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Hemodynamic and ventilatory changes during implant surgery with intravenous conscious sedation

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Abstract

Purpose: This study was conducted to determine the hemodynamic and ventilatory changes during implant surgery with intravenous conscious sedation, and whether preoperative anxiety, gender or age influence these parameters.

Patients and Methods: A prospective study carried out between May 2004 and February 2007, on 102 patients treated with dental implants under local anesthesia and conscious intravenous sedation. Patients completed a questionnaire prior to surgery to evaluate preoperative dental anxiety using Corah's scale. The hemodynamic and ventilatory changes were evaluated by monitoring systolic pressure (SP), diastolic pressure (DP), heart rate (HR) and oxygen saturation (SaO₂). These values were collected at 5 points during surgery; before commencing the operation (baseline value), during local anesthetic injection, at the moment of incision and raising of a mucoperiosteal flap, during implant placement, and finally at suturing. Intravenous conscious sedation was administered between baseline value and injection of the local anesthetic.

Results: The highest SP and DP were recorded at baseline and at suturing. The highest HR was recorded at the moment of incision and raising of the mucoperiosteal flap; the lowest SaO₂ was recorded at local anesthetic injection. There was no relationship between hemodynamic and ventilatory values and preoperative anxiety or gender. A greater age was associated with higher SP and lower SaO₂, these differences being statistically significant.

Conclusions: Most of the cardiovascular and ventilatory changes induced by the implant surgery with intravenous conscious sedation were within normal ranges. The results indicate that midazolam with fentanyl do not produce important hemodynamic and ventilatory changes, being a good association for intravenous conscious sedation in dental implant surgery.

Key words: Hemodynamic changes, dental implants, conscious sedation.

Introduction

The term conscious sedation represents a drug-induced state in which the conscious patient is rendered free of fear, anxiety, and apprehension while remaining comfortably relaxed. Conscious sedation is not a method of pain control (1). Dental anxiety and pain can lead to hemodynamic changes such as hypertension or increased heart rate which can be controlled with a correct sedation technique. In dental implant surgery, where a very long procedure is expected, local anesthesia may be insufficient to perform an adequate operation, and conscious intravenous sedation is an option (2). The administration of intravenous conscious sedation by the anesthetist is safe and results in a low incidence of adverse events (3). Alemany-Martínez et al. (4), evaluated the hemodynamic changes during the surgical removal of lower third molars, and concluded that most of the cardiovascular changes induced by surgical extraction of molars were within normal ranges. Parworth et al. (5), during third molar surgery, administered propofol and fentanyl in one group and midazolam and fentanyl in another. Systolic and diastolic blood pressure were lower in both groups at the 5-minute intraoperative period, these differences being statistically significant. Both groups showed a significant increase in heart rate at the 10- and 15-minute periods. Average oxygen saturation remained above 99% at the 5-minute intraoperative periods during the entire procedure in both groups. They concluded that the differences in systolic and diastolic pressure, heart rate and oxygen saturation were not clinically important, and no intervention was required. The aim was to study the changes in blood pressure (systolic and diastolic), heart rate, and oxygen saturation under intravenous conscious sedation during implant surgery. We evaluated the influence of patient preoperative anxiety, gender and age on these changes.

Material and Methods

A prospective study was made on 102 patients treated with dental implants under local anesthesia and conscious intravenous sedation between May 2004 and February 2007. Indication for conscious intravenous sedation was the placing of 4 or more implants or if surgery was to last more than 60 minutes. The inclusion criteria were patients in ASA I-II-III, requiring implants with local anesthesia and intravenous conscious sedation. Exclusion criteria were incomplete questionnaires returned by the patients.

Patients were instructed to fast for 6 hours before their appointment and to bring a responsible person to accompany them home after sedation. All patients were treated in a clinic equipped with the appropriate sedation and monitoring facilities.

Before surgery, in the waiting room, patients completed a questionnaire to evaluate preoperative dental anxiety

using Corah's scale (6). The questionnaire contains 4 items on different feelings concerning dental consultation. Each question has 5 possible answers, ranging from a) = 1 (no anxiety) to e) = 5 (high anxiety). Therefore, the possible score ranges from 4 to 20 (7,8). Anxiety is considered low when scores are equal to or less than 6, moderate with scores between 7 and 12, and high with scores equal to or greater than 13 (9).

