ORIGINAL RESEARCH   **MONITORED ANESTHESIA CARE**

Dexmedetomidine for monitored anesthesia care for sub-dural hematoma evacuation

Kurinchi Raja[1], Rammoorthi Rao[2], Sunil Baikadi Vasudevarao[3]

1-kurinchiraja60@gmail.com{ORCID: 0000-0001-9347-5483}

2-Associate professor, rammoorthi30@gmail.com {ORCID: 0000-0001-8647-2081}

3-Associate professor, drsunilbv@gmail.com {ORCID: 0000-0002-8326-8605}

Department of Anesthesia & Intensive Care, KMC Hospital, Ambedkar Circle, Attavar, Mangalore, Karnataka 575001, India.
Correspondence: Sunil Baikadi Vasudevarao; E-mail: drsunilbv@gmail.com; Phone: 09620178559

Abstract

Background & objective: We studied the safety and effectiveness of combination of dexmedetomidine and fentanyl for chronic sub-dural hematoma (CSDH) evacuation. Main objectives of the study were to register the effects on the combination on the cardio-respiratory and analgesic outcome.

Methodology: 56 patients with CSDH were divided into two group. Patients of Group A received dexmedetomidine 1 µg/kg over a period of 10 min with fentanyl 1 µg/kg, followed by an infusion of dexmedetomidine 0.3 µg/kg/min. Group B received fentanyl 1 µg/kg and midazolam 0.03 mg/kg IV. Sedation scores, hemodynamic changes and serial arterial blood gas (ABG) measurements were compared between the two groups.

Results: Heart rate and diastolic blood pressure were significantly lower in Group A compared to Group B throughout the observation period after premedication. Systolic blood pressure readings were significantly lower in Group A compared to Group B from 10 min onwards till the end. ABG analysis showed that Group A had significantly lower PCO_2 levels during and at the end of surgery and significantly higher PO_2 at the end of procedure.

Conclusion: The use of dexmedetomidine is associated with significantly higher PO_2 at the end of the surgical procedure. It results in lower heart rate, systolic and diastolic blood pressures and PCO_2 levels during and at the end of the subdural hematoma evacuation, but the fall remains within the physiological range.

Key words: Dexmedetomidine; Fentanyl; Monitored anesthesia care; Subdural hematoma

1. Introduction

Evacuation of chronic subdural hematoma (CSDH) is one of the most commonly performed procedure in neurosurgery. CSDH is quite frequent among elderly patients who often have age related co-morbidities. General anesthesia for CSDH evacuation is associated with an increased hospital stay in this particular patient group.[1] Surgery under local anesthesia has some disadvantages, like movements by an uncomfortable, uncooperative patient during the procedure. Currently,

CSDH evacuation is being done under monitored anesthesia care at many centers, and its efficacy and safety has been proven by several studies.[2]

During neurosurgery, it is important to maintain optimal operating conditions and stable cerebral and central hemodynamics, especially avoiding sudden increase in intracranial pressure or acute swelling of brain. Rapid recovery from anesthesia is most essential for immediate postsurgical neuro-evaluation, and during this period any sudden increase in BP can sometimes result in post-op hematoma formation.[3]

Opioids prevent hemodynamic response to intubation and extubation; but can cause respiratory depression, hypercapnia, and raised intracranial pressure.[4]

Alpha 2-Adrenergic agonists have been used predominantly for their sympatholytic, sedative, anesthetic sparing and hemodynamic stabilizing properties.[5] There are many beneficial effects of dexmedetomidine in neuroanesthesia. Dexmedetomidine has shown analgesic effects without causing significant respiratory depression.[6] Pre-operative use of dexmedetomidine provides hemodynamic stability, reduces intraoperative opioid requirements, and has beneficial effects in terms of neuronal protection.[7,8] A study in traumatic brain injury patients showed dexmedetomidine produces good sedation without causing any adverse cerebral physiological effects.[9]

For evacuation of CSDH numerous agents like sufentanil, fentanyl, midazolam, dexmedetomidine, propofol, and local anesthetics (LA) have been used under monitored anesthesia care.[1,10-12] We compared the mixture of fentanyl, dexmedetomidine and LA infiltration, with fentanyl, midazolam and LA infiltration in elderly patients with associated comorbids regarding the effect of dexmedetomidine and fentanyl combination on hemodynamics, arterial PO_2 and PCO_2 levels.

