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Original Article

Oxygen Saturation During Dental Surgery with Local Anesthesia Alone and in Combination with Sedation in Medically Compromised Patients

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ABSTRACT

Objective. *The aim of this study was to determine which specific operative events are associated with change in SaO2 and blood pressure and heart rate in patients undergoing exodontia or minor oral surgery with local anaesthetic Medically compromised patients with Local anaesthesia alone or in combination with sedation.* ***Methods***. *Arterial oxygen saturation (SaO2) with Heart rate and blood pressure was measured in 60 patients divided into two equal groups. Group I consisted of 30 patients receiving LA alone and undergoing simple extraction minor oral surgery, group II 30 patients receiving LA with oral midazolam and undergoing simple extraction or minor oral surgery.* ***Results***. *There was a decrease in SaO2 from the baseline in 10% of group I patients, represented in 3 patients, 2 of them asthmatic and one anxious patient who the BP and HR raised slightly during LA admiration. There was a fall in SaO2 from the baseline in 53% of patients in group II, represented in 16 patients, the majority of them asthmatic and anxious patients, 6 patients with history of ischemic heart disease. The majority of these decreases in SaO2 or raining in BP or HR were associated with breath holding, in response to fear or emotional stress, during administration of LA due to vasoconstrictor effect or during elevation of teeth. The patients in group II showed a significantly (P<0. 001) greater maximum decrease in SaO2 from the baseline value compared to group I. The length of the operating time was longer in group II than that in group I, and the patients of group II were more anxious than the patients in group I.* ***Conclusion***. *It was concluded that during simple extraction and minor oral surgery under LA alone or in combination with sedation procedures such as elevation of the tooth or administration of the LA may as a result of Breath holding cause reduction in SaO2 or raising in BP or HR. In fit patients this may be of little consequence, however patients with existing airway disease or Medically compromised patients may suffer significant falls in SaO2 or alter the Blood Pressure and Heart Rate. Therefor Monitoring of vital signs and oxygen saturation recommended during simple extraction dental surgery procedure and sedation as premedication for cardiac patients would be recommended.*

Keywords: *Oxygen, Surgery, Sedation, Compromised patient, Vital Signs.*

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INTRODUCTION

An unexpectedly high incidence of clinical oxygen desaturation has been noted in control patients, having only local anaesthetic, (Hilal et al 2002) and during sedation studies (20% Lowe and Brook 1991, and 40% White et al 1989).

Falls in % Oxygen saturation (SaO2) during third molar removal under local anaesthesia may have

implications for other types of dental procedures, (Lowe and Brook 1991and Hilal et al 1997). It has been proposed that reduction in % SaO2 may be due to breath holding or restriction of the upper airway or be secondary to breath holding in response to fear, (White et. al. 1989 and Hilal 1997). That the maximum reduction in SaO2 in patients receiving local anaesthesia alone, occurred during the operative procedure (Lowe and Brook 1991).

Studies on oxygen saturation during dental surgery have concentrated upon the effects of different general anesthesia and sedation techniques and the use of supplemental oxygen. Little information is available concerning the change in SaO2 that occur during dental procedure s in patients being treated under Local anesthesia alone or in combination with sedation.

The combination of dental stress and local anaesthetics containing vasoconstrictor can potentially produce significant and possibly serious complication in the patients with a compromised cardiovascular system. The heart rate and blood pressure are the two hemodynamic parameters that are routinely monitored during dental procedures.

During studies of patients undergoing sedation, an unexpectedly high incidence of clinical oxygen desaturation was observed in control patients during third molar removal under local anaesthesia alone, (20% Lowe and Brook 1991, and 40% White et al 1989). The fall seen in % oxygen saturation (SaO2) during third molar removal under local anaesthesia may be due to breath holding or restriction of the upper airway and may have implications for other types of dental procedures, (Lowe and Brook 1991). Others have suggested that falls in SaO2 in patients receiving local anaesthesia alone occur secondary to breath holding response to fear, (White et. al. 1989). Hypoxia in any patient may also be related to age, ability to cope with stress or underlying medical problems, (Hempenstall et al 1986). The timings of maximum reduction in SaO2 in patients receiving local anaesthesia alone, occurred during the operative procedure in the study reported by Lowe and Brook (1991). They suggested that further study is required to determine which specific operative events are associated with changes in SaO2 in patients undergoing oral surgery and receiving local anesthesia alone.

