A state-of-the-art wearable sensor for heart rate based seizure detection in epilepsy

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PURPOSE

• To develop and validate a wearable low power prototype device for heart rate based epileptic seizure detection
• Objectives: sensitivity (SEN), positive predictive value (PPV) and technical feasibility

METHODS

• Observational study (non-randomized, open, single-site)
• 10 subjects previously diagnosed with frequent (>1/week) major epileptic seizures with heart rate changes
• Major seizures: tonic-clonic, generalized tonic or clonic and hypermotoric
• At night during 1-4 weeks per subject
• Total of 30-50 major seizures
• Results verified by visual analysis of recorded video and comparison to previously analyzed EEG-video data

ALGORITHM

Embedded real-time implementation of the algorithm proposed in [2] (fig. 3)
• Embedded RR interval computation based on wavelet transform [3]
• Detection of pattern that is characteristic for epileptic seizures (fig. 4)
• Original model extended with a plateau phase
• Events/alarms differ in relevance
• Adjustable parameters

RESULTS

Preliminary results indicate heart rate based detection of major seizures by the proposed wearable sensor system is successful, clinically and technically
• Patients tolerate the device well and show no signs of discomfort
• For optimized sensitivity and positive predictive value the detection algorithm needs to be tuned to the patient based on seizure characteristics
• Tuned settings enable differentiation between clinically relevant and irrelevant (major) seizures (see patient 3)
• Current study will finish end of 2010
• Next phase: towards product development and market introduction
• Continuing R&D on seizure detection: multi-sensor approaches

LITERATURE CITED


SYSTEM DESIGN

Wearable sensor system [1] for real-time heart rate based seizure detection
• Lightweight and miniaturized (~20g / 52x36x15mm 3)
• Low power electronics (autonomy: 24 hours)
• Wireless communication for data and real-time event/alarm transmission
• Ultra-low-power bio-potential read-out ASIC
• Two wired electrode leads with patches on the chest
• Worn on the upper arm (fig. 2)

CONCLUSIONS

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FURTHER INFORMATION Please contact busselmv@kempenhaeghe.nl

More information and literature on this and related projects can be obtained at:
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