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Original research article

Haemodyamic Changes and Complication of Dexmedetomidine and Bupivacaine in Infraumbilical Surgeries in Paediatrics Age Groups: A Comparative Study

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Abstract

Introduction: Pain is perhaps the most feared symptom of a disease, which a man is always trying to alleviate and conquer since ages. Pain is defined, by International Association for the study of Pain, as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage.

Material and Methods: This study was conducted at Basaveshwar teaching and general hospital attached to Mahadevappa Rampure Medical College, Gulbarga from December 2011 to July 2012. This study included 60 children, of either sex, coming for various elective infra-umbilical surgical procedures such as herniotomies, circumcision, orchidopexy, perineal surgeries and minor lower extremity procedures.

Results: There was significant difference in the heart rate between the two groups AT 15 min ($p<0.05$),bradycardia observed in group B was amenable to treatment with atropine and no significant difference in other time interval ($p > 0.05$)

Conclusion: The present study demonstrated that caudal administration of bupivacaine 0.25% (1ml/kg) with dexmedetomidine (1 μg/kg) resulted in superior analgesia with longer duration of action compared with 0.25% bupivacaine (1 ml/kg) alone, without any significant difference in the hemodynamic parameters and the incidence of side-effects except bradycardia amenable to treatment.

Key words: Heart rate, systolic blood pressure, diastolic blood pressure, infraumbilical surgeries

Introduction

Pain is perhaps the most feared symptom of a disease, which a man is always trying to alleviate and conquer since ages. Pain is defined, by International Association for the study of Pain, as "an unpleasant sensory and emotional experience associated with actual or potential tissue

damage or described in terms of such damage **.**El-Hennawy AM, Abd-Elwahab AM, Abd-Elmaksoud AM, El-Ozairy HS, Boulis SR evaluated Sixty patients (6 months to 6 yr).They were evenly and randomly assigned into three groups in a double-blinded manner. After sevoflurane in oxygen anaesthesia, each patient received a single caudal dose of bupivacaine 0.25% (1 ml kg(-1)) combined with either dexmedetomidine 2 microg kg(-1) in normal saline 1 ml, clonidine 2 microg kg(-1) in normal saline 1 ml, or corresponding volume of normal saline according to group assignment. Hemodynamic variables, end-tidal sevoflurane, and emergence time were monitored. Postoperative analgesia, use of analgesics, and side-effects were assessed during the first 24 h. Addition of dexmedetomidine or clonidine to caudal bupivacaine significantly promoted analgesia time [median (95% confidence interval, CI): 16 (14-18) and 12 (3-21) h, respectively] than the use of bupivacaine alone [median (95% CI): 5 (4-6) h] with P<0.001. However, there was no statistically significant difference between dexmedetomidine and clonidine as regards the analgesia time (P=0.796). No significant difference was observed in incidence of hemodynamic changes or side-effects. It concluded addition of dexmedetomidine or clonidine to caudal bupivacaine significantly promoted analgesia in children undergoing lower abdominal surgeries with no significant advantage of dexmedetomidine over clonidine and without an increase in incidence of side-effects[1]. Saadawy IBoker A, Elshahawy MA, Almazrooa A, Melibary S, Abdellatif AA,Afifi W evaluated Sixty children (ASA status I) aged 1-6 years undergoing unilateral inguinal hernia repair/orchidopexy.They were allocated randomly to two groups (n = 30 each). Group B received a caudal injection of bupivacaine 2.5 mg/ml, 1 ml/kg; Group BD received the same dose of bupivacaine mixed with dexmedetomidine 1 microg/kg during sevoflurane anesthesia. Processed electroencephalogram (bispectral index score), heart rate, blood pressure, pulse oximetry and end-tidal sevoflurane were recorded every 5 min. The characteristics of emergence, objective pain score, sedation score and quality of sleep were recorded post-operatively. Duration of analgesia and requirement for additional analgesics were noted. The end-tidal sevoflurane concentration and the incidence of agitation were significantly lower in the BD group (P < 0.05). The duration of analgesia was significantly longer (P < 0.001) and the total consumption of rescue analgesic was significantly lower in Group BD compared with Group B (P < 0.01). There was no statistically significant difference in hemodynamics between both groups. However, group BD had better quality of sleep and a prolonged duration of sedation (P < 0.05). It concluded caudal dexmedetomidine seems to be a promising adjunct to provide excellent analgesia without side effects over a 24-h period. It has the advantage of keeping the patients calm for a prolonged time[2]. Xiang Q, Huang DY, Zhao YL, Wang GH, Liu YX, Zhong L, Luo T evaluated Sixty children aged 12-72 months undergoing unilateral inguinal hernia repair. They were randomly assigned to receive either bupivacaine 0.25% (1 ml kg(-1); Group B) or bupivacaine plus dexmedetomidine (1 μg kg(-1); Group BD). The response to hernial sac traction was defined as an increase in heart rate or systolic arterial pressure by >20%, and was treated with ketamine rescue (2 mg kg(-1)). After the surgery, fentanyl was administered as needed with a nurse-controlled analgesia pump. Only one subject in Group BD (3.33%) needed ketamine rescue, as opposed to 13 subjects in Group B (43.33%; P<0.001). The first fentanyl injection occurred at a much later time point in Group BD (median: 860 vs 320 min in Group B; P<0.001). Total consumption of fentanyl was significantly lower in Group BD [2.5 (1.2) vs 6.9 (1.6) μg kg(-1) 24 h(-1) than in Group B; P=0.008].It concludes that addition of dexmedetomidine to caudal bupivacaine could reduce the response to hernial sac traction, and prolong the duration of postoperative analgesia in children undergoing inguinal hernia repair[3].

