A Mixed Simulator of Ethnic Variability to Propofol during Sedation and Analgesia

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Introduction

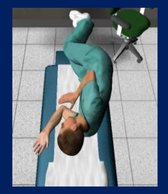
Ethnic variability to propofol anesthesia has been described [1,2]. During propofol sedation and analgesia, there is always the risk of overdose and patients inadvertently sliding into general anesthesia which can be aggravated if the clinician is not trained in airway management. We conducted a simulator-based study to investigate if, as part of the transition from formulaic to patient-centered medicine, patient ethnicity is taken into account, especially when administering potent drugs such as propofol for sedation and analgesia.

Methods

We designed and built a mixed reality simulation of propofol sedation and analgesia during an upper gastrointestinal (GI) endoscopy. We adapted data on ethnicity and propofol [1,2] to scale the loss and recovery of consciousness (LOC, ROC) thresholds for Caucasians in the Fechner propofol model [3] to Indians (South Asians from the Indian subcontinent) and Africans, based on email confirmation from Dr. Fechner that his data was from Caucasians. Thus, using Caucasians as the norm (1.0), the mean propofol consumption to achieve similar BIS (bispectral index) value was set for Africans at 0.82 [2] and for Indians at 0.78 [1]. The mean time to eye opening from propofol anesthesia was set for Africans at 1.6 [2] and for Indians at 1.9 [1]. We did not simulate inter-patient variability within an ethnic group because it would have been a confounding factor. The patient was represented by both a manikin and a virtual human projected onto a wall. A video of an actual upper GI endoscopy was played back during the simulation. The appearance of the virtual patient and the programmed pharmacokinetics and pharmacodynamics (PK/PD) can be readily altered to represent 3 different ethnicities (African, Indian, Caucasian). With IRB approval and informed consent, a convenience sample of twenty-two 2nd-, 3rd- and 4th-year medical students administered propofol sedation and analgesia to a mixed reality simulator (male, 32 years old, 66 – 68 kg) for an upper GI endoscopy. Each participant sedated 3 patients (Caucasian, Indian, African) during the study.

Results

Duration of loss of consciousness (LOC), used as a measure of over-sedation, was significantly higher for the African (289.54 ± 188.0; p=0.003) and Indian (313.81 ± 166.49; p<0.05) patient compared to the Caucasian patient (81.72 ± 130.12). Patients from ethnicities with known sensitivity to propofol were over-sedated.



Caucasian

Asian

African-American

Conclusions

Our data indicate a lack of awareness of ethnic variability in propofol response in our study participants and the possible need for education and training in ethnic variability to drugs at medical schools and PK/PD models for model-driven patient simulators that vary based on the ethnicity of the simulated patient. This latter need may become more pressing as mannequin manufacturers have begun introducing diversity in their offerings by providing the choice of different skin tones while, as far as we can tell, the PK/PD models remain based on data collected from primarily Caucasian populations. As globalization shrinks our world and makes patients more diverse and as patient-centered medicine gains momentum, we expect these two trends to emphasize the need to address these potential learning gaps. We are in the process of repeating this study with anesthesia providers.

References

1. Ortolani O, Conti A, Chan YK, Sie MY, Ong GSY: Comparison of propofol consumption and recovery time in Caucasians from Italy, with Chinese, Malays and Indians from Malaysia. Anaesthesia and Intensive Care 2004; 32:250-5
2. Natarajan A, Strandvik GF, Pattanayak R, Chakithandy S, Passalacqua AM, Lewis CM, Morley AP: Effect of ethnicity on the hypnotic and cardiovascular characteristics of propofol induction. Anaesthesia 2011; 66:15-19
3. Fechner J, Ihmsen H, Hatterscheid D, Schiessl C, Vornov JJ, Burak E, Schwilden H, Schüttler J: Pharmacokinetics and clinical pharmacodynamics of the new propofol prodrug GPI 15715 in volunteers. Anesthesiology 2003; 99(2): 303-13

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