EFFECTS OF SUPPLEMENTAL OXYGEN DURING ENDOSCOPY

Ramrakha SC, Borody TJ, Pang G, Herdman KJ, Campbell EK, Torres M
Centre for Digestive Diseases, Sydney, Australia

ABSTRACT

AIM: Levels of oxygen saturation decrease as depth of sedation increases during endoscopic procedures. This study examined the response to supplemental O_2 in patients using a bite block with nasal and oral supplemental ports (Oxyguard™). **METHODS:** 100 fasted patients undergoing elective panendoscopic examination were studied. All patients had a pre-anaesthetic examination including respiratory function with a peak flow meter and assigned an American Society of Anaesthesiologists (ASA) score. An endoscopist performed all examinations while an emergency physician administered the sedation agents which were a combination of midazolam, fentanyl and propofol in titrated doses. Oxyguard™ was then inserted. Patient clinical parameters were recorded as increasing depth of sedation was achieved and supplemental O_2 at 4L/min was commenced once O_2 saturation reached 90%. O_2 saturation was measured at 15sec intervals. **RESULTS:** After sedation the mean levels of arterial O_2 saturation dropped significantly from baseline (95.7±1.9) to mild (93.8 ± 1.9) ($p<0.0001$) and deep sedation (92 ± 2%) ($p<0.0001$). In some cases O_2 saturation continued to drop further to a nadir even after supplemental O_2 was applied. From this point there was a time-dependent increase in O_2 saturation levels. This was similar in males and females. All patients had higher oxygen saturation levels reaching baseline levels after administration of O_2 via Oxyguard™ mouthpiece than those recorded before oxygenation. These levels were maintained during the endoscopic procedure, with a mean saturation level of 95.6 ± 1.7% at 1min ($p=0.68$). Cardiorespiratory complications were not observed with heart rate and $ETCO_2$ levels remaining relatively constant throughout the procedure. **CONCLUSIONS:** Sedation caused a predictable decrease in O_2. This was similar in both males and females. Supplemental O_2 via Oxyguard™ resulted in rapid recovery of O_2 within 60 seconds.

INTRODUCTION

Cardiorespiratory embarrassment secondary to hypoxia is by far the most common complication of panendoscopic examination.[1,2,3] The mortality rate for a study, which on average is 8-10 mins, has been reported at estimates of 1/7500-1/11000.[4] In spontaneously breathing patients, a combination of hypoventilation from sedation or the effects of obstruction by the competition for space upon intubation by the endoscope may cause hypoxia. The process of pre-oxygenation, which is often used in general anaesthetic practice, is ineffective as the lack of seal does not allow for nitrogen washout.[5]

Although endoscopic examination can be carried out safely without sedation[6], once an option is given, most patients generally prefer sedation.[5] However, when a decision is made for sedation, the depth of sedation is often unpredictable. Certain patients have a greater gag response, more baseline anxiety, tolerance to benzodiazepine or underlying drug and alcohol history which may complicate their response to conscious sedation. The disinhibition of conscious sedation hinders further cooperation from the patient and the choice is often to increase sedation to a greater depth to allow for endoscopic intubation. The additional use of propofol, in combination with traditional agents (benzodiazepine +/- narcotics) has allowed for rapid increase in depths of sedation.[7] The issue of oral versus nasal oxygenation has not been completely resolved.[8,9] The need for supplemental oxygenation however is universally accepted.[12]

AIM

The aim of this study was to determine the rate of rise of oxygen saturation and cardiorespiratory effects in spontaneously breathing well patients (ASA I and II) who were deeply sedated and who were neither apnoeic nor obstructed as determined by $ETCO_2$ monitoring.

METHOD

Healthy fasted patients (ASA I and II) undergoing routine endoscopy were selected. Patients were over the age of 18 and without significant existing cardiorespiratory illness.

A peak flow reading was obtained during their pre-anaesthetic assessment which was compared to the predicted value as per height, gender and race. Gradually deeper sedation was achieved using a titrated combination of midazolam, fentanyl and propofol. Depth of sedation was in accordance with ASA references.

