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ORIGINAL PAPER

Predictors of treatment failure and outcome assessment of extracorporeal shock wave lithotripsy with the Dornier Compact Delta® III Pro: Experience from the first 1000 treatments

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Summary *Background: The Dornier Compact Delta® III Pro is a next-generation extracorporeal shock wave lithotripter featuring flat-panel detector technology for enhanced imaging and a compact modular design. This study evaluates treatment outcomes and predictors of failure for this system, representing the first published clinical experience.*
Methods: We retrospectively analyzed the first 1,000 consecutive patients treated with the Dornier Compact Delta® III Pro for renal or ureteric stones between May 2022 and November 2023 at a secondary hospital. Stone-free status was assessed via radiography, ultrasonography, or computed tomography (CT) within three months post-treatment. Predictive factors for treatment failure were identified through univariate and multivariate logistic regression analyses.
Results: The cohort had a median age of 37 years (IQR: 32-44.2) and a body mass index (BMI) of 26 kg/m² (IQR: 24-29). Key characteristics included: prior urologic interventions in 36.6% of patients, single stones in 79.8% (median size 9 mm, IQR: 7-10), a median stone density of 1000 Hounsfield Units (HU) (IQR: 760-1200), and hydronephrosis observed in 55.3% of cases. Initial ESWL success was achieved in 80.5% of cases, increasing to 87.5% following repeat sessions (mean treatments: 1.2). Multivariate analysis identified four independent predictors of treatment failure: prior urologic intervention (adjusted odds ratio [aOR] 2.64, 95% CI 1.75-4.00, p < 0.001), multiple stones (aOR 0.45, 95% CI 0.24-0.77, p = 0.011), increased skin-to-stone distance (per cm: aOR 1.18, 95% CI 1.06-1.30, p < 0.001), and higher stone density (per 100 HU: aOR 1.12, 95% CI 1.06-1.18, p < 0.001).
Conclusions: The Dornier Compact Delta® III Pro achieved an 87.3% stone-free rate with failure predictors consistent with established lithotripsy literature. These findings support the adoption of this device as an effective ESWL system, particularly for institutions prioritizing advanced imaging and a space-efficient design.

KEY WORDS: Urolithiasis; ESWL; Dornier; Predictive factors; Stone-free rate.

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INTRODUCTION

Urolithiasis represents a significant public health concern, affecting millions globally, with an estimated prevalence of 2-3%, and a recurrence rate of 50% (1). The existing literature delineates various treatment modalities for renal and ureteral stones, including conservative management, endourological procedures, and open surgery (2).
Extracorporeal shock wave lithotripsy has evolved considerably since its inception, establishing itself as a pivotal treatment option for renal and ureteral stones (3).
The Dornier Compact Delta® III Pro optimizes the latest advancements in ESWL technology, featuring enhanced shock wave generation, improved imaging capabilities, and refined patient positioning systems (4). These innovations contribute to increased treatment efficacy, reduced procedural pain, and minimized recovery time, thereby solidifying ESWL's role in contemporary urological practice (3, 4).
Numerous studies have identified various predictive factors influencing complications and the *stone-free rate* (SFR) following ESWL for renal and ureteral stones. Among these, stone characteristics, such as size, density, location, shape, and degree of impaction, are critical determinants for treatment efficacy (5, 6). For instance, larger, denser stones, particularly those located in anatomically challenging areas like the lower pole of the kidney with steep infundibulopelviceal angle, are associated with lower SFRs and higher treatment failures. Moreover, patient-related factors, including age, comorbidities, congenital anomalies, the degree of obstruction, infection status, *body mass index* (BMI), skin to stone distance can further alter treatment outcomes (5-7).
Despite these advancements, there is a notable lack of studies about the latest, new generation lithotripters (8). Understanding the factors influencing SFRs is essential for optimizing patient selection and treatment strategies. In this context, the present study aims to assess SFRs and identify major negative predictive factors, influencing the success of ESWL utilizing the Dornier Compact Delta® III Pro, based on a retrospective analysis of our first 1000 patients treated at a secondary hospital.

Patients and methods

Study design

This retrospective study was conducted at *Hazm Mebaireek General Hospital, Hamad Medical Corporation, Doha, Qatar*, between May 2022 and November 2023.

