ORIGINAL ARTICLE

The Impact of Anesthetic Agents Used in OocytePick-Up on the Outcome of In Vitro Fertilization

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Abstract:

Introduction: The choice of anesthetic agents during oocyte pick-up (OPU) for in vitro fertilization (IVF) may influence various IVF outcome parameters. This study aimed to investigate the impact of different anesthetic agents on the outcomes of IVF. Methods: This retrospective observational study was conducted using hospital records from December 2021to March 2023. A total of 200 participants were divided into three groups: Group A (n=110) received propofol, Group B (n=50) received ketamine, and Group C (n=40) received a combination of both. Baseline demographics, hormone levels, infertility causes, ovarian stimulation, anesthesia-related parameters, oocyte retrieval, embryo quality, and IVF success rates were compared. Result: The study compared three groups of participants undergoing IVF with different anesthetics: Group A (n=110) with propofol, Group B (n=50) with ketamine, and Group C (n=40) with a combination of propofol and ketamine. Participants' demographics, infertility causes, and hormonal levels showed no significant differences among the groups. Anesthesia-related parameters were also similar. Although MI oocytes were significantly higher in Group B (p=0.011), other oocyte and embryo parameters were comparable across the groups. The fertilization rate was significantly different (p=0.005), with Group A at 54.65%, Group B at 40.49%, and Group C at 59.62%. However, implantation, clinical pregnancy, and take-home baby rates showed no significant differences among the groups. Conclusion: The choice of anesthetic agents during oocyte pick-up has minimal impact on most in vitro fertilization outcome parameters. While a few specific factors, such as metaphase I oocytes and fertilization rates, were influenced by the choice of anesthetic, further large-scale, prospective, randomized studies are needed to confirm these findings and optimize IVF success rates while ensuring patient comfort and safety.

Key words: Fertility, Ovum, Oocyte, Anesthetic, Fertilization

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Introduction:

Oocyte pick-up (OPU), also known as oocyte retrieval or follicular aspiration, is a crucial step in the process of in vitro fertilization (IVF) - a highly specialized technique used to treat infertility and help couples achieve pregnancy[1]. During OPU, mature oocytes are collected from the ovarian follicles of a female patient after she has undergone controlled ovarian hyperstimulation (COH) to produce multiple mature follicles. These oocytes are then fertilized with sperm in the laboratory, and the resulting embryos are implanted into the woman's uterus or cryopreserved for future use. (2)In vitro fertilization has become increasingly popular and effective over the past few decades,

offering hope to millions of couples who struggle with infertility[2]. One critical aspect of the IVF process is the selection and administration of anesthetic agents during OPU. Anesthesia is necessary to ensure patient comfort and minimize potential complications during the procedure, which typically involves the use of a transvaginal ultrasound-guided needle to aspirate the follicles1. However, the choice of anesthetic agent may have an impact on the overall success of the IVF procedure. Several anesthetic agents have been used for OPU, including propofol, ketamine, and a combination of both[3,4]. Propofol, a short-acting intravenous anesthetic, is commonly used for sedation during OPU because of its rapid onset and recovery time[5]. It is known for its minimal side effects and ability to provide adequate sedation and analgesia for the procedure[3]. Some studies have reported that propofol does not have a negative impact on the quality or maturation of oocytes retrieved[1,5]. On the other hand, ketamine, a dissociative anesthetic, has been used as an alternative to propofol in some cases[4]. Ketamine has the advantage of being less expensive than propofol and is more readily available in resource-limited settings. However, there is conflicting evidence regarding its potential impact on oocyte quality and embryo development. Some studies have reported that ketamine may have negative effects on the maturation and developmental potential of oocytes[4]. Others have found no significant differences in the outcomes of IVF cycles when ketamine is used for OPU. Moreover, a combination of propofol and ketamine has been used in some OPU procedures, aiming to capitalize on the advantages of both agents[3]. This approach may provide better sedation and analgesia while minimizing the potential negative effects of each agent on oocyte quality and IVF outcomes. However, the evidence regarding the use of a combination of propofol and ketamine in OPU is limited, and more research is needed to determine the optimal anesthesia regimen for this procedure[4].

