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Spinal mepivacaine versus bupivacaine for ultrasound guided transvaginal oocyte retrieval. A comparative study

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Abstract

Study objective: The most important limitation for spinal anesthesia in the ambulatory setting is the prolonged motor blockade and delayed postoperative ambulation. The current study was conducted to compare spinal mepivacaine–fentanyl combination versus conventional combination of spinal bupivacaine with fentanyl for surgical anesthesia of ultrasound-guided transvaginal oocyte retrieval for in vitro fertilization (IVF).

Patients and methods: Sixty female patients undergoing ultrasound-guided transvaginal oocyte retrieval for in vitro fertilization on ambulatory basis were enrolled in the current study. Patients were randomly distributed in to one of two equal groups: mepivacaine group (group M) and bupivacaine group (group B). Patients in group M received intrathecal 37.5 mg of isobaric mepivacaine 1.5% plus 10 μg fentanyl while patients in group B received intrathecal 12.5 mg of hyperbaric bupivacaine 0.5% plus 10 μg fentanyl. Primary outcome measure was the time to complete motor block regression. Secondary outcome measures included the peak sensory blockade level achieved, the times for sensory block regression to S1 dermatome, post-anesthesia stable ambulation, 1st voiding, and hospital discharge. The incidence of perioperative adverse events was also recorded.

Results: Two patients (one in each group) were excluded from the study due to failed block and conversion to general anesthesia. The peak sensory blockade levels (T_6–T_{10}) were satisfactory for procedural anesthesia in the remaining patients of both groups. Patients in group M had significantly faster sensory block regression to S1 and motor block resolution when compared with group B ($P < 0.05$). Times to steady ambulation, voiding and hospital discharge were significantly shorter in group M when compared with group B ($P < 0.05$). There was no intergroup significant difference as regards the incidence of perioperative adverse events, and none of the patients reported transient neurological symptoms (TNS) or postdural puncture headache in both groups.

Conclusion: The mepivacaine–fentanyl combination was superior to bupivacaine–fentanyl combination for spinal anesthesia of ultrasound-guided transvaginal oocyte retrieval on ambulatory basis because of faster sensory and motor block resolution and the shorter time to ambulation and hospital discharge with reliability of surgical anesthesia and no difference in the incidence of perioperative adverse events between both groups.

Keywords: Oocyte retrieval, Spinal anesthesia, Mepivacaine, Bupivacaine

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Background

Oocyte retrieval for IVF was performed by laparoscopy under general anesthesia in a hospital setting but the development of transvaginal ultrasound allowed oocyte retrieval through the vaginal wall under sonographic guidance (Vlahos et al. 2009). It is a relatively brief (20 to 30 min) outpatient procedure and the principle of ambulatory anesthesia is used in these patients (Ankur et al. 2015).

The pain expressed during aspiration of oocyte is identical to intensive menstrual pain and produced by the needle inserted through vaginal wall and by mechanical stimulation of the ovary (Kwan et al. 2013). The various anesthetic modalities used for transvaginal oocyte retrieval include conscious sedation, general anesthesia, and regional anesthesia as paracervical, epidural, and subarachnoid blocks (Vlahos et al. 2009).

Most of the anesthetic agents being used in general anesthesia have been found in the follicular fluid and may have adverse effects on oocyte fertilization, implantation, and embryonic development. Prolonged period of exposure with general anesthesia can lead to lower pregnancy and delivery rates (Wilhelm et al. 2002). Spinal anesthesia is an efficient method for oocyte retrieval. A study conducted by Azmude et al. demonstrated that spinal anesthesia increased the chance of fertilization success (27%) in comparison to general anesthesia (15%) (Azmude et al. 2013); however, the foremost limitation of many local anesthetics for spinal anesthesia in day case surgery is prolonged motor blockade and delayed ambulation (O'Donnell et al. 2010). Isobaric mepivacaine has been used for outpatient spinal anesthesia due to its markedly lower incidence of transient neurologic symptoms and similar duration of action when compared with lidocaine (Liguori et al. 1998).

The aim of the current study was to compare spinal mepivacaine–fentanyl combination versus conventional combination of spinal bupivacaine with fentanyl for surgical anesthesia of ultrasound-guided transvaginal oocyte retrieval for IVF.

