

ICU Sedation Opportunity and Ocular Microtremor (OMT) Clinical Data

Study	Objective	Results	Conclusions
OMT: A Tool for Measuring Depth of Anaesthesia Bojanic, Simpson, Bolger Br J Anaesth 2001; 86: 519-522	To determine whether OMT can determine loss of consciousness (LOC)	Mean peak count frequency before administration of propofol (80.55 ± 5.89 Hz) is statistically different than mean peak count at LOC (43.81 ± 7.33 Hz).	OMT is affected by propofol and may be an indicator of depth of anaesthesia.
Ocular Microtremor During General Anesthesia: results of a Multicenter Trial Using Automated Signal Analysis Heaney et. Al. Anesthesia Analgesia 2004; 99:775-80	Evaluate an automated system of OMT signal analysis in a diverse patient population undergoing general anesthesia	OMT frequencies at each of the major time points satisfied tests for normality of distribution. Mean OMT frequency decreased significantly at loss of responsiveness and remained decreased significantly below the baseline (awake) level at each time point during unconsciousness. At return to consciousness, OMT frequency was significantly more than any mean value during unconsciousness. Area under ROC curve to predict return of response to verbal command at emergence was 0.939. No differences between volatile agents. No significant differences with NMB.	An automated signal response analysis module for real-time measurement of OMT frequency may be used as a measure of anesthetic effect across a broad range of patients anesthetized with a variety of anesthetic regimens.
Minute Eye Movements During Sleep Coakley, Williams and Morris Electroencephalography and Clinical Neurophysiology, 1979, 47:126-131	Study the effect of sleep on minute eye movements using a closed eye transducer	High frequency ocular microtremor was recorded before sleep in all subjects and with the onset of sleep this activity diminished. Mean frequency before sleep was around 100Hz.. During light sleep amplitude fell and frequency dropped to around 65Hz. There was a further fall in both amplitude and frequency associated with stages III-IV. During periods of rapid eye movement OMT activity was observed with frequencies resembling those seen in the alert state.	

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OMT in Brain Stem Death Bolger, Bojanic, Phillips et al Neurosurgery. 1999 Jun; 44(6): 1201-6	To determine if OMT can establish brain death.	<p>Normal subjects OMT (89.6 ± 6 Hz) was statistically different than comatose patients with no signs of brain death (50.7 ± 16 Hz).</p> <p>31 out of 32 patients in brain death diagnosed group had "no OMT activity"</p> <p>Sens.=97%, spec. =100% for evaluating patients for brain death (n=64 all coma patients)</p>	OMT may be an inexpensive and sensitive test for the presence of brain stem activity.
Comparison of Ocular Microtremor and Bispectral Index During Sevoflurane Anaesthesia Kevin, Cunningham, Bolger Br J Anaesth 2002; 89 (4): 551-555	<p>To study the effect of sevoflurane anaesthesia on OMT.</p> <p>To compare OMT with Bispectral Index (BIS) as a predictor of response to verbal command during anaesthesia.</p>	<p>OMT frequency decreased significantly at LOS [85(82-88) awake vs. 48 (39-52)].</p> <p>Positive and negative predictive values were also higher in OMT compared to BIS (93% vs. 74% and 84% vs. 71% respectively).</p> <p>OMT gave better logistic regression models than BIS to discern awake vs. LOC at onset of anaesthesia and return to consciousness.</p> <p>Neuromuscular block (n=10) did not affect accurate measurement of OMT frequency.</p> <p>Sensitivity and specificity were higher for OMT than BIS to distinguish asleep from awake states at emergence from anaesthesia (85% vs. 76% and 94% vs. 69% respectively).</p>	OMT is suppressed by sevoflurane and accurately predicts response to verbal command. OMT may be a useful monitor of depth of sedation.
Ocular Microtremor Activity in Comatose Subjects Bolger, Bojanic, Phillips et al	<p>To determine if OMT can indicate early mortality in unconscious patients.</p> <p>To assess the correlation between depth of coma and OMT activity.</p>	<p>OMT in normal group (86.9 ± 6 Hz) was statistically different than OMT in comatose patients (50.7 ± 16 Hz).</p> <p>High correlation between GCS and OMT ($p < 0.00001$).</p> <p>Significant association between abnormal VOR and OMT ($p < .002$).</p> <p>Mean initial OMT in survival group (60.5 ± 2.3 Hz) was statistically different than the group that died (37.8 ± 3.9 Hz).</p> <p>All patients (n=10) with initial OMT of <45 Hz died.</p> <p>Sensitivity=77%, specificity=100% for initial OMT</p>	OMT is significantly reduced in comatose patients. Initial OMT readings may have prognostic value for coma outcome.