Hilal et al 2007 in his study concluded that during simple extraction and minor oral surgery under LA alone procedures such as elevation of the tooth or administration of the LA may as a result of Breath holding cause reduction in SaO2. In fit patients this may be of little consequence, however patients with existing airway disease may suffer significant falls in SaO2. The results also explain reduction in SaO2 during specific events in patients receiving sedatives reported in other studies.

Eehab et al 2009 reported that a minor oral surgery is conceder a problem of emotional stress for many patients and that it is possible to alter the heart rate and blood pressure so he recommended the use of sedation in oral surgery treatment

Hypoxemia is a serious risk associated with surgical procedures, especially in patients compromised by age or underlying medical conditions, (Hempenstall et al 1986). Patients are also at risk during administration of certain drugs such as general anaesthetic agents and sedative drugs. Prevention of hypoxemia or raising in Blood Pressure or Heart rate requires early detection of arterial oxygen desaturation and monitoring of vital signs. It is recognized that the detection of hypoxia by observation for physiological signs of hypoxia such as cyanosis, bradycardia, and hypertension, requires measuring blood pressure, respiratory rate, pulse rate, in addition to observing skin colour, which in itself is unreliable and has been shown to vary between different observers, (Comroe et al 1947). The use of the pulse oximeter and automatic non-invasive blood pressure monitor enables the clinician to indirectly measure arterial saturation, HR and BP continuously and noninvasively. This enables early warning of minor degrees of oxygen desaturation to be detected before cyanosis is apparent. The problem may then be corrected by adjusting the airway, administering

supplemental oxygen, stimulating the patient, or by administering drugs to reverse the respiratory depression effects of the anaesthetic agents or sedative drugs.

METHODS

Patients

Sixty patients undergoing treatment in Zentan Dental Hospital Libya were entered into the study. The patients were grouped into two groups; group I includes 30 patients undergoing third molar surgery receiving LA alone. Group II involved 30 patients undergoing third molar surgery receiving in combination with sedation. Information on drug usage / any airway Heart diseases and smoking history was obtained.

A (Biox 3700) pulse oximeter linked to a computer recorded the patient's pulse and SaO2 every 6 seconds from entry into the dental surgery to discharge. HR and BP recorded using automatic noninvasive blood pressure monitor. Before the procedure was begun or any medication was given, baseline values for SaO2 and heart rate were recorded.

Statistical analysis

Data were analyzed using the paired student's t-test, Pearson's correlation coefficient, and one-way analysis of variance (Epistat statistical package). The relationship between Sex, age, amount of LA and sedation given, operating time and %drops in SaO2 from preoperative value was determined. Comparison of anxious to non-anxious, males to females and smokers to nonsmokers were analyzed by the paired student's t-test. Comparison of % drop in oxygen saturation baseline, Heart Rate and Blood Pressure from the pre-operative of Group I to that of Group II were also analyzed.

RESULTS

Group I Local anesthesia alone

About 19 males and 11 females mean age 38.5 years (SD ± 14.4 years). 12 nonsmokers and 18 smokers mean number of cigarettes smoked per day was 15.4. Extraction was undertaken using 3.4 ± 1.7 ml of 2% lignocaine and 1: 80,000 adrenalines. Operating time was 20.6 ± 6.6 minutes.

Group II Local anaesthesia and sedation

15 males and 15 females mean age 37 years (SD ± 16.5 years). 21 nonsmokers and 9 smokers mean number of cigarettes smoked per day was 13.2. Surgery was undertaken using 5 ± 2.1 ml of 2% lignocaine and 1: 80,000 adrenalines in addition, a mean of 6.5 ± 0.88 mg midazolam was given intravenously before LA, operating time was 37.6 ± 17.87 minutes.

