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ORIGINAL RESEARCH

Assessment of Alteration in Capnometry Monitoring during Intravenous Sedation with Midazolam for Oral Surgical Procedures

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ABSTRACT

Introduction: Capnography is routinely used for monitoring of patients subjected to sedation for different surgical procedures. There is still paucity of data highlighting the capnographic assessment of patients on midazolam sedation undergoing oral surgical procedures. Hence, we planned the present study to assess the alterations occurring in the end-tidal carbon dioxide ($ETCO_2$) values monitored during intravenous (IV) sedation with midazolam during various oral surgical procedures.

Materials and methods: The present study included assessment of alteration in $ETCO_2$ values occurring during oral surgical procedure. After meeting the inclusion and exclusion criteria, a total of 40 participants were included in the present study. Pulse oximeter with capnograph (EmcoMeditek Pvt., Ltd., India) device was used for assessment of respiratory rate (RR) and $ETCO_2$ values. The mean of 12 readings over a period of 1 minute before the starting of first infusion was referred to as baseline time. By evaluating the first four readings at an interval of 15 seconds during the 1st minute of infusion, we obtained the 1 minute average reading. All the data were compiled and recorded and assessed by the Statistical Package for the Social Sciences (SPSS) software.

Results: A total of 40 participants were included, out of which, 20 were males and 20 were females. At the baseline time, mean value of $ETCO_2$ was 31 mm Hg, while mean value of oxygen saturation (SpO_2) was 36%. Out of total 40 participants, 15 showed the presence of respiratory depression. Out of these 15 participants, $ETCO_2$ changes from baseline were observed in 13 participants.

Conclusion: No oxygen should be delivered, unless until required, to the healthy participants undergoing dental sedation procedures, for marinating the sensitivity of pulse oximetry during assessment of respiratory depression.

Clinical significance: In patients undergoing sedation procedures, various monitoring techniques should be employed as respiratory depression is a commonly encountered risk factor.

Keywords: Capnography, Midazolam, Oral surgery, Sedation.

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INTRODUCTION

There has been drastic tangling in the historical aspect of both anesthesia and dental field ever since the ending of the 19th century.[1] When it comes to respiratory monitoring, a considerable amount of variability exists in various dental procedures being carried out in different dental clinics in relation to the type of anesthesia and analgesia used.[2,3] In the world of modern-day oral surgery, ventilation has been overpowered by oxygenation therapy by the advancements and use of pulp oximetry. One of the techniques that are increasingly becoming popular these days in the field of procedural sedation is capnography.[4] Since there exists a variety of variation in the sedation techniques employed all over different dental clinics, it is difficult to summarize different capnography studies.[5,6] Also, there is paucity of data in the current literature

highlighting the use of capnometry for monitoring the RR of sedated participants undergoing various oral surgical procedures. Hence, we planned the present study to assess the alterations occurring in the $ETCO_2$ values monitored during IV sedation with midazolam during various oral surgical procedures.

MATERIALS AND METHODS

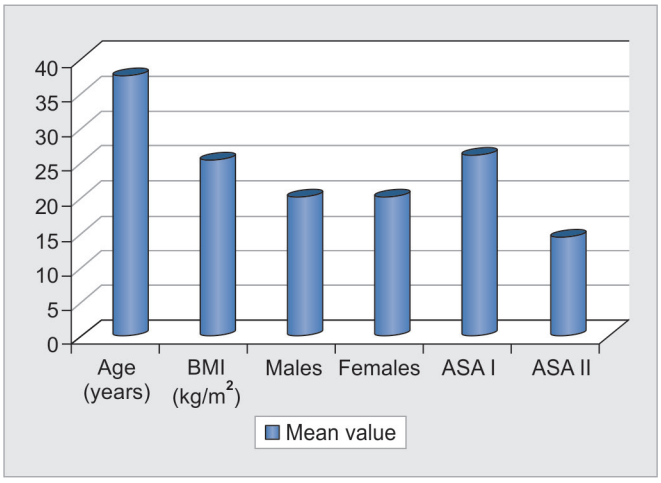
The present study was conducted in the Department of Oral Surgery of the Dental Institute and included assessment of alteration occurring in $ETCO_2$ values during oral surgical procedure. Ethical approval was taken from the Institutional Ethical Committee and written consent was obtained after explaining in detail the entire research protocol. Inclusion criteria for the present study included as follows:

- Patients between the age group of 18 and 60 years
- Patients without history of any systemic illness
- Patients with negative history of any kind of respiratory illness
- Patients with body mass index (BMI) <35 kg/m^2
- Patients without any known drug allergy history
- Patients in whom sedation was indicated for dental procedures due to dental anxiety or due to invasive dental procedure
- Patients undergoing surgical extractions of impacted third molar

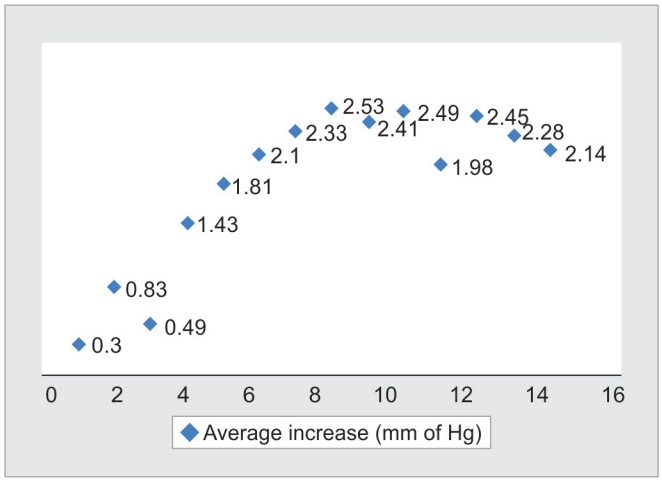
After meeting the inclusion and exclusion criteria, a total of 40 participants were included in the present study. Pulse oximeter with capnograph (EmcoMeditek Pvt., Ltd., India) device was used for assessment of RR and $ETCO_2$ values. Placement of monitoring equipment was done in patients before start of the study. For conducting continuous sampling of carbon dioxide at 50 mL/minute, disposable oral-nasal cannula was attached to the equipment. Routine administration of supplement oxygen was not done in all the patients, until unless required. Pulse oximetry value of <95% was considered as primary outcome measure. When $ETCO_2$ value was more than 50 mm Hg, the patient was said to have been suffering from hypoventilation. Based on the past definitions of following a reduction of 10 mm Hg from the initial baseline values as a measure of atypical ventilation, we defined our criteria of hypoventilation.[7] The $ETCO_2$ values might show decreased pattern during hyperventilation state. This feature might be a common finding in anxious dental patients in which hyperventilation associated with anxiety is a common finding. Before the administration of midazolam, recording of all the values was done followed by capturing of data for a minimum of half an hour after the first infusion. Administration of midazolam was done at a rate of 1 mg/minute until it reached an endpoint. Slurring of speech and drooping of eyelid were the features set for recording the endpoint. Throughout the dental procedure, the clinicians maintained the verbal contact with the patients. All the data were recorded and was transferred to a laptop and was evaluated by SPSS software, version 16.0. The mean of 12 readings over a period of 1 minute before the starting of the first infusion was referred to as baseline time. By evaluating the first four readings at an interval of 15 seconds during the 1st minute of infusion, we obtained the 1 minute average reading. Chi-square test and paired t-test were used for the assessment of level of significance. The p-value <0.05 was taken as significant.

RESULTS

A total of 40 participants were included in the present study. Out of 40 patients, 20 were males and 20 were females. Mean BMI of the patients was 25.2 kg/m^2. Out of 40, 26 patients belonged to American Society of Anesthesiologist (ASA) I and 14 patients belonged to ASA II (Graph 1). When statistical tests were applied for mean alteration in the $ETCO_2$ from the baseline time, we observed significant alteration at 6th, 7th, and 10th minute of time in comparison with baseline time (Graph 2 and



Graph 1: Demographic and clinical details of the patients



Graph 2: Mean alteration in the $ETCO_2$ from baseline

Table 1: Statistical result for mean alteration in the $ETCO_2$ from the baseline time

Time (minutes)	*Average increase (mm Hg)*	*p-value*
1	0.30	0.23
2	0.83	0.25
3	0.49	0.12
4	1.43	0.33
5	1.81	0.25
6	2.10	0.01*
7	2.33	0.02*
8	2.53	0.15
9	2.41	0.09
10	2.49	0.01*
11	1.98	0.81
12	2.45	0.10
13	2.28	0.09
14	2.14	0.27

*Statistically significant value in comparison to baseline value

Table 1; $p < 0.05$). Mean value of $ETCO_2$ at baseline time was 31 mm Hg (Table 2). Mean value of SpO_2 at baseline time was 36%. Out of 40 participants included in the present study, respiratory depression was recorded in 15 participants. Out of these 15 participants, $ETCO_2$ changes from baseline were observed in 13 participants, while 8 participants showed changes in capnography before desaturation (Table 3).

