

Telemonitoring for Early Asthma Detection in Children

Ratko Magjarevic, Sinisa Sovilj and Vedran Bilas

Faculty of Electrical Engineering and Computing, University of Zagreb,
Zagreb, Croatia

1. Introduction

The aim of this study is to present a pilot study of an asthma monitoring system based on wheezing detection in respiratory sounds of infants. The system is intended for use in closed rooms like patients' apartments or kindergartens. In the preliminary study, we showed that electronic auscultation and analysis of breathing performed in a group of 26 asthmatic infants (1-7 years) enabled the early detection of possible asthmatic seizures. In the monitoring system we are developing, the transducers (microphones, an accelerometer and a resistive belt) will be built into wearables and connected to a processing and telemetric (communication) unit. Raw data are transmitted to the stationary side where they are analysed/processed for possible early detection of signs of asthmatic seizures, and timely alerting of parents and, in further step of the project also automatic connecting to the medical centre where data would be also analysed on line by a physician, stored and used for further educational and scientific purposes.

2. Materials and methods

Our research consists of several parts: 1) testing the feasibility of the use of electronic auscultation for early detection of asthmatic seizures, 2) analysis of technological aspects for designing a system with desirable characteristics, 3)ascertaining willingness of medical specialists to contribute in such a research and finding their requirements for its implementation, 4) testing willingness of the parents or other persons taking care of asthma patients to use the system, including ICT, in delivery of health care, and finally, 5) exploring costs-benefits issues for establishing a service that could be integrated into the existing health care system.

In the period of 6 months, the measurements and recordings of respiratory sounds were performed on 26 infants (1-7 years) identified as asthmatic patients. We used two types of transducers: electret microphone (EK-3024, Knowles Electronics) and accelerometer (BU-3173, Knowles Electronics) positioned on the right chest side just beyond the clavicle. Both transducers are used because the microphone has a much higher sensitivity compared to the accelerometer which in opposite is much less sensitive to background noise.

Wheezing was detected in case of seven patients during an asthmatic seizure. With three patients who were brought during a seizure, no wheezing was detected. One of them was medicated before the measurement of the respiratory sounds. With three patients who came for regular control examination, wheezing was detected though no obstruction was diagnosed by the physician. 16 patients who came for a regular examination and had no obstruction diagnosis had also no wheezing. Therefore the presence of wheezing was considered as a valuable parameter in early detection. The timing of wheezing was also analysed in order to detect whether they occur during inspiration or expiration, which was in turn monitored

by measurements of the changes of the resistive belt resistance. After digitizing, the data is transferred to the receiver connected to a PC which enables the analysis, alarm rising and connection to a medical centre for consulting.

3. Discussion

This pilot project showed that wheezing can be a valuable predictor of asthma detection especially among children who have problems in using other monitoring devices, like peak flow meters. However, the incidence of false alarms in the early stage of our research is quite high, but acceptable due to the high level of concern of parents for the health of their children. One of the problems for extensive application of the system is the population, the costs of the equipment and the necessity to understand the basic functions of the ICT equipment involved. However, continuous monitoring of asthma patients helps preventing severe attacks and improving life quality.

4. Conclusion

The application of rather complex telemonitoring systems consisting of a measurement and processing unit, a communication link with possibly several receivers and a real time data processing and connection to a medical centre seem to be very limiting for the child. However, most of the telemonitoring equipment is built into a wearable and does not reduce the mobility of the patient making it highly acceptable. The link of the processing unit to the Internet enables easy access to the consulting medical service and appropriate medical actions in time. The use of ICT in providing telemonitoring benefits the patients and is compatible with the public health care system.

References

- [1] G. Charbonneau, E. Ademovic, BMG Cheetham, LP Malmberg, Vanderschoot, ARA Sovijarvi. "Basic techniques for respiratory sound analysis", *European Respiratory Review*, 10:77, 625-635, 2000.
- [2] M. Oud, EH. Doojies, JS. Van der Zee. "Asthmatic Airways Obstruction Assessment Based on Detailed Analysis of Respiratory Sound Spectra", *IEEE Transactions on biomedical engineering*, 47 (11): 1450-1455, 2000.
- [3] I. Mazic, S. Sovilj, R. Magjarevic, "Analysis of Respiratory Sounds in Asthmatic Infants", *MEASUREMENT 2003, Proceedings of the 4th International Conference*, Smolenice, Slovak Republic, pp. 125 – 128
- [4] N. Saranummi, I. Korhonen, M. van Gils and S. Kivisaari, "Barriers limiting the diffusion of the ICT for proactive and pervasive health care", in *IFMBE Proc., 9th Mediterranean Conference on Med. Biol. Eng. Comput.*, vol. 1/1, Pula, 2001, pp. 23-26.
- [5] J. Finkelstein and R. H. Friedman, "Telemedicine system to support asthma self-management", in *Proc. IEEE EMBS Int. Conf. Information Technology Applications in Biomedicine*, Arlington, 2000, pp. 164-167.
- [6] V. Bilas, A. Stipic-Markovic, J. Stipic, "Towards a feasible telemonitoring system to support asthma patients", in *IFMBE Proc., 2nd European Medical and Biological Engineering Conference*, vol. 3 (1), Vienna, 2002, pp. 524-525.