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Effect Site Concentrations of Propofol for Dental Treatment under Deep Sedation in Intellectually Disabled Patients

지적 장애를 가진 환자의 치과치료를 위한 깊은 진정시 프로포폴의 적절한 효과처 농도

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이 승 화

Abstract

Effect Site Concentrations of Propofol for Dental Treatment under Deep Sedation in Intellectually Disabled Patients

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Introduction: It is difficult to provide effective dental treatment in severely intellectually disabled patients because of the difficulty of verbal communication. Usually ambulatory general anesthesia is selected as a method of behavioral management in long-duration procedures. But, intravenous deep sedation is also effective in simple and short-time dental treatments for them. Propofol is the most commonly used anesthetic for sedation and target-controlled infusion (TCI) is useful for dental treatment. However, it is difficult to assess and maintain an adequate depth of sedation in patients with severe intellectual disabilities because of problems with airway maintenance during dental treatments, inappropriate pain control and co-morbidities of brain and internal organs. Therefore, in this study we aimed to evaluate the adequate propofol target concentration for dental treatment in severely intellectually disabled patients.

Patients and Methods: After approved by the IRB of Seoul National University Dental Hospital, we undertook retrospective review of the sedation service records of severely intellectually disabled patients who underwent dental treatment under propofol sedation from January 2009 to May 2012. For these patients we provided deep sedation using propofol TCI infusion pump at the initial target concentration of propofol 2 - 3 mcg/ml according to patients. To provide an adequate deep sedation state, we adjusted the target concentration of propofol 0.5 mcg/ml per every step according to the state of unconsciousness, and the conditions of sedation and the side effects such as airway problems. When the conditions were stabilized to do dental treatment we maintained the concentration without change and we recorded the concentration changes. We evaluated the initial target concentration, stabilized concentration of propofol and monitored vital signs, including BIS score using sedation records.

Result: Total 73 patients (40 male and 33 female patients) were included in the study. The average ages of the patients were 31 ± 17 (15 – 81) years old. Every participant was severely intellectually disabled who were 17 of mental retardation, 16 of autism, 16 of brain and cerebral palsy disorder, 7 of epilepsy, 5 of Down syndrome, 6 of dementia and blind, and 2 of severe gag reflex patients. The kinds of dental treatment were cavity treatment, surgical tooth extraction, crown setting treatment, scaling, and dental implantation. The mean sedation duration was 72.5 ± 19.8 (40 – 145) minutes. The initial Propofol target concentration infusion amount was 3.0 ± 0.6 (1.5 - 5.0) mcg/ml. The propofol effect site concentration was 2.9 ± 0.7 (1.0 - 5.0) mcg/ml. The average value of BIS was 57.2 ± 13 (28 – 82). During the treatment period, there were no sudden

movement of the patients and severe airway obstruction. Every patient was discharged after a 1-hour period of recovery room stay.

Conclusion: The propofol effect site concentration for deep sedation in intellectually disabled patients was lower than during the procedure of fiberoptic intubation for ordinary adults. However, using titration of target concentration, propofol target-controlled infusion (TCI) was a useful and safe method in their management during dental treatment.

Keywords : intellectually disabled, dental treatment, deep sedation, propofol target concentration

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I. Introduction

The need of receiving routine dental treatment for people with disabilities is very crucial to keep their oral health intact. However, in reality it has been reported in U.S department of Health and Human Services Health Resources Services Administration in 2001 that patients with special needs exhibited poor oral hygiene, more severe periodontal disease, more decayed tooth surfaces, and greater treatment needs than peoples without disabilities [1]. There are several elements inhibiting them to provide appropriate dental treatment such as psychological barriers, economic barriers, and educational efforts. However, one of the most barriers to receive treatment in the dental field is their behavioral management difficulties [2]. For example, in the case of showing negative behaviors due to patient's dental anxiety and fear concerning pain or impossible to receive general dental treatment by involuntary muscle movements, physical restraint such as using coercive methods to treat anxious and immobile patients becomes the final resort in most case, which is never a good or desirable thing. Patients who have severe anxiety and panic disabilities, communication disabilities, and involuntary movement disorders might be arduous to provide normal dental treatment. Therefore, here is the reason why deep sedation or furthermore general anesthesia should be considered as the first aid of treatment plan. Deep sedation or general anesthesia can offer certain degree of quality dental care without patient cooperation in the status of reduced or subdued body