A total of 1,000 adult patients (≥ 16 years) with renal collecting system and ureteric stones (≤ 25 mm) underwent *extracorporeal shock wave lithotripsy* (ESWL) using the Dornier Compact Delta® III Pro lithotripter (*Dornier MedTech GmbH, Germany*).

The study was performed in accordance with the ethical principles outlined in the Declaration of Helsinki and received approval from the Medical Research Center of the institution (ID MRC-01-25-167). Due to the retrospective nature of the study, the ethics committee waived the requirement for patient consent while ensuring that patient confidentiality and data protection measures were strictly adhered to.

Inclusion criteria

Adult patients (≥ v16 years) with ureteral and/or renal stones with a maximum diameter less than 25 mm were included.

Exclusion criteria

– Active *urinary tract infection* (UTI) or urosepsis,
– Active anticoagulation,
– Pregnancy,
– Untreated coagulopathies,
– Poorly controlled hypertension,
– Aortic aneurysms,
– Bilateral ureteric stone,
– Solitary kidney, and
– Renal insufficiency.

Pre-treatment assessment

All patients underwent comprehensive assessment, including complete medical history, physical examination, laboratory analyses (urine analysis, urine culture and/or sensitivity analysis, complete blood count, coagulation profile, blood urea nitrogen analysis, and serum creatinine levels), and radiological examinations (plain abdominal radiograph, ultrasonography, and computed tomography scan).

ESWL procedure

The extracorporeal shock wave lithotripsy procedure was conducted using the Dornier Compact Delta® III Pro lithotripter (*Dornier MedTech GmbH, Germany*) at a maximal intensity of 15 kV. Patients were positioned in a supine position and received sedation and analgesia throughout the procedure. A low initial power setting of 8 kV was employed, with sequential voltage ramping to maximize patient comfort. For kidney stones ultrasound imaging was conducted to localize stone fragments and monitor fragmentation in real-time, while fluoroscopy was used for targeting ureteric stones.

Post-treatment and outcome

Patients were assessed for the first time 2 weeks following the initial session using a plain radiograph. Repeat treatment was instituted in 66 cases where fragmentation was deemed inadequate (defined as either no fragmentation or stone fragments exceeding 4 mm in size). Successful ESWL was defined as the absence of any visible stones on radiological images within a 3-month post-treatment period either on plain radiograph, US, or CT scan ordered based on the practitioner's preference. Stones with no change or the presence of fragments larger than 4 mm beyond 3 months were considered as failure.

Data collection

A self-constructed questionnaire was developed for the purpose of data collection. Information was obtained from participants through structured interviews and examinations of their medical records. Independent, validated chart reviews facilitated the collection of data. Patient characteristics recorded included age, gender, *body mass index* (BMI), comorbidities, prior radiologic interventions, and the use of anticoagulants. Stone characteristics documented encompassed size, location, *skin-to-stone distance* (SSD), density measured in *Hounsfield Units* (HU), and the presence of hydronephrosis. Additionally, details regarding the ESWL treatment were captured, including the number of shock waves delivered, required power, frequency, analgesia usage, pain tolerance, fluoroscopy time and dosage, treatment duration, and the total number of sessions. Treatment outcomes measured included stone clearance, any postoperative emergencies, complications, and the necessity for further procedures.

All data collected were assessed for accuracy, completeness, and consistency. Two independent reviewers achieved an inter-rater agreement of 98.2% on key variables, with any discrepancies addressed by a senior consultant urologist.

Statistical analysis

Statistical analyses were performed using SPSS v22 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics were utilized to characterize the study population, with continuous variables reported as means ± *standard deviation* (SD) for normally distributed data or as medians *interquartile range* (IQR) for non-normally distributed data. Categorical variables were presented as frequencies (%). Bivariable analyses involved chi-square or Fisher's exact tests for categorical variables, and t-tests or Mann-Whitney U tests for continuous variables.

Multivariable logistic regression models were employed to identify independent predictors of ESWL treatment failure, incorporating variables with p-values < 0.2 from the bivariable analysis or those deemed clinically relevant. Model fit was assessed using the Hosmer-Lemeshow test, with p-values > 0.05 indicating adequate fit. Discrimination was evaluated using the area under the *receiver operating characteristic* (ROC) curve.

Variables exhibiting multicollinearity (*variance inflation factor* [VIF] ≥ 5), sparse data (cell counts < 5), or excessive missingness (> 15%) were excluded from the final models.