Material and Methods:
This study was conducted at Basaveshwar teaching and general hospital attached to Mahadevappa Rampure Medical College, Gulbarga from December 2011 to July 2012.This study included 60 children, of either sex, coming for various elective infra-umbilical surgical procedures such as herniotomies, circumcision, orchidopexy, perineal surgeries and minor lower extremity procedures.

Inclusion criteria:
- Age group of 2-10 yrs
- ASA grade I and II
- Patients coming for elective infraumbilical surgeries

Exclusion criteria:
- ASA grade III and IV
- Infection at the site of injection
- Coagulopathy or anticoagulation
- Congenital abnormalities of lower spine and meninges
- Active disease of the CNS
- History of allergy to local anaesthetics

Results:

Table 1: Changes in Heart Rate

Time interval (min)	Group A Mean ± SD	Group B Mean ± SD	Mean difference	P value	Significance
Baseline	93.27±6.2	91.47±6.8	1.8	0.28	NS
0	93.4±6.3	91.4±5.97	2	0.21	NS
5	93.4±6.6	92.2±6.4	1.2	0.49	NS
15	97.27±6.04	89.1±13.6	8.2	0.004	Significant
30	96.47±6.1	93.13±8.8	3.3	0.09	NS
45	94.2±6.24	92.8±5.5	1.4	0.37	NS
60	93±5.98	90.47±6,7	2.5	0.12	NS
120	*90*.33±6.2	90.27±7	0.06	0.97	NS
180	90.13±6.57	89.47±6.08	0.66	0.68	NS

In group A, the mean baseline heart rate was 93.27 ± 6.2 per minute which increased to 93.4 ± 6.6 at 5 min. The heart rate gradually decreased to 90.13 ± 6.57 per minute at 180 minutes. The mean baseline heart rate in group B was 91.47 ± 6.8 per minute which increased to 92.2 ± 6.4 at 5 minutes and suddenly decreased to 89.1± 13.6 at 15 minutes and then increased to 93.13±8.8 at 30 minutes after treatment with atropine and gradually decreased to 89.4 ± 6 at 60 at 180 minutes. There was significant difference in the heart rate between the two groups AT 15 min ($p<0.05$),bradycardia observed in group B was amenable to treatment with atropine and no significant difference in other time interval ($p > 0.05$).