Group I

- 10% incidence of Decrease %SaO^2 3 patients, and 1 patient 3 % alter HR or BP.
- Patient 1: 32 years old male asthmatic, smoked 10 cigarettes per day, extraction of the upper right second molar tooth, 9% decrease %SaO2 occurred immediately following injection of LA (2.2ml) and lasted one minute.
- Patient 2: 43 years old male asthmatic, non-smoker, extraction of the upper right third molar tooth. LA 3ml, decrease %SaO2 3% occurred during elevation of the tooth and lasted 2.5 minutes, operating time 11 minutes.
- Patient 3: 36 years old female, anxious with a VAS of 75 out of 100 (the highest value recorded in our sample), LA (4.4 ml), to extract the lower left second premolar and the first and second molars teeth. 3% decrease %SaO2 started during elevation of the teeth and lasted 3 minutes. The patient was also observed to hold her breath during elevation of the tooth and cried; it was during this period that oxygen saturation was observed to fall. The HR and BP altered slightly during LA administration lasted for one minute.
- Apart from the above three patients there was no correlation between decrease %SaO2 and the number of cigarettes smoked, between smokers and nonsmokers. This is in contrast to a study by Alec 1989 who reported that

there was a correlation between the incidence of arterial oxygen desaturation and smoking history of >30 pack-years.

- There was no correlation between decrease %SaO2 and anxiety, patients those whose VAS score was above the mean for the group were compared to those who were not anxious (VAS score below the mean). Due to our sample size we have only a low statistical power and to ensure that the lack of correlation seen was indeed a true lack (90% power) a sample size of 260 cases would be required.

Group II

- 53% incidence of decrease %SaO2 16 patients. 20% altered HR BP.
- Half of these patients 5 were anxious [VAS.50] and 3 were asthmatic.
- Decreased %SaO2 was not correlated to the age / gender of the patients, to the amount of local anesthetic, or to the operating time. There was no correlation between ê %SaO2 from baseline and the anxiety level of the patients.
- The highest ê %SaO2 was 13%, which occurred in one patient, a 24 years old female who did not smoke, and underwent surgical removal of a lower right third molar tooth. The amount of LA given was 8 ml, in addition of 6.2 mg Midazolam was given IV the operating time was 48 minutes and the anxiety level of the patient was 48 out of 100. The reduction in SaO2 from the baseline started after suturing was completed and the patient was in sitting position and was talking to the operator, this drop lasted 3.5 minutes, the patient was asked to take deep breaths. The SaO2 was 99% when the patient was discharged. The fall in SaO2 may have been due to postural hypertension when the patient was returned to the sitting position at the end of surgery.
- The second highest ê %SaO2 11% occurred in a 22 years old female, non-smoker, anxiety level by VAS 32 who underwent surgical removal of a lower right third molar tooth. LA given was 6.6 ml, in addition of 5 mg Midazolam was given IV operating time 37 minutes. The fall in SaO2 started following completion of tooth removal/suturing - the patient became very anxious and cried. During this "anxiety" attack the SaO2 was observed to fall to 86%. BP and HR was slightly raised.
- 20 % of patient s Group The HR and BP was observed to raise from the baseline 5±2-minute post sedation in IHD patients due to emotional stress or due to respiratory depressant effect of sedative agents.
- No significant changes the HR or BP from the baseline all groups even 5 minute after LA injection.

DISCUSSION

The findings of relative hypoxia in 10% of patients receiving LA alone undergoing exodontia and MOS and in 53% of patients receiving LA in addition to sedation and undergoing simple extractions minor oral surgery are similar to the findings of (40% reported by White 1989 and 20% reported by Lowe and Brook 1991), for cases undergoing minor oral surgery under LA alone and confirms that potential for reduction in SaO2 is an ever present although often unnoticed event in exodontia.