2. Methodology

This prospective observational parallel study was done during December 2014 to August 2016. The sample size was calculated using the formula –

n= 2(Zα+Zβ)2x σ2

 d2

Where Zα = 1.96 (with 95% confidence interval), Zβ = 1.28 (with 90% power), σ= SD, d= Mean difference

56 ASA class 1, 2 and 3 patients, ages 18 - 80 y, posted for CSDH evacuation were selected for the study after approval by ethical committee. Pregnant women, patients with low pre-operative HR (< 50/min), active respiratory illness, uncontrolled diabetes mellitus, uncontrolled hypertension, patients on clonidine treatment, and heart block, were excluded from study.

During the pre-anesthetic evaluation, the anesthetic procedure was explained to the patient to alleviate anxiety. Routine laboratory investigations included hemoglobin, complete blood count, urine analysis, blood random sugar, blood urea and serum creatinine. ECG, chest x-ray and coagulation profile.

An informed written consent for anesthesia was obtained. A fasting for 6 h was advised with pantoprazole 40 mg and inj. ondansetron 4 mg one hour before the procedure. Routine monitors were used. An intravenous cannula and arterial cannula were inserted for drug/fluid administration (Ringer's lactate) and ABG samples, respectively. Baseline values for heart rate (HR), respiratory rate (RR), oxygen saturation, systolic blood pressure (SBP), diastolic blood pressure (DBP) were recorded. Baseline ABG sample was taken and oxygen through face mask (6 L/min) was started. Preloading with ringer lactate (10 ml/kg) was done before premedication.

GCS was measured and recorded before giving medication to the patient and after completion of surgery. Patients were given a sedation score on the basis of Richmond Agitation Sedation Scale (RASS) immediately before premedication and every 5 min till 25 min and at the end of the procedure. It is a 10-point scale with 4 stages of agitation and 5 stages of sedation along with a calm, alert state (0 point).

Three ABG recordings were done during the study. One before giving medication, second during the procedure (around 30 min after premedication) and the third at the end of procedure. PCO_2, PO_2, pH, and bicarbonate levels were noted and compared between the groups (Table 1). The patients were divided into two groups by block randomization.

Group-A: received 1 µg/kg fentanyl + 1 µg/kg bolus dose of dexmedetomidine over 10 min and then 0.3 µg/kg/h infusion.

Group-B: received 1 µg/kg fentanyl + 0.02 mg/kg midazolam

Additional doses of fentanyl 1 µg/kg were given when the patient showed signs of pain/excessive movement. Number of additional fentanyl doses given in each group was noted. Hypotension (< 30% fall in BP) or bradycardia (HR < 40/min) was treated with inj. mephentermine 6 mg or inj. atropine 0.6 mg IV. A fall in oxygen saturation or prolonged apnea was noted and treated appropriately.

After medication, the HR, BP, RR, and sedation score

Table 1: shows arterial blood gas values in Group A and B

Parameter	Timing	Group A (Mean ± SD	Group B (Mean ± SD)	t value	p
$cHCO_3$ (mmol/L)	Before premedication	23.443 ± 1.877	21.486 ± 1.476	4.34	< 0.001**
	During the procedure	23.225 ± 1.777	23.418 ± 1.990	.38	.704
	At the end of the procedure	22.957 ± 1.670	24.493 ± 1.685	3.43	.001**
pCO_2 (mmHg)	Before premedication	36.250 ± 4.006	38.196 ± 2.492	2.74	.098
	During the procedure	37.014 ± 4.514	41.032 ± 4.271	3.42	.001**
	At the end of the procedure	38.079 ± 3.207	43.700 ± 3.930	5.86	< 0.001**
pH	Before premedication	7.411 ± .033	7.402 ± .047	.82	.414
	During the procedure	7.379 ± .049	7.379 ± .035	.01	.995
	At the end of the procedure	7.374 ± .022	7.359 ± .024	2.41	.020*
pO_2 (mmHg)	Before premedication	98.818 ± 32.716	112.286 ± 4.153	3.60	.081
	During the procedure	240.989 ± 62.604	226.214 ± 23.651	1.17	.248
	At the end of the procedure	181.879 ± 34.936	157.679 ± 9.787	3.53	.001**

*p-value = significant; **p-value = highly significant*

using the above-mentioned scales were noted every 5 min till 25 min and at the end of the procedure. Local anesthetic infiltration was given to all patients before starting surgery. The wincing/movement of the patient when the surgeon infiltrates the LA was also looked for. In the postoperative recovery area GCS was assessed and documented.