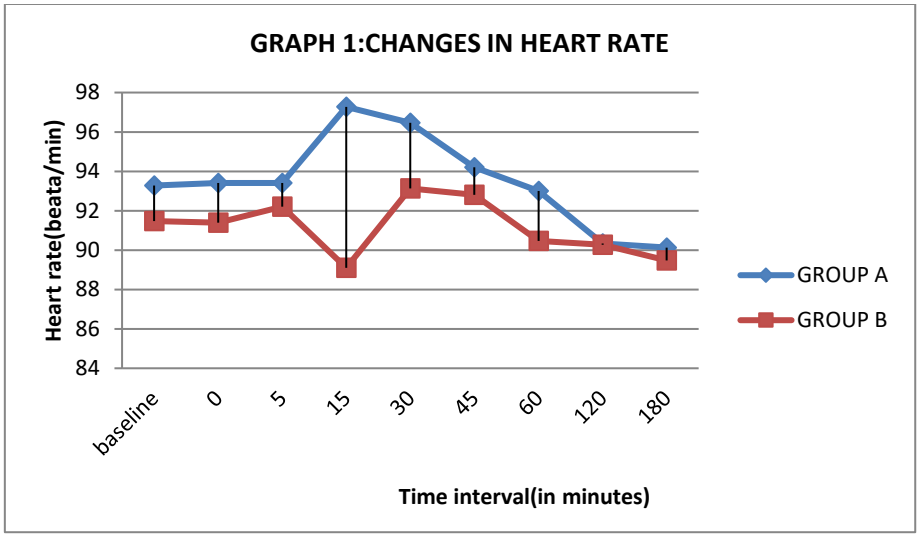


Table 2 : Changes in Systolic Blood Pressure

Time interval(min)	Group A Mean ± SD	Group B Mean ± SD	Mean difference	P value	significance
Baseline	97.87±5.4	98.6±4.1	0.8	0.55	NS
0	98.3±4.9	98.6±4.1	0.3	0.82	NS
5	98.6±5.15	99.3±4.4	0.7	0.59	NS
15	95.3±4.3	97.4±4.1	2.1	0.055	NS
30	95.4±4	96.1±4.6	0.7	0.52	NS
45	96±4	96.5±4.4	0.5	0.72	NS
60	96.8±4.7	96.7±4.7	0.1	0.96	NS
120	97.7±5.2	97.1±4.9	0.6	0.65	NS

The mean baseline systolic blood pressure was 97.8 ± 5.4 mm Hg in group A. It increased to 98.6 ± 5.15 mm Hg at 5 min and then gradually decreased to 97.7 ± 5.2 mm Hg at 120 minutes. In group B, the mean baseline systolic blood pressure was 98.6 ±4.1 mm Hg, which increased to 99.3 ± 4.4 mm Hg at 5 minutes and then gradually decreased to 97.1 ± 4.9 mm Hg at 120 minutes. At all time interval, the p value was > 0.05 and hence the differences in the systolic blood pressure were insignificant at all time intervals. Changes in systolic blood pressure.

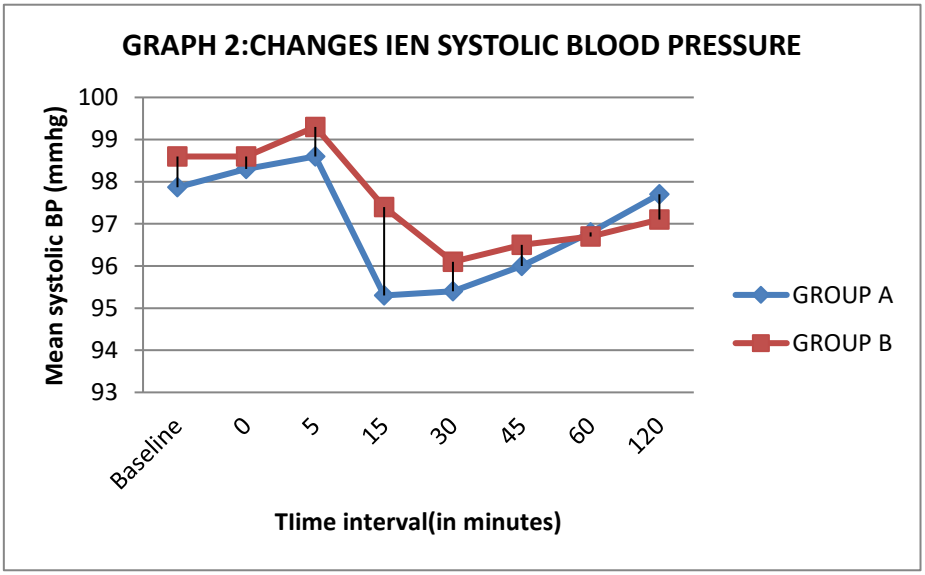


Table 3 : Changes in Diastolic Blood Pressure

Time interval (min)	Group A Mean ± SD	Group B Mean ±SD	Mean difference	P value	Significance
Baseline	59.5 ±3.7	61.3 ±3.8	1.8	0.06	NS
0	59.5 ±3.7	61.5 ±3.7	2	0.32	NS
5	59.9 ±4	61.8 ±4.2	1.9	0.07	NS
15	58.4 ±3.8	60 ±4.3	1.6	0.12	NS
30	57.2 ±3.7	59.2 ±4.6	2	0.06	NS
45	57.5 ±3.4	58.8 ±3.9	1.3	0.17	NS
60	57.8 ±3.4	59.6 ±3.7	1.8	0.05	NS
120	59.4 ±3.3	60 ±3.7	0.6	0.49	NS
180	59.6 ±3.5	60.3 ±3.4	0.7	0.39	NS