Patients and method

After obtaining approval of research ethical committee of Ain Shams University and patients' written informed consents, the current prospective randomized double-blinded study was conducted on 60 adult female patients scheduled to undergo transvaginal oocyte retrieval procedure under sonar guidance in gynecology/obstetrics Ain Shams University Hospital through the period from April 2019 to November 2019.

The inclusion criteria included female patients aged between 21 and 40 years with the American Society of Anesthesiologist (ASA) physical status I or II, while the exclusion criteria include patients who refuse spinal anesthesia, psychiatric illness, those with known hypersensitivity to amide local anesthetics or opioids, and those with contraindications to spinal anesthesia including presence of cutaneous infection at the site of the planned puncture, untreated hypovolemia, increased intracranial pressure, coagulopathy, and grossly deformed vertebral column. For further accuracy of data collected, we exclude morbid obese patients (body mass index $> 40 \, kg/m^2$), those in extremes of height (<150 cm or > 185 cm) and those with neurologic deficits that could interfere with collection of sensory and motor recovery data. Also, cases with failed spinal anesthesia (no sensory or motor blockade) or inadequate surgical anesthesia (experienced pain during the procedure) who needed conversion to GA were excluded. Following written informed consent, patients were randomized into one of two equal groups (30 patients in each group): mepivacaine group (group M) and bupivacaine group (group B) using closed envelop method.

Anesthesia technique

General preoperative fasting guidelines were followed. On arrival to the operating room, the patients were monitored with pulse oximetry, electrocardiography, and noninvasive blood pressure. A peripheral 20-gage intravenous cannula was inserted, an intravenous infusion of ringer's solution of 5 ml/kg was started as pre-anesthetic hydration and the patients received intravenous midazolam 0.03 mg/kg before positioning for lumbar puncture in sitting position.

The spinal injectate in both groups was prepared in a 5-mL syringe by an experienced anesthesiologist who was also responsible for doing the subarachnoid block. After proper sterilization of the patients back and local anesthesia for the puncture site using 3 ml of xylocaine 2%; subarachnoid block was performed using midline approach at the L3-4 or L4-5 interspace with 25-gage pencil-point needle (Unilever®, Unisis Corp., Japan) using a 20-g introducer. After the subarachnoid space was identified via clear-steady flow of cerebrospinal fluid (CSF), the patients in group M received intrathecal 2.5 ml (37.5 mg) of isobaric preservative free mepivacaine (Carbocaine ® 1.5% Hospira Inc., Lake Forest, IL USA) plus 0.2 mL (10 μg) fentanyl (Sunny Pharmaceutical, Egypt under license of Hamelin Pharmaceuticals, Germany) (total volume 2.7 ml), while patients in group B received intrathecal 12.5 mg of hyperbaric bupivacaine 0.5% (Astra Zeneca, USA) plus 10 μg fentanyl (total volume 2.7 ml). No barbotage was done during injection then the patients were returned immediately to supine position with just a small pillow under their heads and the remainder of the intraoperative and postoperative anesthetic management was done by a different

anesthesiologist who was blinded to the type of spinal injectate given.

After patients placement in supine position; sensory level was assessed using pinprick stimulation bilaterally at the mid clavicular line starting from the feet in a cephalad direction every 2 min using a 22-G needle until the peak dermatomal level stabilized for four consecutive tests while motor block was also assessed using Bromage scale (Bromage 1978) where 0 = no paralysis (full flexion of the knees and feet), 1 = inability to raise extended leg (just able to move knees), 2 = inability to flex knees (able to move feet only), and 3 = inability to flex ankle joint (unable to move the knees or feet) 5 min after spinal injection then at 5-min intervals for 20 min until patient had Bromage 3 then the patient was positioned in lithotomy position and the procedure was started. Patients with failed spinal blockades or inadequate surgical anesthesia received general anesthesia and were excluded from the study.