Data were collected about demography, sedation, hemodynamics, arterial blood gas values, duration of surgery, additional fentanyl requirement and GCS score; and compared between the groups. Proportions were compared using Chi-square test of significance. The students' 't' test was used to determine whether there was a statistical difference between the groups in the parameters measured. A p < 0.05 was accepted as statistical significance. IBM SPSS Statistics version 17 was used for this purpose.

3. Results

3.1. Demography: The mean age in Group A was 69.29 ± 8.9 y and in Group B was 67.14 ± 7.4 y, which is not significant (p = 0.332). The mean weight in Group A was 61.46 ± 6.3 kg and in Group B was 59.86 ± 7.1 kg which was statistically not significant (p = 0.376). Respiratory rate and oxygen saturation measured by pulse oximetry was comparable in both group without any significance (p > 0.05)

3.2. Sedation score: There was no significant difference in the sedation score between the two groups before premedication. However the sedation score was higher and and statistically highly significant in Group A compared to B at 15(p < 0.001)min,20 min(p = 0.004) and higher in Group B at the end of the procedure (p < 0.001).No significant difference was observed at 5min(p = 0.174), 10 min (p = 0.098) and 25 min (p = 0.322) after premedication between the two groups.

3.3. Heart rate: No significant difference in the heart rate between the two groups was found before premedication. However, the heart rate difference was statistically highly significant (p < 0.001) in Group A compared to Group B throughout the observational period after premedication from 5 min till 25 min and at the end of the procedure.

3.4. SBP: There was no significant difference in the SBP between the two groups before premedication (p = 0.151) and at 5 min (p = 0.263) after premedication. However, the SBP was statistically significant in Group A compared to Group B at 10 min (p = 0.022) after medication and highly significant (p < 0.001) throughout the rest of the observational period from 10 min till 25 min after premedication and at the end of the procedure.

3.5. DBP: No significant difference in the DBP was found between the two groups before premedication (p = 0.104). However, the DBP was statistically highly significant (p < 0.001) in Group A compared to Group B throughout the observational period after premedication from 5 min till 25 min and at the end of the procedure.

3.6. Arterial blood gas analysis: Analysis was done before premedication, during the procedure and at the end of the procedure. From the above data, the arterial blood gas analysis shows a highly significant difference with respect to PCO2 during the procedure (p = 0.001) and at the end of the procedure (p < 0.001). There was no significant difference with respect to PH before premedication (p = 0.414), during the procedure (p = 0.995) but significant at the end of the procedure (p = 0.020). The cHCO3 values showed a highly significant difference (p < 0.001) between the groups before premedication and at the end of the procedure whereas there was no significant difference (p = 0.704) with respect to those values during the procedure. PO_2 values showed highly significant difference only at the end of procedure (p = 0.001).

3.7.   **Wincing while giving LA infiltration**: In Group A, out of 28 patients only 6 had wincing during the local anesthetic infiltration by the surgeon i.e. 21.4%;however, in Group B, out of 28 patients, 13 had wincing during the local anesthetic infiltration by the surgeon i.e. 46.4% which was statistically significant (X2=3.9, p = .048, sig). Six patients in Group B received additional fentanyl (1 µg/kg, p = 0.001) whereas no one in Group A received fentanyl. Duration of surgery in Group A was 57.6 ± 14.2 min, whereas in Group B it was 69.7 ± 17.8 min, which was statistically significant between the groups (p = 0.012). The Glasgow coma scale scores of all the patients in both the groups were invariably found to be the same before and after the procedure.

