

What Is The TCI Dose Required When Using Propofol For Conscious Sedation During Dental Procedures? : A Retrospective Study

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Abstract

OBJECTIVE:

Propofol has become a popular choice of drug for conscious sedation during dental procedures. We have undertaken a study to determine the settings required when delivering propofol using target controlled infusion (TCI). We have also reported the adverse events during sedation.

DESIGN:

We describe a retrospective observational analysis of propofol administered via a Target Controlled Infusion (TCI) pump for conscious sedation while having a dental procedure under local anaesthesia. All the patients were healthy with no contraindications to sedation. They were monitored with pulse oximetry, non-invasive blood pressure and end-tidal CO₂. The initial target plasma propofol concentration was set between 1 and 1.5 mcg per ml and adjusted thereafter to achieve the desired level of sedation. All adverse events and interventions required to rectify them were recorded.

SETTING:

Multiple private dental practices in Sydney and Brisbane, Australia.

SUBJECTS:

One hundred and fifty-one consecutive patients undergoing dental surgery.

RESULTS:

Sedation and treatment were satisfactorily completed in 150 patients. The mean target propofol concentration required was 1.55 mcg per ml. (SD - 0.54 mcg/ml, range - 0.50 to 3.20 mcg/ml).

Adverse events occurred in 16 or 10.6% of patients, none of which resulted in significant morbidity or mortality.

CONCLUSION:

Intravenous sedation with target-controlled propofol infusions is safe and effective. Adverse events are relatively common but rarely life-threatening.

INTRODUCTION

Intravenous sedation for patients undergoing dental procedures has been common practice in Australia for many decades. Until recently the main agents used consisted of a combination of a benzodiazepine such as Midazolam and an

opiate such as Fentanyl or Morphine. The growth in popularity of propofol for procedural sedation in emergency medicine¹ and other specialities such as gastroenterology for endoscopy and colonoscopy² has led to its increased use as a sedative for dental procedures^{3,4}, often by non-

anaesthetists. Well publicised adverse outcomes which includes deaths has led, quite rightly, to concerns about its safety when used by non-anaesthetists⁵ in an ambulatory setting.

Propofol (2,6-diisopropylphenol) is a powerful short-acting hypnotic and sedative agent and is characterised by its rapid onset and short duration of action.⁶ It can be delivered by either target controlled infusion (TCI), patient-controlled target infusion or by intermittent boluses. Its duration time has led to its preference over agents such as midazolam as patients wake sooner⁷, have minimal post-sedation effects⁸ and are ready for earlier discharge. It does however carry with it certain risks, most notably respiratory depression and hypotension.

The TCI system consists of an infusion pump containing software which imitates the pharmacokinetic model for propofol. Using the Schneider TCI model, the patient's weight is programmed into the pump and a bolus dose is delivered to achieve a selected target blood propofol concentration followed by a continuous infusion to maintain that concentration. The initial setting is usually between 1 and 1.5mcg of propofol per ml of plasma. The patient's response is then observed and the setting adjusted to reach the desired level of sedation. Should a deeper level of sedation be required the setting is increased in small increments (0.2 -0.5) and the pump will deliver additional boluses and a subsequent higher infusion rate. Conversely if the patient is felt to be too deeply sedated the setting is reduced with the infusion ceased and then restarted at a lower infusion rate.

The guideline for administration of sedation for dental procedures (PS9) is joint statement by the several professional bodies including the Australian and New Zealand College of Anaesthetists and the Australian College of Dental Surgeons. Particular statements of note within the guideline include:

Intravenous anaesthetic agents such as propofol must only be used by a second medical or dental practitioner trained in their use because of the risk of unintentional loss of consciousness. These agents must not be administered by the proceduralist.⁹

We describe a retrospective observational study of clinical practice using TCI infusion of propofol to achieve conscious sedation while undergoing dental procedures under local anaesthesia. The primary aim of this study was to report the

average TCI programmed serum level to achieve adequate sedation. A secondary aim was to examine the adverse event rate and the measures taken to rectify these.

METHODS

We have retrospectively analysed 151 consecutive sedation cases which used TCI propofol for adult patients undergoing dental procedures under local anaesthesia. All cases were performed in private practice settings and were subject to assessment, selection, written consent and discharge. Following pre-operative assessment all patient were positioned in a dental chair.

All patient were given sedation by a doctor who was not involved in the procedure. Patients were monitored with pulse oximetry, non-invasive blood pressure monitoring and end tidal capnography. The majority of patients did not routinely receive supplemental oxygenation.