The procedure was carried out by the same surgeon and anesthetist. The protocol for administration of conscious sedation was: midazolam 0.05mg/kg and fentanyl 1µg/kg; the local anesthetic was administered once good sedation had been achieved. In all cases articaine 4% with a vasoconstrictor (adrenaline 1:200,000) was used. If the patient remained tense propofol 20-30mg was added.

Anesthesia was maintained with midazolam 1mg and fentanyl 0.5-1µg/kg, every 30 or 60 minutes in function of patient state and anesthetic depth. If necessary, propofol was administered on demand in successive bolus of 20mg. Atropine 0.01mg/kg was administered to patients under 30 years of age or with a basal heart rate lower than 60bpm when no contraindicating medication was present.

The hemodynamic and ventilatory changes were evaluated by monitoring systolic pressure (SP), diastolic pressure (PD), heart rate (HR) and oxygen saturation (SaO₂). These values were collected at 5 moments; before commencing surgery (baseline value), during local anesthetic injection, at the moment of incision and raising a mucoperiosteal flap, during placement of implants and finally at suturing. Intravenous conscious sedation was administered after obtaining the baseline value and before local anesthetic injection.

The SPSS version 15.0 (SPSS Inc, Chicago, IL) was used for all statistical analyses. Statistical significance was considered for p values less than .05 in all cases. Mixed ANOVAS were made with a repeated means factor (phases of surgical procedure), and another factor between characters (sex, anxiety). Age was analyzed with Pearson's correlation.

Results

Twelve patients were excluded for returning incomplete questionnaires. The final study comprised ninety patients (57 women and 33 men; mean age 54.1 years [range, 27 to 85]) who underwent implant surgery with conscious intravenous sedation. Six hundred ninety-three implants were placed (mean 7.7 implants per patient). Average time of surgical procedure was 98 minutes.

The highest SP and DP were recorded at baseline and at suturing. The highest HR was recorded at the moment of incision and raising of the mucoperiosteal flap, and the lowest SaO₂ was recorded at the local anesthetic

