Prediction of metastatic disease by computer aided interpretation of tumor markers in patients with melanoma: a feasibility study

Aims: Cutaneous melanoma, one of the most aggressive tumors, potentially leads to widespread metastasis. The prediction of metastatic events through tumor markers and pretest probability could substantially improve treatment patterns, potentially reduce additional diagnostic workup to increase patient well-being and may reduce costs.

Methods: To predict metastatic events in patients with cutaneous melanoma, a knowledge based system (KBS) will permit a combination of prognostic evidence and provide quantitative analysis. For the interpretation of the tumor classification, the programming language Arden Syntax was used. Machine learning methods like the artificial neural network (ANN) were realized in Matlab 2010b as well as for the performance of an optimal curve fitting to make a point about the current patient's survival rate.

Results: The KBS is divided into three interpretation parts: (1) the rule-based interpretation of the most recent tumor classification, according to the American Joint Committee on Cancer, (2) the interpretation of the tumor markers S100β, MIA and LDH, routinely used for follow-up, by logistic regression analysis and (3) risk assessment of the current patient's survival rate by using the survival curves considering the tumor stage. The interpretation of the tumor markers (data set with 493 single measurements) resulted in areas under the curves of the ROC plots for detecting metastasis that ranged from 0.688 to 0.793, whereby the combination of the tumor markers showed slightly better results. A new improved function to fit the survival curve made it possible to calculate the slope of the survival curves at any temporal discrete point. The system combines all calculated likelihoods using a Bayesian model. Finally, the developed knowledge based system of this thesis was implemented as a clinical decision support system in a hospital information system for clinical validation.
Conclusions: This KBS will calculate the individual likelihood for metastatic events. Our system aims to produce results that are compatible with a medical expert’s opinion.