Intravenous infusion of ringer's solution was continued intraoperative. The total amount of intravenous fluids for the entire perioperative period was restricted to be ≤ 1000 mL to avoid bladder distension. Hypotension (defined as drop of mean arterial blood pressure more than 20% change from base line) was managed by increasing the rate of the intravenous fluid infusion and 5 mg IV boluses of ephedrine. If bradycardia (heart rate < 50 beats/min and symptomatic) 0.01 mg/kg IV atropine boluses were administered.

After the end of the procedure, patients were transferred to a post-anesthesia care unit (PACU) and assessed every 15 min for spinal anesthesia resolution. After sensory and motor block resolution the ability for ambulation was assessed every 15 min. Postoperative analgesia was provided on demand and may include nonsteroidal anti-inflammatory drugs (ketorolac 30 mg) diluted to 10 ml slowly intravenous, and/or paracetamol (perfalgan, Bristol-Myers Squibb Pharmaceutical Limited NY, USA) 1 gm by intravenous infusion. Patients who experienced nausea and vomiting was treated by intravenous ondasetron 4 mg. Patients were discharged to home only after successful voiding and fulfilling the modified post-anesthesia discharge scoring system criteria for day surgery (Chung 1995) (The total score is 10. Patients with a score of ≥ 9 are considered fit for safe home discharge).

The primary outcome of the current study was to assess the duration of motor block, the time measured from the achievement of Bromage scale of 3 until regression to Bromage 0. The secondary measures included:

- The peak sensory blockade level achieved after subarachnoid local anesthetic injection

- The duration of sensory block was the time measured from the time of the highest block level achieved till the regression to S1 dermatome (defined as perceiving normal sensation on sensory examination of the lateral aspect of the foot).
- The times to first analgesia requirement, stable ambulation (achieving post-anesthesia discharge ambulation score = 2 points steady gait/no dizziness), 1st urination, and readiness to hospital discharge (Modified Post-Anesthesia Discharge Scoring System score ≥ 9) (Chung 1995) were recorded from the point of administration of the spinal anesthetic.
- The incidence of perioperative adverse events like hypotension, bradycardia, nausea/vomiting, and shivering which were recorded during and after the procedure. Follow-up telephone calls by the anesthesia investigator who was blinded to the randomization was done for each patient for 2–3 days later to assess for delayed postoperative complications as transient neurological symptoms (defined as new onset back pain or dysesthesia which radiate to the buttocks, hips, thighs, or calves which occur within the first 24 h of surgery and lasting for 2–3 days) (Gozdemir et al. 2016) and postdural puncture headache was similarly followed up to 7 days postoperative and patient was requested to come again to the hospital if required for proper management.

Statistical analysis

Sample size calculation was performed by GPower® version 3.1.5 computer software [Franz Faul, Universität Kiel, Germany, 2012], and the sample size of 30 patients in each group was calculated for 80% power, 95% confidence interval, and 5% alpha error. After reviewing the literature, no previous study was done comparing between the two interventions regarding the mean duration of motor block recovery. So assuming an effective size of 0.8 (whend), the needed sample size is 30 case per group taking into consideration 10% dropout rate. Patients' data were collected, tabulated, and then analyzed using SPSS version 16.0 computer software (Chicago, IL, USA). Data are presented as means ± standard deviation or number of patients (with corresponding percentage of total). Comparison of numerical variables including (age, weight, height, duration of the procedure, n of oocyte retrieved. and recovery times) between the two study groups was performed with an unpaired Student t test while the comparison of categorical variables including ASA physical status, peak sensory blockade levels, and incidence of periprocedural adverse events between the two study groups was performed by the Chi square or Fisher's exact test as appropriate. Statistical significance was established at $P < 0.05$.

Modified post-anesthesia discharge scoring system for determining home-readiness (Chung 1995)

Vital signs
BP and pulse within 20% of preoperative baseline, 2
BP and pulse 20–40% of preoperative baseline, 1
BP and pulse 40% of preoperative baseline, 0
Activity level
Steady gait, no dizziness, or meets preoperative level, 2
Requires assistance, 1
Unable to ambulate, 0
Nausea and vomiting
Minimal: successfully treated with PO medication, 2
Moderate: successfully treated with IM medication, 1
Severe: continues after repeated treatment, 0
Pain
Acceptability
Yes, 2
No, 1
Surgical bleeding
Minimal: does not require dressing change, 2
Moderate: up to two dressing changes required, 1
Severe: more than three dressing changes required, 0

The total score is 10. Patients achieving a score ≥ 9 are considered fit for discharge home

Results

Demographic data
Two patients (1 patient in each group) were dropped out due to failed spinal block. The remaining 58 patients (29 patients in each group) were followed up all the study procedure and included in the final data analysis. There were no statistically significant differences between the two study groups as regards the demographic data and ASA status ($P > 0.05$) (Table 1).