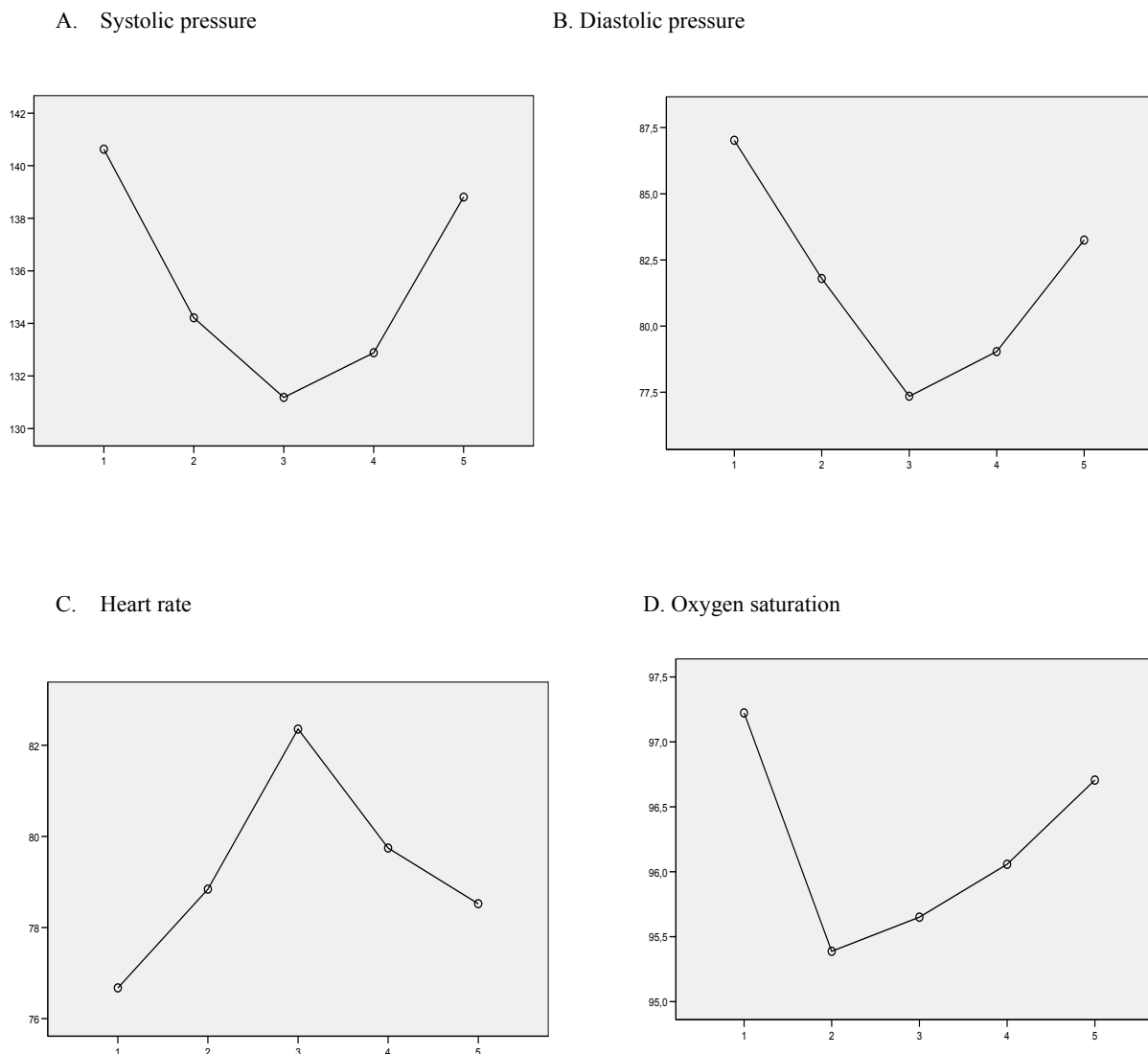


Fig. 1. Hemodynamic-ventilatory evolution (A. Systolic pressure; B. Diastolic pressure; C. Heart rate; D. Oxygen saturation) during the surgical procedure. Numbers represent each stage of the surgery (1. Baseline value; 2. Local anesthetic injection; 3. Incision and raising of mucoperiosteal flap; 4. Placement of implants; 5. Suturing). SP and DP are expressed in mmHg, HR in bpm and SaO2 is expressed as percentage.

injection. Fig. 1 shows the evolution of SP, DP, HR and SaO2 during surgery.

Regarding SP and DP, there was a statistically significant decrease between baseline value and the incision and raising of the mucoperiosteal flap ([SP; $d=9.45$; $p<0.001$] and [DP; $d=9.67$; $p<0.001$]), and a statistically significant increase between placement of implants and suturing ([SP; $d=-5.92$; $p=0.019$] and [DP; $d=-4.21$; $p=0.012$]). There was a statistically significant increase in HR between baseline value and the incision and raising of the mucoperiosteal flap ($d=-5.68$; $p<0.001$) and a statistically significant decrease between the incision and raising of the mucoperiosteal and suturing ($d=3.83$; $p=0.008$). SaO2 decreased significantly between base-

line value and the incision and raising of the mucoperiosteal flap ($d=1.57$; $p<0.001$), and significantly increased between local anesthetic injection and suturing ($d=-1.32$; $p=0.001$).

Table 1 shows the hemodynamic and ventilatory values in relation to preoperative anxiety and gender. A lower preoperative patient anxiety was associated with highest SP and DP, and lowest SaO2. Patients with high preoperative anxiety showed highest HR. Men showed higher SP and DP values than women.

There was no relationship between hemodynamic and ventilatory values and preoperative anxiety and gender. A greater age was associated with higher SP and lower SaO2, these differences being statistically significant (Table 2).

Table 1. Hemodynamic and ventilatory values in relation to preoperative anxiety and gender.

Hemodynamic ventilatory value	Preoperative anxiety			Gender	
	Low	Moderate	High	Women	Men
Systolic pressure	137.2±3.8	132.7±2.8	134.7±4.2	131.4±2.5	139.6±3.2
Diastolic pressure	81.9±1.9	80.54±1.4	80.5±2.1	78.8±1.2	84.5±1.6
Heart rate	76.6±2.2	80.6±1.6	82.8±2.5	82.2±1.5	76.2±1.9
Oxygen saturation	95.7±0.3	96.2±0.3	97.2±0.4	96.6±0.2	95.8±0.3

Table 2. Relationship between hemodynamic-ventilatory values and preoperative anxiety, gender and age.

