

Attention should be paid to the dose of propofol during target-controlled infusion

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Citation

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Abstract

Target-controlled infusion (TCI) is useful for anesthetic management using propofol because a TCI system can automatically adjust the dose to keep the predicted concentration of propofol at the target concentration that was input into the TCI system by an anesthesiologist. However, human error such as inputting incorrect weight can cause administration of propofol at an inappropriate dose. Therefore, attention should be paid to whether the dose is appropriate or inappropriate against a target concentration. We calculated the dose of propofol during TCI with 3 $\mu\text{g/mL}$ of the target propofol concentration and found that the dose converged to 4.884 (mg/kg/h) and that the dose can be calculated in many periods by multiplying the target concentration ($\mu\text{g/mL}$) by 1.7-2.3. Since the concentration of propofol depends on only the dose independent of personal characteristics, the dose that should be administered (mg/kg/h) can be estimated by doubling the target concentration ($\mu\text{g/mL}$) and we should therefore repeatedly confirm that the appropriate dose is being administered.

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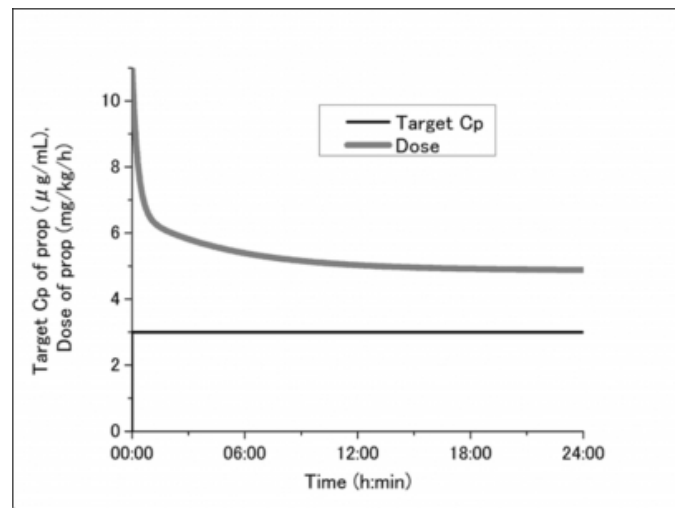
TO THE EDITOR

A target-controlled infusion (TCI) system is very convenient because a syringe pump with a built-in DiprifusorTM (AstraZeneca, London, UK) can adjust the propofol dose by means of just inputting the expected target concentration of propofol during anesthetic management after inputting the patient's characteristics such as weight and age before starting administration. However, confirmation of matching dose with predicted plasma concentration (Cp) displayed on the syringe pump is thought to be always necessary for preventing human errors such as inputting incorrect weight. We calculated the predicted Cp using TIVAtainerTM (available at: <http://www.eurosiva.org/>; accessed on May 1, 2010) with Marsh's parameter [1] when it was assumed that propofol was administered using TCI with 3 $\mu\text{g/mL}$ of the target concentration in a 40-year-old male with a height of

170 cm and weight of 70 kg (Figure 1). The dose converged to approximately 4.884 mg/kg/h under the above conditions.

Figure 1

Figure 1. Target plasma concentration and dose of propofol with time.



The patient is assumed to be a 40-year-old male with a height of 170 cm and weight of 70 kg. Propofol dose decreases with time during administration of propofol at the target plasma concentration of 3 $\mu\text{g/mL}$ and converges to approximately 4.884 mg/kg/h. Cp: plasma concentration, prop: propofol.

Cp of intravenous anesthetics in a steady state can be predicted using the following equation [2]:

Figure 2

$$\text{Concentration } (\mu\text{g/ml}) = \alpha \times \text{dose (mg/kg/min)}, \quad (1)$$

$$\alpha = \frac{\text{Weight (kg)}}{\text{Cl}_1 \text{ (L/min)}}, \quad (2)$$

where Cl_1 is metabolic clearance. Cl_1 of propofol is affected only by weight and varies in proportion to weight [1].

Therefore, value “ α ” is constant in all patients and the value is 36.84. Formula (1) can be written as the following formula:

Figure 3

$$\text{Dose (mg/kg/h)} = \beta \times \text{Concentration } (\mu\text{g/ml}), \quad (3)$$

$$\beta = 1.628. \quad (4)$$

Value β is also constant in all patients. We can confirm that the dose is appropriate against the target concentration by

using formulas (3) and (4) in the steady state. However, in the case of propofol, much time is needed until a steady state is reached. Thus, if value β is calculated from the data in figure 1 using formula (3), value “ β ” falls below 2.3 at about 40 min after starting administration, reaches 2.0 at about 2 hours and 7 min after starting administration, and falls below 1.7 at about 10 hours and 9 min after starting administration. These values are the same regardless of the patient’s characteristics or target concentration as long as the patient has not been administered propofol before starting TCI and target concentration has not been changed. We can approximate the appropriate dose (mg/kg/h) by means of doubling concentration ($\mu\text{g/ml}$).

It should constantly be confirmed during TCI that the administered dose (mg/kg/h) of propofol matches the value calculated by doubling the target concentration ($\mu\text{g/ml}$).

References

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