Capnocheck Plus™ was used to record pulse oximetry (digital probe) and to assess for airway obstruction or apnoea (nasal side stream capnography sampler). As the study was aimed at spontaneously breathing patients, maintenance of an airway was supervised by a dedicated person ensuring timely correction of airway obstruction.

Supplemental oxygenation was via use of oxygenating bite block (Oxyguard ™) designed to provide oxygen both nasally and orally.[10,11] Supplemental oxygen at a rate of 4L/min was commenced as soon as the saturation level fell to 90%. A reading was obtained at 15sec, 30sec and 1min. Additional readings were obtained at introduction of the endoscope, midway and the end of the procedure, carried out by an experienced endoscopist using Pentax equipment.

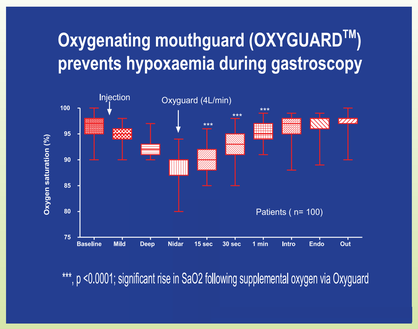

Figure 1. Oxygen saturtaion levels of patients using standard Oxyguard™ during endoscopy.

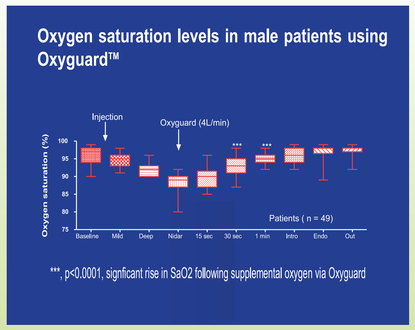

Figure 2. Oxygen saturation levels in males patients during endoscopy.

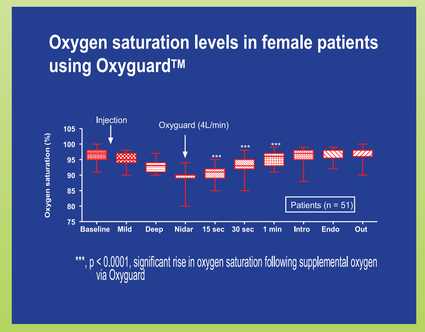

Figure 3. Oxygen saturation levels in female patients during endoscopy.

Figure 4. Image showing patient under sedation. Yellow Oxyguard™ has been used with the endoscope. Capnocheck Plus™ shown in the background used to monitor patient status and oxygen saturation.

Pearson's Correlation	HR	$ETCO_2$	RR
r	-0.047	0.049	-0.084
P value	0.17	0.15	0.014

HR = Heart Rate, $ETCO_2$ = End Tidal CO_2, RR = Respiratory rate

Table 1. Relationship between changes in oxygen saturation and HP, $ETCO_2$, and RR, following sedation, during endoscopy and supplemental oxygen.

RESULTS

After sedation the mean levels of arterial O_2 saturation dropped significantly from baseline (95.7±1.9%) to mild (93.8±1.9) ($p<0.0001$) and deep sedation (92±2%) ($p<0.0001$). In some cases O_2 saturation continued to drop further to a nadir even after supplemental O_2 was applied. From this point there was a time-dependent increase in O_2 saturation levels. This was similar in males and females.

All patients had higher oxygen saturation levels reaching baseline levels after administration of O_2 via Oxyguard™ mouthpiece than those recorded before oxygenation. These levels were maintained during the endoscopic procedure, with a mean saturation level of 95.6±1.7% at 1min ($p=0.68$). Cardiorespiratory complications were not observed with heart rate and $ETCO_2$ levels remaining relatively constant throughout the procedure.

Multivariate analysis of variables contributing to falls in oxygen saturation following sedation, during endoscopy, and with supplemental oxygen, showed that respiratory rate (RR) was significantly associated with oxygen desaturation ($p=0.014$). Other variables including $ETCO_2$, HR, gender, age, PFER and body weight were not related.

All patients tolerated the procedure. Apart from a single episode of laryngospasm that occurred at the end of the procedure, and which resolved quickly with bag valve mask ventilation, there were no adverse effects. Only seven of the 100 patients did not require supplemental oxygen.

