Medical Xpress

'Smart stethoscope' advance in monitoring treatment of kidney stones

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This is a prototype of 'Smart Stethoscope.' Credit: University of Southampton

A new listening device, developed by scientists from the University of Southampton, is being used to monitor the effectiveness of the treatment of kidney stones - saving patients unnecessary repeat therapy and x-ray monitoring.

If kidney stones cannot be dissolved by drugs, the favoured procedure is lithotripsy. Lithotripsy works by focusing thousands of shock waves onto the kidney stones in an effort to break them into pieces small enough to urinate out of the body or be dissolved by drugs.

However, it is difficult to discover exactly when the treatment has succeeded in breaking the stone and patients frequently have to experience more shocks than necessary, or be sent home when an insufficient number of shocks have been delivered to break the stone.

The new 'Smart stethoscope' has been developed by a team from the University's Faculty of Engineering and the Environment in collaboration with Guy's and St Thomas' Foundation Trust (GSTT) and Precision Acoustics Ltd. The programme was led by Professor Tim Leighton from the University's Institute of Sound and Vibration Research (ISVR).

The 'Smart stethoscope' is placed on a patient's skin as they undergo shock wave treatment for kidney stones and assesses whether the treatment is working. It listens to the echoes, which reverberate around the body after each shock wave hits the stone. The device is now being used clinically at the London hospitals of GSTT.

Professor Leighton says: "It's an imperfect analogy, but consider a railwayman walking along the length of a train, hitting the metal wheels with a hammer, If the wheel rings nicely, he knows that it's not cracked. If the wheel is cracked, it gives a duller sound.

"We are looking for the stone to go from being intact at the start of treatment (when it will give a nice ring "tick" sound) to being fragmented at the end of the treatment (when it will give a duller "tock" sound)."

Professor Leighton's research, which includes the computational fluid dynamics (CFD) use to inform judgements underpinning the invention of the smart stethoscope, is published in the latest issue of the Royal Society journal *Proceedings of the Royal Society A*.

Dr Fiammetta Fedele of GSTT said: "Professor Leighton's CFD predictions of the acoustic signals emitted when bubbles collapse against kidney stones during SWL led (through collaboration with GSTT and Precision Acoustics Ltd.) to a £5,000 passive acoustic sensor. When placed on the patient's skin this sensor diagnoses successful SWL treatments (with 94.7 per cent accuracy in clinical trials, compared to the 36.8 per cent achieved by clinicians with the current state-of-the-art equipment suite). An accurate diagnostic is needed to conform with the 2004 'The NHS improvement Plan: putting people at the heart of public services' of reducing the 'patient pathway', because currently 30-50 per cent of SWL patients require re-treatment and an unknown are overdosed."

The NHS is trialling the smart stethoscope as part of major plans to reduce inaccurate diagnoses and ineffective treatments, and so far GSTT has used the sensor on over 200 patients.

In subsequent use of the device, GSTT have found it has the additional benefit that it can detect whether the treatment will work, before the stage when any possible adverse side effects from the treatment are likely to have occurred. This allows ready identification of those patients who should not receive this treatment, but whom should be referred to some other therapy to treat their kidney stones.

Professor Leighton says: "The research in the paper describes how we reached the decision stage to move from relatively inexpensive computer simulation to much more costly clinical trials in collaboration with NHS. This is a critical stage in R+D of this type – if the move is taken too early, the expensive clinical trials do not have adequate underpinning science and engineering, resources are wasted, and the eventual patient benefit is delayed. But conversely if the decision to move is taken too late, then the positive benefits to patients can be delayed for years.

"The research in this paper also defines the parameters needed by our commercial partner (Precision Acoustics Ltd.) to build a robust clinical sensor from the laboratory version we had made. It has taken seven years of research and development to arrive at a clinical device from the initial fundamental research done in the early 1990's by Dr Coleman of GSTT and myself. It was hard work with a great team, and seeing the positive patient outcomes now makes it all worthwhile. "

Provided by University of Southampton

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