Use of a Passive Acoustic Sensor to predict success of ESWL treatment based on initial 500 shocks.

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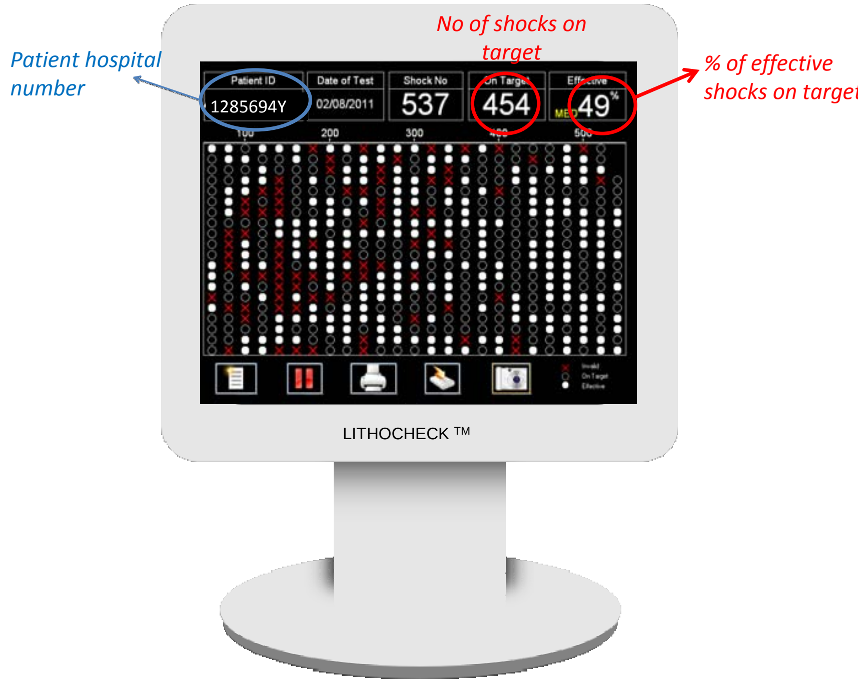
Introduction & Objectives

Extracorporeal shockwave lithotripsy (ESWL) has been used since the 1980s for the non-invasive treatment of urinary stones, however, there has been little advance in providing the operator feedback on the procedure success. We have previously presented our initial findings of the 'Smart Stethoscope' - a Passive Acoustic Sensor (PAS) which can be used to monitor the effectiveness of ESWL. Characteristics of passive acoustic emissions generated as a shock strikes a stone indicate whether it is effective (on target and causing cavitation). Using the newest prototype (Lithocheck ™), we have tested the ability of the system to predict the treatment outcome after a 'test dose' of 500 shocks.

Method

A modified 2.5cm sensor was taped to the flank of consented patients with renal stones.

The number of effective shocks were predicted by PAS at 500 and at end of treatment. This was correlated with clinical outcome on follow up X-ray with over 50% fragmentation deemed as successful.



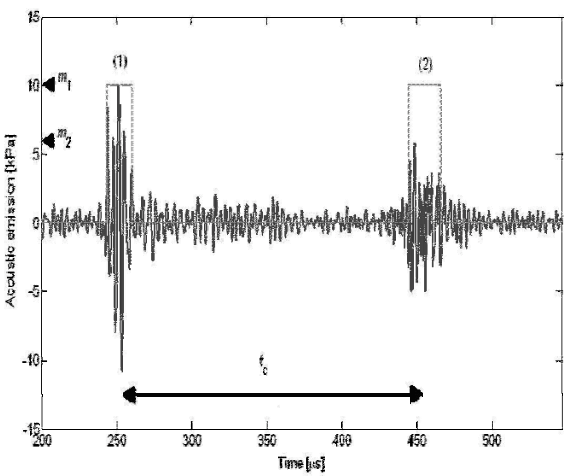


FIG 1: Double peak acoustic emission. m_1 maximum amplitude of first burst (1), which represents reflections from the stone and cavitation emissions. m_2 maximum amplitude of second burst (2), which represent cavitation within and around the stone. t_c time between the bursts which represents cavitation collapse times and is influenced by stone targeting.

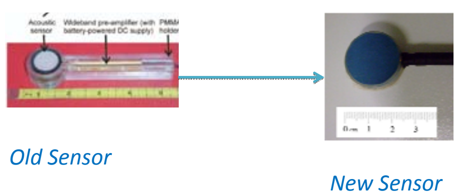


FIG 2: Old acoustic probe, now modified to a smaller lighter version. The previous bulky amplifier is no longer incorporated into the probe but is part of the monitor.

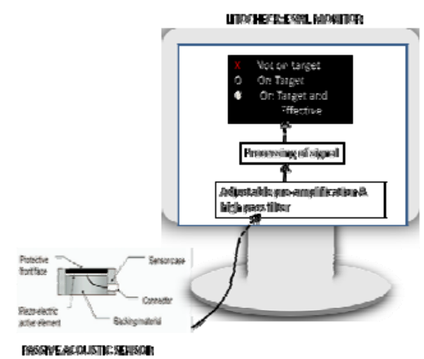


FIG 3: Emission from the stone (s) and surrounding bubbles are picked up by the PAS and translated into a visual output on the monitor.

Results

20 treatments have been monitored with the new prototype in 1 month (August –September 2011). 10 patients to date have had follow-up X-ray within 3 weeks, each had 2545±686 shocks. 5 patients showed a stone fragmented of 50% or more 4 patients showed a stone not changed or fragmented less than 50%. 1 patient was excluded as the stone was only 2mm. Figure 4 shows, the difference between the two groups is statistically different at both 500 shocks (218 ± 48 vs 67 ± 49 effective shocks) and at the end of treatment (680 ± 279 vs 244 ± 75 effective shocks).

Conclusion

The initial phase II study shows that there is a high correlation between the number of effective shocks predicted by PAS and clinical outcome. This could be used clinically in the future for assessing whether a stone is suitable for a course of ESWL or if the patient should be offered surgery, thus avoiding the morbidity and financial costs of ineffective ESWL sessions.

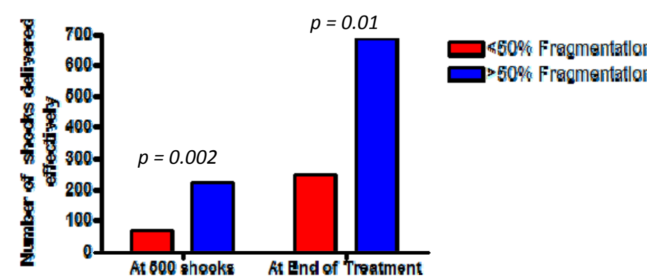


FIG 4: The number of effective shocks delivered at 500 shocks and at end of treatment

For further information please contact kay.thomas@gstt.nhs.uk

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