clots and to diagnose renal calculi with high sensitivity and specificity of over 90% [8-13]. The ability of NCCT to detect density differences as low as 0.5% has been used to determine the composition and fragility of urinary stones, and hence the outcome of ESWL [14]. In previous studies, the NCCT attenuation value of urinary calculi has been investigated as a method to predict the outcome of ESWL for two main purposes: avoiding the extra medical costs associated with nonproductive exposure of renal tissue to ESWL sessions, and seeking alternative patient management strategies [15-17].

The objective of this study was to investigate the effects of stone density ((as measured by Hounsfield Units (HU) on NCCT)), stone size, and stone location on ESWL outcome and stone fragmentation of urinary calculi.

Methods

This is a prospective study that included 75 patients initially, however 10 patients were excluded due to elevated creatinine levels (more than 2 mg/dL), bleeding diathesis or obstructed kidney. Thus, the analyses, results and conclusions of this study were based on 65 patients who were prospectively followed at Al-Salam Teaching Hospital in Mosul from March 2012 to December 2012.

All 65 patients had initially undergone clinical, biochemical and radiological assessments before ESWL treatment sessions. Of the 65 patients, 38 were males (58%) and 27 were females (42%), mean age of 42 ± 17 years (17-76).

Urinary stone sizes ranged between 5-25 mm; of which 8 were located in the upper calyx, 9 in the mid calyx, 17 in the lower calyx, 24 in the renal pelvis and seven in the upper ureter. Fifteen patients had stone sizes less than or equal 10 mm, thirty patients had stone sizes of 11-20 mm, while the rest (20 patients) had stone sizes of 21-30 mm.

The maximal linear diameter of the stone was measured by NCCT scan. NCCT scan using contiguous three-millimeter section slices through the stone was performed and viewed on soft tissue setting (window width 350; window level 150 HU). Siemens Somatom Plus 4 scanner, at 120 kV and 206 mA, was used at a scan rate of one second per image. A pixel map of the largest region of interest within the stone was performed and consisted of 100 attenuation values in a 10 x 10 matrix; with each value on the pixel map representing the attenuation value for four pixels. The lowest, highest and most common attenuation values were recorded and the mean stone attenuation value was then calculated.

ESWLs of all patients were undertaken by the same staff using Siemens Electromagnetic Lithostar Multiline Lithotripter with fragmentation performed under fluoroscopic or ultrasonographic guidance.

A maximum of 2800 shock waves were delivered in each treatment session with maximum energy level of four. ESWL treatment was terminated if satisfactory fragmentation was noted earlier before delivering the maximum number of shocks (i.e., 2800) and before reaching the maximum number of ESWL sessions (i.e.,) 4 sessions.

Patients underwent plain x-ray or ultrasound 3 weeks after each ESWL session to determine if there is no stone fragmentation or if there are significant residual fragments (≥ 5 mm) which warrants another ESWL session.

The maximum number of ESWL sessions was 4 and the maximum duration of follow up was 12 weeks after which there is either complete stone clearance or failure of ESWL signifying failure of stone fragmentation or the presence of significant residual fragments (≥ 5 mm).

This failure of ESWL treatment indicates the need for another treatment option. Patients who achieved complete stone clearance underwent plain x-ray or ultrasound 6 weeks after treatment completion for final assessment of outcome.

In 16 patients with stones larger than 20 mm, or lower calyx stones larger than 15 mm, J.J. stent was inserted prior to ESWL. Thus the 65 patients were divided into two groups according to the outcomes of ESWLs.