4. Discussion

Dexmedetomidine is effectively being used in ICU and OT settings as a sedative, analgesic and anxiolytic. In this study sedation score was significant better (p < 0.001) in Group A compared to B at 15 min, 20 min after premedication and in Group B at the end of the procedure. Additional fentanyl consumption in 6 patients in Group B may be the reason for this. Study done by Rohini Surve et al. compared use of dexmedetomidine vs general anesthesia for CSDH evacuation and found recovery was considerably early in the dexmedetomidine group compared to GA.[1] Bishnoi V et al. compared infusion of dexmedetomidine with fentanyl, midazolam combination and found early recovery in dexmedetomidine group.[11]

Various studies have shown that dexmedetomidine causes bradycardia and lowers BP.[13,14] In our study the heart rate was significantly lower in Group A (p < 0.001) compared to Group B throughout the observational period after premedication.[16,17] The SBP was significantly low (p < 0.022) in Group A compared to Group B 10 min after medication; and highly significant (p < 0.001) throughout the rest of the observational period. The DBP was significantly (p < 0.001) lower in Group A compared to Group B throughout the observational period. Observations made in this study showed that the patients in Group A were hemodynamically stable throughout the procedure. There was no incidence of bradycardia or hypotension during the study period probably due to preloading in all patients. These outcome on HR and SBP/DBP were similar to the observations of Srivastava VK et al.[12] They observed lower mean HR, and MAP in dexmedetomidine group in comparison to preoperative values.

ABG analysis revealed a progressive rise of both PO_2 and PCO_2 levels in both the groups. In Group A mean PCO_2 level was 38.07 ± 3.2 at the end of procedure as compared to Group B [43.7 ± 3.9 (p < 0.001)], which was statistically highly significant. Group A showed mean PO_2 levels of 181.87 ± 34.9 at the end of procedure as compared to Group B [157.67 ± 9.8 (p < 0.001)], which was statistically highly significant. This is in agreement with the article on current role of dexmedetomidine by Kaur M et al.[5] They mentioned about a rise of PCO_2 level following intravenous dexmedetomidine with the preservation of hypercapnic ventilator response in healthy volunteers. Su Hyun et al. observed significantly higher PO_2/FiO_2 ratios in patients who received dexmedetomidine patients.[15] Contradicting to these studies Lodenius A et al. observed sedation by dexmedetomidine do reduce hypoxic and hypercapnic response of ventilation.[16] In our study pH was comparable at baseline and intraoperative period but the difference was statistically significant at the end of the procedure (p = 0.02).

In Group A, out of 28 patients only 6 had Wincing on the local anesthetic infiltration by the surgeon was observed in more patients in Group B as compared to Group A (X2=3.9, p=.048, sig). Additional fentanyl requirement was higher in Group B than in Group B. Wang W et al. observed rescue fentanyl requirement

was higher in group which received dexmedetomidine 0.5 µg/kg over 10 min compared to those who received dexmedetomidine 1µg/kg or sufentanil 0.3 µg/kg over 10 min.[10]

Surgical duration in Group A was 57.6 ± 14.2 min vs. 69.7 ± 17.8 min in Group B. It is probably due to less movement and comfortable patient during the procedure. Srivastava et al. also observed more surgeon satisfaction in dexmedetomidine group but patient opinions were similar in both the groups.[12]

The Glasgow Coma Scales before and after the procedure were found to be the same in both groups, thus proving that both these sedative agents had no role in the GCS grading of the patients.

5. Conclusion

We conclude that dexmedetomidine added to fentanyl along with infiltration of local anesthesia for surgeries for chronic sub-dural hematoma burr hole evacuation helps in hemodynamic and respiratory stability with lesser fentanyl consumption during the procedure. PO_2 level remains significantly higher at the end of procedure. Hemodynamic parameters are lowered but within physiological range but central ventilatory drive is maintained when used with small dose of fentanyl.

Conflicts of interest: None declared by the authors.