Procedure-related variables
There was no statistically significant difference between the two study groups as regards the duration of the procedure and number of oocytes retrieved ($P > 0.05$) (Table 2).

Regional blockade measurements
Peak sensory level achieved in the study groups
Except for the two patients who were excluded from the study due to failed block and conversion to general

Table 1 Demographic patients' characteristics and ASA status (data are presented as mean ± SD)

	Group M	Group B	P value
Age (years)	33.73 ± 5.62	32.45 ± 7.14	0.451
Weight (kg)	79.53 ± 8.24	76.94 ± 11.56	0.330
Height (cm)	164.43 ± 6.55	165.77 ± 5.83	0.414
ASA			
I	20	22	0.557
II	9	7	

Table 2 Procedure-related variables in both groups (data are presented as mean ± SD)

	Group M	Group B	P value
Procedure time (min)	34.67 ± 5.12	35.62 ± 4.32	0.456
Oocytes retrieved (n)	7.84 ± 1.12	8.25 ± 1.93	0.326

anesthesia (1 patient in each group), the peak sensory blockade levels (T_6–T_{10}) was satisfactory for procedural anesthesia in the remaining patients in both groups. None of the patients in either group had inadequate muscle relaxation or experienced any discomfort till the end of the procedure. More patients in group M had the peak sensory blockade level at T_6, T_7, and T_8 than in group B, 4 (13.79%) vs 3 (10.34%),7 (24.13%) vs 4 (13.79%), and 8 (27.58%) vs 6 (20.68%), respectively, while more patients in group B had the peak sensory blockade level at T_9 and T_{10} than in group M, 9 (31.03%) vs 6 (20.68%) and 7 (24.13%) vs 4 (13.79%), respectively, with no statistical significant difference between both groups ($P > 0.05$) (Table 3).

Regarding the duration of spinal blockade in the study groups
Patients in group M had statistically faster return of sensory function (measured from the time of the highest block till the regression to S1 dermatome) (127. 45 ± 19.54 vs 198.62 ± 22.32 min, $P < 0.05$) and motor function (the time measured from the achievement of Bromage scale 3 until regression to Bromage 0) (108.32 ± 17.32 vs 187.25 ± 19.34 min, $P < 0.05$) when compared with group B (Table 4).

The time to 1st postoperative analgesic requirement
The time to 1st postoperative analgesic requirement was significantly longer in group B when compared with group M ($P < 0.05$) (Table 5).

Regarding the recovery criteria and readiness for discharge
Patients in group M showed highly significant shorter time to ambulation, 1st urination, and home discharge than patients in group B ($P < 0.05$) (Table 6).

Table 3 Peak sensory block height achieved in both groups (data are presented as number of patients (with corresponding percentage of total))

Peak sensory block height	Group M	Group B	P value
T6	4 (13.79%)	3 (10.34%)	0.686
T7	7 (24.13%)	4 (13.79%)	0.315
T8	8 (27.58%)	6 (20.68%)	0.539
T9	6 (20.68%)	9 (31.03%)	0.368
T10	4 (13.79%)	7 (24.13%)	0.315

Table 4 Duration of spinal blockade in both groups (data are presented as mean ± SD)

	Group M	Group B	P value
Time to sensory block regression to S1 (min)	127. 45 ± 19.54	198.62 ± 22.32*	P < 0.05
Duration of motor blockade (min)	108.32 ± 17.32	187.25 ± 19.34*	P < 0.05

*Statistically significant (P < 0.05) (group B versus group M)