Patients were then cannulated and given a pre-sedative dose of Midazolam 1-3mg. Some patients were also given up to 50mcg of fentanyl. A TCI propofol infusion was then commenced using a B Braun perfusor space. The Schneider model was selected and an infusion was commenced in the range of 1-1.5mcg/ml. The goal was to achieve a sedation score of 3 (responds to commands only) using the Ramsay Sedation Scale whereby the patient felt relaxed and at ease yet was able to follow the dentist's commands and express discomfort should local anaesthesia be inadequate. The TCI setting was adjusted either up or down in response to inadequate sedation or over sedation which may be demonstrated by either disinhibition, hypoxia or apnoea.

The maximum TCI setting during the procedure to achieve the desired level of sedation was recorded along with adverse events and any necessary interventions to rectify them.

RESULTS

151 patients were considered acceptable for conscious sedation during their dental procedure. 150 of the patients successfully completed their procedure. The patient characteristics are presented in Table 1.

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Table 1

Patient Characteristics

Total Patients	151
Age Range	16-73
Average Age	35.7
Males	56 (37.1%)
Females	95 (62.9%)
ASA	
ASA 1	130
ASA 2	21
ASA 3 or 4	0
Mallampati	
1	97
2	47
3	4
4	3

The duration of the procedure ranged from 3 minutes to 3 hrs 55 minutes. The mean target propofol concentration to achieve satisfactory conscious sedation defined by a Ramsay Sedation Score of 3 was 1.55. (SD - 0.54 mcg/ml, range - 0.50 to 3.20 mcg/ml).

10.6 % of patients suffered an adverse event. Table 3 lists the adverse event/s for each patient, the interventions required and the TCI rate at which they occurred. The most common adverse event was hypoxaemia with oxygen saturations falling below 90%. All episodes responded with either a verbal instruction to breathe or administration of supplemental oxygenation via nasal cannulae. Of note no patients required assisted ventilation either by Bag-Valve mask or intubation. The single case which was aborted was done so due to the patient's inability to tolerate any dental instrumentation in his mouth.

Table 2

Adverse Events

	Adverse Event	Intervention Required	Max TCI dose
1	Agitation	Verbal stimulation	1.4
2	Unable to tolerate anything in mouth	sedation aborted	2
3	Hypoxia (Sats <90%)	Verbal stimulation, O2 supplementation	1.8
4	Hypoxia (Sats <90%)	Verbal stimulation	1.3
5	Hypoxia (Sats <90%)	Verbal stimulation, O2 supplementation	2.2
6	Hypoxia (Sats <90%)	Verbal stimulation, O2 supplementation	1.8
7	Hypoxia (Sats <90%)	O2 supplementation	1.8
8	Hypoxia (Sats <90%)	Verbal stimulation	1.4
9	Hypoxia (Sats <90%)	Verbal stimulation, O2 supplementation	2.3
10	Hypoxia (Sats <90%), Apnoea > 20 seconds	Verbal stimulation, O2 supplementation	1
11	Hypoxia (Sats <90%)	Jaw Thrust / Chin lift	2
12	Apnoea > 20 seconds	Verbal stimulation, O2 supplementation, Physical Stimulation	0.6
13	Apnoea > 20 seconds	Verbal stimulation	1.6
14	Hypoxia (Sats <90%), Apnoea > 20 seconds	Verbal stimulation, O2 supplementation	1
15	Agitation	nil intervention required	1.7
16	Hypoxia (Sats <90%), Apnoea > 20 seconds	Verbal stimulation	1

DISCUSSION

TCI infusion of propofol can be used safely and successfully to provide conscious sedation for patients having dental procedures. While the target propofol concentration level will usually range between 1 and 3, the exact level needs to be tailored to each individual's response following the initial setting.

The results of this study provide similar results to Blayney et al¹⁰ who noted a mean TCI higher concentration rate of 2.1mcg/ml and a lower adverse rate of 9.3% although we disagree with their statement that "only anaesthetists working in an appropriate clinical setting" practice this technique. Although the event rate is significant the response required to rectify them was simple and usually required little more than instructing the patient to take a deep breath or giving nasal oxygen. Although no patient required assisted ventilation, should it be required this skill can be easily acquired through a short period of training and credentialing either by an anaesthetist or a non-anaesthetist with training and experience in airway management such as a GP Anaesthetist, Emergency Physician or Intensivist. Although further study with more patients is required, we feel if patients are adequately monitored with respect to sedation level and ventilation using end-tidal CO₂ monitoring the likelihood of a patient requiring advanced airway techniques such as endotracheal intubation is so

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small that maintenance of this skill by non-anaesthetists, whilst admirable, is not essential. We agree with the position stated in PS9 that the doctor providing the sedation should not be involved with the procedure.

This study provides additional data to assist anaesthetists and non-anesthetist dental sedationists develop protocols for conscious sedation with a target controlled infusion of propofol for dental procedures. Further study could involve a prospective study to validate these findings or a randomised control trial to compare manual administration verses TCI administration of propofol looking at total drug given and adverse event rates.

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