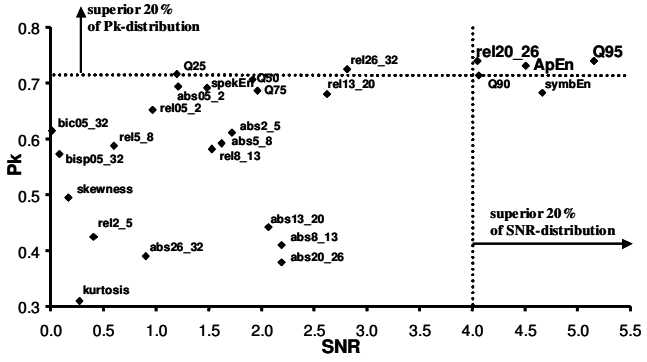
Simultaneous analysis of clinical endpoints and signal-to-noise ratio identifies suitable EEG parameters for monitoring anaesthesia

Ch. Jeleazcov, F. Bremer, H. Schwilden
Klinik für Anästhesiologie, Friedrich-Alexander-Universität, Erlangen, Germany

Introduction:
The suitability of EEG derivations as surrogate parameters for 'depth of anaesthesia' is usually quantified only by the prediction probability Pk, an association statistic to clinical endpoints.[1] Also, few clinical endpoints are used, like consciousness vs. unconsciousness.[2] However, a high association statistic alone is not sufficient, moreover the association to clinical endpoints should ideally contain no time delay. This requires a low hysteresis, which implies a high signal-to-noise ratio (SNR) of the EEG derivations. This study investigates 26 frequently computed EEG derivations from volunteers during 17 clinical endpoints under propofol application and identifies those parameters with highest Pk and SNR as suitable for monitoring anaesthesia.

Methods:
With the appropriate ethics committee approval and informed consent from participants, we analysed 54 hr EEG recorded during 2 consecutive propofol applications to unpremedicated volunteers. The depth of anaesthesia was reflected by 9 clinical endpoints at 17 different times. For the computation of the Pk-value we used the median of the analysed EEG derivation nearby the clinical endpoint. After noise estimation of each EEG derivation with the algorithm proposed by Tukey[3], we computed the SNR-value as ratio of signal variance to noise variance. The superior 20% of the EEG parameters in the Pk- and SNR-distribution were considered as suitable for monitoring depth of anaesthesia.

Results:
Relative Power 20-26 Hz (rel20-26), Approximate Entropy (ApEn) and 95. Quantile of Power Spectrum (Q95) show a Pk≥0.72 and a SNR≥4.0 (Figure).



Conclusions:
The simultaneous analysis of Pk and SNR clearly identifies the higher spectral components of the power spectrum as parameters with a robust discrimination between the derived levels of depth of anaesthesia. Newer EEG derivations like the entropy quantities do not contribute to a relevant increase in Pk- or SNR-values. The bispectral EEG derivations show low Pk- and SNR-values and are not suitable for monitoring anaesthesia.

References:
1)Bauerle K, Greim CA, Schroth M, et al.Br J Anaesth 2004;92(6):841-845. 2)Vakkuri A, Yli-Hankal A, Talja P, et al. Acta Anaesthesiol Scan 2004;48:145-153. 3)Tukey JW: Exploratory Data Analysis. Addison-Wesley 1977.