DISCUSSION

The greatest sedation requirement is during the initial introduction of the endoscope. This is associated with gagging and a potential for obstruction, because of competition for the oropharyngeal space by the endoscopist and the person administrating sedation. Deep level of sedation was associated with a decrease in oxygen saturation in the spontaneously breathing patient. This is generally predictable with increasing depth of sedation.

While capnography is useful in identifying trends in respiratory rates, absolute $ETCO_2$ values are not predictive. This is due to the large dead space present, and contamination by oxygen flow.

Oxygen saturation recovered with the use of supplemental oxygen delivered at 4L/min via Oxyguard™. Oxygen saturation rose quickly within the first minute in most patients and by the 1.5-2 minute mark for all patients. These deeply sedated patients all had successful intubation by the endoscopist and there were no further episodes of desaturation.

CONCLUSION

1. Deep sedation is associated with a predictable and sequential decrease in oxygen saturation.
2. Supplemental oxygenation achieves adequate oxygenation within 1 minute. In patients undergoing endoscopy it is desirable to attempt intubation once this nadir is corrected and re-oxygenation has occurred.
3. There is a potential danger in the setting of gastroenterologist-administered sedation, as premature insertion, or catch up sedation in attempting insertion, may cause synergistic hypoventilation and airway obstruction.

REFERENCES - 1. Dark DS, Campbell DR, Wesselius LJ. Arterial oxygen desaturation during gastrointestinal endoscopy. Am J Gastroenterol. Oct 1990; 85(10):1317-21. **2.** Barkin JS, Krieger B, Blinder M, Bosch-Blinder L, Goldberg RI, Phillips RS. Oxygen desaturation and changes in breathing pattern in patients undergoing colonoscopy and gastroscopy. Gastrointest Endosc. 1989 Nov-Dec; 35(6):526-30. **3.** Patterson KW, Noonan N, Keeling NW, Kirkham R, Hogan DF. Hypoxemia during outpatient gastrointestinal endoscopy: the effects of sedation and supplemental oxygen. **4.** Daneshmend TK Bell GD Logan RFA Sedation for upper gastrointestinal endoscopy: Results of a nationwide survey. Gut 1991; 32:12-15 **5.** Wang CY, Ling LC, Cardosa MS, Wong AK, Wong NW. Hypoxia during upper gastrointestinal endoscopy with and without sedation and the effect of pre-oxygenation on oxygen saturation. Anaesthesia. 2000 Jul; 55(7):654-8. **6.** Fisher NC, Bailey S, Gibson JA. A prospective, randomized controlled trial of sedation vs. no sedation in outpatient diagnostic upper gastrointestinal endoscopy. Gastrointest Endosc. 1993 Sep-Oct;39(5):620-5. **7.** Koshy G, Nair S, Norkus EP, Hertan HI, Pitchumoni CS. Propofol versus midazolam and meperidine for conscious sedation in GI endoscopy. Am J Gastroenterol. Jun 2000; 95(6):1476-9. **8.** Hebbard GS Royse CF Bjorksten AR. Oxygen supplementation during upper gastrointestinal endoscopy: a comparison of two methods. Endoscopy. 1994 Mar;26(3):278-82 **9.** Bell GD Quine A, Antrobus JH, A, Burridge M, Coady TJ, Lee J. Modern upper gastrointestinal endoscopy: a prospective randomized study comparing continuous supplemental oxygen via the nasal or oral route Gastrointest Endosc. 1992 May-Jun; 38(3):319-25 **10.** Borody, TJ. Methods of Oxygen Delivery During Upper Gastrointestinal Endoscopy 1994; 26:320-321. **11.** Brandl, S., Borody, TJ., Andrews P., Morgan, A., Hyland, L., Devine, M. Oxygenating Mouthguard alleviates hypoxia during gastroscopy. Gastrointestinal Endoscopy.1992; 38(4):415-417. **12.** Practice Guidelines for sedation and analgesia by non anaesthesiologists. Anaesthesia 2002; 96:1004-1017.

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