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Dexmedetomidine versus lidocaine as an adjuvant to general anesthesia for elective abdominal gynecological surgeries

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Abstract

Study objective: The current study was conducted to compare the effect of perioperative administration of intravenous dexmedetomidine versus lidocaine on the perioperative hemodynamic changes, anesthetic consumption, anesthesia induction, and recovery times in patients undergoing elective abdominal gynecological surgeries under general anesthesia.

Materials and methods: Ninety female patients undergoing elective abdominal gynecological surgeries were enrolled in the current study. Patients were randomly distributed to one of three equal groups: group L received lidocaine (1.5 mg/kg loading, 2 mg/kg/h infusion), group D received dexmedetomidine (1 μg/kg loading, 0.5 μg/kg/h infusion), and group C received isotonic saline 0.9% in the same volume and pattern as the study drugs. Hemodynamic parameters including mean arterial pressure (MAP) and heart rate (HR), anesthetic consumption and induction, recovery times, and time to the first postoperative analgesic demand were recorded.

Results: The MAP and HR after endotracheal intubation and in the subsequent recordings were significantly lower in group L and D when compared with group C with no significant difference between group D and L. The propofol induction dose and mean end-tidal isoflurane concentration were significantly lower in group L and D when compared with group C and were also significantly lower in group D when compared with group L. The intraoperative fentanyl consumption was significantly lower in group L and D when compared with group C with no significant difference between group D and L. The anesthesia induction time was significantly shorter in group L and D when compared with group C; it was also significantly shorter in group D when compared with group L with no significant difference as regards the anesthesia recovery time and the response time between the three study groups. The time to the first postoperative analgesic requirement was significantly longer in group D and L when compared with group C; it was also significantly longer in group D when compared with group L.

Conclusion: Both dexmedetomidine and lidocaine could be a useful adjuvant to general anesthesia in patients undergoing abdominal gynecological surgeries. However, dexmedetomidine has a better sparing effect on intraoperative anesthetic consumption and longer time to the first postoperative analgesic demand than that of lidocaine with no significant difference between both agents on intraoperative analgesic demand.

Keywords: Gynecological surgeries, Dexmedetomidine, Lidocaine, Hemodynamics, Anesthetic consumption, Postoperative analgesic demand

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Background

Dexmedetomidine, an imidazole compound, is the pharmacologically active dextroisomer of medetomidine that displays specific and selective α2-adrenoceptor agonism. Activation of these receptors in the brain and spinal cord inhibits neuronal firing, causing hypotension, bradycardia, sedation, and analgesia (Gertler et al. 2001). Lidocaine is the local anesthetic which is used more often, and it is considered the prototype of amino-amide local anesthetics. Systemic lidocaine used as a continuous infusion at the perioperative period has analgesic, antihyperalgesic, and anti-inflammatory properties which make it capable of reducing intra- and postoperative drug consumptions and patients' hospital stay (Oliveira et al. 2010a). The goal of the current study was to compare the effects of perioperative intravenous lidocaine and dexmedetomidine on the hemodynamic changes, anesthetic consumption, anesthesia induction, recovery times, and the time to the first postoperative analgesic requirement in patients who underwent elective abdominal gynecological surgeries under general anesthesia.

Materials and methods

After obtaining the approval of the research ethical committee of Ain Shams University and patients' written informed consents, the current randomized, double-blinded, placebo-controlled study was conducted on 90 female patients scheduled to undergo elective abdominal hysterectomy under general anesthesia in Ain Shams University Hospitals through the period from July 2015 to July 2016. As the intensity of surgical stimulus might impact the perioperative hemodynamics and the intraoperative anesthetic utilization, all efforts were made in the current study in order to keep up consistency in surgical stimulus so that the patients in the three study groups underwent the same type of surgery (elective abdominal hysterectomy).

Inclusion criteria include female patients aged between 30 and 60 years with the American Society of Anesthesiologist (ASA) physical status I or II while exclusion criteria include patients with known allergy to any of the study drugs and with cardiac conduction defects, those with hepatic or renal insufficiency, and patients who are running regularly on B blockers, α2 adrenergic agonist, sedatives, and psychoactive medications.