The mean baseline diastolic blood pressure in group A was 59.5 ± 3.7 mm Hg which increased to a maximum of 59.9 ± 4 mm Hg at 5 minutes and gradually decreased to 59.6 ± 3.5 mm Hg at 180 minutes. In group B the mean baseline diastolic blood pressure was 61.3 ± 3.8 mm Hg, increased to 61.8 ± 4.2 mm Hg at 5 minutes and progressively declined to 60.3 ± 3.4 mm Hg at 180 minutes. There was no significant difference in the diastolic blood pressure (p>0.05) at any of the time intervals,

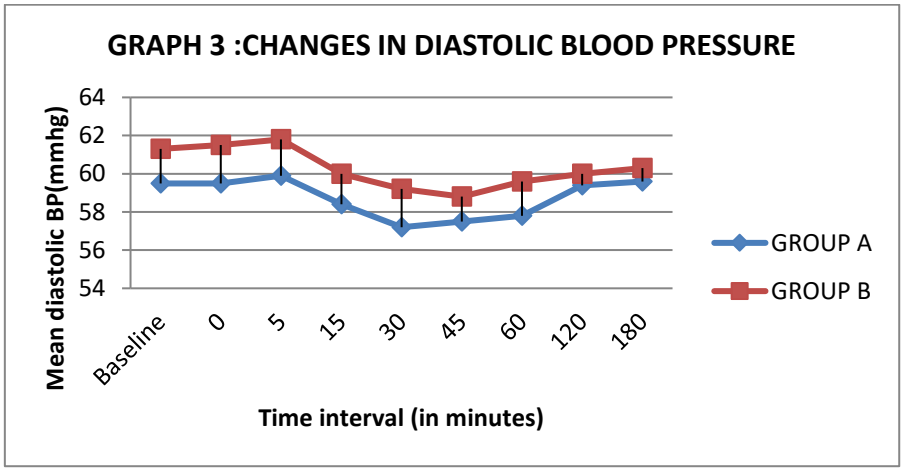


Table 4 : Changes in Respiratory Rate

Time interval(min)	Group A Mean ±SD	Group B Mean ±SD	Mean difference	P value	Significance
Baseline	23.9±1.9	24.6±3.1	0.7	0.28	NS
0	23.9±1.9	24.6±3.1	0.7	0.28	NS
5	23.8±1.9	25±3.9	1.2	0.12	NS
15	22.7±2.2	24.3±4.4	0.6	0.08	NS
30	22.5±2.2	23.6±3.8	1.1	0.09	NS
45	22.5±1.9	23.3±2.4	0.8	0.17	NS
60	22.6±2	23±2.3	0.4	0.36	NS
120	21.8±1.5	22.5±2.5	0.7	0.14	NS
180	21.8±1.5	22.5±2.3	0.7	0.19	NS

In group A the mean baseline respiratory rate was 23.9 ± 1.9 per min; it gradually decreased to 21.8 ± 1.5 per min at 180 min. The mean baseline respiratory rate in group B was 24.6± 3.1 per min which increased to 25 ± 3.9 per min at 5 min and reduced to 22.5 ± 2.3 per min at 180 min. The difference in the respiratory rate between the two groups was statistically not significant (p > 0.05) at any time interval.

