Table 5. Means and 95% Probability Confidence Intervals

Variable		Mean	95% Confidence Interval	
			Lower bound	Upper bound
Stone density (Hounsfield units)	Success group	675	570	710
	Failure group	1075	905	1202
Stone Size (Diameter in millimeters)	Success group	18.3	15.6	20.2
	Failure group	18.8	15.7	22.5
Number of treatment sessions	Success group	1.4	1.2	1.7
	Failure group	2.6	2.2	2.9
Number of shock waves	Success group	4015	3412	4620
	Failure group	7218	6270	8160

Discussion

ESWL is still considered the best treatment for calculi less than 20 mm. The success rate is in the range of 60-90% in various series but the outcome of this therapy depends on different factors including stone composition, stone location, pelvicalyceal anatomy and stone size [15,17,18]. The success rate of ESWL for renal and upper ureteral calculi in Iraqi patients has been evaluated in some studies and is comparable to the other series, ranging between 60-85% and it is inversely related to stone size [3-5]. These studies described the effect of stone size on the success rate of ESWL but they didn't consider other factors as stone density and stone location in the urinary tract, therefore, further studies are needed to assess the effect of these factors on the success rate of ESWL in Iraqi patients. Stone composition seems to play the most important role in the outcome of treatment, however, still it cannot be known accurately before stone retrieval and analysis. The crystals excreted in urine after ESWL can give an idea about stone composition.

Plain x-ray has been used to predict the outcome of ESWL treatment by comparing stone density with bone density. However, this method has some disadvantages since the stone diameter and appearance might not be measured accurately, especially in the presence of bowel gas interference or neighboring bony structures and the density measurement is subjective [2]. In this study, we used plain CT scan which is a non invasive technique and provides greater density discrimination than plain x-ray. CT scan is more accurate in the evaluation of urinary stones [19]. It can distinguish density differences as low as 0.5% compared to only 5% discrimination using plain x-ray [2,7]. Recently, it is reported that the use of dual-energy multidetector CT can improve the detection of renal stone composition [20].

Joseph et al [2] suggested that stones with CT attenuation value of greater than 950 HU and stones required 7500 shockwaves failed to achieve fragmentation. Gupta et al [21] showed that the worst outcome of ESWL was in patients with calculus densities of more than 750 HU and diameters of more than 1.1 cm, and their clearance rate were only 60%. In our study, the success of ESWL treatment is almost always guaranteed when the CT attenuation value is less than 700 HU, while, at the same time, treatment failure is almost certain when the CT attenuation value exceeds 900. This is comparable to the results of recent studies [17,22,23]. Stone densities in the range of 700-900 HU may, or may not, respond successfully to ESWL treatment. Unlike Gupta et al [21], this study found that stone densities of more than 700 HU may fail to respond successfully to ESWL treatment. In addition, contrary to Gupta et al [21], this study revealed that stone diameters of up to 20 mm may still (depending on stone density) respond successfully to ESWL treatment. Contrary to Joseph et al [2], the results of this study clearly reveal that stones with densities exceeding 900 HU are difficult to fragment. However, unlike Joseph et al [2], up to