Preparation of the study drugs

Both loading and infusion doses of 2% lidocaine hydrochloride (Sigma-Tec Pharmaceutical Industry Co., A.R.E.) and dexmedetomidine hydrochloride (Precedex 200 μg/2 ml; Hospira, Inc., Rocky Mount, USA) were calculated according to the patient's body weight and diluted in a total 50 ml of normal saline 0.9%. The syringes of the infused drugs were prepared by an anesthesiologist who was not in charge of the case and infused through syringe pumps with non-labeled reservoirs to be sure that the observing anesthesiologist was blinded to the infused drug.

Anesthetic technique

In the operating theater, intravenous access was obtained and the standard monitoring which consisted of electrocardiography (ECG), peripheral oxygen saturation (SpO_2), noninvasive blood pressure (NIBP), and capnography was applied. The level of anesthesia was monitored with the bispectral index (BIS). BIS monitor electrodes were placed on the skin of the forehead after cleaning it with alcohol and were connected to BIS VISTA™ Monitoring System (Aspect Medical System, MA, USA). The depth of neuromuscular blockade was monitored by electromyography (Relaxogram; Datex-Ohmeda Inc., Helsinki, Finland), the ulnar nerve was stimulated transcutaneously at the wrist of the left forearm using train-of-four (TOF) mode, and the force of contraction of left adductor pollicis muscle was measured and recorded using force-displacement transducer. Also, the left forearm was wrapped in a cotton blanket to minimize cooling. The patients were assigned randomly by using a computerized program to one of three groups. Patients in group L received a loading dose of intravenous lidocaine 1.5 mg/kg over 10 min followed by an intravenous infusion of 2 mg/kg/h using infusion pump (B-Braun, Bethlehem, USA) till 10 min before the end of the procedure. Patients in group D received 1 μg/kg of intravenous dexmedetomidine over 10 min followed by an intravenous infusion of 0.5 μg/kg/h using infusion pump for the same duration. Group C patients were given intravenous isotonic saline 0.9% in the same volume and manner as the study drugs.

No sedative premedication was received, metoclopramide 10 mg was given slowly intravenous as antiemetic prophylaxis, all patients were preoxygenated with 100% oxygen for 3 min, and anesthesia was induced with intravenous 1 μg/kg fentanyl (Sunny Pharmaceutical, Egypt, under the license of Hamelin Pharmaceuticals, Germany) followed by intravenous propofol (Propofol 1%; Fresenius Kabi Deutschland GmbH Grazia) 10 mg increments every 5 s until the BIS reached a value of 60. After the loss of consciousness, intravenous atracurium (Tracrium; GlaxoSmithKline Manufacturing) 0.5 mg/kg was administered, and the patients were intubated with cuffed 7.5 mm ID when complete single-twitch depression (T1 = 0%) was obtained and capnography was connected. The patients' lungs were mechanically ventilated using a Datex-Ohmeda Inc. (3030 Ohmeda Drive, Madison, WI, USA) anesthesia machine attached to a closed circuit system using volume-controlled mode: fresh gas flow (4 l/min), oxygen 50%–air 50%, tidal volume (7–8 ml/kg), I:E ratio of 1:2,. and respiratory rate (12/ min) in order to achieve end-tidal

CO_2 of 30–35 mmHg. Anesthesia was maintained with isoflurane (Forane; Baxter Healthcare Corporation, USA) titrated by 0.2% aiming BIS in the target range of 40–60, and muscle relaxation was provided with atracurium top-up doses (0.1 mg/kg) guided with TOF count aiming to maintain it as 1/4. Patients in the three study groups received their intraoperative fluid requirements by Ringer's solution as follows: maintenance of 1.5 ml/kg/hr, third space losses of approximately 5–6 ml/kg/hr (considering hysterectomy procedure as moderate surgical trauma), and deficit divided to be received as 50% in the first hour, 25% in the second hour, and 25% in the third hour.

Signs of insufficient analgesia were defined as an increase in HR and MAP exceeding 20% of baseline values while BIS within the targeted range was managed with additional boluses of intravenous fentanyl 0.5 μg/kg. If the MAP dropped below 60 mmHg, ephedrine 3 mg IV bolus and fluid bolus were given which could be repeated after 3 min if required. Atropine 0.5 mg IV bolus was given if HR decreased to less than 50 beats/min.

