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 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 we have hypothesised whether we can predict overall outcome of a session of ESWL from the first 500 shocks delivered.

MATERIAL & METHODS: The 2.5cm sensor was taped to the flank of consented patients with renal stones. During this ethically approved phase II trial, results did not influence management. Outcome of treatment was predicted by the PAS at 500 shocks and at the end of the treatment. The clinical outcome of each monitored treatment was established at the patient’s follow-up imaging after the procedure. A clinician (blinded to the classification of the PAS system) assigned a clinical treatment score (CTS)based on the comparison of the pre–treatment stone X-Ray against the follow-up X-Ray. The CTS ranged from 0 (no change in the stone) to 5 (stone disappeared). Treatments with a CTS$\geqslant$3 (the stone was halved in size or smaller) were

considered as successful.

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. 5/10 patients showed a stone fragmented of 50% or more 5/10 patients showed a stone not changed or fragmented of less than 50%. The difference between the two groups is statistically different for both 500 shocks (218 ± 48 vs 67 ± 49 effective shocks) $p<0.002$ and at the end of treatment (680 ± 279 vs 244 ± 75 effective shocks) $p<0.01$.

CONCLUSIONS: This initial phase II study shows that the measure of effectiveness provided by the PAS device after 500 shocks was predictive of the final treatment 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.