



Safety in Epilepsy Institutions Sécurité dans les établissements d'épilepsie



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Abstract

There is growing concern about patient safety in situations where patient do not live at home. Specialised epilepsy institutions will have to pay much attention to the required level of safety. Automatic detection of epileptic seizures is required. This article gives an overview of the individual risk assessment and developments in seizure detection systems. These vary from simple rhythmic movement detector to systems based on advanced audio analysis. Best results will be obtained with multimodal systems, one of which is described.

Keywords: Epilepsy care- Safety risk- SUDEP- Seizure detection- Clinical research.

Résumé

L'inquiétude grandit au sujet de la sécurité des patients dans des situations où le patient ne vit pas à la maison. Les institutions spécialisées d'épilepsie auront à faire beaucoup attention au niveau de sécurité requis. La détection automatique des crises d'épilepsie est nécessaire. Cet article donne un aperçu de l'évaluation et de l'évolution des systèmes de détection de saisie du risque individuel. Celles-ci varient du simple détecteur de mouvement rythmique aux systèmes basés sur l'analyse audio de pointe. Les meilleurs résultats seront obtenus avec les systèmes multimodaux, dont l'un est décrit ici.

Mots-clés: Soins de l'épilepsie- Risque sécuritaire- SUDEP- Détection de crises- Recherche clinique.

Introduction

In Europe and other parts of the world there are growing concerns seen with regard to safety of patients with epilepsy who do not live at home. The risk of sudden death is high for people with epilepsy (20x increased compared to normal people) especially in the institutionalised group (one death in 300 patient years). In contrary to those who stay at home, often no surveillance of a nearby caregiver can be offered after a seizure because they are not detected. Therefore surveillance support needs to be developed for epilepsy institutions (figure 1) to provide a level of safety comparable to that at home.



Figure 1: Kempenhaeghe is a specialised epilepsy institution providing all kinds of health care for epilepsy, varying from chronic institutionalised patients with a mental impairment to selection for epilepsy surgery.

Required level of care

According to Shorvon and Tomson, data from a pooled analysis of risk factors indicate that the higher the frequency of tonic-clonic seizures, the higher the risk of SUDEP [1]; furthermore, risk of SUDEP is also elevated in male patients, patients with long-duration epilepsy, and those on antiepileptic polytherapy. Position in the bed may also increase the risk according to some studies (figure 2).

Shorvon and Tomson conclude that supervision after a tonic-clonic seizure by which they mean continuous attendance until full consciousness is restored should be the standard level of care [1]. This attendance is only possible if tonic-clonic seizures are properly detected, especially at night.



Figure 2: Results of one systematic review. The Risk Factor is given a positive (to the right) or a negative value (to the left) based on the results of various studies and corrected for the number of included SUDEP cases. AED: anti epileptic drugs, VNS: vagal nerve stimulation, TC seizure: tonic clonic seizure [2].

be possible. A second problem is the distinction of the proper epilepsy-related sounds from the numerous other aspecific noises. We calculated that only 1 out of 400 sound alarms was epilepsy related (in a population of 300 patients whom all were suffering from epilepsy). So a more sophisticated sound analysis seemed useful. After quantified analysis (Fourier Transform) detection of epilepsy-related sounds indeed became very efficient if this sound was previously individually defined [4], figure 3. For example sounds related to bronchial secretion due to impaired breathing were recognized with '95% sensitivity and ' 95% specificity. At this moment we are currently testing such an individualized audio detection system in our institute.

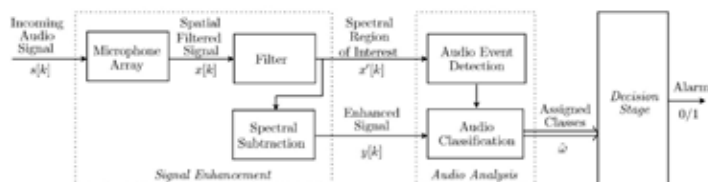


Figure 3: Model of automatic detection of specific audio signals related to epilepsy.

Seizure detection, multimodal systems

Most other systems that are currently in use are based on analysis of movement [5], they have a reasonable performance, but false positives and false negatives remain a problem. Therefore we believe that the best future for detection of seizures by non-EEG systems lays in a multimodal detection system, combining movement, heart rate, audio and video-analysis. In the Netherlands such a system is currently being tested (figure 4). Final results are expected in 2015. Of course for non-convulsive seizure states non-EEG sensors will not be adequate. For this type of seizures EEG remains the diagnostic standard, but this is as yet impossible in the chronic care.



Figure 4: The multimodal 'Teleconsortium' detection project that is currently being carried out in the Netherlands.

Integrated care

Of course adequate seizure detection is worthless without providing enough nursing care afterwards. Nurses have to be educated in recognition of seizures and making decision to administer medication during prolonged or complicated seizures. Furthermore transport and ICU facilities are needed in the nearby environment of the institute. Most important for integrated care are adequate detection and nursing surveillance.

Individual risk assessment

Each patient should be assessed at admission for the risk of complications due to the epilepsy. This assessment should include knowledge of the type of seizures and seizure frequency and lead to a decision for the need of a (nocturnal) seizure detection system. In the nearby future the choice of the proper seizure detection system will also part of this preventive procedure.

Conclusion

The risk for sudden death in epilepsy is difficult to manage in the epilepsy institutions due to the fact that adequate care after tonic-clonic seizures cannot always be given. Automatic detection is needed, but systems are not yet adequately developed. However this is improving in the next years. Therefore it is wise that those who are going to provide centralised and specific epilepsy care are aware of developments in this area. Close collaboration with organisations that have experience in integrated care (detection and nursing surveillance) can help to solve this issue.

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