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Dexmedetomidine versus Dexamethasone as Adjuvants to Bupivacaine for Ultrasound Guided Rectus Sheath Block in Pediatric Abdominal Surgery

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ABSTRACT

Background: The use of ultrasound as a guide for regional anesthesia has become common practice and a new challenge to anesthesiologists. Besides its benefits of reduced complications, it also helps in reducing the total anesthetic dose required with higher block success rates. There is also the advantage of direct observation of the pattern of anesthetic spread.

Objective: To compare between dexamethasone and dexmedetomidine as adjuvants to bupivacaine in rectus sheath block applied during pediatric abdominal surgeries.

Patients and methods: This prospective randomized study was conducted at Mansoura University Children Hospital. We included a total of 60 pediatric patients undergoing elective abdominal surgery. The study was conducted over the period of two years, starting from January 2019 till December 2020.

Results: The mean age of the included patients was 4.7, 4.7, and 4.6 in groups C, D, and Z respectively. Operative time and duration of anesthesia did not show any significant difference between the three groups. The duration of analgesia showed a highly significant difference between the three groups. Group Z showed its superiority as it had a mean analgesic duration of 15.3 hours, followed by Group D which had mean value of 13.02 hours.

Conclusion: Both dexamethasone and dexmedetomidine were efficient adjuvants to local anesthetics as they were associated with significant prolongation of the duration of analgesia, decrease in postoperative analgesia, and better patient satisfaction compared to bupivacaine alone.

Keywords: Bupivacaine, Dexamethasone, Dexmedetomidine, Pediatric Abdominal Surgery, Ultrasound.

INTRODUCTION

Effective perioperative pain management for the pediatric patient continues to be challenging. Avoiding the undertreatment of pediatric pain is critical, because inadequate analgesia may lead to longer hospital stays, patient dissatisfaction and an increased risk of morbidity and mortality [(1)].

In an effort to reduce postoperative pain and opioid use, rectus sheath blocks (RSB) have become increasingly popular in the pediatric population, and have been used to provide analgesia after umbilical and epigastric hernia repair, laparoscopic surgery, and pyloromyotomy [(2)].

The rectus sheath block aims to anesthetize the anterior rami of nerves T9–11[(3)]. Initial RSBs were performed without the aid of ultrasound (US); however, the use of ultrasound to provide image-guided placement of regional blocks has been increasing [(4)].

Studies in adults and children have compared the rectus sheath block with opioids alone for analgesia after laparoscopic surgery, showing favorable results [(5)]. It was successfully used in chronic pain management of pediatric abdominal wall pain [(6)].

Various adjuncts have been added to local anesthetics to extend its postoperative analgesic time, for example, fentanyl, neostigmine, clonidine, and most recently dexamethasone and dexmedetomidine [(7)].

Dexamethasone has various perioperative uses, mainly to reduce inflammation and to prevent nausea and vomiting [(8)]. Another useful use for dexamethasone is the synergistic analgesic effect when added to local anesthetics epidurally that reduce postoperative analgesic needs. Different theories attempt to explain its analgesic effects. One theory stated that dexamethasone might have a direct local anesthetic effect on the nerve [(9)].

While dexmedetomidine is an alpha 2 agonist which has sedative, analgesic, and opioid-sparing effect [(10)]. It prolongs the duration of analgesia by its local vasoconstrictive effect and by increasing the potassium conductance in A-delta and C-fibers [(11)]. It also exerts its analgesic action centrally via systemic absorption or by diffusion into the cerebrospinal fluid and reaches alpha 2 receptors in the superficial laminae of the spinal cord and brainstem or indirectly activating spinal cholinergic neurons [(12,13)]. The sedative effects of dexmedetomidine are mostly due to stimulation of the alpha 2 adrenoceptor in the locus coeruleus [(14)].

The aim of the current study was to compare between dexamethasone and dexmedetomidine as adjuvants to bupivacaine in rectus sheath block applied during pediatric abdominal surgeries.

PATIENTS AND METHODS

This prospective randomized study was conducted at Mansoura University Children Hospital aiming to compare between dexamethasone and dexmedetomidine as adjuvants to bupivacaine in rectus

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sheath block applied during pediatric abdominal surgeries. We included a total of 60 pediatric patients undergoing elective abdominal surgery. The study was conducted over the period of two years, starting from January 2019 till December 2020.