The study drug infusion was terminated about 10 min before the surgery end. After the skin closure, isoflurane was discontinued and a combination of intravenous atropine 0.02 mg/kg and neostigmine 0.05 mg/kg were administered after the return of T1 = 25% or > 2 responses on neuromuscular monitoring to reverse the residual neuromuscular blockade. When BIS values reached 80 and TOF ratio (T4/T1) is 0.9, patients were extubated, and then transferred to the postanesthesia care unit (PACU). Postoperative nausea and vomiting (PONV) were treated with granisetron (Granitryl 1 mg/ml; Alex Co., for Egy-pharma, Egypt) 1 mg slowly intravenous. Postoperative pain was treated with intravenous infusion of paracetamol 1 g (Perfalgan, Bristol-Myers Squibb Pharmaceutical, USA) over 10 min, and if the pain persisted, the patients received fentanyl 20 μg intravenous which could be repeated after 15 min if postoperative pain persisted until pain became controlled. The following variables were recorded in all groups:

1. Hemodynamic measurements

MAP and HR were recorded at baseline, after the bolus of the study drug, after anesthesia induction, 1 min after intubation, 15-min interval during the remaining of the procedure, after extubation, and just after arriving to PACU.

2. Anesthetic agent consumption
   (a) The propofol induction doses are the total propofol dosage that was administered till the BIS value reached 60.
   (b) The end-tidal isoflurane concentration was recorded at a 15-min interval throughout the anesthesia maintenance, and the mean values during this period were obtained for data analysis.
   (c) Intraoperative fentanyl requirements.
3. The following times were recorded:
   (a) Anesthesia induction time is the time from the start of propofol boluses till reaching BIS value of 60.
   (b) Anesthesia recovery time is the time from the cessation of isoflurane till reaching a BIS value of 80.
   (c) Response time is the time from the cessation of isoflurane till patients can respond to verbal command.
   (d) The time to the first postoperative analgesic demand.

Statistical analysis

Sample size calculation was performed by using the statistical software Epi Info 2000 (CDC, Atlanta, USA), and the sample size of 30 patients in each group was calculated with a power of the test of 80% and confidence interval of 95% and 5% alpha error. Data were collected, tabulated, and then analyzed using SPSS version 16.0. (SPSS, Inc., Chicago, IL, USA). Numerical variables were presented as mean ± standard deviation, and the comparison of numerical variables between study groups was performed by using analysis of variance (ANOVA) test with Tukey's honest significant difference (HSD) post hoc test. The comparison of categorical variables between study groups was performed by chi-square or Fisher's exact test as appropriate. *P* values less than 0.05 were considered statistically significant.

Results

Demographic data

There was no statistically significant difference between the three study groups regarding age, weight, ASA physical status, and surgery duration (Table 1).

Hemodynamic measurements

Regarding MAP changes in the study groups

Baseline MAP was comparable between the three study groups with no statistically significant difference. After the bolus of study drugs, the MAP dropped in group D when compared with baseline values to be significantly lower when compared with group C and L with no significant difference between group C and L. After anesthesia induction, the MAP decreased in the three study groups compared with postdrug bolus values to be significantly lower in group D and L when compared with group C with no significant difference between group D and L. One minute after endotracheal intubation, the MAP increased in the three study groups

Table 1 Demographic patients' characteristics (mean ± SD or ratio)

	Group C	Group L	Group D	*P* value
Age (year)	48.4 ± 7.5	49.7 ± 6.8	47.7 ± 8.3	0.584
Weight (kg)	82.5 ± 8. 4	79.3 ± 12.7	81.7 ± 9.6	0.466
ASA (I/II)	16/14	17/13	18/12	0.873
Surgery duration (min)	106.9 ± 15.7	110. 4± 19. 3	105.2 ± 16.6	0.290

when compared with postanesthesia induction values to be significantly higher in group C when compared with group D and group L with no significant difference between group D and L. In the subsequent recordings, the MAP was significantly lower in group D and L when compared with group C with no significant difference between group D and L for the remaining of the surgical time. After tracheal extubation, the MAP increased in the three study groups to be significantly higher in group C when compared with group D and L with no significant difference between group D and L. Upon the arrival to PACU, the MAP decreased in the three study groups when compared with postextubation values to be significantly lower in group D and L when compared with group C with no significant difference between group D and L. (Table 2). Hypotension was observed in two patients in group C, one patient in group L, and one patient in group D due to intraoperative blood loss which promptly responded to fluid blouses and intravenous ephedrine increments.