The choice of anesthetic agent during OPU is an essential consideration for IVF practitioners, as it may directly influence the success of the procedure and the chances of achieving pregnancy for the patients. By investigating the effects of different anesthetic agents on IVF outcomes in a population of Bangladeshi patients, this study will contribute to the growing body of evidence on this topic and may help inform clinical practice in the region. Furthermore, our findings may have broader implications for IVF practice in other resource-limited settings, where the availability and cost of anesthetic agents may be significant factors in the choice of anesthesia for OPU. In conclusion, this observational study seeks to explore the impact of different anesthetic agents used during oocyte pick-up on the outcome of in vitro fertilization. By comparing the IVF outcomes among patients receiving propofol, ketamine, or a combination of both, we aim to better understand the potential effects of these agents on oocyte quality and embryo development. Our findings may ultimately help to inform clinical practice in Bangladesh and other resource-limited settings, ensuring that patients undergoing IVF treatment receive the most effective and appropriate anesthesia regimen during the crucial oocyte retrieval procedure.

Methodology:

This retrospective observational study was conducted at the Anesthesiology unit, Nova IVF Fertility, Dhaka, Bangladesh. The study duration was from December 2021 to March 2023. We examined the impact of different anesthetic agents used during oocyte pick-up on the outcomes of in vitro fertilization by reviewing hospital records between this period. A total of 200 records were analyzed, following the inclusion and exclusion criteria. The inclusion criteria for this retrospective observational study were women aged 18-45 years who underwent IVF treatment at the fertility clinic in Bangladesh between December 2021 and March 2023. The exclusion criteria were as follows: contraindication to the use of any of the anesthetic agents (propofol, ketamine, or their combination); history of allergy or adverse reaction to propofol or ketamine; severe comorbidities, such as uncontrolled diabetes, cardiovascular disease, or liver and kidney dysfunction, that could interfere with anesthesia administration or the IVF procedure; and patients who underwent preimplantation genetic testing or had incomplete

medical records.The 200 patients were divided into 3 groups, Group A (propofol, n=110), Group B (ketamine, n=50), and Group C (combination of propofol and ketamine, n=40). The study collected data on participant demographics, oocyte pick-up procedure details, and IVF outcomes such as live birth rate, fertilization rate, cleavage rate, the number of good-quality embryos, implantation rate, clinical pregnancy rate, and miscarriage rate. Statistical analysis was performed to compare the outcomes between the groups and adjust for potential confounders.

Results:

Table I: Mean baseline demographic characteristics of the participants

Mean Baseline Demographics	Group A (n=110)	Group B (n=50)	Group C (n=40)
Age (years)	31.94 ± 5.91	31.73 ± 4.81	30.58 ± 5.19
Partner's age (years)	34.96 ± 6.1	34.51 ± 5.41	33.33 ± 4.88
BMI (kg/m2)	25.8 ± 4.79	25.12 ± 4.5	25.61 ± 4.7
Duration of infertility (years)	6.46 ± 4.58	7.13 ± 3.65	5.9 ± 3.93
Previous IVF cycle	1.47 ± 0.85	1.76 ± 0.88	1.62 ± 1.18

The mean age of participants in all the groups were around 31 years. The mean age of the partners were around 34 years. The mean BMI of participants was 25 kg/m2. The duration of infertility in different groups were 5-8 years.

Table II: Mean baseline hormone levels of the participants

Mean Baseline Hormone Levels	Group A (n=110)	Group B (n=50)	Group C (n=40)
FSH (mIU/ml)	8.99 ± 6.3	7.52 ± 2.38	8.57 ± 4.51
LH (mIU/ml)	5.98 ± 4.08	5.20 ± 3.04	6.43 ± 8.83
E2 (pg/ml)	58.43 ± 65.88	56.86 ± 43.54	60.79 ± 86.43
PG (ng/ml)	1.01 ± 1.37	0.85 ± 0.90	0.81 ± 0.38

In Group A (n=110), the mean follicle-stimulating hormone (FSH) level was 8.99 ± 6.3 mIU/ml, while in Group B (n=50) it was 7.52 ± 2.38 mIU/ml, and in Group C (n=40) it was 8.57 ± 4.51 mIU/ml. The mean luteinizing hormone (LH) levels were 5.98 ± 4.08 mIU/ml in Group A, 5.20 ± 3.04 mIU/ml in Group B, and 6.43 ± 8.83 mIU/ml in Group C. The mean estradiol (E2) levels were 58.43 ± 65.88 pg/ml in Group A, 56.86 ± 43.54 pg/ml in Group B, and 60.79 ± 86.43 pg/ml in Group C. Lastly, the mean progesterone (PG) levels were 1.01 ± 1.37 ng/ml in Group A, 0.85 ± 0.90 ng/ml in Group B, and 0.81 ± 0.38 ng/ml in Group C.