Regarding the incidence of adverse events in the studied groups

The perioperative adverse events were evaluated and recorded in the two study groups (Table 7). Hypotension occurred in 6 patients in group M and 4 patients in group B which was managed by with increasing the rate of the intravenous fluid infusion and ephedrine 5-mg boluses but no patient had bradycardia in both groups with no intergroup statistical significant difference ($P > 0.05$). Two patients developed nausea/vomiting in each group which was treated by intravenous ondansetron 4 mg while shivering occurred in 3 patients in group B (10.34%) and 2 patient in group M (6.89%) which responded to small dose of intravenous pethidine (25 mg) with no intergroup statistical significant difference ($P > 0.05$). None of the patients developed postdural puncture headache nor transient neurological symptoms (TNS) in both groups with no intergroup statistical significant difference ($P > 0.05$). Only 4 patients (2 patients in each group) had mild backache localized to the injection site with no radiation sensory or motor symptoms that resolved spontaneously within in 24 h.

Discussion

The use of spinal anesthesia in ambulatory surgery has placed an added demand for a local anesthetic with a fast onset and short duration of action (Zaric and Pace 2009). The aim of the current study is to compare (mepivacaine–fentanyl) combination with (bupivacaine–fentanyl) for spinal anesthesia for ultrasound-guided transvaginal oocyte retrieval.

In the current study, the demographic patients' data, duration of surgery, and the number of oocytes retrieved were comparable between the two study groups ($P > 0.05$). Two patients (1 patient in each group) were excluded from the study due to failed block and conversion to general anesthesia. The peak sensory blockade levels obtained after spinal anesthesia (T_6–T_{10}) was satisfactory for surgical anesthesia in the remaining patients of both groups with no intergroup statistical significant difference ($P > 0.05$) (Table 3).

Spinal isobaric mepivacaine was used in multiple previous studies for outpatient anesthesia (O'Donnell et al. 2010; Zayas et al. 1999; Pawlowski et al. 2000; Pawlowski et al. 2012; Kahn et al. 2015). The dose response relationships for spinal isobaric mepivacaine 1.5% was evaluated by Zayas et al. (Zayas et al. 1999) and the median peak sensory level obtained by them was significantly lower in the 30-mg dose group than in the 45- or 60-mg dose groups (T9 versus T6 and T5, respectively). Pawlowski et al. (Pawlowski et al. 2000) used two doses (60 and 80 mg) of plain mepivacaine 2% for ambulatory spinal anesthesia and the peak sensory blockade levels obtained by them was ($T_4 \pm 2$). Using a lower dose of isobaric mepivacaine in the current study (37.5 mg); the peak sensory blockade levels obtained after spinal anesthesia (T_6–T_{10}) was lower than those obtained by Pawlowski et al. (Pawlowski et al. 2000). The baricity of local anesthetic solution also influences the local anesthetic spread and block height since gravity causes hyperbaric solutions to flow downward in the CSF, whereas hypobaric solutions tend to rise. In contrast, gravity has no effect on the distribution of truly isobaric solution (Hocking and Wildsmith 2004).

The recovery of sensory and motor function is a challenge for hospital discharge for surgeries done on ambulatory basis. Previous studies compared multiple bupivacaine doses for ambulatory surgeries and found that higher doses of hyperbaric bupivacaine (10 or 15 mg) had a significant prolonged recovery, whereas lower doses (< 7.5 mg) had a higher incidence of block failure (25%) (Nair et al. 2009). Mepivacaine is an amide local anesthetic that differs from bupivacaine by the absence of a single butyl group on the tertiary amine, making it less lipophilic and shorter acting than bupivacaine (Pawlowski et al. 2000). The results of the current study showed that there was a statistically significant earlier sensory and motor block regression with earlier steady ambulation and hospital discharge in group M when compared with group B ($P < 0.05$). These findings were consistent with those reported by Mahan et al. (Mahan et al. 2019) who assessed the time of return of neurologic function after spinal isobaric mepivacaine vs hyperbaric bupivacaine anesthesia for total knee

Table 5 The time to 1st postoperative analgesic (data are presented as mean ± SD)

	Group M	Group B	P value
The time to 1st postoperative analgesic (min)	151.62 ± 23.62	246.67 ± 21.64*	P < 0.05

