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Outcomes of Extracorporeal Shock Wave Lithotripsy (ESWL) for kidney stone treatment in Hilla City, Iraq

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ABSTRACT

Background: Extracorporeal Shock Wave Lithotripsy (ESWL) is a noninvasive therapy that splits kidney stones through the application of shock waves. *Aim:* This study evaluated ESWL treatment success rates for kidney stones in two major hospitals in Hilla City, Iraq. *Methodology:* This research thoroughly evaluated ESWL success-determining variables and associated obstacles. It examined 2000 patients whose medical archives were revised from 2017 to 2024. The study recorded information regarding patient demographics, stone location, size, measurements, composition details, and treatment method inputs. Postoperative follow-up lasted between 12 and 24 months. *Results:* The participants comprised 72% male patients, with an average age of 46.3 years. The success rating and treatment number of sessions improved more for patients with stone sizes <1 cm than for those with larger stones. Among all factors influencing treatment duration, ESWL requires stone dimensions to play a key role. The kidney served as the site of stone formation in 72% of the cases, and half of the patients experienced stone recurrence within five years. *Conclusion:* ESWL is effective as a stone treatment therapy, and success ratings depend on stone dimensions and placement positions in the body. This method must be considered essential for treating and predicting possible stone return. This research offers evidence that urologists can apply and manage ESWL treatment in Hilla City.

KEYWORDS

ESWL, lithotripsy, nephrolithiasis, Extracorporeal Shock Wave Lithotripsy, renal stone

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1. INTRODUCTION

Millions of people worldwide have kidney stones (urolithiasis) and suffer from major health complications and substantial economic costs. The worldwide upward trend in kidney stones continues to affect Iraq, where minimal invasiveness is important for treating this condition [1]. ESWL revolutionized nephrolithiasis after its introduction in the early 1980s. High-energy shock waves in ESWL create stone fragments that allow patients to pass naturally from the body [1,2]. Urologists and patients endorse ESWL because of its strong performance, less invasive nature, and shorter healing period, unlike surgical procedures [3].

Multiple studies have demonstrated that ESWL treatment success depends on stone characteristics, such as dimensions, material composition, stone position, and related patient health factors

[3,4]. ESWL's usual treatment success measures between 70% and 85%; however, it shows lower stone fracturing rates when treating big stones and stones located at the lower end of the kidney [5].

ESWL is the initial therapeutic approach for kidney stone treatment in Hilla City, central Iraq [1]. This study analyzes ESWL success rates by studying effectiveness alongside critical treatment determinants and local medical center complications experienced by patients in this demographic. Patient care optimization, together with treatment strategy development, depends on a complete understanding of these essential factors. Hence, this study aimed to deliver important findings about ESWL treatment for Hilla City urologists and advance knowledge of shock wave lithotripsy practices.

2. METHODOLOGY

2.1. Study design and data collection

The researchers conducted a retrospective analysis of 2000 ESWL patients treated at Al-Hilla and Al-Imam Al-Sadeq Teaching Hospitals in Babylon, Iraq, from 2017 to 2024. The study collected data on patient age demographics together with stone information, including location, composition, and size, as well as pre-procedure care, double-J stents, ESWL technique settings comprising machines and imaging systems, number of treatment sessions, staffing, and patient requirements leading to treatment results.

2.2. Inclusion/exclusion criteria

This study analyzed patients who had stones in their urinary tract revealed via radiographic examinations and measured 1 to 2.5 cm that appeared anywhere in the kidney, upper ureter, or lower ureter of patients aged >45 years. The therapy needed to exclude stones bigger than 2.5 cm as well as uncontrolled medical conditions, pregnancy, single kidney operation, anatomical urological irregularities, recent urinary tract infections, former ESWL treatment failure, significant anxiety, moderate claustrophobia, active bleeding conditions, and major uncontrolled medical issues.

