An AI can determine Gleason scores for prostate cancer diagnosis

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Biopsies are an important step in prostate cancer diagnosis. Improving the accuracy of biopsies could therefore improve the diagnosis process. An exciting new study from The Netherlands has developed an AI (artificial intelligence) to improve the analysis of biopsy tissue and Gleason grading.

Biopsies are very important tests for diagnosing prostate cancer. Whilst scans can see the tumour size and position, the biopsy allows pathologists to see the actual cancer cells. The Gleason score comes from the biopsy - an indication of how aggressively the cancer is growing.

Different types of biopsies
During a biopsy, fine needles are inserted into the prostate gland. These needles remove small amounts of tissue for pathologists to analyse. Some biopsies spread the needles out over the entire gland. These are called systematic biopsies. The needles go into random parts of the prostate, trying to cover all regions of the gland. Depending on the size of the prostate, this could mean 10 samples, or even up to 50.

A newer approach is the targeted biopsy. This technique uses imaging to aim for tumours, rather than taking samples from random regions. MRI-targeted biopsies are common in Australia. These use MRI imaging to direct needles to the tumour site. A fusion biopsy combines MRI and ultrasound to create a 3D image of the prostate to target the tumour.

There are two procedures for performing biopsies that are commonly used in Australia. The prostate is reached through the rectum during a TRUS biopsy. Alternatively, during a transperineal biopsy needles go through the perineum, which is the area between the anus and scrotum.
A biopsy is usually done as an out-patient procedure and your doctor will likely advise a course of antibiotics afterwards to reduce the chance of infection. The biopsy tissue is sent to a pathologist to identify cells cancerous and normal cells.

**How are biopsy samples analysed?**

After the procedure, many small pieces of the prostate gland need to be analysed. These are first preserved in a fixing solution. They are transported to a pathology laboratory and embedded into wax. Once encased in the wax, very thin slices are cut; approximately 1/200th of a millimetre thick. The slices are placed on glass microscope slides, then stained with coloured solutions. The colours highlight different parts of the cells and tissue on the slide. A pathologist looks at the cells using a microscope to analyse the biopsy sample. If the pathologist sees cells that look like cancer, they will assign scores to the different types of cancerous regions, ranging from 1 to 5. Type 1 tissue has the lowest risk and type 5 the highest. These scores are used to generate the Gleason grade, telling us if cancer is present, how aggressively it’s growing and how much of the gland is affected.

This process has many steps that can be automated. Automation is very useful for the pathology laboratory. It reduces variation between the results from different labs. It also reduces variation between results from the same lab, for tests done on different days. But there is one part of this process that isn’t automated – the role of the pathologist looking down the microscope. There is evidence of variation due to this factor, meaning that the biopsy analysis is not optimal.

**An AI for analysing biopsy tissue**

A new study has been published in a top journal that tested an AI (artificial intelligence) for Gleason grading. The researchers behind this study work at Radboud University Medical Center in The Netherlands. 1,243 men contributed biopsy specimens to the study. Most of these men had prostate cancer, with 141 cleared of the disease. From these men, 5759 biopsy tissue samples were provided for analysis.

The aim of the study was to ask if an AI (artificial intelligence) could determine the Gleason grade of prostate cancer as well as leading expert pathologists.
The artificial intelligence process developed for determining Gleason scores is a type of deep learning. This deep learning system performs a type of image pattern recognition on a computer. It starts with an initial program, then is shown numerous cancerous and healthy images of the prostate in order to train the system on what looks cancerous, and what looks healthy. This training (deep learning) is unsupervised, in that it doesn’t require human input. The raw data that it uses does not need to be organised or labelled. Instead the system effectively learns from pathologists by reading the accompanying pathology report for the tissue samples.

After a period of learning on thousands of specimens, the AI was tested in a validation phase. This phase saw results from the AI compared to those of 3 expert pathologists. These experts were uropathologists, whose particular area of expertise was in diagnosing prostate cancer. There was very high agreement between the AI and the expert panel. The AI was then compared to results from a panel of 15 other pathologists from various different countries. Results from this test show that it was more accurate than 10 out of 15 of these pathologists.

The researchers concluded that the AI could determine the Gleason grade of prostate cancer from biopsy samples at a standard similar to expert pathologists. It could therefore contribute to diagnosing prostate cancer.

Currently this AI is in the testing phase and is not used in Australian pathology labs. The authors believe that, after further development, it could be used to generate “second opinions” on biopsy results as a back-up. It could also be used in health settings where resources are limited or to reduce the variability in results between clinics.