Software for solving life-threatening medical puzzles

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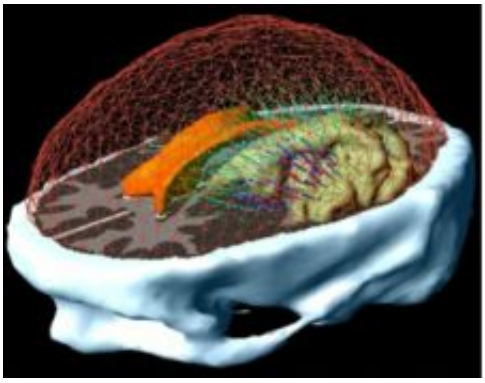

(PhysOrg.com) -- New software is under development that doctors hope will help them identify brain tumours in children that will grow aggressively.

Some brain tumours in children remain benign and doctors choose not to operate. But a small percentage of those will suddenly start to grow aggressively.

Doctors have not identified what triggers that aggressive tumour growth, despite the vast array of data they hold on their child patients - demographic, environmental, genetic and clinical data, as well as images such as MRI and CAT scans of the developing tumours.

But a new software tool called AITION can integrate all the medical data from a tumour patient and then analyse it to calculate the probable factors that are stimulating tumour development, combining up to 30 correlated variables. AITION provides an overview of the causal relationship across all factors.

Graphical network of causal relationships

AITION's conclusions are displayed as a 'knowledge model', a graphical network of medical factors with links that represent the correlations between them. Strongly interdependent concepts are directly connected, loosely dependent concepts are not connected at all. The patient's doctors can play around with the knowledge model. They can improve the model by adding information they know to be true about the patient. They can use the model to test the likely effects of different types of medication, surgery or treatments on the tumour's growth and the patient's health.

"We have shown the knowledge models to doctors treating brain tumours, juvenile idiopathic arthritis, [as well as] to cardiologists and they have found it quite intuitive," says Harry Dimitropoulos, one of the researchers from the University of Athens where AITION is being developed as part of the EU-funded Health-e-Child project.

"Because of the graphical way it presents the data they have found it easy to click on the links. Some training is required if they want to look in depth at how conclusions were reached, or to modify the statistics or the graph."

The causal-probabilistic algorithms within AITION are well established, solid and reliable, according to Dr Dimitropoulos.

However, because the diseases are rare, data is available on only small numbers of children. An AITION test on juvenile idiopathic arthritis had

only 50 patients initially. That has been expanded to 200 and the tool is becoming more stable and more reliable.

AITION's logic can lead to mistakes. For instance, if most of the patients over 16 years old in a knowledge model are also smokers, AITION may infer that being a smoker causes one's age to be over 16. To try to eliminate that kind of error, AITION uses a priori knowledge encapsulation (grouping variables in hierarchies) to constrict the possible conclusions that can be drawn from the data.

The researchers' next step will be to link AITION to ontologies of medical data (exhaustive databases of facts and concepts on a particular topic) to provide even more context for AITION's probability calculations and predictions.

The team also wants to expand the number of variables that can be considered in AITION's calculations of causal probability. "In theory, AITION can be expanded to as many features as you want," says Dimitropoulos. "We are preparing a mechanism that uses partitioning and parallel processing to create sub-graphs that can then be merged. But this is research at an early planning stage."

From overview to discovery

The very fact that AITION can model all the factors in a disease to give doctors an overview of the problem is an advantage, stresses Dimitropoulos.

AITION has already analysed data to infer likely disease causes or optimal future treatments that match the assessments of the doctors. But it adds even greater value when the models start to generate new knowledge. Already, AITION has identified that one blood test may be unnecessary because the information it provides is available from other

sources. It will require results from many more patients to validate this.

The team is also planning to identify unique factors about the tumours that become aggressive by combining genetic markers with clinical and other data in AITION. Identification, followed by early surgical intervention, would be a major medical step forward.

The Health-e-Child project received funding from the ICT strand of the EU's Sixth Framework Programme for research.

This is the first of a two-part Health-e-Child special feature.

More information: Health-e-Child project

Provided by ICT Results