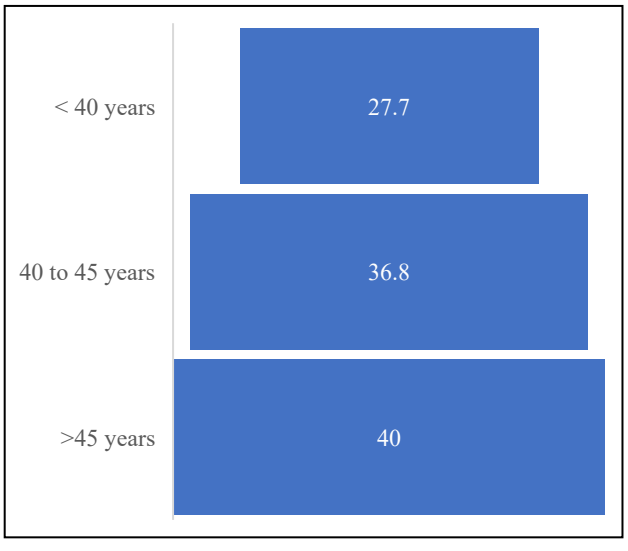

Figure 3: Miscarriage rates.

Overall CPR-51.4%, LBR-65.38% and miscarriage rate was 34.61%. A decreasing trend in both CPR and LBR was observed with advanced paternal age (Table 2). However, these differences not statistically significant (CPR: p=0.329, LBR: p=0.74). Miscarriage rate was higher when paternal age increases (miscarriage rate: p=0.74).

Table 2: Outcome among participants.

Number of donors ICSI cycle	Number of clinical pregnancies	Number of live births	Number of miscarriages	Number of patients lost during follow-up	Number of ongoing pregnancies	Number of twin pregnancy
101	52	34	18	5	2	4

DISCUSSION

The increasing age of parenthood is a global phenomenon, and while the adverse impact of advanced maternal age on reproductive outcomes is well established, the contribution of paternal age remains less clearly defined.[5] The present study evaluated the effect of paternal age on CPR, LBR and miscarriage rate in donor ICSI cycles, thereby minimizing the confounding influence of oocyte quality and allowing a focused assessment of male age-related factors.

In this study the miscarriage rate was higher, 34.61%, despite the use of donor oocytes across various paternal age groups which may be due to rising maternal age affecting the pregnancy outcomes. In this study, although both CPR and LBR showed a declining trend with increasing paternal age, the differences did not reach statistical significance. These findings are consistent with several published studies reporting that paternal age alone may not significantly influence ART outcomes when donor oocytes are used. Beguería et al demonstrated that the use of donor oocytes mitigates the negative impact of advanced paternal age on pregnancy outcomes, suggesting that oocyte quality plays a dominant role in embryo developmental competence.[6] Similarly, Cito et al reported comparable fertilization, implantation, and pregnancy rates across different paternal age groups in donor egg ICSI cycles.[7] Despite the lack of statistical significance, the observed increase in miscarriage rates among men aged >45 years in our study aligns with growing evidence linking advanced paternal age to higher rates of pregnancy loss. Several studies have attributed this to increased sperm DNA fragmentation, accumulation of de novo mutations, and epigenetic alterations associated with aging spermatozoa.[8,9] Advanced paternal age has also been associated with impaired chromatin packaging and increased oxidative stress, which may adversely affect embryo development beyond implantation.[10] The biological mechanisms underlying paternal age-related reproductive decline are multifactorial. Ageing in men is associated with reduced semen volume, sperm motility, and normal morphology, along with a progressive rise in sperm DNA fragmentation index (DFI).[2,11] Structural chromosomal abnormalities in sperm have also been shown to increase with advancing paternal age, contributing to embryonic aneuploidy and pregnancy loss.[2] Even in ICSI cycles, where fertilization is mechanically assisted, elevated sperm DNA damage has been linked to reduced blastocyst quality, increased miscarriage rates, and lower LBRs.[3] Interestingly, twin pregnancies were more frequently observed in younger paternal age groups in the present study. This may reflect better embryo competence and higher implantation potential rather than a direct effect of paternal age. Previous studies have similarly shown higher implantation efficiency and embryo developmental potential in cycles involving younger male partners.

Our findings are also in agreement with systematic reviews and meta-analyses suggesting that while paternal age may not significantly affect fertilization or CPRs in ART, it may have a more pronounced impact on miscarriage and live birth outcomes.[12,13] Guglielmo et al reported that advanced paternal age negatively influenced LBRs and increased miscarriage risk following the first embryo transfer in oocyte donation cycles, emphasizing the importance of male age in determining final reproductive outcomes.[14]

Beyond reproductive outcomes, advanced paternal age has been associated with increased risks of adverse offspring health outcomes, including neurodevelopmental disorders and genetic diseases, further underscoring the clinical relevance of male age in reproductive decision-making. Professional bodies have therefore recommended genetic counseling and informed discussion for couples where the male partner is of advanced age.

The absence of statistical significance in our study may be attributed to the relatively small sample size and retrospective design. Larger prospective studies are required to establish definitive paternal age thresholds beyond which reproductive outcomes are adversely affected. Additionally, the lack of routine assessment of sperm DNA fragmentation and male metabolic parameters in our cohort may have limited deeper analysis of underlying mechanisms. From a clinical perspective, the findings of this study reinforce the importance of including paternal age in fertility counselling, even in donor oocyte programs. While oocyte donation offers an effective solution for age-related female infertility, advancing paternal age may still compromise live birth outcomes. Early evaluation and optimization of male reproductive health, lifestyle modification, and consideration of sperm DNA integrity assessment may help improve outcomes in older men undergoing ART.

Limitations

The limitations of the study are smaller size of the sample, retrospective study, and unequal distribution of patients

CONCLUSION

Oocyte donation continues to be an effective and reliable option for achieving parenthood in couples with compromised female reproductive potential. By utilizing donor oocytes, the confounding influence of oocyte quality related to maternal age is minimized, thereby allowing a more focused evaluation of paternal factors influencing reproductive outcomes. In the present study involving 101 donor ICSI cycles, an overall CPR of 51.4% and a LBR of 65.38% were observed, reflecting acceptable success rates comparable to existing literature. Although a declining trend in both CPR and LBR with increasing paternal age were noted, this association did not reach statistical significance. Nevertheless, the observation of a higher miscarriage rate in men aged >45 years suggests that advancing paternal age may adversely influence post-implantation outcomes even in donor oocyte cycles. The increased miscarriage rate in older paternal age groups may be attributed to age-related deterioration in sperm quality, including increased DNA fragmentation, accumulation of de novo mutations, and epigenetic alterations, which are not corrected by the use of donor oocytes. Although statistical significance was not achieved, likely due to the retrospective design and limited sample size, the consistent downward trend in reproductive outcomes with advancing paternal age carries important clinical implications. These findings emphasize that paternal age should be overlooked during infertility evaluation and counselling, even in the context of egg donation programs.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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