DISCUSSION

Capnometry is a routinely employed noninvasive assessment technique that permits rapid and efficient monitoring of ventilation, circulation, and metabolism.[8] Literature quotes paucity of data and evidence regarding the use of capnometry in oral surgical procedures. Hence, we planned the present investigation for evaluating the changes occurring in the exhaled carbon dioxide during IV sedation in patients undergoing oral surgical procedures.

In the present study, we observed that mean BMI of all patients was 25.2 kg/m^2 (Graph 1). Significant results were obtained while comparing the alteration of $ETCO_2$ at 6th, 7th, and 10th time interval in comparison from the baseline values (Graph 2 and Table 1; $p < 0.05$). Our results were in collaboration with the results obtained by Brady et al[9] who reported similar findings in their study. Mishra et al[10] assessed the effectiveness of IV dexmedetomidine and midazolam in patients undergoing oral surgical procedures. They analyzed a total of 60 participants between the age group of 18 and 65 years and divided them randomly into two study groups. Group IV consisted of patients receiving dexmedetomidine, while Group XIV consisted of patients receiving midazolam. They evaluated SpO_2, RR, systolic blood pressure (SBP), diastolic blood pressure (DBP), Ramsay sedation score, and bispectral index score along with

Table 2: Baseline values of vital signs

Baseline vital signs	*Mean value*
$ETCO_2$ (mm Hg)	31
SpO_2 (%)	36
RR (per minute)	21

Table 3: Respiratory depression in participants of present study

Criteria for respiratory depression	*Patients fulfilling the criterion (n = 15*)*
$ETCO_2$ changes from baseline	13
Changes in capnography before desaturation	8
SpO_2 <95%	15

*15 participants fulfilled the criteria of respiratory depression

other clinical parameters of all patients. They observed that greater amount of amnesia was seen in participants belonging to the midazolam group. They observed comparatively lower heart rate, SBP, and DBP in participants belonging to the dexmedetomidine group. In between the two study groups, they did not observe any significant difference in relation to SpO_2, RR, Aldrete score, and Ramsay sedation score. In addition, more patient preference and relaxation was observed in the dexmedetomidine group. From the results, they concluded that for patients undergoing sedation for oral surgical procedures, in comparison to midazolam, IV dexmedetomidine is a comparable alternative. Collado et al[11] assessed the efficacy of conscious sedation protocols using IV midazolam in pediatric patients with intellectual disability (ID). They further compared them with results obtained from dental anxious (DA) patients. They evaluated a total of 98 and 44 patients with ID and DA, respectively, who were scheduled for IV midazolam. Successful dental treatment and level of cooperation as evaluated by modified Venham scale were the evaluation criteria chosen for the present study. In the ID and DA sessions, the mean IV dose of midazolam administered was 8.8 and 9.8 mg respectively. They observed statistically significant results while comparing the oral/rectal midazolam given as premedication therapy for cannulation in ID and DA groups. For both study groups, they observed 90% success rate of dental treatment. In approximately 16 and 7% of the participants of ID and DA group, respectively, minor adverse effects were observed. It was observed that during cannulation, ID group patients were more disturbed.

In our study, mean value of $ETCO_2$ at baseline time was found to be 31 mm Hg (Table 2). We also observed that 15 participants out of all patients showed presence of respiratory depression (Table 3). Brady et al[9] reported similar percentage of patients in their study suffering from respiratory depression. They evaluated the alterations occurring in $ETCO_2$ levels in patients undergoing oral surgical procedures in which midazolam was

administered IV for sedation. They evaluated a total of 33 participants with mean age of 38 years. They monitored various clinical and respiratory parameters using pulp oximetry, blood pressure along with visual assessment. Monitoring of the patients was done with blind capnometry. By assessing the results obtained by *post hoc* analysis, they observed that capillary saturation of oxygen of >95% was present in 33% of participants. In addition, respiratory depression was present in 30% of the participants of their study. They concluded that significant changes occur in the pulse oximetry which is recognizable by capnometry. Nathan and Vargas[12] evaluated the effect of different dosage of midazolam when used singly or on collaboration with various dosage forms of mepridine while treating pediatric dental patients. They reviewed the data records of 120 uncooperative patients with age ranging from 2 to 4 years and divided them randomly into six study groups with 20 participants in each group. The participants received midazolam in quantity of 0.7 or 1 mg/kg, with or without meperidine in quantity of 1 or 1.5 mg/kg. They recorded the efficacy of sedation, time duration of action, requirement for restraining for accomplishment of treatment, and time duration for recovery. Restraining was most commonly required for participants in which midazolam was given singly at a dose of 0.7 mg/kg. The same study group also suffered from maximum agitation. Oversedation was experienced mostly in participants in which combined dose of both drugs was given. Working time was increased significantly in participants by addition of meperidine. From the results, they concluded that both effectiveness and duration of action of midazolam is enhanced by addition of meperidine in treating difficult young pediatric participants. Fan et al[13] comparatively evaluated the effectiveness of midazolam and dexmedetomidine in participants undergoing various dental procedures. They enrolled a total of 60 participants for their study and recorded all the clinical, personal, and medical data of them. They did not observe any significant difference while comparing the duration of surgical procedure and the quantity of local anesthetic solution required in two study groups. Comparatively slower heart rate was observed in participants of dexmedetomidine group. They concluded that in treating dental patients, both dexmedetomidine and midazolam have approximately equal efficacy.