Regarding HR changes in the study groups

Baseline HR was comparable between the three study groups with no statistically significant difference. After the bolus of study drugs, HR dropped in group D when compared with baseline values to be significantly lower when compared with group C and L with no significant difference between group C and L. After anesthesia induction, HR decreased in the three study groups when compared with postdrug bolus values to be significantly lower in group D and L when compared with group C with no significant difference between group D and L. One minute after endotracheal intubation, the HR increased in the three study groups when compared with postanesthesia induction values to be significantly higher in group C when compared with group D and L with no significant difference between group D and L. In the subsequent recordings, the HR was significantly lower in group D and L when compared with group C with no significant difference between group D and L for the remaining of the surgical time. After tracheal extubation, the HR increased in the three study groups to be significantly higher in group C when compared with group D and L with no significant difference between group D and L. Upon the arrival to PACU, the HR decreased in the three study groups when compared with postextubation values to be significantly lower in group D and L when compared with group C with no significant difference between group D and group L. (Table 3). None of the patients in the current study had bradycardia in the three study groups.

Table 2 Mean arterial blood pressure (mmHg) changes in the study groups (data are presented as mean ± SD)

	Group C	Group L	Group D
Baseline	96.14 ± 13.5	95.23 ± 10.86	94.75 ± 14.44
After study drug infusion	97.88 ± 14.1	93.44 ± 11.52	85.32 ± 12.23$^{\cdot i}$
After anesthesia induction	83.56 ± 13.88	75.53 ± 11.44*	70.46 ± 9.45$^{\cdot}$
1 min after intubation	109.32 ± 18.55	91.27 ± 14.88*	84. 83 ± 13.72$^{\cdot}$
15 min	98.44 ± 15.33	82.33 ± 12.26*	77. 85 ± 10.63$^{\cdot}$
30 min	89.24 ± 12.67	78.93 ± 10.36*	74.68 ± 8.99$^{\cdot}$
45 min	84.32 ± 11.43	77.34 ± 9.55*	72.19 ± 7.44$^{\cdot}$
60 min	85.66 ± 13.44	75.89 ± 11.73*	71.47 ± 8.35$^{\cdot}$
75 min	88.65 ± 14.38	77.55 ± 13.72*	72.64 ± 10.63$^{\cdot}$
90 min	85.55 ± 12.66	76.73 ± 11.86*	72.42 ± 9.14$^{\cdot}$
1 min after extubation	97.77 ± 15.32	85.49 ± 13.74*	78.75 ± 11.69$^{\cdot}$
Upon arrival to PACU	93.65 ± 13.78	80.34 ± 11.65*	73.85 ± 10.74$^{\cdot}$

*Statistically significant (*P* value < 0.05) (group L versus group C)
·Statistically significant (*P* value < 0.05) (group D versus group C)
·iStatistically significant (*P* value < 0.05) (group D versus group L)

Table 3 Heart rate (beat/min) changes in the study groups (data are presented as mean ± SD)

	Group C	Group L	Group D
Baseline	86.14 ± 9.73	84.23 ± 11.45	82.87 ± 12.67
After study drug infusion	85.33 ± 10.56	81.44 ± 12.94	74. 32 ± 9.23[˙ i]
After anesthesia induction	80.56 ± 9.32	73.53 ± 10.44*	68.46 ± 7.45[˙]
1 min after intubation	96.32 ± 13.45	82.47 ± 12.26*	75.63 ± 9.72[˙]
15 min	89.44 ± 11.97	75.85 ± 10.68*	70.83 ± 8.63[˙]
30 min	83.76 ± 10.63	72.93 ± 11.87*	69.74 ± 8.54[˙]
45 min	81.32 ± 11.43	71.34 ± 9.55*	67.59 ± 7.21[˙]
60 min	84.43 ± 9.89	72.89 ± 10.94*	68.47 ± 8.35[˙]
75 min	82.55 ± 10.78	72.26 ± 9.63*	69.35 ± 8.76[˙]
90 min	84.18 ± 9.84	73.23 ± 10.76*	68.75 ± 8.44[˙]
1 min after extubation	94.67 ± 11.73	80.85 ± 12.68*	74.85 ± 9.68[˙]
Upon arrival to PACU	88.62 ± 9.25	76.23 ± 10.73*	70.64 ± 8.73[˙]

*Statistically significant (*P* value < 0.05) (group L versus group C)
˙Statistically significant (*P* value < 0.05) (group D versus group C)
[i]Statistically significant (*P* value < 0.05) (group D versus group L)

Anesthetic agent consumption

Propofol induction doses

The propofol induction dose was significantly lower in group L and D when compared with group C. It was also significantly lower in group D when compared with group L (Table 4).