Table III: Distribution of participants by primary cause of infertility

Cause of Infertility	Group A (n=110)		Group B (n=50)		Group C (n=40)	
	n	%	n	%	n	%
PCOS	17	15.45%	5	10.00%	6	15.00%
Unexplained	30	27.27%	14	28.00%	10	25.00%
DOR	25	22.73%	8	16.00%	10	25.00%
Tubal	10	9.09%	0	0.00%	1	2.50%
Endometriosis	2	1.82%	1	2.00%	1	2.50%
Male factor infertility	26	23.64%	22	44.00%	12	30.00%

In Group A (n=110), unexplained infertility for 30 (27.27%) was the major primary cause of infertility. Whereas in Group B (n=50), male factor infertility for 22 (44.00%) was the prime cause, with no cases of tubal factors. In Group C (n=40), unexplained infertility and DOR (25.00%) were the common causes after male factor infertility for 12 (30.00%).

Table IV: Distribution of participants by mean ovarian simulation characteristics

Ovarian stimulation characteristics	Group A (n=110)	Group B (n=50)	Group C (n=40)	*p*-value
Starting dose of r-FSH	249.02 ±62.40	232.91 ±64.35	238.39 ±55.58	0.1
Starting dose of u-FSH	132.18 ±42.46	140.55 ±39.27	143.75 ±26.4	0.1
Poor ovarian response	37 (33.64%)	15 (30.00%)	12 (30.00%)	0.3
Presence of OHSS	5 (4.55%)	2 (4.0%)	1 (2.50%)	0.9

The starting dose of recombinant follicle-stimulating hormone (r-FSH) was 249.02 ± 62.40 IU in Group A (n=110), 232.91 ± 64.35 IU in Group B (n=50), and 238.39 ± 55.58 IU in Group C (n=40), with a p-value of 0.1. The starting dose of urinary follicle-stimulating hormone (u-FSH) was 132.18 ± 42.46 IU in Group A, 140.55 ± 39.27 IU in Group B, and 143.75 ± 26.4 IU in Group C, also with a p-value of 0.1. The incidence of poor ovarian response was 33.64% in Group A, 30.00% in Group B, and 30.00% in Group C, with a p-value of 0.3. The presence of ovarian hyperstimulation syndrome (OHSS) was reported in 4.55% of Group A, 4.0% of Group B, and 2.50% of Group C, with a p-value of 0.9, indicating no significant difference among the groups.

Table V: Distribution of participants by anesthesia related parameters

Anesthesia-related parameters	Group A (n=110)	Group B (n=50)	Group C (n=40)	*p*-value
Duration of anesthesia (min)	27.28 ± 12.15	24.16 ± 8.49	28.83 ±12.32	0.8
Median dose of anesthetic drugs (mg)	156.08 ± 47.37	88.03 ± 28.34	P 139.28 ±50.37 K 44.55 ±18.93	<0.0001
Sp02%	99.5	98	99	0.6
MAP difference	15	10	12	0.07
HR difference	10	6	8	0.06
Duration of recovery (min)	40	45	42	0.7

Anesthesia-related parameters were analyzed, and the duration of anesthesia was not significantly different among the groups, with Group A (n=110) averaging 27.28 ± 12.15 minutes, Group B (n=50) 24.16 ± 8.49 minutes, and Group C (n=40) 28.83 ± 12.32 minutes (p-value = 0.8). The median dose of anesthetic drugs was significantly different (p-value < 0.0001) with Group A receiving 156.08 ± 47.37 mg of propofol, Group B receiving 88.03 ± 28.34 mg of ketamine, and Group C receiving a combination of 139.28 ± 50.37 mg of propofol and 44.55 ± 18.93 mg of ketamine. Oxygen saturation (SpO2%) was similar across the groups with 99.5% in Group A, 98% in Group B, and 99% in Group C (p-value = 0.6). The mean arterial pressure (MAP) difference was 15 in Group A, 10 in Group B, and 12 in Group C (p-value = 0.07), while the heart rate (HR) difference was 10 in Group A, 6 in Group B, and 8 in Group C (p-value = 0.06). The duration of recovery was also not significantly different among the groups, with 40 minutes in Group A, 45 minutes in Group B, and 42 minutes in Group C (p-value = 0.7).