movement [3]. Because of low pain, short operation duration, and simple but relative increase in the amount of dental services, the total number of visiting the clinics can be reduced. Besides, the state of consciousness suppresses in a certain dimension, bad experience during sedation can be removed. It is helpful to induce a positive attitude toward future routine dental care [4]. Several types of deep sedation existed as follow: inhalation sedation, oral sedation, and intravenous sedation. Intravenous sedation is the most effective method for dental patients who need special care and it is especially useful for patients with intellectual disability, which is a truly appropriate way of proving deep sedation to disabled patients [5]. Intravenous deep sedation becomes increasingly used to facilitate rapid induction of anesthesia or to provide deep sedation during dental monitored anesthesia care and also reliable and feasible to control the depth of consciousness by titrating possible drugs to maintain adequate sedation. However, the sedative dose required for adequate depth of sedation during intravenous anesthesia is rapid and the currently available intravenous anesthetics do not produce only desired effects such as the danger of loss of consciousness and the risk of hyopnea or respiratory depression by over-sedation. It is necessary to have an appropriate knowledge of administering anesthetic drugs and proper amount of dosage to uphold adequate sedation [6]. In the 1980s, Schuttler and Schwilden [7] was first reported the usage of target-controlled infusion (TCI) method and it is widely used as in the deep sedation or general anesthesia until today. Advance in

computing technology has permitted the development of TCI system, with drugs delivered to blood and lipophilic tissues such as brain and spinal cord in order to reach and sustain specific target blood drug concentrations. With the assistance of target-controlled infusion system, patients can be controlled by anesthesiologists who adjust the blood concentration of proper drugs higher or lower and without the need of complex calculations adequate sedation can be achieved by the properties of drug's pharmacodynamics. Target-controlled infusion (TCI) system has a set of pharmacokinetic parameters to be chosen by use of computer simulation of a known infusion scheme. The selected model is incorporated into a computer-compatible infusion pump. It is adequate to be used in the variety of patient situations whose serum drug concentrations measured in the pharmacodynamics already programmed by the model If the important patient's demographical data such as age, sex, body weight and height and required specific blood concentration have been given to the TCI system, automatically it would provide appropriate target concentrations for the administration of target controlled infusion of certain anesthetic drugs. Clinical trials with such systems have provided appropriate target concentrations for the administration of target controlled infusion of anesthetic drugs [8]. Clinically if the effect-site concentrations of drugs in the central nervous system are stable, patients can be induced into the optimal status of sedation. It can be difficult to maintain the actual administered dose of certain drugs accurately and reach rapidly into a

passively constant target concentration because of the complexity of pharmacodynamic properties of sedative drugs. However, the mathematical algorithm of target-controlled infusion can be adjusted automatically and persistently by the continuous computer assisted intravenous drug delivery and removal system. Therefore, TCI technology is becoming a part of routine anesthesia technique for the practitioners and it is efficient to maintain the target blood concentration and sedation depth rather than the system of manually-controlled infusion [8]. Most dental sedative drugs used to treat anxious or immobile patients are midazolam, propofol, fentanyl, and remifentnil. Propofol is probably one of the most frequently administered anesthetic drugs for induction of sedation and anesthesia because of the short duration of action. It is rapidly and extensively distributed in the body and crosses the blood-brain barrier quickly, and its short duration of action is due to rapid redistribution from the CNS to other tissues, high metabolic clearance, and high lipophilicity. It has two distribution phases which are short initial half-life between 1 and 8 minutes and slower one through 30 to 60 minutes. Terminal elimination half-life of propofol is 3 hours. However, propofol has some side effects such as a larger decrease in systemic arterial blood pressure related to vasodilation, profound bradycardia, suppression of sensory baroreflex response, and inhibition of sympathetic nerve. It is not indicated in elder patients for monitored anesthesia care sedation or in patients with potentially limited cardiac reserve force patients due to the induction of