The mean end-tidal isoflurane concentration during anesthesia maintenance

The mean end-tidal isoflurane concentration required for the maintenance of surgical anesthesia (BIS 40–60) was significantly lower in group L and D when compared with group C. It was also significantly less in group D when compared with group L (Table 4).

The total amount of fentanyl consumption

The total intraoperative fentanyl consumption was significantly lower in group L and D when compared with group C with no significant difference between group L and D (Table 4).

The following times were recorded

Regarding anesthesia induction and emergence times

The anesthesia induction time was significantly shorter in group L and D when compared with group C. It was also significantly shorter in group D when compared with group L with no significant difference between the three study groups as regards the anesthesia recovery and response time (Table 5) .

The time to the first postoperative analgesic requirement

The time to the first postoperative analgesic requirement was significantly longer in group D when compared with group L and C. It was also significantly longer in group L when compared with group C (Table 6) .

Discussion

The current study was conducted to assess the effects of intravenous infusion of dexmedetomidine and lidocaine on the perioperative hemodynamics, anesthetic agent requirements, and recovery profiles in patients who underwent elective abdominal hysterectomy surgeries under balanced general anesthesia.

Demographic patients' data, duration of surgery, and the baseline hemodynamic parameters were comparable between the three study groups. The MAP and HR after endotracheal intubation and in the subsequent recordings were significantly lower in group L and D when compared with group C with no significant difference between group D and L. The hemodynamic effects of

Table 4 Anesthetic agent consumptions during intraoperative period (mean ± standard deviation)

Anesthetic agent consumptions	Group C	Group L	Group D
Propofol induction doses (mg/kg)	2.09 ± 0.33	1.82 ± 0.27*	1.53 ± 0.19[˙ i]
Mean (Et Iso) concentration %	1.06 ± 0.21	0.83 ± 0.18*	0.61 ± 0.12[˙ i]
Total intraoperative fentanyl (μg)	136.25 ± 29.73	104.68 ± 18.54*	92.87 ± 11.67[˙]

*Statistically significant (*P* value < 0.05) (group L versus group C)
˙Statistically significant (*P* value < 0.05) (group D versus group C)
[i]Statistically significant (*P* value < 0.05) (group D versus group L)

Table 5 Anesthesia induction and emergence times (mean ± standard deviation)

Time recorded	Group C	Group L	Group D
Propofol induction time (s)	82.79 ± 11.32	72.16 ± 9.83*	62.65 ± 7.42*,i
Anesthesia recovery time (min)	6.81 ± 2.43	6.12 ± 3.18	5.87 ± 3.26
Response Time (min)	9.45 ± 2.65	8.78 ± 3.56	7.94 ± 3.42

*Statistically significant (*P* value < 0.05) (group L versus group C)
*Statistically significant (*P* value < 0.05) (group D versus group C)
iStatistically significant (*P* value < 0.05) (group D versus group L)

dexmedetomidine in the current study were consistent with previous studies. A study done on 81 patients who underwent different elective surgeries under general anesthesia showed that perioperative dexmedetomidine provided a stable perioperative hemodynamic profile and blunted the pressor response to intubation and extubation (Patel et al. 2012). Similarly, the attenuation of various surgical stress responses and maintenance of the hemodynamic stability by dexmedetomidine were observed in another study in which dexmedetomidine was assessed as an adjuvant to general anesthesia in 60 patients who underwent different elective surgical procedures (Rao et al. 2014). The effect of dexmedetomidine on hemodynamics could be explained by its stimulation of presynaptic α2-receptors that enhance the negative feedback inhibition of noradrenaline release from the peripheral nerve terminal (Morgan et al. 2006) and its inhibitory effect on central sympathetic outflow caused by the stimulation of the α2-receptor in locus coeruleus of brainstem (Farag et al. 2012).

Large doses or rapid injection of dexmedetomidine has been associated with adverse events such as hypotension, bradycardia, and even sinus arrest in healthy young volunteers with high vagal tone secondary to the attenuation of plasma catecholamine release (Patel et al. 2015). Thus, in the current study, the preinduction dexmedetomidine bolus 1 μg/kg was infused slowly (over 10 min) and none of the patients had bradycardia requiring intervention in group D.

