Deep learning with transfer learning on basal-cell carcinomas subtype automated classification

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Introduction

Deep-learning algorithms are an emerging approach in medical image classification due to their performance, and, through them, a new concept arose - transfer learning. This implies replacing the final layers of a trained network and retraining it for a new task, while keeping the weights from the imported layers.

Material and methods

Addressing the pathology of basal-cell carcinomas we have designed and trained a deep-learning convolutional network capable of classifying ten different subtypes. Transfer learning from a well-known general-purpose image classification network – AlexNet – was used. 2520 patches with basal-cell carcinomas, were independently labeled by two pathologists as infiltrating (36), with adnexal differentiation (480), micronodular (660), sclerosing (morphea-like) (12), nodular (120), nodular adenoid variant (60), nodular keratotic variant (96), nodular nodulocystic variant (240), pigmented (492), superficial (324). 85% of the data were used for training and 15% for testing on 100 independent training sequences. Each of the 100 resulted networks independently labeled the whole dataset.

Results and discussion

Mean and standard deviation accuracy (ACC) for the networks was of 85±17, while for the area under the receiver operating characteristic (AUC) was 0.87±0.15. The normal distribution of the classification error shows that the network reached a maximum classification rate on the dataset. Supposing a larger dataset would slightly increase the classification ACC the resulted classifier could assist pathological diagnosis, providing first or second opinion and thus aiding the pathologist into making an accurate and reliable diagnosis.

Conclusion

Having a relatively small and unbalanced dataset, we conclude that the resulted networks show promising ACC and AUC, and in turn, this proves that transfer learning from AlexNet can be successfully used on histological images.

KW: deep learning basal-cell carcinomas transfer learning AlexNet