Sample size calculation:

The required sample size was calculated using the IBM[a] SPSS[a] SamplePower[a] version 3.0.1 (IBM[a] Corp., Armonk, NY, USA). A previous study by **Hamill *et al.*** [15] reported that the mean (SD) pain score at 18-24 hours in the group of children underwent laparoscopic appendicectomy by rectus sheath block using bupivacaine was 3.58 cm (SD 0.4). A minimal sample size of 18 cases in each group had 90% power to detect a 0.5 difference in the mean pain score, at 5% significance level. With considering 10% rate as a drop out, total number of 20 cases in each group was included.

Inclusion criteria: Age between 2 and 6 years, both genders were included, ASA class I or II, and undergoing elective abdominal surgery under general anesthesia.

Exclusion criteria: History of cardiovascular, respiratory, or neurological diseases, history of renal, hepatic, or hormonal disease, known allergy to any of the study medications, bleeding diathesis, and active skin infection over the area of injection.

The included 60 patients were randomly allocated into three equal groups according to the drugs injected for the rectus sheath block: Group C: Included 20 cases who received 1 ml/kg bupivacaine 0.125% diluted in normal saline. **Group D:** Included 20 cases who received 1 ml/kg bupivacaine 0.125% in addition to dexmedetomidine 1 mcg/kg diluted in saline. **Group Z:** Included 20 cases who received 1 ml/kg bupivacaine 0.125% in addition to dexamethasone 0.1 ml/kg diluted in saline.

Ethical consideration:

An informed written consent was obtained from the parents of the included children, after complete explanation of the details and complications of each intervention. The study gained approval from the local ethical committee and Institutional Review Board (IRB) of Mansoura University. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Patient evaluation:

- Preoperative visit and assurance.
- All patients were assessed clinically and investigated for the exclusion of any of the above-mentioned contraindications.
- The needed laboratory work was complete blood count (CBC); prothrombin time (PT) and concentration (PC), partial thromboplastin time (PTT), bleeding time (BT), clotting time (CT), renal and liver function tests.
- All cases were classified according to the American Society of Anesthesiologists (ASA) [16].

Anesthetic technique:

Patients were premedicated with oral midazolam (0.5 mg/kg). After arrival to the operating theater, patients were monitored by non-invasive blood pressure, electrocardiography and pulse oximetry. Intravenous 22 gauge cannula was inserted after the application of EMLA cream applied one hour before surgery. Intravenous infusion of half normal saline in glucose 5% solution was initiated before surgery (4 ml/kg for first 10 kg of patient weight and 2 ml/kg for the next 10 kg and 1 ml/kg for every kg above 20 kg).

Anesthesia was induced by IV fentanyl 1 ug/kg, propofol 2-2.5 mg/kg, and rocuronium 0.6 mg/kg. Tracheal intubation was carried out after complete muscle relaxation. Anesthesia was maintained with 2% sevoflurane vaporized in air oxygen mixture. Patients' lungs were ventilated by pressure controlled ventilation to achieve a $PaCO_2$ of 35-40 mm Hg.

Rectus sheath block technique:

Rectus sheath block was performed under ultrasound guidance (Toshiba Xario, China). The sheath and lateral edge of the rectus muscle were localized. Also, the peritoneum and the aponeurosis of ipsilateral transverse abdominis, internal and external oblique muscles were identified. After aseptic preparation of the puncture site and administration of sterile ultrasound gel, the block was performed with a facet tip needle which was introduced in the long axis parallel to the ultrasound probe to reach the lateral border of the rectus muscle, and then was advanced slowly and carefully until the tip of the needle was seen just between the posterior aspect of the rectus abdominis and its sheath. A single injection of drugs of each group was injected each side under the real-time ultrasound control.

In all patients skin incision was performed at least 15 min after placement of the block. At the end of the surgery, sevoflurane was discontinued and neuromuscular blockade was antagonized with 0.04 mg/kg neostigmine and 0.02 mg/ kg atropine. Tracheal extubation was performed, then patients were transferred to post-anesthesia care unit (PACU).

Statistical analysis

Results were statistically analyzed by using statistical package for the social sciences (SPSS 26.0, IBM/SPSS Inc., Chicago, IL). Two types of statistical analysis were conducted. It included estimates for summarizing the continuous data as mean and standard deviation (SD) for normally distributed data or median and range for skewed data. Frequency with percentage (%) was used for presenting qualitative data, which were compared by Pearson Chi-square ($\chi 2$) test. Fisher's exact test was used instead of Chi-Square (χ^2) test when the assumption that at least 80% of the expected frequencies are greater than five was violated.

One-way ANOVA test was used for continuous data to test for significant difference between more than two normally distributed groups.

Assumptions of normality in each group and homogeneity of variances were verified using Shapiro-Wilk test and Levine's test, respectively. Kruskal-Wallis test was used to compare between more than two groups of skewed data. Tukey honestly significant difference (Tukey-HSD) test was used as a post hoc test to adjust for multiple comparisons after significant ANOVA test to indicate which significant difference between pairs of groups whereas Bonferroni post hoc test was used after significant Kruskal-Wallis test. P value < 0.05 was considered significant.

RESULTS

The demographic and operative data of the studied groups are shown in table 1. Neither operative nor anesthetic times were significantly different between the study groups.

Table (1): Demographic and operative data of the cases in the three study groups

Items	Group C (n=20)	Group D (n=20)	Group Z (n=20)	p-value
Age (years)	4.7 ± 1.3	4.7 ± 1.2	4.6 ± 1.3	**>0.05**
Sex				
-Male	8 (40%)	10 (50%)	9 (45%)	**>0.05**
-Female	12 (60%)	10 (50%)	11 (55%)	
Weight (Kg)	15.5 ± 2.9	15.4 ± 2.6	15.6 ± 2.7	**>0.05**
ASA score				
1	19 (95%)	20 (100%)	20 (100%)	**>0.05**
2	1 (5%)	0 (0%)	0 (0%)	
Duration of operation (min)	64.26 ± 4.11	67.08 ± 5.15	65.14± 5.28	**>0.05**
Duration of anesthesia (min)	77.6 ± 5.8	77.4 ± 3.8	78.4 ± 6	**>0.05**

Continuous data are expressed as mean±SD. Categorical data are expressed as Number (%)

The duration of analgesia showed a highly significant difference between the three groups. Group Z showed its superiority as it had the highest mean analgesic duration followed by Group D. Group C had the lowest duration of analgesia. Accordingly, both paracetamol and diclophenac consumption followed the duration of analgesia. Group Z that had the longest duration received the lowest analgesic doses for both drugs, followed by group D, and group C. There was a significant difference between the three groups regarding the consumption of paracetamol and NSAIDs.

Table (2): Parameters of analgesia in the three study groups

Items	Group C (n=20)	Group D (n=20)	Group Z (n=20)	p-value
Duration of analgesia (hours)	9.4 ± 1.38	13.02 ± 1.74	15.30± 1.98	P<0.001*
				P1<0.001*
				P2<0.001*
				P3=0.013*
Total dose of acetaminophen (mg)	517.31 ± 82.10	369.50 ± 62.22	325.46 ± 71.38	P<0.001*
				P1<0.001*
				P2<0.001*
				P3=0.010*
Total dose of rectal diclophenac (mg)	18.67 ± 5.02	15.47± 4.13	13.75 ± 3.85	P<0.001*
				P1<0.001*
				P2<0.001*
				P3=0.042*

Data are expressed as mean ± SD.
P: intergroup significance
P1: significance between Group C and Group D
P2: significance between Group C and Group Z
P3: significance between Group D and Group Z.
*: significant

Intraoperative heart rate measurements did not show significant difference between the three groups indicating equal effective analgesia with block in the three groups. This scenario existed till 8 hours after operation, when group C started to express a significant increase in heart rate compared to the other groups. After good control of pain in group C with analgesics, group D started to express elevated heart rates at 12 hours, which was also consistent with its analgesic duration. Moreover, group Z was the last one to develop significant increase in heart rate, and that was noticed 16 hours after operation.

Table (3): Basal and follow-up values of heart rate (beat/min.) of the studied groups throughout the study

Hear rate (Beat\minute)		Group C (n=20)	Group D (n=20)	Group Z (n=20)	p-value
Basal		125.7 ± 12.4	123.5 ± 10.2	123 ± 11.8	**>0.05**
Intraoperative	**10 minutes**	120.8 ± 11.1	126 ± 12.5	124.1 ± 14.3	**>0.05**
	20 minutes	126.5 ± 9.9	129.2 ± 14.2	122.5 ± 18.7	**>0.05**
	30 minutes	123.7 ± 11.1	120.5 ± 13.4	121.9 ± 13	**>0.05**
	40 minutes	115.3 ± 6.6	114 ± 8.6	115.9 ± 7.4	**>0.05**
	50 minutes	117.1 ± 7.4	118.4 ± 9.1	117.9 ± 7.6	**>0.05**
	60 minutes	114.8 ± 8.5	116.5 ± 7.9	115.2 ± 9.1	**>0.05**
PACU		116.4 ± 7.3	117.3 ± 6.4	117.6 ± 2.4	**>0.05**
Postoperative	**2 hours**	118.7 ± 9	117.6 ± 11.9	114.2 ± 13.9	**>0.05**
	4 hours	118.5 ± 9.7	120.9 ± 12.1	118.2 ± 13.4	**>0.05**
	6 hours	117.9 ± 10.1	118.3 ± 12.5	117.3 ± 13.6	**>0.05**
	8 hours	126.7 ± 10.4	114.5 ± 13.1	113.5 ± 13.5	**0.009***
	10 hours	130.6 ± 11	119.5 ± 13.2	118.5 ± 13.6"	**0.006***
	12 hours	118.3 ± 11.3	129.6 ± 13.5	117.3 ± 14.3	**0.007***
	14 hours	118.8 ± 11.2	123.7 ± 13.2	119.1 ± 14	**>0.05**
	16 hours	**121.1 ± 10.8**	**122.4 ± 12.8**	**130.1 ± 14.2**	**>0.05**

Data are expressed as mean ± SD. P: intergroup significance *: significant

No significant difference was detected between the three groups regarding MAP measurements either intraoperatively or postoperatively.

Table (4): Basal and follow-up values of mean arterial blood pressure (MAP) (mmHg) of the studied groups throughout the study

MAP (mmHg)		Group C (n=20)	Group D (n=20)	Group Z (n=20)	p-value
	Basal	74.5 ± 8.9	75.3 ± 5.5	74.2 ± 6.3	**>0.05**
	10 minutes	77.8 ± 7.9	73.8 ± 6.7	73.5 ± 4.9	**>0.05**
Intraoperative	**20 minutes**	73.1 ± 6.8	71 ± 4.7	71.4 ± 6.1	**>0.05**
	30 minutes	73.4 ± 5.6	74.3 ± 4.8	71.9 ± 6	**>0.05**
	40 minutes	70.2 ± 4.7	72.6 ± 3.6	71.4 ± 7.6	**>0.05**
	50 minutes	71.58 ± 5.3	73.88 ± 3.4	72.6 ± 6.8	**>0.05**
	60 minutes	75.81 ± 5.2	77.96 ± 4.4	74.8 ± 5.6	**>0.05**
PACU		74.4 ± 6.4	75.2 ± 5.2	76.3 ± 6.3	**>0.05**
	2 hours	77.9 ± 6.6	74.5 ± 4.7	75.3 ± 4.2	**>0.05**
	4 hours	77.6 ± 6.7	73.2 ± 4.4	74.3 ± 4.3	**0.028***
Postoperative	**6 hours**	77 ± 5.8	72.2 ± 4	73.3 ± 4.1	**0.006***
	8 hours	75.9 ± 5.9	72.3 ± 4.1	72.4 ± 3.9	**0.029***
	10 hours	74.8 ± 5.8	72.7 ± 3.9	74.2 ± 4.2	**>0.05**
	12 hours	73.8 ± 5.3	71.3 ± 3.9	72.5 ± 3.6	**>0.05**
	14 hours	73.4 ± 5.9	70.6 ± 3.7	71.2 ± 3.4	**>0.05**
	16 hours	**73.2 ± 6**	**70.3 ± 3.9**	**70.5 ± 3.5**	**>0.05**

Data are expressed as mean ± SD. P: intergroup significance

CHEOPS score did not show any significant difference between the three groups during the first 4 hours after operation. However, group C showed a significant increase in their score compared to the other two groups at 8-hour reading. After 12 hours, group D stared to express significantly higher scores with the resolution of local anaesthetic action. On subsequent readings, no significant difference was detected between the three groups regarding that parameter.