The final analysis considered variables with p-values < 0.05 and *adjusted odds ratios* (aOR) with corresponding 95% *confidence intervals* (CIs) as statistically significant.

Results

Patient and stone characteristics

Table 1 presents the demographic and clinical characteristics of 1,000 patients undergoing *extracorporeal shock wave lithotripsy* (ESWL). The median age was 37.0 years (IQR: 32.0-44.2), with a male predominance (99.7%). Left-sided stones were more common (54.7%) than right-sided stones (45.3%). The median BMI was 26.0 kg/m² (IQR: 24.0-29.0), and the majority of patients (79.0%) had no comorbidities; 7.5% had *diabetes mellitus* (DM), 9.6% had *hypertension* (HTN), and 0.3% had *coronary artery disease* (CAD). Prior urologic interventions (e.g., *percutaneous nephrolithotomy* [PCNL], *ureteroscopy* [URS], or previous ESWL) were reported in 36.6% of patients, while 10.8% had undergone previous *double-J* (DJ) stenting (28 patients [2.8%] for ureteric stones and 80 patients [8.0%] for renal stones). Single stones predominated (79.8%), with a median size of 9.0 mm (IQR: 7.0-10.0) and density of 1,000.0 *Hounsfield Units* (HU) (IQR: 760.0-1,200.0). Hydronephrosis was present in 55.3% of cases. Laboratory results included median creatinine levels of 86.0 µmol/L (IQR: 77.0-97.0), *blood urea nitrogen* (BUN) of 4.2 mmol/L (IQR: 3.4-5.1), and hemoglobin of 14.8 g/dL (IQR: 14.0-15.5). Preoperative urine cultures were negative in 97.4% of cases. Stones were primarily renal (59.1%) or ureteral (40.7%), with a median stone-to-skin distance of 9.0 cm (IQR: 8.0-11.0).

ESWL procedure details

The mean power delivered was 6.6 ± 1.2 kV (range: 2.0-10.0), with an average of 3,314.1 ± 517.2 shocks per session (range: 900.0-4,200.0). Procedures lasted an average of 44.0 ± 5.1 minutes (range: 15-57), with 96.0% utilizing a frequency of 80 shocks per minute. Guidance was provided via ultrasound (50.3%) or fluoroscopy (49.7%). Analgesia included midazolam/morphine (61.2%) or fentanyl (37.2%). Most patients (89.6%) tolerated the procedure well; 8.0% reported mild pain, while 2.4% had low tolerance for the procedure.

Treatment outcomes

Initial ESWL success was achieved in 80.5% of cases,

Table 1.
Patient and stone characteristics of individuals who underwent extracorporeal shock wave lithotripsy.

