Assessing depth of sedation in patients using a mobile phone test of visual reaction time

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Background

An objective measure of the degree of sedation produced by agents such as propofol would be useful both in clinical practice to help reduce the incidence of over-sedation and in research studies. A number of methods for monitoring level of sedation have been suggested, but none of these is ideal:

- Observer or patient-rated sedation scales
- EEG measures
- Auditory evoked potentials

Visual reaction time (VRT) has recently been suggested as a useful measure of depth of sedation (Ref 1). However, the equipment used was inconvenient in the clinical setting (patients wearing goggles attached to a personal computer). An alternative is to perform similar tests of VRT using handheld computers or mobile telephones. This method is both convenient and highly portable.

Arrow Reaction Time (ArrowRT) A series of arrows appears on the screen, each arrow pointing to the left or to the right.
The patient presses a left or right button as quickly as possible to indicate the direction of the arrow.

Observer's Assessment of Alertness/ Sedation (OAA/S) Scale

Responsiveness	Assessment Categories: Speech	Facial Expression	Eyes	Composite Score Level
Responds readily to name spoken in normal tone	Normal	Normal	Clear, no ptosis	5 (Alert)
Lethargic response to name spoken in normal tone	Mild slowing or thickening	Mild relaxation	Glazed or mild ptosis (less than half the eye)	4
Responds only after name is called loudly and/ or repeatedly	Slurring or prominent slowing	Marked relaxation (slack jaw)	Glazed and marked ptosis (half the eye or more)	3
Responds only after mild prodding or shaking	Few recognizable words	-	-	2
Does not respond to mild prodding or shaking	-	-	-	1 (Deep Sleep)

For each assessment category, mark the statement that best describes the condition of the patient.
Assign the composite score corresponding to the lowest level at which any statement is marked.
Assess responsiveness first.
For *Speech*, ask the subject to repeat the sentence "the quick brown fox jumps over the lazy dog".

The Study

Patients were studied immediately before elective surgery with no pre-medication. Two baseline recordings of VRT were performed using the ArrowRT programme (www. penscreen.com) on a mobile telephone

Propofol was then given by controlled infusion with a customised system. Initially, an effect-site target concentration of 0.3 µg/ml was set and this was increased in 0.2 µg /ml increments until the patient became too drowsy to carry out the test. Measurements were made at each level of sedation, once the calculated effect-site concentration reached the target:

- Two one-minute assessments of VRT
- Self-rated sedation using visual analogue scales (VAS)
- Observer's rating using the Observer's Assessment of Alertness/Sedation (OAA/S), a five-point scale (Ref 2).

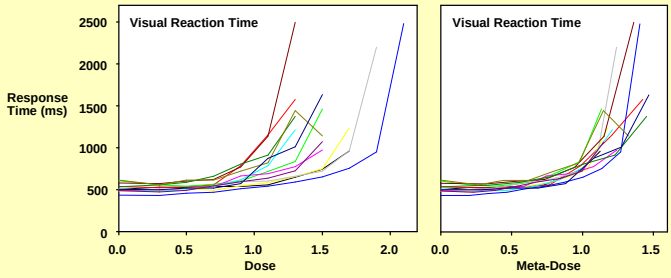
Results

20 patients (13 M; aged 28 - 64) were studied. VRT increased with dose of propofol in all patients, the greatest increase being observed above 0.7 µg /ml (calculated). The increase in VRT from baseline before patients became unable to carry out the test was 187 ± 96% (range 85 - 472%)

To allow for the fact that individual subjects differed in their response to propofol, a dose metameter was calculated for each subject. This was scaled so that 1.0 was the dose at which the VRT was 1.5x the baseline level. This allowed the dose-responses to be compared more easily (see figures below)

Patient VAS scores also increased with increasing propofol levels but the last score measured before the patient became too drowsy to complete further VAS assessments was very variable (range 4 - 99 mm)

OAA/S score fell with increasing propofol levels. In all 19 subjects who completed the study to the point where they were unable to carry out the VRT and VAS tests, OAA/S score had fallen to 3 on a 1-5 scale. OAA/S score was better correlated with VRT (Spearman's r = -0.85) than with VAS (r = -0.64)



Discussion and Conclusions

- **Increasing levels of propofol sedation cause an increase in two-choice reaction time which is particularly marked just before the patient becomes too drowsy to carry out the test.**
- **The increase in reaction time is not linear, but is an accelerating function of increasing propofol concentrations, as illustrated using the dose metameter.**
- **The arrow reaction time test appears to be superior to patient-rated visual analogue scales in the assessment of propofol sedation.**
- **We have shown that a reaction time test programmed on a mobile phone is easy to use by patients in a clinical setting.**

References.

1. Kim KM, Jeon WJ, Lee DH, Kang WC, Kim JH, Noh GJ. Changes in visual and auditory response time during conscious sedation with propofol. Acta Anaesthesiol Scand 2004; 48:1033 – 1037

2. Chernik DA, Gillings D, Laine H, Hendler J, Silver JM, Davidson AB, Schwam EM, Siegel JL. Validity and reliability of the Observer's Assessment of Alertness/ Sedation Scale: study with intravenous midazolam. J Clin Psychopharmacol 1990; 10:244 – 251

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