severe hypotension. In addition, it has recently been reported that propofol could produce 22-45 percent of transient apnea following induction doses and further exacerbated its side effects by decreasing the sensitivity to carbon dioxide, reducing laryngeal reflex, and decreased functional residual volume of expiratory capacity. Aside from its adverse effects, one of the most frequent side effects is pain on injection, especially in smaller veins. This pain arises from activation of the pain receptor, TRPA1, found on sensory nerves and can be mitigated by pretreatment with lidocaine. In general, it is known that the effect site concentrations of propofol for the purpose use of conscious sedation are 0.8-2 mcg/ml and for that of the deep sedation and general anesthesia are more than 2.5 mcg/ml. In case of dental care for patients with disabilities under the deep sedation, clinically more than 2.5 mcg/ml of required plasma concentration are necessitated to maintain a safe amnesia or sedation. However, it is hard to assess and maintain an adequate depth of sedation in patients with intellectually disabled patients because of problems with airway maintenance during dental treatments and inappropriate pain control. Yet, little has been reported about the proper dosage of both initial target concentration and effect-site concentration during procedure for the disabled. Therefore, in this study we aimed to evaluate the adequate propofol effect-site concentration by use of target-controlled infusion system for dental treatment in intellectually disabled patients who were conducted at Seoul National University Dental Hospital clinic. We undertook retrospective

review of the sedation service records of severely intellectually disabled patients over the age of 15 to analyze the extent of effect-site concentration of propofol to be maintained in the deep sedation status.

II. Patients and Methods

We have been approved by the IRB of Seoul National University Dental Hospital before the research. The study is a retrospective review of the sedation service records of severely intellectually disabled patients over the age of 15. We reviewed all charts of patients receiving propofol by use of target-controlled infusion for deep sedation from Seoul National University Dental Hospital dental clinic with disabilities from January 2009 to June, 2012.

1. propofol target controlled infusion sedation at Seoul National University Dental Hospital dental clinic with disabilities

As patients with disabilities admitted to outpatients, we scheduled for the patients the available date and time of deep sedation after the evaluation of the patient's cooperation and the extent and degree of treatment invasiveness. Along with preoperative evaluation, we have conducted appropriate examination laboratory test for each patient. Also, we educated and scheduled patients to be presented the day after fasting, if needed. TCI apparatus used Orchestra (Base Primia,Fresinius Kabi, France) and pharmacokinetic model of 2% propofol (Fresenius Kabi, France) was used into Schnider model. Depending on the degree of the patient cooperation, we properly inserted intravenous catheter of the patients. For these patients we provided deep sedation using propofol TCI infusion pump at the initial effect site

target concentration of propofol 2 - 3 mcg/ml according to patients. To provide an adequate deep sedation state, we adjusted the target concentration of propofol 0.5 mcg/ml per every step according to the state of unconsciousness, and the conditions of sedation and the side effects such as airway problems. We provided 3-5 liters/min of oxygen through the nasal cannula and checked the standard monitoring including noninvasive arterial blood pressure, ECG, pulse oximetry, carbon dioxide capnography, respiratory monitoring unit, and BIS (bispectral index) monitors. If the patients achieved loss of consciousness and those statuses were stabilized, we offered appropriate amount of 2% lidocaine local anesthetic injection near the site of the pain to be induced. If patients regained consciousness during the procedure of dental treatment, their cooperation might be impossible to achieve through their mobilization. It is crucial to maintain the depth of deep sedation and be supported by additional important indicators such as respiratory rate, airway maintenance, and vital signs. If appropriate dental procedures have been reached, we sustain it without changing the target concentration. If necessary, airway intervention or drug administration would be given. If the medical condition were met, we discharged patients to their home.

2. Selection of the Patients

We included all patients receiving propofol by use of target-controlled infusion for

deep sedation from Seoul National University Dental Hospital dental clinic with disabilities from January 1, 2009 to June, 2012. The total number of patients was 132. We analyzed the patient sedation chart data and distinguished between conscious sedation and deep sedation procedure. Then, we selected the charts receiving propofol by use of target-controlled infusion for deep sedation. Adults over age of 15 were chosen and the final number of patients selected was 73.