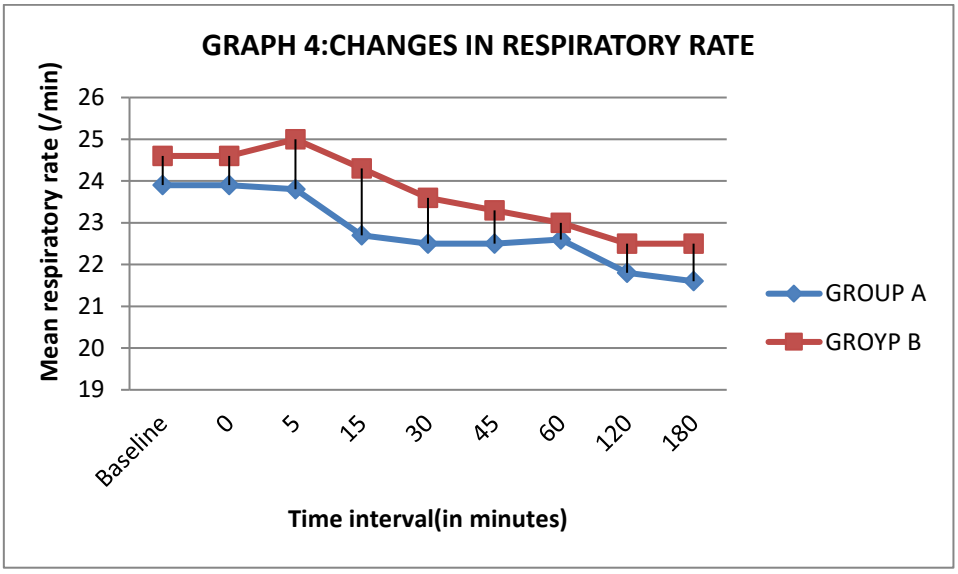
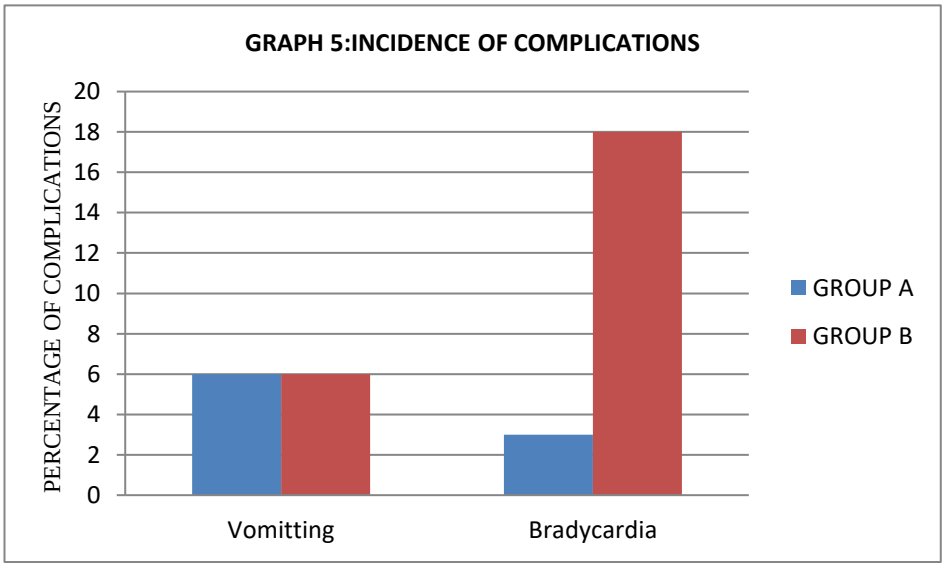


Table 5: Incidence of Complications

Complications	Group A	Group B
Hypotension	0	0
Bradycardia	1(3%)	6(18%)
Vomitting	2(6%)	2(6%)
Dural puncture	0	0
Blood vessel puncture	0	0
Pruritis	0	0
Respiratory depression	0	0

The incidence of nausea and vomiting was among 2(6%) children in group A compared to 2(6%) in group B. This was not statistically significant. The incidence of bradycardia was among 1(3%) and 6(18%) children in group A and group B respectively p value is 0.044 which is less than 0.05 and is statistically significant. There was no incidence of hypotension, dural or vessel puncture and respiratory depression in the two groups. The incidence of vomiting and bradycardia.



Discussion:

Concentration and dosage of the drug:

Gunter JB et al[4] have reported that 0.175% bupivacaine offered the best combination of effectiveness and rapid recovery and discharge for paediatric surgical outpatients. Armitage [5] has recommended 0.25% bupivacaine in a dose of 0.5 ml/kg lumbosacral, 1 ml/kg for thoraco-lumbar 1.25 ml/kg for mid-thoracic level of block and the plasma bupivacaine levels were always below 1.2µg/ml, which was below toxic levels. However, Cook B et al[6] used 0.25% bupivacaine (1ml/kg) for paediatric herniotomy and orchidopexy respectively, as a single shot caudal block. In our study also, we have used a single dose of 0.25% bupivacaine (1ml/kg). Higher concentration can produce motor blockade in the immediate post-operative period and delay discharge. Since all the patients are monitored for 24 hours postoperatively in our hospital, 0.25% bupivacaine was used for post-operative analgesia. A number of papers on the use of caudal dexmedetomidine have been published over the past 10 years focusing primarily on the quality of analgesia obtained with local anaesthetics. Saadawy IBoker A and colleagues found that the mean duration of post-operative analgesia with caudal bupivacaine 0.25% (1ml/kg) was significantly increased by addition of dexmedetomidine 1µg/kg compared with plain bupivacaine.[7] Ghada Foud El-Baradey [8] used dexmedetomidine (2µg/kg) with bupivacaine 0.25% (1ml/kg) caudally in children aged 1-9 years for inguinal herniotomy surgeries.caudal dexmedetomidine was very effective adjunct to bupivacaine as it prolongs duration of post operative analgesia and sedation.In our study, we chose 0.25% bupivacaine which provides better quality of analgesia when compared to lower concentrations and dexmedetomidine 1µg/kg which prolongs the duration of analgesia significantly while avoiding the side effects like excessive sedation associated with higher doses.