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		less than 45Hz and mortality.	
Dominant Frequency Content of Ocular Microtremor from Normal Subjects Bolger, Bojanic, Sheahan, et al. Vision Research 1999; 39: 1911-1915	To establish the dominant frequency signal content of ocular microtremor in healthy normal subjects using the Piezoelectric strain gauge technique and the peak counting method.	Mean OMT frequency by manual peak counting was 83.68 Hz SD 5.78. Mode frequency was 83 and the median was 83.8 Hz. Range was 70-103 Hz. No significant differences in gender ($p=0.7$) but significant with age over 70 years ($p<0.008$).	Mean OMT frequency in normal, healthy subjects was 83.68 Hz SD 5.7. Mean OMT frequency stratified by age over/below 70 years: below 70 years was 86.69 Hz SD 7.29 above 70 years was 80.54 Hz SD 4.73.

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<p>Ocular Microtremor (OMT): a New Neurological Approach to Multiple Sclerosis Bolger C, Bojanic S, Sheahan N, et al J Neurol Neurosurg Psychiatry 2000; 68: 639-642</p>	<p>To investigate the potential use of the OMT record as a diagnostic test for multiple sclerosis.</p>	<p>Mean OMT frequency in control group was 86.15 Hz (SD 6.3) Mean OMT in MS group was 71.3 Hz (SD 10.53) Mean OMT in MS with brain stem disease 67.09 Hz (SD 8.9) 78% of MS patients and 89% of patients with clinical evidence of brain stem or cerebellar disease had at least one abnormality in OMT pattern.</p>	<p>The recording of OMT provides a new neurophysiological method for assessing patients with MS. Presence of OMT pattern abnormality similar to what is seen on other neurophysiological techniques.</p>
<p>Effect of Age on Ocular Microtremor Activity Bolger C, Bojanic S, Sheahan N, et al Journal of Gerontology 2001; 56A(6), M386-M390.</p>	<p>To examine the changes in OMT activity related to aging.</p>	<p>OMT activity significantly correlated with age (correlation coefficient, $r = -0.36$, $p < 0.002$). Strongest correlation is between frequency content of bursts and age ($r = -0.53$, $p < 0.001$)</p>	<p>Age has a negative correlation with OMT activity (overall frequency, frequency content of the baseline and frequency content of the bursts). Different values of normal should be assigned to patients 60 years and older.</p>
<p>Ocular Microtremor in Patients with Idiopathic Parkinson's Disease Bolger C, Bojanic S, Sheahan N, et al J Neurol Neurosurg Psychiatry 1999; 66: 528-531</p>	<p>To examine the effect of Parkinson's Disease on tonic output from oculomotor nuclei using OMT as a measurement index.</p>	<p>The mean overall OMT frequency in the control group was significantly higher than in the study group (81.64 Hz SD 6.10 vs. 67.68 Hz SD 10.75, $p < 0.00001$). In the study group, patients who are "off" have a significantly lower OMT frequency than patients who are "on". Mean peak frequency of "off" group was 58.88 Hz (SD 10.35) vs. "on" group 73.78 Hz (SD 5.55), $p < 0.0019$.</p>	<p>The inability of Parkinson's patients to initiate voluntary eye movement is not fully explained by the abnormalities in oculomotor function. The OMT record may be a useful objective method for the assessment of Parkinson's patients.</p>

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The Correlation of Ocular Micro-tremor (OMT) Signals with Patient Level of Consciousness Unpublished Data	To examine the use of OMT in outpatient surgeries To validate a new instrument design	Mean OMT values were significantly different between the four levels of sedation; 1A.NOR vs 2 LOR 16.59 Hz. 7.95 2 LOR vs 3 PROC 25.59 Hz. 12.26 3 PROC vs 4 ROR -6.58 Hz. 3.15	OMT dissociates propofol – induced levels of sedation The new instrument measures and records OMT comparable to previous instrument
Peri-Operative Evaluation of Sedation Depth in Cardiac Surgery Validity and Reliability of Ocular Micro-Tremor (OMT) During Anesthesia and Intensive Care Sedation Prospective Observational Longitudinal Cohort Study (Phase II in progress)	To evaluate the validity and reliability of OMT to measure levels of sedation as compared to the RASS scale	PRELIMINARY: The correlation between OMT and the RASS is significant with Pearson r of 0.8440 and R-square of 0.7123	PRELIMINARY: These data provide contingent validity for Reactivity in the context of: <ul style="list-style-type: none"> • Multi rater variability • RASS test as a semi-controlled stimulus