Deep-learning neural network in prostate cancer detection and grading

**BACKGROUND**

Prostate cancer (PC) is globally the second most common cancer and fifth most frequent cause of mortality in men (1). The pathological Gleason grade grouping (GG), which is based on the glandular architecture applied on prostate biopsies, is considered the most accurate diagnostic and predictive tool for patient outcome (2-3). By artificial intelligence (AI), the diagnostic work-up is expected to become less subjective and faster compared to the current, fairly labour-intensive manner. Automated GG diminishes interobserver variation (4).

**METHODS**

To train a deep neural network for the detection and grading of PC, an uropathological expert team annotated 59 scanned prostate biopsies with 0.26µm/pixel resolution. Glandular areas were annotated into benign, Gleason 3, Gleason 4, cribriform Gleason 4 and Gleason 5. For an independent validation of agreement between AI and a pathologist, 214 biopsies were analysed using a 7-tier grouping: benign (0), GG1–5, and three subgroups in GG 5 (Gleason 4+5, 5+4, 5+5).

**RESULTS**

From the training areas, AI assigned benign, G3, G4, cribriform G4 and G5 with a total area error of 12.33, 1.25, 0.99, 0.80 and 0.14 %, respectively. In the independent analysis of 214 biopsies, there was total agreement between AI and clinician in 58 cases. AI gave a higher GG in 134 cases, and clinician in 22 cases compared with AI.

**CONCLUSION**

The currently applied AI algorithm is feasible for detecting and grading PC. AI may have direct implications in clinical diagnostics of PC in the future by reducing clinical workload. Similar approaches may be applicable for other malignancies as well.

---

Authors:
Kevin Sandeman
Faculty of Medicine, Medicum, University of Helsinki, Finland
Sami Blom
Fimmic Oy, Helsinki, Finland
Tuomas Ropponen
Fimmic Oy, Helsinki, Finland
Tuomas Mirtti
Faculty of Medicine, Medicum, University of Helsinki, Finland

References: