LETTERS

Assessment of visual pursuit in post-comatose states: use a mirror

One of the first clinical signs differentiating the minimally conscious state (MCS) from the vegetative state is the presence of visual pursuit occurring in direct response to moving or salient stimuli.[1] At present, there is no consensus on what visual stimulus should be employed at the patient's bedside in the assessment of visual pursuit in post-comatose states. Indeed, several behavioural "coma scales" use different stimuli to evaluate visual pursuit: the Coma Recovery Scale-Revised (CRS-R) and Western Neuro-Sensory Stimulation Profile (WNSSP) employ a moving mirror; the Coma/Near Coma Scale, Wessex Head Injury Matrix (WHIM) and Sensory Modalities Assessment and Rehabilitation Technique (SMART) use a moving person; the WNSSP, SMART, WHIM and Full Outline of Unresponsiveness Scale use a moving object or finger (for references see review by Majerus and colleagues[2]).

The aim of the present study was to determine whether the assessment of pursuit eye movements in MCS is influenced by the choice of the visual stimulus. Therefore, we prospectively studied visual pursuit using a standardised presentation of a moving mirror compared with a moving person and a moving object.

METHODS

MCS patients were studied free of sedative drugs in the acute (ie, within 4 weeks) and chronic (ie, more than 4 weeks after insult) setting. The diagnosis of MCS was made according to the Aspen workgroup criteria for MCS[1] and based on CRS-R assessment made by two experienced and skilled neuropsychologists (AV and CS). Each patient was assessed in the sitting position and patient preparation employed a standardised arousal facilitation protocol, as defined in the CRS-R. The goal of this intervention was to prolong the length of time the patient maintained arousal.

Table 1 Number of minimally conscious patients showing visual pursuit (n = 38) as a function of the stimulus used

Stimulus	No of patients showing visual pursuit (%)
Mirror only	11 (29)
Person only	2 (5)
Object only	0 (0)
Mirror and person	4 (11)
Mirror and object	2 (5)
Person and object	0 (0)
Mirror, person and object	19 (50)

Visual pursuit was evaluated using a standardised methodology, as described in the CRS-R (mirror tracking) and the WHIM (person and object tracking). In brief, a round mirror (diameter 15.2 cm) or object (11.4 cm; ball or cup) was held 15.2 cm in front of the patient's face and was moved slowly 45° to the right and left of the vertical midline. For visual pursuit assessment using a moving person, the examiner walked slowly 45° to the right and left of the vertical midline. Stimuli were presented twice for each direction and the order of presentation was randomised. Visual pursuit was defined as a full range (ie, 45°) eye movement without loss of fixation on two occasions in any direction. If the above criterion was not met, the procedure was repeated assessing one eye at a time using an eye patch.

Differences between visual pursuit, as assessed by the mirror, person or object, were assessed using binomial testing. Results were considered significant at a p value <0.05.

RESULTS

Of 51 patients included (36 men; mean age 59 (SD 17) years), 28 (55%) were studied in the acute (mean interval 15 (6) days) and 23 (45%) in the chronic (4 (21) months) setting. Aetiology was traumatic in 24 (47%) and non-traumatic in 27 (53%) patients (ie, ischaemic or haemorrhagic stroke (n = 11), anoxic encephalopathy (n = 11), metabolic encephalopathy (n = 3) and toxic encephalopathy (n = 2)). Thirty-eight (75%) of the 51 MCS patients showed pursuit eye movement occurring in response to moving salient stimuli.

In the 38 MCS patients showing pursuit eye movements, 36 tracked a moving mirror (95%; 18 traumatic; 20 acute) compared with 25 who tracked a moving person (66%; $p<0.01$; 12 traumatic; 14 acute) and 21 who tracked a moving object (55%; $p<0.01$; nine traumatic; 15 acute) (table 1).

The difference between visual pursuit assessed by using a moving person or a moving object was not significant. Visual pursuit preference was not significantly different in terms of aetiology or time since insult.

DISCUSSION

Our data show that the clinical assessment of visual pursuit depends on what moving stimulus is used. MCS patients tend to best track their own reflection as compared with tracking a moving person or object. In everyday social interactions, autoreferential stimuli capture our attention and give rise to a sense of self-awareness, as reflected in the cocktail party phenomenon when hearing our own name. Similarly, we have shown that seeing one's own face also has very strong attention grabbing properties in healthy subjects.[3] Previous functional imaging studies have shown activation of anterior and posterior midline structures (ie, mesiofrontal and precuneal cortices) during self-face presentation in healthy volunteers (for review see Laureys and colleagues[4]). Interestingly, these areas are amid the most metabolically impaired in patients in a vegetative state, incapable of sustained visual pursuit.[5]

Thirteen of 51 patients failed to show visual pursuit (25%). Neurological assessment showed that five of these 13 patients (38%) failed to eye blink to threat; the remaining eight patients (62%) had intact brainstem reflexes while showing reproducible but inconsistent command following. In line with previous studies,[6] visual impairment probably explains this finding.

Two patients showed visual pursuit to a stimulus other that the mirror. In both cases, presentation of the mirror was used as the last stimulus and hence fatigue might explain exceptional tracking of a moving person in the absence of mirror tracking. MCS patients typically show fluctuating signs of voluntary interaction with their environment and observed responses may be easily exhausted (eg, see Giacino and colleagues[1]).

The clinical implications of our findings are important as more than a fifth of the MCS patients with visual pursuit only tracked a moving mirror (and not a moving person or object) and hence would have been misdiagnosed as being vegetative. Our findings emphasise the importance of using a mirror when evaluating eye tracking in post-comatose states.

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REFERENCES

1. **Giacino JT,** Ashwal S, Childs N, *et al*. The minimally conscious state: definition and diagnostic criteria. *Neurology* 2002;**58**:349–53.
2. **Majerus S,** Gill-Thwaites H, Andrews K, *et al*. Behavioral evaluation of consciousness in severe brain damage. *Prog Brain Res* 2005;**150**:397–413.
3. **Bredart S,** Delchambre M, Laureys S. One's own face is hard to ignore. *Q J Exp Psychol* 2006;**59**:46–52.
4. **Laureys S,** Perrin F, Bredart S. Self-consciousness in non-communicative patients. *Conscious Cogn* 2007;**16**:722–41.
5. **Laureys S,** Owen AM, Schiff ND. Brain function in coma, vegetative state, and related disorders. *Lancet Neurol* 2004;**3**:537–46.
6. **Andrews K,** Murphy L, Munday R, *et al*. Misdiagnosis of the vegetative state: retrospective study in a rehabilitation unit. *BMJ* 1996;**313**:13–16.