3. Data extraction

We did research on the changes in propofol target concentration and vital signs, propofol infusion duration, total sedation duration, dental treatment duration, recovery room stay minutes, and complications and types of disabilities and dental treatments.

(1) Types of disabilities and dental treatments

Evaluation of patient's disabilities and dental treatments reviewing the dental sedation records

(2) Propofol TCI Record evaluation

a. Evaluation of initial propofol target concentration and the changes in effect-site concentration of propofol during dental treatment period by reviewing the chart of each patient (Figure 1). In patient’s sedation record, the initial Ce (effect-site

concentration) stand for an initial set target concentration in effect-site, stabilized Ce mean an effect-site target concentration during dental treatment without intervention including patient mobilization nor side effect, and average Ce showed the mean concentration during total sedation period.

b. Adverse effects occurred during the patient's intravenous sedation assessment (what is written on the anesthetic chart)

c. Basic demographic evaluation criteria: patient's gender, age, body weight, height, and duration of the procedure

d. Total propofol infusion time and total dosage evaluation

e. Changes in vital signs (heart rate, respiratory rate, arterial blood pressure, and blood oxygen saturation)

f. Depth of anesthesia stability as measured by the bispectral index (BIS)

g. Additional administration of other sedation medications and emergency aid

h. Evaluation of patient recovery room stay

I. Outcomes of types of side effects

J. The classification of disabilities

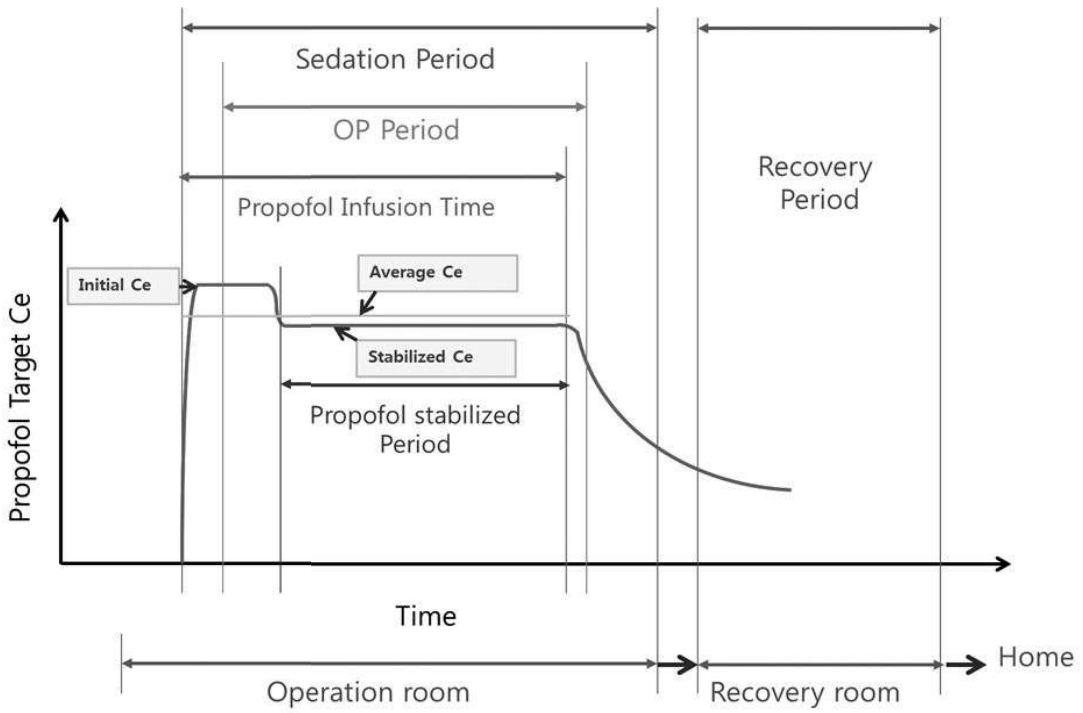

Fig 1. Evaluation Indexes of propofol effect site concentration change and time variables (Note. Ce = effect-site concentration, initial Ce stands for an initial set target concentration in effect-site, stabilized Ce means an effect-site target concentration during dental treatment without patient mobilization nor side effect, and average Ce implies the mean concentration during total sedation period)

4. Statistical analysis

Characteristics of selected patients and categorical data were presented by frequency analysis. The continuous variables of propofol effect site target concentration were expressed as means ±standard error of the mean (S.E.M) and showed the range between minimum and maximum values. The ordinal date was presented as numbers (percentage).