Characteristic	Subgroup	Total (n = 1000)	Stone Clearance		P-value
			Yes (n = 875)	No (n = 125)	
Age (years)	Median (IQR)	37.0 (32.0-44.2)	37.0 (32.0-44.0)	38.0 (30.0-45.0)	0.951
Gender	Male	997 (99.7%)	870 (99.7%)	127 (100%)	1.000
	Female	3 (0.3%)	3 (0.3%)	0 (0%)	
Laterality	Left	547 (54.7%)	484 (55.4%)	63 (49.6%)	0.255
	Right	453 (45.3%)	389 (44.6%)	64 (50.4%)	
Body mass index (kg/m²)	Median (IQR)	26.0 (24.0-29.0)	26.0 (24.0-29.0)	27.0 (24.0-30.0)	0.099
Comorbidities	None	790 (79.0%)	685 (78.5%)	105 (82.7%)	0.571
	Diabetes Mellitus	75 (7.5%)	68 (7.8%)	7 (5.5%)	
	Hypertension	96 (9.6%)	85 (9.7%)	11 (8.7%)	
	CAD	3 (0.3%)	2 (0.2%)	1 (0.8%)	
	Others*	36 (3.6%)	33 (3.8%)	3 (2.4%)	
Previous DJ stenting	No	892 (89.2%)	781 (89.5%)	111 (87.4%)	0.585
	Yes	108 (10.8%)	92 (10.5%)	16 (12.6%)	
Previous urologic intervention	No	634 (63.4%)	570 (65.3%)	64 (50.4%)	**0.002**
	Yes	366 (36.6%)	303 (34.7%)	63 (49.6%)	
Stone number	Single	798 (79.8%)	687 (78.7%)	111 (87.4%)	**0.030**
	Multiple	202 (20.2%)	186 (21.3%)	16 (12.6%)	
Stone size (mm)	Median (IQR)	9.0 (7.0-10.0)	9.0 (7.0-10.0)	9.0 (7.0-11.0)	0.052
Stone density (HU)	Median (IQR)	1000.0 (760.0-1200.0)	980.0 (750.0-1200.0)	1100.0 (911.5-1250.0)	**< 0.001**
Hydronephrosis	No	447 (44.7%)	387 (44.3%)	60 (47.2%)	0.602
	Yes	553 (55.3%)	486 (55.7%)	67 (52.8%)	
Creatinine (µmol/L)	Median (IQR)	86.0 (77.0-97.0)	86.0 (77.0-97.0)	86.0 (78.5-94.5)	0.787
Blood urea nitrogen (mmol/L)	Median (IQR)	4.2 (3.4-5.1)	4.3 (3.4-5.2)	4.0 (3.2-5.1)	0.122
White blood cells (mcL)	Median (IQR)	7.7 (6.6-9.2)	7.8 (6.6-9.2)	7.5 (6.8-9.1)	0.525
Hemoglobin (g/dL)	Median (IQR)	14.8 (14.0-15.5)	14.8 (14.0-15.5)	14.8 (14.0-15.5)	0.734
Preoperative urine culture	Negative	974 (97.4%)	847 (97.0%)	127 (100%)	0.094
	Positive	26 (2.6%)	26 (3.0%)	0 (0%)	
Stone-to-skin distance (cm)	Median (IQR)	9.0 (8.0-11.0)	9.0 (8.0-11.0)	10.0 (9.0-12.0)	**< 0.001**
Stone location	Kidney	591 (59.1%)	523 (59.7%)	68 (54.4%)	**0.034**
	Ureter	407 (40.7%)	350 (40.1%)	57 (45.6%)	
	Bladder	2 (0.2%)	2 (0.2%)	0 (0%)	

IQR: Interquartile range; CAD: Coronary artery disease; HU: Hounsfield units.
** Others: Includes chronic kidney disease, asthma, etc.*
Bold p-values: Statistically significant (p < 0.05).

increasing to 87.5% following repeat sessions (mean treatments: 1.2). Success rates varied by stone location:
– Renal stones: 78.2% (lower calyx: 76.0%, mid calyx: 80.6%, upper calyx: 81.3%, renal pelvis: 82.4%).
– Ureteral stones: 83.1% (proximal ureter: 82.0%, distal ureter: 83.7%).

Treatment failure occurred in 12.5% (n = 125), necessitating additional interventions: semirigid URS (5.4%), flexible URS (0.7%), or PCNL (0.4%). Postoperative complications arose in 4.6% (n = 46), primarily renal colic (4.2%). Rare complications included bowel perforation (0.1%, n = 1), urosepsis (0.1%), and pyelonephritis (0.1%). Bowel perforation details (n = 1): A 36-year-old male with a history of recurrent renal stones and prior ESWL treatments developed acute abdominal pain 4 hours after ESWL for an 8-mm right upper ureteral stone. Preoperative evaluation revealed leukocytosis (WBC 13×10³/μL) with 80% neutrophils. CT imaging demonstrated pneumoperitoneum and mesenteric stranding. During emergent laparoscopy, purulent intraperitoneal fluid was noted along with a 6-mm small bowel perforation 120 cm distal to the duodenojejunal flexure with adhesions. Due to limited space and adhesions the procedure was converted to open. The patient underwent primary repair with peritoneal lavage and concurrent Double-J stent placement for persistent ureteral obstruction. The presence of purulent fluid during exploration suggested early localized peritonitis. The patient made a full recovery postoperatively, highlighting the importance of prompt surgical intervention in such rare complications.

Predictors of ESWL failure

Univariate analysis identified significant predictors of ESWL failure, including prior urologic intervention (17.2% *vs.* 10.1%; p = 0.002), multiple stones (7.9% *vs.* 13.9%; p = 0.030), higher stone density (1100.0 *vs.* 980.0 HU; p < 0.001), and increased stone-to-skin distance (10.4 vs. 9.6 cm; p < 0.001). However, multivariate analysis confirmed significant predictors of ESWL failure, including prior intervention (aOR 2.64; 95% CI: 1.75-3.99; p < 0.001), multiple stones, which were associated with reduced odds of clearance (OR 0.45; 95% CI: 0.24-0.77; p = 0.003), increased stone density, where each 100-HU increase raised the risk of failure (OR 1.00; 95% CI: 1.00-1.00; p < 0.001), and stone-to-skin distance, where each 1-cm increase elevated failure odds by 18% (OR 1.18; 95% CI: 1.06-1.30; p = 0.002). Stone location (kidney *vs.* ureter) was found to be non-significant (p = 0.547) (Table 2).