*Statistically significant (P < 0.05) (group B versus group M)

Table 6 Recovery criteria and readiness for discharge (data are presented as mean ± SD)

Time to	Group M	Group B	*P* value
Stable ambulation (min)	172.65 ± 37.56	232.54 ± 34.22*	*P* < 0.05
First urination(min)	196.43 ± 32.42	285.55 ± 39.55*	*P* < 0.05
Patients hospital discharge(min)	217.55 ± 35.44	309.89 ± 40. 24*	*P* < 0.05

*Statistically significant (*P* < 0.05) (group B versus group M)

arthroplasty. In their study, patients in mepivacaine group had earlier recovery to normal sensory function and gross motor function by with decreased time to 1st urination, earlier patient mobilization, and shorter hospital stay when compared with bupivacaine ($P < 0.05$).

In the current study, the time to Bromage scale of 0 was (108.32 ± 17. 32) in group M vs (187.25 ± 19.34) in group B (P < 0.05), while the time to stable ambulation was (172.65 ± 37.56) in group M vs (232.54 ± 34.22) in group B (P < 0.05). There was a discrepancy following spinal anesthesia between the time to recovery of gross motor function (tested by Bromage scale) and the actual time to recovery of functional balance needed for steady ambulation, which is delayed for a time after gross motor function recovered completely and this finding was also observed in multiple previous studies using spinal anesthesia for surgeries on ambulatory basis (O'Donnell et al. 2010; Zayas et al. 1999; Pawlowski et al. 2000; Pawlowski et al. 2012). The relation among motor function, balance, and postural stability is complicated. They are determined by the integration of visual, somatosensory, and vestibular inputs by the brainstem and cerebellum. Walking balance remained impaired long (90–120 min) after clinical criteria for functional recovery from spinal anesthesia were met (Imarengiaye et al. 2003).

The results of the current study showed that there was a significant earlier time to initial urination in group M when compared with group B ($P < 0.05$). Spontaneous micturition is the last function to recover after motor block resolution, and requires the regression of sensory block to below the S3 dermatome (Manassero and Fanelli 2017). The faster regression of sensory and motor block in group M when compared with group B

Table 7 The incidence of perioperative adverse events in both study groups

Side effects	Group M	Group B	*P* value
Hypotension	6 (20.68%)	4 (13.79%)	0.717
Bradycardia	0 (0%)	0 (0%)	-
Nausea/vomiting	2 (6.89%)	2 (6.89%)	-
Pruritus	0 (0%)	0 (0%)	-
Shivering	2 (6.89%)	3 (10.34%)	0.639
Postdural puncture headache	0 (0%)	0 (0%)	-
TNS	0 (0%)	0 (0%)	-

leaded to a faster recovery of bladder function. Patients at low risk of postoperative urinary retention, such as those with no history of postoperative urinary retention and that have not undergone hernia or urology surgery, can be discharged home without urination with instructions to return to the hospital if they cannot void within 6–8 h after discharge (Awad and Chung 2006). In the current study, we preferred to confirm patients' spontaneous micturition before hospital discharge to avoid patient readmission or the additional costs of providing homecare nurses that may outweigh any savings from discharging these patients earlier.

Our results showed no intergroup significant difference as regards the incidence of perioperative adverse events ($P > 0.05$). Hypotension occurred in 6 patients in Group M and 4 patients in Group B. The hypotension quickly resolved with fluid loading or ephedrine injection and no patient had bradycardia in both groups. There was no significant difference for the incidence of nausea and vomiting, and shivering between both groups. Pruritus is a well-known complication of intrathecal opioids. In the current study, it did not occur in any of the patients in both groups and this finding could be contributed to the lower dose of fentanyl (10 μg) used in the current study when compared with conventional doses of fentanyl (25 μg) usually used as adjuvant for local anesthetics in spinal anesthesia. This finding was consistent with those reported by Ali et al. (Ali et al. 2018) who compared varying doses of intrathecal fentanyl on in 243 females undergoing cesarean section under spinal bupivacaine anesthesia. In their study, the incidence of pruritus was significantly lower with 10 and 15 μg of intrathecal fentanyl when compared with 25 μg fentanyl (0 and 3 vs 22 patients) with no statistically significant difference as regards the quality of surgical anesthesia.