III. Results

Total 73 patients (40 male and 33 female patients) were included in the study. The ages of the patients were 31 ± 17 (15 – 81) years. Basie demographical data including weight, height, and ASA PS classes were showed on table 1. Every participant was severely intellectually disabled who were 17 of mental retardation, 16 of autism, 16 of brain and cerebral palsy disorder, 7 of epilepsy, 5 of Down syndrome, 6 of dementia and blind, and 2 of severe gag reflex patients sited on table 2. The kinds of dental treatment were cavity treatment, surgical tooth extraction, crown setting treatment, scaling, and dental implantation on table 3. Propofol infusion statuses were listed on table 4. Table 5 is about Sedation status and duration in details. The mean sedation duration was 72.5 ± 19.8 (40 – 145) minutes. The initial propofol target concentration infusion amount was 3.0 ± 0.6 (1.5 - 5.0) mcg/ml. The stabilized propofol effect-site concentration was 2.9 ± 0.7 (1.0 - 5.0) mcg/ml. The mean value of BIS was 57.2 ± 13 (28 – 82). During the treatment period, there were no sudden movement of the patients and severe airway constriction. Every patient was discharged after a 1-hour period of recovery room stay (Table 5). The classification of sample determination in disabilities was expressed on table 6.

Table 1. Characteristics of patients

	Male	Female	Total
Sex	40	33	73
Age (years)	29 ± 14 (15 – 81)	33 ± 20 (16 – 81)	31 ± 17 (15 –81)
Weight (Kg)	59.6 ± 14.2 (31 –93)	53.7 ± 12.2 (34 –82)	57.0 ± 13.6 (31 –93)
Height (cm)	166.0 ± 8.8 (145 –180)	153.7 ± 5.1 (144 –162)	160.3 ± 9.6 (144 –180)
ASA PS I/II/III	3/33/4	2/26/5	5/59/9

(Note. Values are mean ± SD, ASA PS stands for American society of Anesthesiologists patient status)

Table 2. Type of disabilities

Type of Disabilities	Male	Female	Total	Total (%)
Mental Retardation	7	14	21	28.8%
Autism	14	2	16	21.9%
Brain ds. & Cerebral Palsy	9	7	16	21.9%
Seizure	1	6	7	9.6%
Down syndrome	4	1	5	6.8%
Dementia	0	3	3	4.1%
Blind	3	0	3	4.1%
Sever Gag Reflex	2	0	2	2.7%
Total	40	33	73	100.0%

Table 3. Type of dental treatments

Dental treatment	Count	%	Treatment duration (minutes)
Dental caries Tx.	56	76.7%	45.9 ± 15.6 (15 - 80)
Crown setting	6	8.2%	36.6 ± 12.9 (20 - 55)
Surgical extraction	4	5.5%	31.2 ± 7.5 (25 - 40)
Scaling	2	2.7%	32.5 ± 10.6 (25 - 40)
Dental caries Tx. & scaling	2	2.7%	85 ± 42.4 (55 - 115)
Dental caries Tx. & surgical extraction	1	1.4%	55
Dental caries Tx. & crown setting	1	1.4%	35
CT taking	1	1.4%	25
Total	73	100.0%	44.8 ± 17.3 (15 - 115)

(Note. crown setting means in term of prosthetics point of view. CT = cone beam, Tx = treatment)