Authors'contribution: KR: Conduct of study work

RR: concept

SBV: manuscript editing

6. References

1. Surve RM, Bansal S, Reddy M, Philip M. Use of dexmedetomidine along with local infiltration versus general anesthesia for burr hole and evacuation of chronic subdural hematoma. J Neurosurg Anesthesiol. 2017;29(3):274-280. [PubMed] DOI: 10.1097/ANA.0000000000000305
2. Lin N, Vutskits L, Bebawy JF, Gelb AW. Perspectives on Dexmedetomidine Use for Neurosurgical Patients. J Neurosurg Anesthesiol. 2019 Oct;31(4):366-377. [PubMed] DOI: 10.1097/ANA.0000000000000554
3. Velly LJ, Simeone P, Bruder NJ. Postoperative care of neurosurgical patients. Curr Anesthesiol. 2016;6(3):257-266. DOI: 10.1007/s40140-016-0175-4
4. Flower O, Hellings S. Sedation in Traumatic Brain Injury. Emerg Med Int. 2012;2012:637171. [PubMed] DOI: 10.1155/2012/637171
5. Kaur M, Singh PM. Current role of dexmedetomidine in clinical anesthesia and intensive care. Anesth Essays Res. 2011;5(2):128-133. [PubMed] DOI: 10.4103/0259-1162.94750
6. Giovannitti Jr JA, Thoms SM, Crawford JJ. Alpha-2 adrenergic receptor agonists: A review of current clinical applications. Anesth Prog. 2015;62(1):31-38. [PubMed] DOI: 10.2344/0003-3006-62.1.31
7. Tang C, Xia Z. Dexmedetomidine in perioperative acute pain management: A non-opioid adjuvant analgesic. J Pain Res. 2017;10:1899–1904. [PubMed] DOI: 10.2147/JPR.S139387
8. Lee S. Dexmedetomidine: present and future directions. Korean J Anesthesiol. 2019 Aug;72(4):323-330. [PubMed] DOI: 10.4097/kja.19259
9. James ML, Olson DM, Graffagnino C. A pilot study of cerebral and haemodynamic physiological changes during sedation with dexmedetomidine or propofol in patients with acute brain injury. Anaesth Intensive Care. 2012;40(6):949-573. [PubMed] DOI: 10.1177/0310057X1204000605
10. Wang W, Feng L, Bai F, Zhang Z, Zhao Y, Ren C. Safety and efficacy of dexmedetomidine vs sufentanil in monitored anesthesia care during burr hole surgery for chronic subdural hematoma: A retrospective clinical trial. Front Pharmacol. 2016;7:410. [PubMed] DOI: 10.3389/fphar.2016.00410
11. Bishnoi V, Kumar B, Bhagat H, Salunke P, Bishnoi S. Comparision of dexmedetomidine versus midazolam fentanyl combination for monitered anesthesia care during burrhole surgery for chronic subdural hematoma. J Neurosurg Anesthesiol. 2016;28(2):141-146. [PubMed] DOI: 10.1097/ANA.0000000000000194
12. Srivastava VK, Agarwal S, Kumar S, Khan S, Sharma S, Kumar R. Comparative evaluation of dexmedetomidine and propofol along with scalp block on hemodynamics and postoperative recovery for chronic subdural hematoma evacuation under monitored anesthesia care. Turk J Anesthesiol Reanim. 2018;46:51-56. [PubMed] DOI: 10.5152/TJAR.2018.16878
13. Imabayashi T, Ikoma K, Kikuchi T, Kakihana Y, Kanmura Y. Heart rate variability during infusion of dexmedetomidine. Crit Care. 2011;15(1):P352. DOI: 10.1186/cc9772
14. Zhang X, Wang R, Lu J, Jin W, Qian Y, Huang P, et al. Effects of different doses of dexmedetomidine on heart rate and blood pressure in intensive care unit patients. Exp Ther Med. 2016;11(1):360-366. [PubMed] DOI: 10.3892/etm.2015.2872
15. Lee SH, Kim N, Lee CY, Ban MG, Oh YJ. Effects of dexmedetomidine on oxygenation and lung mechanics in patients with moderate chronic obstructive pulmonary disease undergoing lung cancer surgery: A randomised double-blinded trial. Eur J Anaesthesiol. 2016 Apr;33(4):275-282. [PubMed] DOI: 10.1097/EJA.0000000000000405
16. Lodenius A, Ebberyd A, Cedborg AH, Hagel E. Mkrtchian S, et al. Sedation with dexmedetomidine or propofol impairs hypoxic control of breathing in healthy male volunteers: A nonblinded, randomized crossover study. Anesthesiology. 2016;125:700-715. [PubMed] DOI: 10.1097/ALN.0000000000001