None of the patients developed postdural puncture headache in both groups which could be contributed to our use of small (25) gage pencil-point spinal needles. Also, none of the patients developed TNS when questioned at 24, 48, and 72 h postoperatively in both groups. Bupivacaine has the lowest incidence of transient neurological symptoms (0 –1.3%) (Hodgson et al. 1999), but its long duration of action delaying home discharge is the only drawback. Lidocaine, traditionally the most widely used local anesthetic agent for ambulatory

surgical procedures because of its short duration of action, has been implicated in cases of both temporary and permanent neurological deficits (O'Donnell et al. 2010). The reports of unacceptably high rate of TNS after spinal lidocaine anesthesia (reportedly up to 32%) generated the interest to find alternative local anesthetics for spinal anesthesia on ambulatory basis (Zaric and Pace 2009).

Mepivacaine is a local anesthetic with physicochemical properties and duration comparable to lidocaine (Pawlowski et al. 2000). A lot of controversy as regards the incidence of TNS after mepivacaine spinal anesthesia exists. A previous study by Hiller and Rosenberg (Hiller and Rosenberg 1997) found a 30% incidence of TNS in patients receiving two milliliters of 4% mepivacaine (80 mg) for knee arthroscopy while Liguori et al. (Liguori et al. 1998) reported an incidence of TNS using 1.5% mepivacaine and 2% lidocaine to be 0 and 22% which was supported by multiple previous studies revealed a very low or even no incidence of TNS with different doses of isobaric mepivacaine (O'Donnell et al. 2010; Liguori et al. 1998; Zayas et al. 1999; Kahn et al. 2015; Imarengiaye et al. 2003), and in a recent cohort study by Sankar et al. (Sankar et al. 2018) of 679 spinal anesthetics, 606 (89%) were per formed using 2% mepivacaine and the remaining 73 (11%) were performed with 1.5% mepivacaine. Two hundred and twenty (32%) and six (0.9%) spinal anesthetics included intrathecal fentanyl (5–25 μg) or morphine (50 μg), respectively, in an admixture with isobaric mepivacaine. They found one documented occurrence of TNS among a total of 679 mepivacaine spinal anesthetics (0.14%; CI 0.02–1.04%) and they conclude that the rate of TNS associated with mepivacaine spinal anesthesia is markedly lower than that previously reported in the literature.

The major differences between the study by Hiller and Rosenberg (Hiller and Rosenberg 1997) with its high incidence of TNS and these other studies including our current one are the following: First, Hiller and Rosenberg used a hyperbaric mepivacaine and placed the patients in a head-up tilted position immediately after lumbar puncture which create pooling of the local anesthetic solution and may have increased the incidence of TNS, while in other studies including our current one, isobaric mepivacaine was used and patients were turned back to the horizontal supine position immediately after the spinal injection. Second, Hiller and Rosenberg administered 80 mg of mepivacaine which is larger dose than that used in the other studies (30–60 mg).

Study limitations
The current study had several limitations. It was a single-center study. Also, the small sample size may not

have enabled the detection of adverse events that could occur with a low frequency.

Conclusion
In conclusion, using mepivacaine–fentanyl combination was superior to bupivacaine–fentanyl combination for spinal anesthesia of ultrasound-guided transvaginal oocyte retrieval on ambulatory basis because of faster sensory and motor block resolution and the shorter time to ambulation and hospital discharge with reliability of surgical anesthesia and no difference in the incidence of perioperative adverse events between both groups.

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References
Ali MA, Ismail S, Sohaib M et al (2018) A double-blind randomized control trial to compare the effect of varying doses of intrathecal fentanyl on clinical

efficacy and side effects in parturients undergoing cesarean section. J Anaesthesiol Clin Pharmacol 34:221–226

Sharma Ankur, Borle Anuradha, Trikha Anjan. : Anesthesia for in vitro fertilization Journal of Obstetric Anesthesia and Critical Care / Jul-Dec 2015 / Vol 5 | Issue 2.