Table 4. Propofol Infusion Status

Characteristics	Value
Initial propofol target Concentration(Ce) (μg/ml)	3.0 ± 0.6 (1.5 – 5.0)
Average propofol target Concentration(Ce) (μg/ml)	2.9 ± 0.6 (1.5 – 4.0)
Stabilized propofol target Concentration(Ce) (μg/ml)	2.9 ± 0.7 (1.0 – 5.0)
Highest propofol target Concentration(Ce) (μg/ml)	3.2 ± 0.7 (1.5 – 7.0)
Lowest propofol target Concentration(Ce) (μg/ml)	2.6 ± 0.8 (0.0 – 4.0)
Total Propofol Infusion Duration (minute)	53.9 ± 18.2 (25 - 115)
Infusion Duration of Initial propofol target (minute)	29.4 ± 24.4 (5 - 90)
Infusion Duration of Stabilized propofol target (minute)	41.6 ± 18.3 (15 - 90)
Counts of propofol target Concentration(Ce) Changes	2.1 ± 1.3 (1 - 6)

(Note. Values are mean ± SD, Ce = concentration)

Table 5. Sedation status and duration

Characteristics	Value ± SD (Range)
Total Sedation Duration (minute)	72.5 ± 19.8 (40 – 145)
Dental Treatment Duration (minute)	44.8 ± 17.3 (15 – 115)
Recovery Room Stay (minute)	53.5 ± 18.4 (20 – 160)
Propofol Infusion Duration (minute)	53.9 ± 18.3 (25 – 115)
Systolic Blood Pressure (mmHg)	105.8 ± 19.8 (74 – 195)
Diastolic Blood Pressure (mmHg)	59.5 ± 17.3 (42 – 100)
Pulse Oximetry (%)	99.1 ± 2.6 (91 – 100)
BIS	57.2 ± 15.0 (26 – 82)

(Note. Values are mean ± SD, BIS stands for the bispectral index)

Table 6. The classification of disabilities

Disability degree	Numbers	%
Mental disability 1st degree	33	45.2%
Mental disability 2nd degree	11	15.0%
Autism 1st degree	8	10.9%
Autism 2nd degree	3	4.1%
Brain lesion 1st degree	4	5.4%
Brain lesion 2nd degree	1	1.3%
Brain lesion 3rd degree	1	1.3%
Dementia 1st degree	2	2.7%
Language diablility 3rd degree	1	1.3%
Unclassified	9	12.3%
Total	73	100

IV. Discussion

In this study, I suggest 3.0 mcg/ml as the initial propofol target concentration for target controlled infusion (TCI) in order to administer deep sedation during dental treatment for uncooperative adult patient. Usually, the doctor who uses TCI infuser changes the target concentration according to state of sedation of patient during operation. But the initial target concentration of ordinary patient usually selected for the best concentration for fast induction and anesthesia stabilization. And, the initial target concentration could be adjusted according to the conditions of patients. At now, little has been reported about the proper dosage of initial target concentration for the disabled. Therefore, in this study the stabilized propofol effect-site concentration during dental treatment under deep sedation was 2.9 ± 0.7 (1.0 - 5.0) mcg/ml, so initial propofol target concentration of 3.0 mcg/ml even though there are individual variations among the cases. This target concentration would be meaningful for the doctors who want to administer propofol as anesthetics for deep sedation in special care dental clinic. The advantages of propofol infusion with TCI system for deep sedation are fast induction, little intraoperative wakening and short recovery time to be discharged [9]. Averagely, when propofol infusion pump has been terminated patients recover less than 5 minutes in cases of short time sedation procedures [10]. It was because the continuous infusion pump controlled by pharmacokinetic parameters less fluctuated the peaks and valleys of drug concentrations in the plasma rather than

