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Non-Invasive System for Measuring Intra-Abdominal Pressure

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Extended Abstract

Purpose: Monitoring surgical and intensive care patients is an usual procedure in hospital units[1]. The rise of intra-abdominal pressure (IAP) is a well-documented phenomenon, leading to increased morbidity and mortality [2], [3]. The objective of this study was to create a non-invasive system of IAP measurement based on computational intelligence systems [4]. From the bibliographic research carried out, no applications of artificial neural network (ANN) and adaptive-network-based fuzzy inference system (ANFIS) were used to determine IAP.

Methods: The selection of the features was realized according with the literature review of the parameters that can be influenced by IAP [2]. The database used was collected in a population of 42 dogs submitted to surgery and divided into 2 groups: sick (with abdominal disease that can affect IAP) and healthy (dogs submitted to elective surgery). 372 measurements of 18 parameters (weight, abdominal perimeter, abdominal cavity surface area (ACSA), temperature, heart rate, amplitude measurement of P, R and T wave, intervals measurements of P, QRS, T, PQ and QT, systolic, diastolic and mean blood pressure, values of capnography and pulse oximetry) were used as input and 1 parameter as output (direct measurement of IAP) to build the ANN and ANFIS. In the construction of the ANN several types of architecture were tested, such as activation and training functions. The ANFIS was created with 2 types of inference system, Sugeno and Mandani, and the clustering of data were performed with the Fuzzy C-Means, subtractive clustering and self-organizing maps (SOM). Data were divided into 3 groups, training (50%), testing (25%) and validation (25%) in order to evaluate the networks [4], [5].

Results

The IAP showed average results of 4.05 ± 3.60 mmHg and the parameters with the highest statistical correlation with the IAP were: weight (cc0.48), ACSA (cc0.46), perimeter (cc0.34), diastolic (cc0.25) and mean blood pressure (cc0.17), duration of the QRS (cc0.20) and the amplitude of the R wave (cc0.12). Systems based on the 18 inputs were constructed and a simplified system was created only with the inputs with the highest correlation with the output. The best ANN created was built with 7 inputs, with the activation function Tansig and the training function Bayseian regularization. This network showed results of linear regression coefficient of 0.97. The ANFIS that demonstrated the best results was also constructed with the simplified model, with only 7 entries. The best results were obtained with Sugeno inference system and 20 rules demonstrating an error of 2.10 (training), 1.73 (test) and 3.79 (validation).

Conclusion: This type of non-invasive methodology allows the determination of IAP continuously. The ANN and the ANFIS created allowed predicting IAP with low error compared to real values. This type of methodology can be used in human medicine.

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