Fall and Rise Times of the qCON and qNOX Indices During Induction and Recovery of Anaesthesia

Introduction: An important issue with the current hypnotic effect and pain/nociception monitors is the separation between the hypnotic and the analgesic effects. In this context, it is of interest to compare the different behavior of consciousness and nociception indices during different periods of the surgical procedure. The objective of this study was to analyze the performance of the qCON and qNOX indices after drug induction and during recovery of consciousness by measuring their fall and rise times.

Methods: After IRB approval and written informed consent, data was recorded from 140 patients scheduled for general anaesthesia with a combination of propofol and remifentanil, both infused using a TCI system. The qCON 2000 monitor recorded the qCON and qNOX indices of hypnotic effect and pain/nociception (Quantium Medical, Barcelona, Spain). Both indices were derived from the frontal electroencephalogram (1). The fall times (Figure 1a) were defined as the difference between the times when the effect site concentration of propofol or remifentanil was above zero (T_0) and the time when qCON and qNOX reached a value below 85 ($T_{<85}$) and 65 ($T_{<65}$). The rise times (Figure 1b) were defined as the difference between the time of recovery of consciousness (eye opening) or response to noxious stimuli (T_{RC}) and the times when qCON and qNOX reached a value above 65 ($T_{>65}$) and 85 ($T_{>85}$). Significant differences of the rise and fall times were tested using Mann Whitney U test and Wilcoxon signed-rank test.

Results: Table 1 shows that the qCON decreased below 85 at (median) 148.5 s and below 65 at 183 s after anaesthesia induction, while the qNOX fall times were significantly longer (p-value<0.05). During recovery, the qNOX increased above 65 at (median) 57 s before recovery of consciousness and above 85 at 5 s after recovery of consciousness while the qCON rised to 85 at 96 seconds after qNOX (p-value<0.05).

Conclusion: The qCON has a faster decrease than qNOX after drug induction while it has a slower increase than qNOX during recovery of consciousness. The indices qCON and qNOX were able to detect differences between the times of actions of hypnotic and analgesic agents. The clinical interpretation is that loss of consciousness is achieved before analgesia during anaesthesia induction. During recovery the probability of response to noxious stimuli increases before the patient recovered consciousness as assessed by the qCON. Hence the qNOX could be interpreted as an arousability index.

Acknowledgement: The qNOX was based on an idea from the Department of Anesthesia Hospital CLINIC de Barcelona (Spain) funded by grant PS09/01209 and has been developed in collaboration with Quantium Medical.

Reference:

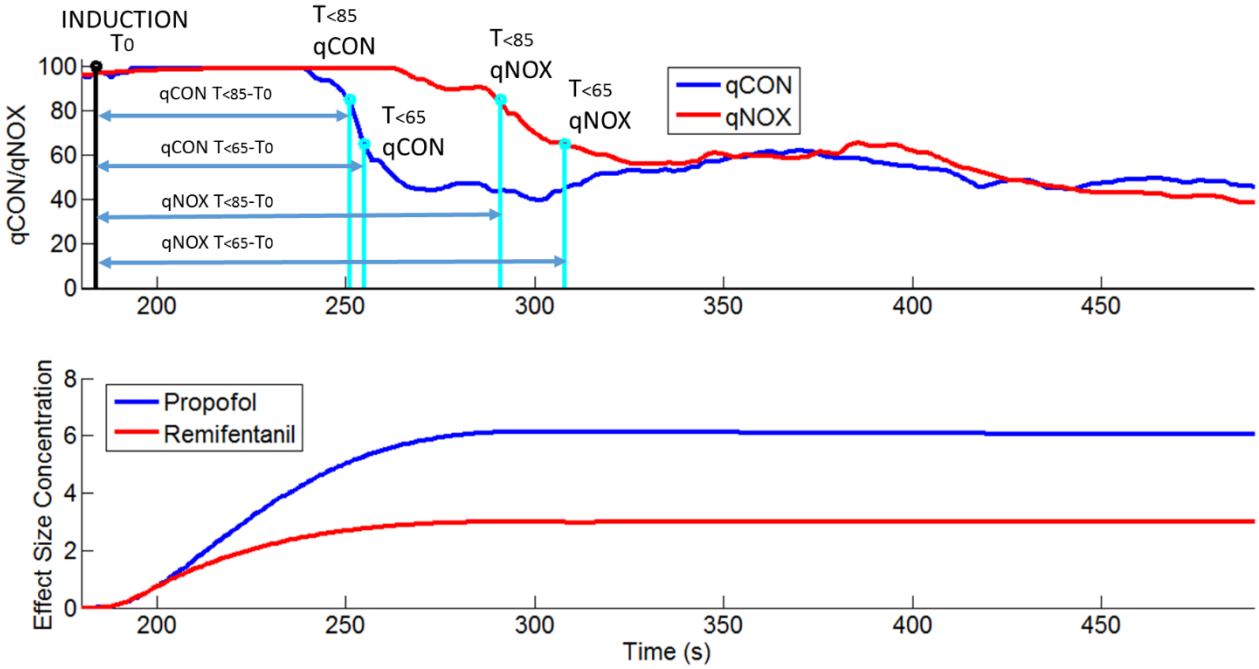
1 Jensen, E. W., Valencia, J. F., Lopez, A., Anglada, T., Agustí, M., Ramos, Y., Serra R., Jospin, M., Pineda, P., Gambus, P. (2014). Monitoring hypnotic effect and nociception