Numerous studies have shown that dexmedetomidine reduces the analgesic and anesthetic requirements in the perioperative period (Aho et al. 1991; Hall et al. 2000; Gurbert et al. 2006). In the current study, there was a significant reduction in the propofol doses required for anesthesia induction with resultant-associated significant decrease in the propofol induction time in patients of group D when compared with the other study groups, and this finding was in accordance with the results of the study done by Sen et al. who studied the effects of perioperative intravenous dexmedetomidine on propofol consumption in patients who underwent spinal surgeries. In their study, results showed that the requirement of propofol for anesthesia induction and maintenance was significantly lower in the dexmedetomidine group when compared with the control group (Sen et al. 2013). A similar reduction in the propofol induction doses was observed in another study done by Peden et al. in which the effect of dexmedetomidine bolus dose 0.63 μg/kg on propofol requirement for loss of consciousness was assessed (Peden et al. 2001).

Table 6 The time to the first postoperative analgesic (mean ± standard deviation)

Time recorded	Group C	Group L	Group D
The time to the first postoperative analgesic (minutes)	24.85 ± 11.32	43.67 ± 16.64*	69.38 ± 19.77*,i

*Statistically significant (*P* value < 0.05) (group L versus group C)
*Statistically significant (*P* value < 0.05) (group D versus group C)
iStatistically significant (*P* value < 0.05) (group D versus group L)

In the current study, there was a significant reduction in isoflurane consumption in patients of group D when compared with the other study groups. Our results support the findings of Alzeftawy and Elsheikh who studied the effect of preoperative dexmedetomidine on the quality of anesthesia and postmastectomy pain in patients who underwent a radical mastectomy. In their study, results showed that isoflurane requirements were significantly lower in the dexmedetomidine group when compared with the control group (Alzeftawy and Elsheikh 2015). A similar reduction in sevoflurane consumption was observed in a study done by Patel et al. in which the effect of perioperative dexmedetomidine on sevoflurane requirements was assessed (Patel et al. 2013).

Another main observation in the current study is that intraoperative fentanyl consumption was significantly lower in patients of group D when compared with group C and the time to the first postoperative analgesic requirement was significantly longer in patients of group D when compared with the other study groups. These findings coincide with the results of a study done by Alzeftawy and Elsheikh. In their study, results showed that there was a significant reduction of intraoperative fentanyl requirement and longer time to the first postoperative analgesic requirement for patients in the dexmedetomidine group when compared with the control group (Alzeftawy and Elsheikh 2015). These findings were also consistent with those obtained by Gupta et al. who studied the role of perioperative intravenous dexmedetomidine on postoperative recovery profile of children who underwent surgery for spinal dysraphism (Gupta et al. 2013). The analgesic activity of α2-agonists seems to be mediated by both supraspinal and spinal mechanisms. It is thought that central α2-adrenoceptors in the locus coeruleus and in the dorsal horn of the spinal cord are involved in this activity (Guo et al. 1996; De Kock et al. 1993).

In the current study, there was no significant difference in the anesthesia recovery time and response time between the patients of group D and the other study groups. Despite their well-known sedative properties, a recent meta-analysis found no evidence that α2-agonists are delaying recovery times when used during the perioperative period which was attributed to the concomitant anesthetic sparing of them (Blaudszun et al. 2012). Moreover, dexmedetomidine-induced sedation qualitatively resembles normal sleep from which patients can easily be aroused. This type of sedation is termed as cooperative or arousable, to distinguish it from sedation that is caused by drugs acting on G-aminobutyric acid receptors, such as benzodiazepines or propofol, which obtund consciousness (Yazbek-Karam and Aquad 2006).

Reports in the literature demonstrate a clinically relevant effect of lidocaine on hypnosis, whether given intravenous (Gaughen and Durieux 2006) or intramuscular (Senturk et al. 2002). In the current study, there was a significant reduction in the propofol anesthesia induction doses with a resultant-associated significant decrease in the propofol induction time in group L when compared with group C and this finding was in accordance with those obtained by Kelsaka et al. who studied the effects of lidocaine on propofol induction dose. In their study, results showed that propofol anesthesia induction doses were significantly lower with intramuscular and intravenous lidocaine groups when compared with the control group (Kelsaka et al. 2011). The major action of propofol is mediated by the facilitation of inhibitory transmission by activating the postsynaptic GABA A receptor-chloride ionophore complex (Marik 2004). Local anesthetics also potentiate GABA-mediated Cl^- currents by inhibiting GABA uptake (Nordmark and Rydqvist 1997). This could be the cause of the reduction of the propofol induction dose caused by lidocaine encountered in the current study.