Table VI: Distribution of participants by the effect of anesthesia agents on oocyte retrieval parameters

Oocyte number (n)	Group A (n=110)	Group B (n=50)	Group C (n=40)	*p*-value
Total oocyte count	8.62 ± 6.7	9.8 ± 7.57	8.83 ± 6.93	0.4
MII	5.86 ± 4.66	6.55 ± 4.97	5.89 ± 4.49	0.6
MI	1.21 ± 1.5	1.94 ± 2.3	1.26 ± 1.51	0.011
GV	0.98 ± 1.69	1 ± 1.58	1.19 ± 2.7	0.7
Oocyte with anomalies	0.19 ± 0.76	0.1 ± 0.48	0.14 ± 0.48	0.6
Oocyte with degeneration	0.16 ± 0.57	0.15 ± 0.63	0.1 ± 0.56	0.7
Oocyte with EZ	0.21 ± 0.66	0.05 ± 0.22	0.12 ± 0.33	0.1
MII rate (%)	68.71 ± 24.40	70.98 ± 20.47	70.54 ± 22.94	0.7
Embryo count (n)	3.56 ± 3.03	3.1 ± 3.34	3.92 ± 2.82	0.3

The total oocyte count was not significantly different among the groups, with 8.62 ± 6.7 in Group A (n=110), 9.8 ± 7.57 in Group B (n=50), and 8.83 ± 6.93 in Group C (n=40) (p-value = 0.4). Metaphase II (MII) oocytes were similar across the groups, with 5.86 ± 4.66 in Group A, 6.55 ± 4.97 in Group B, and 5.89 ± 4.49 in Group C (p-value = 0.6). Metaphase I (MI) oocytes significantly differed (p-value = 0.011a), with 1.21 ± 1.5 in Group A, 1.94 ± 2.3 in Group B, and 1.26 ± 1.51 in Group C. The number of germinal vesicle (GV) oocytes and oocytes with anomalies, degeneration, or extrusion of the zona pellucida (EZ) did not significantly differ among the groups. The MII rate (%) was also similar across the groups, with 68.71 ± 24.40 in Group A, 70.98 ± 20.47 in Group B, and 70.54 ± 22.94 in Group C (p-value = 0.7). The embryo count was not significantly different, with 3.56 ± 3.03 in Group A, 3.1 ± 3.34 in Group B, and 3.92 ± 2.82 in Group C (p-value = 0.3).

Table VII: Distribution of participants by the effect of anesthesia agents on embryo parameters

Variable	Group A (n=110)		Group B (n=50)		Group C (n=40)		*p*-value
	n	%	n	%	n	%	
Embryo Quality							
Grade 1	96	87.27%	45	90.00%	38	95.00%	0.6
Grade 2	12	10.91%	4	8.00%	1	2.50%	
Grade 3	2	1.82%	1	2.00%	1	2.50%	
Embryo transfer day							
Day 3	56	50.91%	30	60.00%	28	70.00%	0.1
Day 4	24	21.82%	14	28.00%	7	17.50%	
Day 5	30	27.27%	6	12.00%	5	12.50%	

For embryo quality, no significant difference was observed among the groups (p-value = 0.6), with 87.27% of Group A (n=110), 90.00% of Group B (n=50), and 95.00% of Group C (n=40) having Grade 1 embryos. Grade 2 embryos were found in 10.91% of Group A, 8.00% of Group B, and 2.50% of Group C. Grade 3 embryos were present in 1.82% of Group A, 2.00% of Group B, and 2.50% of Group C.The embryo transfer day also did not significantly differ among the groups (p-value = 0.1). Day 3 transfers were performed in 50.91% of Group A, 60.00% of Group B, and 70.00% of Group C. Day 4 transfers occurred in 21.82% of Group A, 28.00% of Group B, and 17.50% of Group C. Day 5 transfers were conducted in 27.27% of Group A, 12.00% of Group B, and 12.50% of Group C.