the bolus technique [9]. The drawbacks of using propofol infusion were directly affecting myocardiodepressant effects on the heart and respiratory depressive effects. The former is caused by depressing the mean arterial blood pressure up to 15% to 30% decrease in systolic blood pressure due to the subdued systemic resistance which leaded to significant hypotension in the elderly patients. The later results in apnea from decreasing the tidal volume and minute ventilation [11]. It was popular to use propofol alone for TCI sedation in the dental field. However, TCI sedation with the mixture of propofol and remifentanil was widely used in the medical field and dentistry in order to control pain during procedure. In fact, opioids has huge side effect of respiration depression, so in case of conscious sedation the effect of respiratory suppression is minimal, on the level of deep sedation opioid could be dangerous. In other study of propofol TCI sedation in the maxilofacial surgery the average concentration was 1.1 μg/ml right after local anesthesia injection and 2 μg/ml at the end of procedure [12,13]. The propofol target concentration of sedation for awake fiberoptic intubation was 3.2 ng/ml and the range was from 1.3 μg/ml [14] up to 4.5 μg/ml [13]. In other study, during the fiberoptic procedure, the average concentrations of propofol and remifentanil TCI was between 1.5 and 3.5 μg/ml and between 1.0 and 1.5 ng/ml, respectively [15]. The initial concentration setting of propofol and remifentanil TCI in use of nasotracheal intubation was 2.5 μg/ml of propofol and 1.5 ng/ml of remifentanil [16]. In another study of conscious sedation for extracting impacted wisdom teeth,

the initial target plasma concentration of propofol and remifentanil was 0.5 μg/ml and 1.0 ng/ml respectively [17]. In case of achieving conscious sedation during dental treatment for emotional unstable patients, the propofol TCI infusion concentration was 1.6 μg/ml in anxious group and 1.4 μg/ml in non-anxious group respectively. From their finding, they concluded that between anxious and non-anxious group showed no significant pharmacokinetic differences [18]. Usually deep sedation was applied to general anesthesia as an alternative form, because dental treatments for patients with special needs does not end in one long duration of one visit but a several of simple and less than 1-hour procedure are indicated for them. In past, conscious sedation was the objective of the level of sedation, however, in case of those who have behavioral disabilities are less succeed and all 28 out of 35 was induced to the level of deep sedation which was possible to finish the treatment plan [19]. The level of deep sedation caused not only the loss of consciousness but also airway obstruction and no airway protective reflex. Therefore, it required the presence of anesthesiologists who are suitably trained to detect and manage these problems. If dentists were not familiar with airway management during the procedure, it would be hard to manage the level of deep sedation. Even the treatment required short period of time less than an hour, general anesthesia will be an indication [20]. In addition, how to control both airway management and dental treatment duration is an important factor for treating patients with disabilities which limits the implement of deep sedation. In

this study, average sedation duration was 59 minutes and pure dental treatment duration was only 36 minutes except for the propofol induction time and recovery room stay., The duration could be variable from only 25 minutes to 58 minutes [21], however, it was known that over an hour treatment period could be a problem to the patients with disabilities [22]. There a lot of field of deep sedation, during gastric endoscopic submucosal dissection, it is known that combination of continuous propofol infusion and intermittent midazolam injection could decrease the total dose and infusion rate of propofol and the overall occurrence of adverse events [23]. And it is known that gastric endoscopic procedure that there was no significant difference between complication rates for propofol deep sedation with MAC and meperidine/midazolam administered for moderate sedation [24]. In this study, the BIS value had very wide range, because during deep sedation the target concentration was adjusted according to the conscious state such as movement and side effect such as airway obstruction instead of BIS value. So I think BIS value is not helpful for deep sedation. In one study of deep sedation, BIS values showed a marked variability among individuals during deep sedation (5th-95th percentiles: 25-81). So the authors concluded that BIS monitoring is not suitable for indicating an exact endpoint corresponding to deep sedation [25]. In case of combination of propofol TCI and oral dose of midazolam there is a significant benefit, with a reduction in the dosage of propofol required and in patient anxiety levels before ERCP[26]. There is another report about comparison of TCI and

manually controlled infusion (MCI) for deep sedation. TCI was associated with higher total doses of propofol than was MCI resulting in marginally higher propofol drug costs. However, fewer interventions were required by the anesthetists during the use of TCI compared with MCI. No clinically significant differences were demonstrated in terms of quality of anesthesia or adverse events [27].

V. Conclusion

The propofol effect site concentration for deep sedation in intellectually disabled patients was lower than those without intellectual disability. However, using titration of target concentration, propofol target-controlled infusion (TCI) was a useful and safe method in their management during dental treatment.