In the current study, there was also a significant reduction in the isoflurane consumption in Group L when compared with group C. Several studies proved that systemic local anesthetics reduced inhalational anesthetic consumptions and analgesic demands (Valverde et al. 2004; Villalba et al. 2011). These studies supported that the mechanism by which IV lidocaine decreased the anesthetic requirements was due to its inhibitory effect on the central nervous system (CNS).

An another observation in the current study is that the intraoperative fentanyl consumption was significantly lower and the time to the first postoperative analgesic requirement was significantly longer in patients of group L when compared with group C. Supporting to the current study, McKay et al. reported that perioperative requirements of opioids were reduced by 40% in patients who received perioperative intravenous lidocaine infusion than those who received saline (McKay et al. 2009). Similarly, Kaba et al. proved that patients who received perioperative lidocaine infusion required less perioperative opioid and had earlier hospital discharge (Kaba et al. 2007). Baral et al. studied the effect of perioperative intravenous lidocaine on postoperative pain in patients undergoing upper abdominal surgery, and they found a significant reduction in postoperative pain and analgesic consumption with longer time to the first postoperative analgesic requirement in the lidocaine group when compared with the control group(Baral et al. 2010).

Local anesthetics are attractive tools for pain treatment. They act at the periphery, decreasing the release of inflammatory mediators, and centrally, modifying neuronal responses in the dorsal horn (Jaffe and Rowe 1995). Besides affecting voltage-gated sodium channels present in nociceptors in inflamed tissues, lidocaine affects G protein-coupled receptors (GPCR), NMDA (*N*-methyl-D-aspartate) receptors, and potassium and calcium channels, interfering with the conduction of excitatory impulses on A-delta and C fibers, visceral pain, central sensitization, and immune response (Oliveira et al. 2010b).

An important finding of the current study is that there was no significant difference in the anesthesia recovery time and the response time between the patients of group L and the other study groups despite its CNS depressant properties and this finding can be attributed to the concomitant anesthetic sparing of lidocaine and to our BIS-guided anesthesia in the current study.

Study limitations

The main consideration of perioperative lidocaine use is to achieve therapeutic effects without reaching the toxic serum level. The toxic plasma concentration of lidocaine exceeds 5 μg/ml (Lauretti 2008). One of the major limitations in the current study was that the serum level of the lidocaine was not measured but the dose of lidocaine for bolus and subsequent infusion used in the current study was used safely in multiple previous studies (Cho et al. 2014; Siddarameshwar et al. 2015).

Conclusion

Both dexmedetomidine and lidocaine could be a useful adjuvant to general anesthesia in patients undergoing abdominal gynecological surgeries. However, dexmedetomidine has a better sparing effect on intraoperative anesthetic consumption and longer time to the first postoperative analgesic demand than that of lidocaine with no significant difference between both agents on intraoperative analgesic demand.

Abbreviations

ASA: American Society of Anesthesiologists; BIS: Bispectral index; CNS: Central nervous system; ECG: Electrocardiography; GPCR: G protein-coupled

receptors; HR: Heart rate; MAP: Mean arterial pressure; NIBP: Noninvasive blood pressure; NMDA: *N*-Methyl-D-aspartate; PONV: Postoperative nausea and vomiting; SpO_2: Peripheral oxygen saturation; TOF: Train of four

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Availability of data and materials
The datasets generated during and/or analyzed during the current study are not publicly available due to restrictions based on privacy regulations and informed consent of the participants, but are available from the corresponding author upon reasonable request.

Authors' contributions
MAM contributed to the study conception and design, the acquisition of data, and the analysis and interpretation of data. HMF has drafted the manuscript and its critical revision. Both authors read and approved the final manuscript.

Ethics approval and consent to participate
The current randomized, double-blinded, placebo-controlled study was conducted on 90 female patients scheduled to undergo elective abdominal hysterectomy in Ain Shams University Hospitals through the period from July 2015 to July 2016 after obtaining the approval of the research ethical committee (REC) of the Faculty of Medicine, Ain Shams University (FMASU), at June 2015 with reference number of FMASU 3265/2015 and obtaining patients' written informed consents for the acceptance of participation in the study.

Consent for publication
Not applicable

Competing interests
The authors declare that they have no competing interests

Publisher's Note

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