2329P-Evidence for the utility of artificial intelligence (AI) and image analysis in Ki-67 quantification in solid tumors

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Background

Although it is an important biomarker in oncology (mostly in breast and prostate), Ki-67 immunohistochemistry (IHC) analysis has yet to be standardized. Working groups have provided guidelines for Ki-67 scoring in different cancer types to limit pathologist’s variability.1,2 Digital analysis solutions to assist scoring with image analysis or AI have recently emerged in the evaluation of Ki-67 as rapid and robust solutions. In this context, we compared the results of Ki-67 scoring performed with Aiforia Platform® (AI platform) and Halo® (image analysis supervised software) against three independent pathologists (patho) on various solid tumors.

Method

We gathered 102 tumors (Table 1) of various origins including breast and prostate with the CONSENSUS and Ki-67 clone (30-9) (ROCHE monoclonal primary antibody (mAb)) on the Ventana Benchmark Ultra. Three pathologists were appropriately trained following the International Ki-67 Working Group (IKWG) recommendations and scored tissues accordingly.1,3 Based on deep learning, Aiforia Platform® was able to automatically score Ki-67 positive tumor cells (Ki-67+) within minutes. The random forest classifier from Halo® software was used to separate the image into tumor, non-tumor and background, which was also confirmed by a pathologist. After cell segmentation, Ki-67 was assessed by thresholding.

A matched pairs statistical analysis was performed with JMP® software.

Workflow

1. IKWG scoring training sessions with 3 pathologists
2. Halo® random forest classifier segmentation (tumor vs non-tumor vs background)
3. Pathologist validation
5. Matched pairs analysis comparing means between two correlated variables.

Results: Ki-67 quantification by solid tumor type

Out of 102 cores, only 158 were analyzed due to absence of tissue and/or pathologists unable to score. Ki-67+ cells were detected in 24.38 - 71.7% of the tumor cells on average depending on the analysis approach applied (Table 2). Our study shows a very high consistency of results obtained for 67 scoring between the two image analysis softwares, Aiforia® and Halo® (r²=0.95), on solid tumors analyzed (n=158). The correlation obtained between the pathologists was however weaker (mean r²=0.83), despite appropriate training and following of guidelines, but remains within an acceptable range (Table 3).

Results: Ki-67 quantification on solid tumors

As indicated in table 3 and figure 2, our study shows the highest consistency of results obtained for Ki-67 scoring between the two image analysis softwares, Aiforia® and Halo® (r²=0.95). The correlation gained when matching AI with pathologists was far to strong (r²=0.93/0.82/0.94), whereas the correlation when comparing Halo® against pathologists scoring was mostly fair to moderate (r²=0.76/0.80/0.89). However, the correlation obtained between the 3 pathologists was generally weaker (r²=0.78 for B-A, r²=0.86 for C-A and r²=0.85 for C-B), and the weakest link was path A-Halo (r²=0.76).

Conclusion

This work shows that recent AI-based image analysis tools such as Aiforia® and image analysis supervised software like Halo® provide valuable assistance in the field of Ki-67 quantification in solid tumors.

References

3Welcome to Ki-67 QC calibrator. URL: [http://www.gpcs.ucb.ca/8090/tmballt.0.1/calibrator/index].