Table (5): Analysis of CHEOPS score in the cases within the three study groups

Items	Group C (n=20)	Group D (n=20)	Group Z (n=20)	p-value
0 hr (At PACU)	4.10 ± 0.3	4.07 ± 0.3	4.00 ± 0.1	>0.05
1 hr	4.07 ± 0.3	4.13 ± 0.3	4.10 ± 0.3	>0.05
2 hr	5.01 ± 0.3	4.10 ± 0.3	4.07 ± 0.3	>0.05
4 hr	5.03 ± 1.5	5 ± 1.9	4.73 ± 1.8	>0.05
8 hr	6.57 ± 2.0	4.68 ± 1.2	4.77 ± 1.1	P<0.001* P1<0.001* P2<0.001* P3=0.244
12 hr	5.03 ± 1.4	6.80 ± 2.0	4.07 ± 0.4	P<0.001* P1<0.001* P2=0.019* P3<0.001*
18 hr	4.70 ± 1.5	4.53 ± 1.2	4.77 ± 1.3	>0.05
24 hr	4.13 ± 0.3	4.13 ± 0.1	4.03 ± 0.3	>0.05

Data are expressed as mean±SD. P: intergroup significance. P1: significance between Group C and Group D, P2: significance between Group C and Group Z. P3: significance between Group D and Group Z. *: significant

Regarding sedation level, group D expressed significantly higher sedation scores compared to the other two groups for the early 12 hours after operation. After that time point, no significant difference was detected between the three study groups regarding the same parameter.

Table (6): Ramsey sedation score in the cases within the three study groups

Items	Group C (n=20)	Group D (n=20)	Group Z (n=20)	p-value
0 hr (At PACU)	1 (1-3)	2 (2-4)	2 (1-3)	P= 0.021* P1=0.008* P2=0.648 P3=0.084
1 hr	2 (2-3)	3 (2-4)	2 (2-3)	P= 0.015* P1=0.005* P2=0.756 P3=0.011*
2 hr	2 (2-3)	3 (2-4)	3 (2-3)	P= 0.001* P1<0.001* P2=0.112 P3<0.001*
4 hr	3 (2-3)	3 (3-4)	3 (2-3)	P<0.001* P1<0.001* P2= 0.374 P3<0.001*
8 hr	2 (2-3)	4 (3-4)	3 (2-3)	P=0.009* P1<0.001* P2=0.490 P3=0.002*
12 hr	2 (2-3)	4 (3-4)	2 (2-3)	P=0.001* P1<0.001* P2=0.566 P3<0.001*
18 hr	2 (2-3)	3 (2-3)	2 (2-3)	>0.05
24 hr	2 (1-3)	2 (1-3)	2 (1-3)	>0.05

Data are expressed as median (range). P: intergroup significance. P1: significance between Group C and Group D
P2: significance between Group C and Group Z. P3: significance between Group D and Group Z.

Parent satisfaction showed a significant improvement in the group Z as 90% of parents were satisfied. In group D, 85% of parents were satisfied compared to 70% of parents in group C. Vomiting was encountered in 5%, 10%, and 5%

of the included cases in groups C, D, and Z respectively, with no significant difference between the three groups. Rectus sheath hematoma was encountered in only one case in group C, and it was managed conservatively.

Table (7): Complications and satisfaction of the cases within the study groups

Items	Group C (n=20)	Group D (n=20)	Group Z (n=20)	p-value
Satisfaction				
-Satisfied	14 (70%)	17 (85%)	18 (90%)	**>0.05**
-Not satisfied	6 (30%)	3 (15%)	2 (10%)	
Complications				
Vomiting	1 (5%)	2 (10%)	1 (5%)	**>0.05**
Hematoma	1 (5%)	0 (0%)	0 (0%)	

Data are expressed as Number (%)

DISCUSSION

In general, there was no significant difference between the three study groups regarding general patient characteristics as well as operative time. That ensured proper randomization conducted between our study groups. Additionally, that should nullify any bias that may have skewed the results in favor of one group rather than another one.