2.3. Stone therapy protocol, ESWL session, and instrument

The treatment of 26.1% of patients involved double-J stents when treating patients with bi-renal stones or individuals with urinary tract stones combined with ureteric stones and renal stones. The treatment required between two and ten ESWL sessions lasting ten seconds to effectively deal with different stone sizes and responses. Shockwave lithotripsy treatment at hospital centers was performed using either the Karl Storz® Calcutript Electrohydraulic Shockwave Lithotripsy Unit or Siemens® Lithoskop electromagnetic lithotripter devices. Both devices relied on fluoroscopy for radiopaque stones, yet utilized ultrasound for radiolucent stones.

2.4. Ethical approval

All research procedures followed the Declaration of Helsinki guidelines and obtained authority from Al-Hilla Teaching Hospital (IRB Number: IH/ADD-2023-A07) and Babylon Health Directorate (IRB Number: BHD-2023-42/3), while offering participants full confidentiality and data anonymization along with voluntary consent.

2.5. Statistical analysis

The statistical analysis in this study was simple and did not require advanced techniques. All analyses were conducted using SPSS (version 28).

3. RESULTS

The study involved 2000 patients with a mean age of 46.3 years (range: 5-85 years), comprising 1440 males (72%) and 560 females (28%). Family history of kidney stones was present in 1700 cases (85%), with most patients (1340, 67%) residing in rural areas. Age distribution showed 160 patients (8%) under 20 years, 1540 (77%) aged 20-39 years, 140 (7%) between 40-59 years, and 160 (8%) over 60 years (Table 1).

Stone characteristics and treatment: ESWL session requirements correlated with stone dimensions: 820 patients (41%) with ≤1.0 cm stones needed 2-4 sessions, while 740 (37%) with 1.1-1.7 cm stones required 3-7 sessions, and 440 (22%) with 1.7-2.8 cm stones underwent 4-10 sessions. Anatomical distribution revealed 1440 renal stones (72%), 532 ureteric (26.6%), 28 vesical (1.4%), and 42 mixed-location stones (2.1%). Radiopacity was present in 1320 stones (66%) versus 680 radiolucent cases (34%). Recurrence affected 1366 patients (68.3%), with intrarenal distribution showing 1142 upper pole (57.1%), 564 middle pole (28.2%), and 294 lower pole stones (14.7%) (Table 1).

Laterality and procedural details: Right renal involvement exceeded left-sided cases, with 200 bilateral instances (10%). Ureteric stones showed right-side predominance in both segments, while

left ureter stones occurred in 382 upper (19.1%) and 244 lower cases (12.2%), with 190 bilateral presentations (9.5%). Double-J stents were utilized in 521 patients (26.1%), with ESWL performed using 1200 Storz (60%) and 800 Siemens devices (40%). Ultrasound guided 680 radiolucent stone treatments (34%).

Treatment outcomes: The stone-free rate reached 1500 cases (75%) during follow-up. Recurrence developed in 400 patients (20%) within one year and 600 (30%) within five years. Additional sessions were required for 168 patients (8.4%), while 206 (10.3%) discontinued treatment. Pediatric cases needing anesthesia numbered 6 (0.3%).

Table 1. Comprehensive summary of ESWL study outcomes and patient characteristics.

Variable		Descriptive value
Age (years)	Mean, Range	46.3, 5-85
	<20 N (%)	160 (8%)
	20-39 N (%)	1540 (77%)
	40-59 N (%)	140 (7%)
	>60 N (%)	160 (8%)
Sex	Males N (%)	1440 (72%)
	Females N (%)	560 (28%)
Family history	Positive	1700 (85%)
	Negative	300 (15%)
Residence	Rural	1340 (67.0%)
	Urban	660 (33.0%)
Number of required sessions by the stone Size (cm)	≤1.0 (2-4 sessions)	820 (41.0%)
	1.1-1.7 (3-7 sessions)	740 (37.0%)
	1.7-2.8 (4-10 sessions)	440 (22.0%)
Stone location	Renal	1440 (72%)
	Ureteric	532 (26.6%)
	Vesical	28 (1.4%)
	Mixed	42 (2.1%)
Stone radiolucency	Radiopaque	1320 (66%)
	Radiolucent	680 (34%)
Recurrent stone	Positive history	1366 (68.3%)
	Negative history	634 (31.7%)
Intra-renal location	Upper pole	813 (57.1%)
	Middle pole	402 (28.2%)
	Lower pole	209 (14.7%)
Side of renal involvement	Right	783 (55%)
	Left	499 (35%)
	Bilateral	142 (10%)
Ureteric stone	Right ureter (Upper)	263 (45.7%)
	Right ureter (Lower)	133 (23.1%)
	Left ureter (Upper)	110 (19.1%)