with two EEG-derived indices, qCON and qNOX, during general anaesthesia. Acta Anaesthesiologica Scandinavica, 58(8), 933-941.

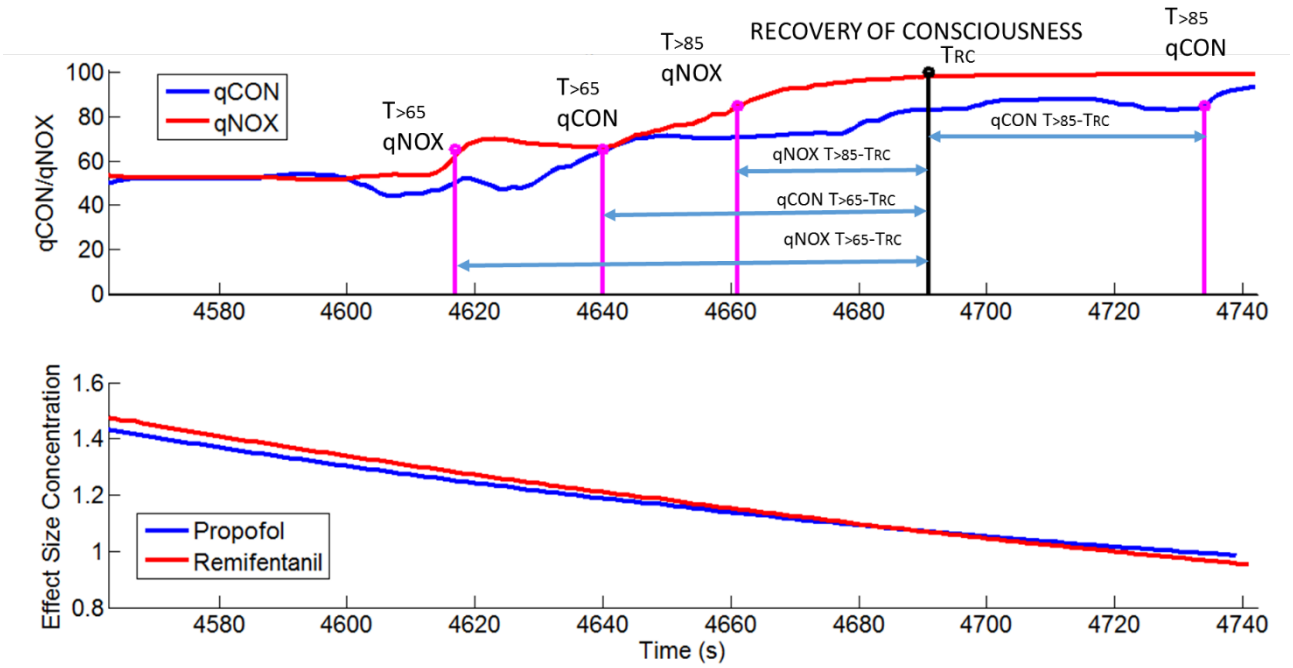
Table 1 – Values of decreasing and increasing time of qCON and qNOX

	qNOX Time (s) median (25th; 75th percentiles)	**qCON Time (s) median (25th ; 75th percentiles)**	**qCON - qNOX Time (s) median (25th ; 75th percentiles)**
DECREASING			
$T_{<85} - T_0$	198.0 (114.0; 245.0)*	148.5 (67.0; 190.0) *	- 24.0 (-64.0; -11.0) **
$T_{<65} - T_0$	249.0 (189.0; 322.0) *	183.0 (122.0; 241.0) *	-36.5 (-113.0; -18.0) **
INCREASING			
$T_{>65} - T_{RC}$	-57.0 (-171.0; 7.0) *	-1.0 (-32.0; 60.0)*	22.0 (3.0; 122.0) **
$T_{>85} - T_{RC}$	5.0 (-44.0; 46.0) *	88.0 (-151.0; -40.0) *	96.0 (26.0; 184.0) **

* p-value<0.005 U of Mann Whitney test; **p-value<0.005 Wilcoxon signed-rank test



(a)



(b)

Figure 1 – Example of qCON and qNOX decreasing and increasing time calculation (a) after drug induction and (b) during recovery of consciousness