We chose to conduct the injection technique prior to the operation. This has two advantages. First of all, it will decrease the stress response during operation due to decreased sensitization leading to decreased anesthetic and analgesic requirements. We believe in the idea of preemptive anesthesia that was originated as a means to decrease postoperative pain in surgical patients. The increased pain experienced at the site of surgery or the uninjured surrounding area is related to sensitization, both centrally and peripherally. Once sensitization is established, pain-controlling treatments become less effective and must be used for longer periods of time postoperatively [(17)]. This realization led to research in prevention of postoperative pain with preemptive analgesia [(18)]. **Crile and Lower** [(19)] were the first to theorize that local anesthesia along with general anesthesia may lead to more successful surgical outcomes long-term by reducing postoperative pain. Secondly, it would be easier for the anesthesiologist to identify the abdominal wall layers and planes before its surgical disruption.

In the current study, group C, which received only bupivacaine in the injectate, showed a mean analgesic duration of 9.4 hours after operation. Participants in this group expressed CHEOPS score lower than 6 for 8 hours following surgery. Also, intraoperative and early postoperative hemodynamic parameters did not show significant differences when compared with the other two groups. Despite having relatively lower outcomes in this groups compared to the other two, RSB with bupivacaine alone was efficacious in maintaining intraoperative and early postoperative analgesia. In children, the RSB has been performed to provide intra- and postoperative analgesia for procedures involving the midline abdominal wall, such as paraumbilical, umbilical and epigastric hernias [(20)], and that supports our findings.

Özcengiz and his associates [(5)] found that RSB led to a mean duration of analgesia of 15 hours which was significantly longer than the control group (2.216 hours – $p < 0.001$). Consequently, there was a significant decrease in the tramadol consumption in the same group (0.95 vs. 4.07 mg/kg in control – $p = 0.01$). Patient satisfaction was significantly better in the RSB group. The previous findings confirm our results regarding the efficacy of RSB technique. However, we reported a relatively shorter analgesic time, as the previous study used levobupivacaine which has a prolonged duration of action compared to the bupivacaine used in our study.

Rectus sheath block even proved its effectiveness in younger patient population. A previous study conducted in 2013 on 26 patients undergoing pyloromyotomy evaluated the analgesic efficacy of rectus sheath block. The rectus sheath block was regarded as successful in all patients as there was no heart rate increase upon surgical skin incision in any of the patients. Two cases (7.6%) needed additional intraoperative rescue analgesia and were administered fentanyl at 20 and 40 min after skin incision. Two more (a total of 4; 15.3%) babies required postoperative analgesia and were administered tramadol droplets and liquid ibuprofen at 15, 120 and 150 min postoperatively. Authors concluded that US-guided rectus sheath block seems to be a simple and quick method for the provision of intra- and postoperative analgesia in infants undergoing conventional pyloromyotomy surgery [(21)].

In the current study, we studied the safety and efficacy of adding dexmedetomidine to the injectate. Plenty of supporting evidence regarding the favourable clinical analgesic profile of dexmedetomidine has led the European Society of Regional Anaesthesia and Pain Therapy in addition to the American Society of Regional Anesthesia and Pain Medicine to develop a Joint Committee Practice Advisory on Las (Local anesthetics) and adjuvant dosage in pediatric regional anesthesia. They recommended the use of dexmedetomidine as an adjunct to LA drugs to prolong the duration of action in peripheral nerve blocks in

children. However, a consensus is lacking about the suggested safe dosage [22].

In our study, we found that dexmedetomidine addition led to a significant prolongation of the analgesic period compared to controls (13.02 vs. 9.4 hours respectively). Also, the total acetaminophen and diclophenac doses showed a significant decrease in that group compered to bupivacaine alone. This in turn led to a significant improvement in parent satisfaction in that group. Perineural administration of dexmedetomidine has previously been shown to increase bupivacaine's block efficacy in animal studies [23]. However, the peripheral effect of dexmedetomidine on block efficacy is not definitively proven.

Hartzell *et al.* [24] conducted a recent study evaluating the effect of adding dexmedetomidine to local anesthesia in RSB during pediatric umbilical hernia repair. A total of 326 cases were included, and they were divided into two groups RSB group (176 cases) and RSB-D (150 cases). Although there was no significant difference between the two groups regarding demographic characteristics, the RSB-D group reported significant decrease in postoperative pain scores ($p < 0.001$) and opioid requirements ($p < 0.001$). In the same context, **Mostafa *et al.*** [25] found that adding dexmedetomidine to LA was associated with a significant increase in the time for first analgesic request (565.0 vs. 206 minutes in control – $p < 0.001$). Also, total analgesic consumption showed a significant decrease in the same group (325.84 vs. 429.0 mg/24 hours in controls – $p = 0.008$). Furthermore, sedation score had significantly higher values with dexmedetomidine application compared to controls ($p = 0.011$). **Qin *et al.*** [26] investigated the effects of different doses of dexmedetomidine in combination with LA for post-anesthesia care unit (TAP) block in patients undergoing laparoscopic procedures. It decreased the anesthetic and opioid consumption. They concluded that adding 0.5 μg/kg dexmedetomidine as an adjuvant for TAP block is the optimal dose to control postoperative pain and surgical stress with limited effects on the patients' hemodynamics.