Capnography can be helpful in patients who need supplemental oxygen. In spite of intense alveolar hypoventilation, supplemental oxygen might avert hypoxemia. In such conditions capnography provide more realistic information. Dental anesthetist should have a variety of alternatives in hand to offer proper sedation.[14,15]

CONCLUSION

Unless until required for marinating the sensitivity of pulse oximetry during assessment of respiratory depression, no oxygen should be administered to the healthy participants undergoing dental sedation procedures. However, we recommend future studies for further exploration of this field of dental surgery.

REFERENCES

1. Anderson JA, Clark PJ, Kafer ER.Use of capnography and transcutaneous oxygen monitoring during outpatient general anesthesia for oral surgery. J Oral Maxillofac Surg 1987 Jan;45(1):3-10.
2. Bennett J, Peterson T, Burleson JA. Capnography and ventilatory assessment during ambulatory dent alveolar surgery. J Oral Maxillofac Surg 1997;55:921-925.
3. Vascello LA, Bowe EA. A case for capnographic monitoring as a standard of care. J Oral Maxillofac Surg 1999 Nov;57(11): 1342-1347.
4. Bennett J. A case against capnographic monitoring as a standard of care. J Oral Maxillofac Surg 1999 Nov;57(11):1348-1352.
5. Weaver J. The latest ASA mandate: CO_2 monitoring for moderate and deep sedation. Anesth Prog 2011 Fall;58(3):111-112.
6. Whitaker DK. Time for capnography-everywhere. Anaesthesia 2011 Jul;66(7):544-549.
7. Deitch K, Chudnofsky CR, Dominici P. The utility of supplemental oxygen during emergency department procedural sedation and analgesia with midazolam and fentanyl: a randomized, controlled trial. Ann Emerg Med 2007 Jan;49(1):1-8.
8. Kupnik D, Skok P. Capnometry in the prehospital setting: are we using its potential? Emerg Med J 2007 Sep;24(9):614-617.
9. Brady PJ, Wilson KE, Meeke R, Girdler NM, Mc Creary C. Capnometry monitoring during intra-venous sedation with midazolam for oral surgery. Oral Surg 2016 May;9(2):94-101.
10. Mishra N, Birmiwal KG, Pani N, Raut S, Sharma G, Rath KC. Sedation in oral and maxillofacial day care surgery: a comparative study between intravenous dexmedetomidine and midazolam. Natl J Maxillofac Surg 2016 Jul-Dec;7(2):178-185.
11. Collado V, Faulks D, Nicolas E, Hennequin M. Conscious sedation procedures using intravenous midazolam for dental care in patients with different cognitive profiles: a prospective study of effectiveness and safety. PLoS One 2013 Aug;8(8):e71240.
12. Nathan JE, Vargas KG. Oral midazolam with and without meperidine for management of the difficult young pediatric dental patient: a retrospective study. Pediatr Dent 2002 Mar-Apr;24(2):129-138.
13. Fan TW, Ti LK, Islam I. Comparison of dexmedetomidine and midazolam for conscious sedation in dental surgery monitored by bispectral index. Br J Oral Maxillofac Surg 2013 Jul;51(5):428-433.
14. Harbuz DK, O'Halloran M. Techniques to administer oral, inhalational, and IV sedation in dentistry. Australas Med J 2016 Feb;9(2):25-32.
15. Viljoen A, Byth K, Coombs M, Mahoney G, Stewart D; Royal Australian College of Dental Surgeons, Australian and New Zealand College of Anaesthetists. Analysis of oxygen saturations recorded during dental intravenous sedations: a retrospective quality assurance of 3500 cases. Anesth Prog 2011 Fall;58(3):113-120.