Decrease in %SaO2 was more common (P<0. 001)in [Group II, 16 of 30 patients 53%] compared with those [Group I, 3 out of 30 patients 10%].

More LA was used in group II than that in group I, the operating time in group II was also longer than that in group I, and the patients in group I were more anxious than that in group II. There was no correlation between ê %SaO2 and operating time or amount of LA used in the study reported by Lowe and brook (1991).

The decrease in %SaO2 seen in asthmatic patients, supports the findings of others and in this group of patients monitoring of % SaO2 during surgery would be warranted. This effect may be especially significant in the elderly, as well as in other patients with underlying medical problems, including chronic obstructive pulmonary disease and obesity, (Miller 1986). The combination of dental stress and local anaesthetics containing vasoconstrictor can potentially produce significant and possibly serious complication in the patient with a compromised cardiovascular system. The heart rate and blood pressure are the two hemodynamic parameters that are routinely monitored during dental procedures.

During studies of patients undergoing sedation, an unexpectedly high incidence of clinical oxygen desaturation was observed in control patients during third molar removal under local anaesthesia alone, (20% Lowe and Brook 1991, and 40% White et al 1989). The fall seen in % oxygen saturation (SaO2) during third molar removal under local anaesthesia may be due to breath holding or restriction of the upper airway and may have implications for other types of dental procedures, (Lowe and Brook 1991). Others have suggested that falls in SaO2 in patients receiving local anaesthesia alone occur secondary to breath holding response to fear, (White et. al. 1989). Hypoxia in any patient may also be related to age, ability to cope with stress or underlying medical problems, (Hempenstall et al 1986). The timings of maximum reduction in SaO2 in patients receiving local anaesthesia alone, occured during the operative procedure in the study reported by Lowe and Brook (1991). They suggested that further study is required to determine which specific operative events are associated with changes in SaO2 in patients undergoing oral surgery and receiving local anaesthesia alone.

Hilal et al 2007 in his study concluded that during simple extraction and minor oral surgery under LA alone procedures such as elevation of the tooth or administration of the LA may as a result of Breath holding cause reduction in SaO2. In fit patients this may be of little consequence, however patients with existing airway disease may suffer significant falls in SaO2. The results also explain reduction in SaO2 during specific events in patients receiving sedatives reported in other studies. This study consistent with Hilal et al study 2007

BP and HR are two hemodynamic parameters that are routinely monitored during dental surgery procedure. In the present study, a sedative (midazolam) was given IV to Group II patients before LA to relieve stress and anxiety that is why there was slightly raise of HR and BP post sedation compared with the baseline values. However, there were no significant changes in HR and BP in all groups. No significant changes the HR or BP from the baseline all groups even 5 minutes after LA injection. The results of this study are consistent with those of Campbell and Langston 1995 and Eehab et al 2009, as the more compromised patients may have higher incidence of RPP and PRQ values.

Eehab et al 2009 reported that a minor oral surgery is conceder a problem of emotional stress for many patients and that it is possible to alter the heart rate and blood pressure so he recommended the use of sedation in oral surgery treatment.

CONCLUSION

The specific events that lead to decrease in %SaO2 appear to be related to breath holding either conscious due to the presence of fluid and instruments in the mouth or related to stress (and or pain) during 'vigorous' surgical events such as elevation of the tooth or administration of LA.

Patients with existing airway diseases are particularly at risk and significant falls in SaO2 were seen in these patients.

The pulse oximeter, already recommended for use during anaesthesia Suresh D and et al (1991), should be available for use in minor oral surgery as well as simple extractions particularly in patients with existing airway impairment or patients with fear experience with dental treatment.

This study shows that smile extraction and minor oral surgical procedure is considered problem of emotional stress for many patients and that possible to alter the heart rate and blood pressure It is therefore recommended the use of sedation in oral surgery treatment. Measurements of the heart rate and blood pressure before a minor surgery of simple extraction procedure must be done and well prepared cardiac risk patient.

Competing interests

Authors have declared that no competing interests exist.

Authors' Contributions

This work was carried out in collaboration between authors.

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