How Good are Predictions of Awakening from a Drug Interaction Display?

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Background: We have a long interest in guiding anaesthesia delivery based on estimated effect-site concentrations[1]. As with infusion anaesthesia there may advantages to using effect-site rather than end-tidal volatile concentrations to guide therapy. Commercial drug-interaction displays such as Drager's Smart PilotView and Navigator from GE use data from models of the interaction between effect-site levels of hypnotics and opioids to display the probability of certain responses. Johnson found subjects woke within +/- 1 min of reaching the 50% probability of awakening[2].

The primary aim of this ongoing study is to assess the point at which patients undergoing a wide range of procedures and anaesthetic techniques first awaken and to relate this to response probabilities from GE-Navigator and to calculated effect-site sevoflurane concentration (Ce-sevo). We also wish to explore the effect of drugs not included in the modeling and to compare the distribution of Ce-sevo at awakening from our older studies.

Method: Ethics committee approval.

For the Navigator study we have data from 97 patients with either sevoflurane (85) or desflurane (22) anaesthesia. The data downloaded from Navigator includes drug doses and timings, and the calculated effect site concentrations and response probabilities over time. We recorded the time at which patients first responded to command (OASS=4/5) and extracted the data for that point in time. We also noted the time at which the probability of responding was 0.5.

Data from another study was used to compare estimation of Ce-sevo. This study looked at the effect of surgery on Ce-sevo at awakening after anaesthesia for a range of surgical procedures in 60 subjects using locally developed systems[3].

Results: Navigator study: mean age 53yr (sd 20) range 16-89yr; weight mean 78(17)kg range 43-122kg. Duration of surgery 109(92)min range 27-828 min. 15 patients received clonidine [range 15-150mcg, mean 68(39)mcg] and 12 morphine [1.5-10mg mean 6(2.6)mg]. Subject woke a mean 4.1(5.0) min after the time they reached 0.5 probability of awakening and at a mean age adjusted MAC-fraction of 0.26(0.14) vol%. Use of adjuncts had a small non-significant effect on MAC-fraction (95%CI -0.096 to 0.037, p=0.38). There was no difference in the MAC-fraction at awakening between data generated by Navigator and our own system (95%CI difference -0.057 to 0.134, p=0.43). Comparing sevoflurane and desflurane there was no difference in the mean offset but desflurane had a narrower distribution.

The best-fit Gaussian distributions had mean (SD) of 2.7 (4.2) and 3.0 (2.8)min respectively.

Comments: Subjects woke over a wide range of volatile concentrations and hence sedation probabilities. 75% of our subjects woke after the time of the 0.5 probability, in part due to different definitions of response. The use of adjuncts had a demonstrable but not statistically significant effect.

Our local system for calculating Ce-sevo gave very similar results to Navigator.

References

1. Kennedy RR, Sakowska MM. Anaesth Intens Care. 2006;34:116.
2. Johnson KB, Syroid ND et al. Anesth Analg. 2010;111:387.
3. Kennedy RR, McKellow M, et al. Anesth Analg. 2013;117:786.