	Left Ureter (Lower)	70 (12.2%)
	Bilateral	55 (9.5%)
Treatment parameters	Double J stent use	521 (26.1%)
	Storz electrohydraulic machine	1200 (60%)
	Siemens electromagnetic machine	800 (40%)
	Ultrasound guidance (Radiolucent stones)	680 (34%)
	Number of sessions	2-10 sessions 2000 (100%)
Response to ESWL and success rate		
≤1 cm	2-4 sessions	1480 (74%)
1-1.7 cm	3-7 sessions	360 (18%)
1.7-2.8 cm	4-10 sessions	160 (8%), some patients preferred ESWL over surgery
All Sizes	Variable	205 (10.3%) non-compliant or missed sessions
All Sizes	Variable	6 (0.3) Pediatric cases require general anesthesia
All Sizes	Variable	115 (5.75%) Failed ESWL and required surgery
All Sizes	Variable	1000 (50%) recurrence rate within 5 years
Associated comorbidities	Hypertension	224 (11.2%)
	Diabetes mellitus	168 (8.4%)
	Obesity	112 (5.6%)
	Chronic kidney disease	56 (2.8%)
Post-Treatment outcomes		
Stone-Free rate	Different periods	840 (75%)
Recurrence rate	Within 5 years	224 (50%)
	Within 1 year	224 (20%)
	Within 5 years	336 (30%)
Additional ESWL sessions required	Different periods	168 5%)

4. DISCUSSION

Our findings significantly advance understanding of kidney stone disease in this population. The age distribution parallels regional studies [1,2], though potential healthcare access disparities may influence these demographics. The striking 85% familial predisposition strongly supports hereditary factors in lithogenesis [6], while the rural predominance (67%) mirrors Pakistani data [7], possibly reflecting shared dietary or environmental exposures.

The inverse relationship between stone size and ESWL success (74% for ≤1 cm vs 8% for 1.7-2.8 cm) confirms known physical limitations in fragmenting larger calculi [9,10], particularly in the anatomically constrained upper ureter. These outcomes validate current size-based treatment algorithms while revealing opportunities for technical refinement. The recurrence patterns and stone localizations show remarkable consistency with recent Iraqi data [1], suggesting disease homogeneity across the region.

Methodological constraints include the retrospective design's inherent variability in follow-up protocols. While pediatric cases were rare (0.3%), their anesthesia requirements and treatment resistance for cystine/matrix stones [11] highlight unique management challenges. The substantial 50% five-year recurrence rate, compounded by frequent comorbidities (11.2% hypertension, 8.4% diabetes), underscores the necessity of holistic stone prevention strategies addressing both metabolic and anatomical factors.

Three key improvements could enhance ESWL outcomes: optimized patient selection, rigorous comorbidity control, and protocol standardization for special populations. Future investigations should prioritize prospective evaluation of combined medical-expulsive therapies for larger stones and establish regional stone registries to track long-term outcomes. The 34% radiolucent stone cohort particularly warrants dedicated imaging protocol development.

5. CONCLUSION

ESWL continues to provide valuable noninvasive stone management benefits to patients seeking treatment in Hilla City, Iraq. The healthcare outcomes of ESWL therapy depend largely on stone dimensions, along with placement, together with adherence from the patient group. Optimizing patient results and reducing stone recurrence requires attention to diagnostic factors as well as the treatment of associated health conditions. Future research needs to develop methods that enhance patient adherence to treatment and long-term management of kidney stone disease in the local population.

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CONFLICT OF INTEREST STATEMENT
The author declares no conflicts of interest.

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