Hemodynamic-ventilatory value	Preoperative anxiety		Gender		Age	
	P	F	p	F	p	r
Systolic pressure	0.42	1.01	0.79	0.36	0.004	0.30
Diastolic pressure	0.29	1.22	0.69	0.51	0.16	0.15
Heart rate	0.97	0.26	0.60	0.66	0.082	- 0.18
Oxygen saturation	0.97	0.12	0.29	1.25	0.001	-0.36

Discussion

Systolic pressure (SP) was observed to decrease significantly before local anesthetic injection, coinciding with the administration of intravenous conscious sedation. These results agree with Paramaesvaran and Kingon (10) and Yokobayashi et al. (11). These authors obtained the same results as Parworth et al. (5), who administered propofol and fentanyl in one group and midazolam and fentanyl in another during third molar surgery, showing a significant decrease in SP 5 minutes into surgery in both groups. In contrast, SP increased for Liao et al. (12) in patients undergoing simple extractions.

Diastolic pressure (DP) increased for Liao et al (12) and decreased for other authors during administration of local anesthetic (10,11). The latter results agree with our study, where a significant decrease in DP was observed before local anesthetic injection, coinciding with the administration of intravenous conscious sedation.

In a study by Paramaesvaran and Kingon (10), and Yokobayashi et al. (11), the heart rate (HR) decreased during the administration of local anesthetic. In our study we observed an increase in HR during injection of local anesthetic, results which agree with Liao et al. (12) and Parworth et al. (5).

Liao et al. (12) propose that the increase in blood pressure and HR during injection of local anesthetic could be due to the release of endogenous adrenaline resulting from emotional stress, and not to the effect of local anesthetic. In our study, we used a local anesthetic (articaine) associated with a vasoconstrictor (adrenaline 1:200,000) after administration of conscious sedation, observing a significant decrease in SP, DP and SaO2 and a moderate increase in HR.

In the study by Parworth et al. (5), oxygen saturation remained at over 99% in all surgeries. Garip et al. (13), administered only midazolam in one group and midazolam with remifentanyl in another during operations on third molars. They observed that none of the midazolam only group had saturation below 97%, and in the midazolam with remifentanyl group 10 of 20 patients had saturation below 95%. In the present study, oxygen saturation remained at over 95% during all operations. For Liao et al. (12), patients with high anxiety had higher SP, DP and HR values, demonstrating that dental anxiety is related with hemodynamic and ventilatory changes. In agreement with these authors, Silvestre et al. (14), using 3 different local anesthetics for molar extractions, showed that patients with more anxiety had an increase

in SP and DP. In a study by Alemany-Martínez et al. (4), during surgical removal of lower third molars without intravenous conscious sedation, patients with high anxiety showed lower SP and DP and higher HR, although the differences were not statistically significant. In our study, in agreement with Alemany-Martínez et al. (4), there was no significant relationship between hemodynamic and ventilatory values and preoperative anxiety. Patients with greater anxiety showed lower SP, DP and SaO₂ values and higher HR. Association between emotional stress and tachycardia due to secondary adrenergic release may explain these effects (15).

For Alemany-Martínez et al. (4), men showed higher SP and DP than women, although lower HR. In the present study, using intravenous conscious sedation, there was no significant relationship between sex and hemodynamic and ventilatory changes. SP and DP were higher in men, and HR higher in women. SaO₂ was lower in men.

Regarding age, in a study by Matsumura et al. (16), patients in middle and advanced age had a greater increase in SP and DP during molar extractions than younger patients. In agreement with these authors, Nagao et al. (17), in dental implant surgery under local anesthesia, showed that SP increased with age. On the other hand, Alemany-Martínez et al. (4), observed no significant hemodynamic and ventilatory changes in their patients. In the present study, increased age was significantly associated with higher SP and lower SaO₂; and also associated with higher DP and lower HR, but without statistical significance.

Hemodynamic and ventilatory values remained stable during dental implant surgery under intravenous conscious sedation. Older age was associated with a higher SP and lower SaO₂. Hemodynamic and ventilatory values were not related with sex and preoperative anxiety. The results of this study indicate that midazolam with fentanyl do not cause important hemodynamic and ventilatory changes, being a good combination for intravenous conscious sedation in dental implant surgery.

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