Awad IT, Chung F (2006) Factors affecting recovery and discharge following ambulatory surgery. Can J Anaesth 53:858–872

Azmude A, Agha'amou S, Yousefshahi F et al (2013) Pregnancy outcome using general anesthesia versus spinal anesthesia for in vitro fertilization. Anesth pain Med 3:239–242

Bromage PR (1978) Epidural analgesia. W.B. Sanders, Philadelphia, pp 144–145

Chung F (1995) Discharge criteria—a new trend. Can J Anaesth 42:1056–1058

Gozdemir M, Muslu B, Sert H et al (2016) Transient neurological symptoms after spinal anesthesia. Clin Invest Med 39(6):27512

Hiller A, Rosenberg PH (1997) Transient neurologic symptoms after spinal anaesthesia with 4% mepivacaine and 0.5% bupivacaine. Br J Anaesth 79: 301–305

Hocking G, Wildsmith JAW (2004) Intrathecal drug spread. BJA 93(4):568–578

Hodgson PS, Neal JM, Pollock JE (1999) et al.:The neurotoxicity of drugs given intrathecally (spinal). Anesth Analg 88:797–809

Imarengiaye CO, Song D, Prabhu AJ et al (2003) Spinal anesthesia: functional balance is impaired after clinical recovery. Anesthesiology 98:511–515

Kahn RL, Cheng J, Bae JJ et al (2015) Lower-dose mepivacaine plus fentanyl may improve spinal anesthesia for knee arthroscopy. HSS J 11:236

Kwan I, BhattacharyaS KF et al (2013) Pain relief for women undergoing oocyte retrieval for assisted reproduction. Cochrane Database Syst Rev 1:cd004829

Liguori GA, Zayas VM, Chisholm MF (1998) Transient neurologic symptoms after spinal anesthesia with mepivacaine and lidocaine. Anesthesiology 88:619–623

Mahan MC, Jildeh TR, Tenbrunsel T (2019) et al.:Time of return of neurologic function after spinal anesthesia for total knee arthroplasty: mepivacaine vs bupivacaine in a randomized controlled trial. Arthroplasty Today 5:226–233

Manassero A, Fanelli A (2017) Prilocaine hydrochloride 2% hyperbaric solution for intrathecal injection: a clinical review. Local Reg Anesth 10:15e24

Nair GS, Abrishami A, Lermitte J et al (2009) Systematic review of spinal anesthesia using bupivacaine for ambulatory knee arthroscopy. Br J Anaesth 102:307–315

O'Donnell D, Manickam B, Perlas A et al (2010) Spinal mepivacaine with fentanyl for outpatient knee arthroscopysurgery: a randomized controlled trial. Can J Anesth 57:32–38

Pawlowski J, Orr K, Kim KM et al (2012) Anesthetic and recovery profiles of lidocaine versus mepivacaine for spinal anesthesia in patients undergoing outpatient orthopedic arthroscopic procedures. J Clin Anesth 24:109

Pawlowski J, Sukhani R, Pappas AL et al (2000) The anesthetic and recovery profile of two doses (60 and 80 mg) of plain mepivacaine for ambulatory spinal anesthesia. Anesth Analg 91:580–584

Sankar A , Behboudi M, Abdallah F W., et al.:Transient neurologic symptoms ollowing spinal anesthesia with isobaric mepivacaine: a decade of experience at Toronto Western Hospital. Anesthesiology Research and Practice 2018:1-5.

Vlahos NF, Giannakikou I, Vlachos A et al (2009) Analgesia and anesthesia for assisted reproductive technologies. Int J GynaecolObstet 105:201–205

Wilhelm W, Hammadeh ME, White PF et al (2002) General anesthesia versus monitored anesthesia care with remifentanil for assisted reproductive technologies: Effect on pregnancy rate. J Clin Anesth 14:1–5

Zaric D, Pace NL (2009) Transient neurological symptoms (TNS) following spinal anesthesia with lidocaine versus other local anaesthetics. Cochrane Database Syst Rev 2:CD003006

Zayas VM, Liguori GA, Chisholm MF et al (1999) Dose response relationships for isobaric spinal mepivacaine using the combined spinal epidural technique. AnesthAnalg 89:1167–1171

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