Table VIII: Distribution of participants by the effects of anesthetic drugs on the success of IVF

Variables	Group A (n=110)	Group B (n=50)	Group C (n=40)	*p*-value
FR (%)	54.65 ± 32.73	40.49 ± 32.89	59.62 ± 29.82	0.005
Implantation (n%)	25 (22.73%)	5 (10.00%)	9 (22.50%)	0.1
Clinical pregnancy	19 (17.27%)	5 (10.00%)	9 (22.50%)	0.3
Take home baby	17 (15.45%)	4 (8.00%)	6 (15.00%)	0.4

Fertilization rate (FR) was significantly different among the groups (p-value = 0.005a), with 54.65 ± 32.73% in Group A (n=110), 40.49 ± 32.89% in Group B (n=50), and 59.62 ± 29.82% in Group C (n=40). Implantation rates, however, did not significantly differ, with 22.73% in Group A, 10.00% in Group B, and 22.50% in Group C (p-value = 0.1). Clinical pregnancy rates were also similar among the groups, with 17.27% in Group A, 10.00% in Group B, and 22.50% in Group C (p-value = 0.3). The rate of taking home a baby was not significantly different, with 15.45% in Group A, 8.00% in Group B, and 15.00% in Group C (p-value = 0.4).

Discussion:

The current retrospective observational study aimed to investigate the impact of anesthetic agents used during oocyte pick-up on the outcome of in vitro fertilization (IVF) in 200 participants from Bangladesh. The main findings of the study indicate that the choice of anesthetic agent may influence certain aspects of IVF outcomes, while other parameters remain unaffected. The baseline demographics, hormone levels, and cause of infertility did not show significant differences among the groups. This was consistent with the findings of other studies, which have reported that patient characteristics, such as age, BMI, and duration of infertility, have a more significant impact on IVF outcomes compared to anesthetic agents[6,7,8]. Ovarian stimulation characteristics, including the starting dose of r-FSH and u-FSH, poor ovarian response, and presence of OHSS, were similar among the three groups. This is in line with previous studies that reported no significant differences in ovarian stimulation parameters between patients receiving different anesthetic agents during oocyte retrieval[9,10]. Anesthesia-related parameters, such as the duration of anesthesia, SpO2%, MAP difference, HR difference, and duration of recovery, were not significantly different among the groups, except for the median dose of anesthetic drugs. This finding corroborates the results of previous research suggesting that the choice of anesthetic agent has a minimal impact on the overall anesthesia process during oocyte retrieval[11]. In terms of oocyte retrieval parameters, the total oocyte count, MII oocytes, GV oocytes, oocytes with anomalies, degeneration, or extrusion of the zona pellucida (EZ), and MII rate did not show significant differences among the groups. However, MI oocytes were significantly different (p-value = 0.011), with Group B having a higher number of MI oocytes. This finding is in contrast with some previous studies that reported no significant differences in oocyte retrieval parameters between different anesthetic agents[9]. The contradiction may be attributed to the different anesthetic agents used in the current study or the specific population studied. Embryo parameters, including embryo quality and embryo transfer day, were similar among the groups. This finding supports the idea that the choice of anesthetic agent during oocyte retrieval does not significantly impact the subsequent embryo development and quality[6,12]. The success of IVF, as measured by fertilization rate, implantation rate, clinical pregnancy rate, and take-home baby rate, showed mixed results. The fertilization rate was significantly different among the groups (p value = 0.005), with Group C having the highest fertilization rate. However, implantation, clinical pregnancy, and take-home baby rates were not significantly different. This finding is in contrast with some studies that reported no significant differences in IVF success rates between different anesthetic agents[13,14]. The discrepancy may be due to variations in the specific anesthetic agents used,

the population studied, or other factors affecting IVF success, such as laboratory conditions and embryo transfer techniques. In conclusion, the current study suggests that the choice of anesthetic agent during oocyte pick-up may influence certain aspects of IVF outcomes, while other parameters remain unaffected. The study's findings are generally in line with previous research, although some discrepancies were noted. Further studies with larger sample sizes and different populations are needed to confirm these findings and better understand the impact of anesthetic agents on IVF outcomes.

Limitations of the Study:

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community. The retrospective design of the study had limited the data collection parameters.

Conclusion:

In conclusion, our retrospective observational study demonstrates that the choice of anesthetic agents during oocyte pick-up has minimal impact on the majority of the in vitro fertilization outcome parameters. The results show no significant differences in oocyte quality, embryo development, and overall success rates among the three groups receiving propofol, ketamine, or a combination of both. However, a few specific factors, such as metaphase I oocytes and fertilization rates, were found to be influenced by the choice of anesthetic. Further large-scale, prospective, randomized studies are needed to confirm these findings and provide a clearer understanding of the potential implications of using different anesthetic agents during oocyte pick-up to optimize IVF success rates while ensuring patient comfort and safety.

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