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국문초록

배경 및 목 적: 치과치료에 심각한 불안과 공포를 보이거나, 의사소통이 어려운 장애를 가진 성인 장애인 환자에서 일반적인 외래 치료로 효과적인 치과 치료가 불가능하다. 이런 환자에서 적절한 치과치료를 위해 전신마취 또는 깊은 진정법이 행동조절을 위해 선택될 수 있다. 특히, 치과 시술이 간단하고 통증이 적으며 짧은 시간이 예상되는 경우 깊은 진정의 적용 대상이 된다. 성인 장애인 환자에서 치과 치료를 위한 깊은 진정 방법으로 구강 내 시야 확보와 신속한 진정 깊이 조절을 위해 프로포폴을 이용한 정주진정법이 흔히 적용된다. 그러나 깊은 진정을 시행하는 경우 과진정에 의한 기도폐쇄, 호흡저하 등의 위험성이 있어 적절한 용량의 투여가 매우 중요하다. 이러한 목적으로 목표농도조절법(TCI)을 이용한 진정법이 시행되는데, 동반된 장애 질환에 따른 영향을 고려하고, 기도 폐쇄 없이 적절한 치과치료를 시행할 수 있는 적절한 양의 프로포폴을 투여하는 것이 필요하다. 그런데, 이러한 목적의 적절한 프로포폴의 투여량에 대한 자료를 찾을 수 없어, 본 연구에서는 후향적 방법으로 환자에게 투여된 프로포폴의 양을 조사하여 목표농도조절법(TCI)시 프로포폴의 적절한 목표 농도에 대하여 알아보고자

하였다.

방 법: 윤리위원회 승인을 얻은 뒤, 2009년 1월부터 2012년 6월까지 프로포폴을 TCI를 이용해 깊은 진정을 시행한 심한 지적 장애를 가진 환자의 진정기록지의 프로포폴의 농도 정보를 후향적으로 분석하였다. 장애인 진료실 마취대장을 이용하여 나이가 15세 이상으로 농도 조절법으로 프로포폴을 투여한 환자를 추출하였다. 각 환자의 진정기록지를 평가하여 깊은 진정을 위해 프로포폴 목표농도를 2-3 mcg/ml로 설정하여 투여를 하였으며, 환자의 진정상태와 BIS 그리고 기도상태에 따라 프로포폴의 농도를 0.5 mcg/ml 씩 조정한 기록이 있는 모든 환자를 선택하였다. 환자의 정보와 프로포폴 투여 농도에 대한 정보를 분석하였다.

결 과: 총 73 명 (남자 40명, 여자 33명)의 환자가 포함되었으며 평균 나이는 31 ± 17 (15 -81) 세였다. 모든 환자는 심한 지적 장애를 가지고 있었으며, 대상 환자의 장애의 종류는 정신지체 21명, 자폐 16명, 뇌질환 및 뇌성마비 16명, 경련 질환 7명, 다운증후군 5명, 치매 3명, 시각장애인 3명, 2명은 심한 구역 반사를 가지고 있는 환자였다. 적용된 치과 시술은 충치 치료, 발치, 스케일링, 임플란트 식립등이 포함되었으며, 평균 진정법 시행시간은 72 ± 19 (40 - 145)분 이었다.

TCI 정주를 위한 초기 농도는 3.0 ± 0.6 (1.5 - 5.0)) mcg/ml 였으며, 안정화된 후 농도는 was 2.9 ± 0.7 (1.0 - 5.0) mcg/ml mcg/ml 이었다. 이때의 평균 BIS 값은 57.2 ± 13 (28 - 82)이었으며 치과치료 중 특별히 갑작스러운 움직임이나 심각한 기도 폐쇄는 발생하지 않았다. 모든 환자는 53.9 ± 18,2 (20 - 150)분 동안 회복 실에서 머문 후 퇴원하였다.

결론 : 지적 장애 환자의 깊은 진정을 위한 목표농도를 평균 3.0 mcg/ml 로 적절한 치과치료가 가능하였다.

주요어 : 지적장애인, 치과치료, 깊은 진정, 프로포폴 목표농도

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