Changes in hemodynamic parameters :

In the present study, heart rate and blood pressure of all the patients were monitored at regular intervals. The mean baseline heart rate was similar in both groups. The mean baseline rate was 93.27 ± 6.2 per minute in group A and 91.47 ± 6.8 per min in group B. Initially there was slight increase in heart rates to 93.4 ± 6.6 and 92.2 ± 6.4 at 5 minute respectively in both the groups. This might be attributed to the premedication with atropine and the surgical procedure itself. On commencement of action of caudal block at 15 minutes the heart rate dropped to 89.1±13.6 in group B and not much change but slight increase in heart rate 97.3±6 in group A. Bradycardia observed in group B was amenable to treatment with atropine. Then there was gradual decrease in mean heart rate in both groups. The mean heart rate was 90 ± 1.3 in group A and 89.4 ± 6 in group B at 180 minutes. Except the sudden decrease in mean heart rate at the point of commencement of caudal action at 15 minutes in group B and it was amenable to treatment there was no significant difference in the heart rates between the two groups at any time interval. There was no significant difference in the blood pressure (both systolic and diastolic) between the two groups at any time interval. The mean baseline systolic blood pressure was 97.87 ± 5.4 mm Hg in group A and 98.6 ± 4.1mm Hg in group B. After an initial rise at 5 minutes, there was a gradual fall in the systolic blood pressure to 97.7 ± 5.2 mm Hg and 97.1 ± 4.8 mm Hg at 120 minutes in group A and B respectively which was only0. 2% and 1.5% below the baseline. The mean baseline diastolic blood pressure was 59.47 ± 3.6 mm Hg in group A and 61.27 ± 3.8 mm Hg in group B. It gradually decreased to 59.37 ± 3.3 and 60 ± 3.6 mm Hg at 120 min after an initial rise at 5 minutes which could be due to surgical procedure itself. There was no incidence of hypotension in both the groups. Bradycardia was seen in group B 6 out of 30 patients which were treated with atropine.Hazeem M,Fowzi MD and Waleed A[9] reported minimal hemodynamic affection in the form of bradycardia. Vijay G Anand[10] and EL-Hennaway AM[11]reported no significant change in hemodynamics.

Changes in respiratory parameters:

In the present study, no significant difference in the respiratory rate between the two groups was observed. There were no cases of respiratory depression in patients of either group as evidenced by a fall in the respiratory rate of less than 10 breaths per minute or a fall in the oxygen saturation of less than 90%. Dexmedetomidine does not suppress respiratory function, even at high doses.[12] It has no adverse effects on respiratory rate and gas exchange. Koroglu A, Demirbilek S, Teksan H, Sagir O, But AK, Ersoy MO[13] in their study showed Dexmedetomidine provided adequate sedation in most of the children aged 1-7 yr without hemodynamic or respiratory effects during MRI procedures.

Complications:

In our study, 2 children in group A and group B had an episode of vomiting which was treated with Inj Metaclopramide (0.1 – 0.2 mg/kg) IV. The incidence of vomiting was similar in both the groups, 6% in both groups. 1 of the children in group A and 6 of the children in group B had bradycardia which was treated with atropine 0.01mg/kg. There was significant difference in incidence of bradycardia in both groups, 3% in group A and 18% in group B.

Conclusion

The addition of dexmedetomidine to bupivacaine in our study resulted in an increase in bradycardia warranting treatment and did not show other side effects. The main side-effects of epidurally administered dexmedetomidine are bradycardia, hypotension and sedation. In our study, hypotension warranting treatment did not occur. Sedation, correlated well with the duration of analgesia.

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