Our findings regarding the increased sedation during the early 12 postoperative hours are equivalent to most of the studies using the same drug as an adjuvant to LA in various types of blocks [27, 28]. Dexmedetomidine was found to significantly increase sedation in a concentration-dependent manner because of its potent analgesic, sedative and sympatholytic properties [28, 29]. **Fritsch *et al.*** [30] observed that adding dexmedetomidine to LA for nerve block extended the duration of analgesia, with the patients appearing sedated and arousable.

Our findings regarding the addition of dexamethasone was associated with a highly significant prolongation of analgesic duration (15.3 vs. 9.4 hours n controls), decrease in analgesic consumption, and improvement of parent satisfaction. In line with our findings, a recent study conducted in Ain Shams University evaluated the use of dexamethasone as an adjuvant to bupivacaine in TAP block in pediatrics. Authors reported an analgesic duration near to ours in the dexamethasone group (15.54 hours), which was significantly longer than controls (9.08 hours – $p < 0.001$). This had a significant impact on postoperative analgesic consumption. Total acetaminophen consumption decreased from 542.31 mg in controls down to 338.46 mg with dexamethasone application. Also, rectal diclophenac decreased from 16.67 mg in the control group down to 13.75 mg with adding dexamethasone [31].

When it comes to comparing both adjuvants in the current study, it was obvious that dexamethasone had the upper hand compared to dexmedetomidine. The studies parameters including duration of analgesia, analgesic consumption, and parent satisfaction were better with dexamethasone. Apparently, no previous study has compared these two specific agents in the RSB technique. **Sridhar *et al.*** [32] reported that dexamethasone was associated with a significant prolongation of the duration of analgesia in caudal analgesia for pediatrics. It was associated with a mean analgesic duration of 450 minutes, compared to 406.25 minutes for dexmedetomidine, and 325 minutes for magnesium sulphate. This comes in line with our findings. **Moeen *et al.*** [33] reported that both of the previous drugs had comparable adjuvant profile when applied in conjunction with bupivacaine after arthroscopic surgery. No significant difference was detected between these two agents regarding analgesic time, or analgesic consumption. Both groups reported better results regarding the above parameters compared to controls. On the other hand, **Kaur *et al.*** [34] reported that using dexmedetomidine as adjuvant prolongs the duration of supraclavicular block and postoperative analgesia compared to dexamethasone with minimal or negligible adverse events. Results revealed similar onset of sensory block in both groups. However, the dexmedetomidine group showed early onset and longer duration of motor block compared to the dexamethasone group. Other authors confirmed the previous findings in ultrasound-guided infraorbital nerve block for cleft lip repair [7]. **Gao *et al.*** [35] reported the same findings with erector spinae block in thoracoscopic lung resections.

As regard the complications encountered in the current study, there was no significant difference between the three groups, and this indicates good pain control in the three groups. Vomiting was encountered in 5%, 10%, and 5% of cases in groups C, D, and Z respectively. Also, rectus sheath hematoma was encountered in only one case (5%) in the bupivacaine group. This hematoma was discovered on the first postoperative day, and measured 2 x 3 cm, and it was managed conservatively. To be fair, we cannot guarantee that this is a complication of the block technique, and it may occur secondary to the surgical incision itself.

CONCLUSION

Based on our findings, both dexamethasone and dexmedetomidine were efficient adjuvants to local anesthetics as they were associated with significant prolongation of the duration of analgesia, decrease in postoperative analgesia, and better patient satisfaction compared to bupivacaine alone.

Dexamethasone appeared to have the upper hand compared to dexmedetomidine compared to the previously mentioned parameters. Nevertheless, better sedation was achieved with the latter.

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