Discussion

The present study aimed to provide significant insights into the efficacy and predictive factors associated with extracorporeal shock wave lithotripsy utilizing the Dornier Compact Delta® III Pro for the management of renal and ureteric stones. The results indicate an overall stone-free rate that increased from 80.7% following the initial ESWL procedure to 87.3% after repeat treatments. This progressive improvement underscores the potential of the Dornier Compact Delta® III Pro to enhance treatment efficacy, marking a noteworthy presence in the contemporary stone management practice.

The demographic characteristics of our cohort provide valuable details into the patient population underwent ESWL. The median age of participants was 37 years, with a substantial predominance of males (99.7%) and a high prevalence of single stones (79.8%). Although these findings corroborate results from previous studies that underscore the male predominance in urolithiasis (9-11), our situation is different, as the area covered by our facility, is mainly occupied by male labor population.

A pivotal finding of our multivariate analysis was the identification of specific predictors for treatment failure following ESWL, with a history of previous urologic intervention emerging as the most significant factor, reflected by an odds ratio of 2.64 (95% CI: 1.75-4.00). This underscores the challenges posed by altered renal anatomy or scarring from prior procedures, aligning with findings from *Gültekin et al.*, which demonstrated that overall stone-free rates after ESWL treatment were significantly lower in patients with a history of prior ureteroscopy or stone surgery, particularly for stones in the lower calix (12). Additionally, repeated ESWL may contribute to long-term fibrotic degeneration of the collecting system, thereby complicating subsequent ESWL treatment efforts (13).

The impact of patient characteristics on the success rate

Table 2.
Predictive factors for extracorporeal shock wave lithotripsy failure in multivariate analysis.

Characteristic		Stone clearance		Multivariate logistic regression			
	Subgroup	Yes (n = 873)	No (n = 127)	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Previous urologic intervention	No	570 (89.9%)	64 (10.1%)	Ref	-	Ref	**< 0.001**
	Yes	303 (82.8%)	63 (17.2%)	1.87 (1.30-2.69)	< 0.001	2.64 (1.75-3.99)	**< 0.001**
Stone number	Single	687 (86.1%)	111 (13.9%)	Ref	-	Ref	**0.006**
	Multiple	186 (92.1%)	16 (7.9%)	0.53 (0.31-0.91)	0.021	0.45 (0.24-0.77)	**0.003**
Hounsfield unit (HU)	(Per 100-unit increase)	-	-	1.12 (1.06-1.18)	< 0.001	1.00 (1.00-1.00) *	**< 0.001**
Stone-to-skin distance (cm)	(Per 1 cm increase)	-	-	1.15 (1.05-1.26)	0.002	1.18 (1.06-1.30)	**0.002**
Stone location	Kidney	523 (88.5%)	68 (11.5%)	Ref	-	Ref	0.241
	Ureter	350 (86.0%)	57 (14.0%)	1.25 (0.86-1.81)	0.241	1.17 (0.70-1.97)	0.548
	Bladder	2 (100%)	0 (0%)	-	-	-	-

IOR = Odds ratio; CI = Confidence interval; Ref = Reference category.
Statistically significant values (p < 0.05) are in bold.
**HU was modeled as a continuous variable; OR represents per 100-unit increase for clinical interpretability.*
Multivariate logistic regression: Adjusted for all significant variables from univariate analysis.
Hosmer-Lemeshow goodness-of-fit test: p = 0.42 (indicating good fit); Area under the ROC curve (AUC): 0.72 (95% CI: 0.67-0.77), suggesting moderate discrimination.

of ESWL remains a subject of debate in literature. Previous studies, such as those by *Shinde et al.*, have indicated that female gender may be a significant negative predictor for stone clearance due to lower pain thresholds in women, which can impact their tolerance to higher energy shock waves, potentially leading to complications (7). Other studies, such as those by *El-Nahas et al.* (14), have identified BMI as a significant factor influencing stone clearance, while *Alharbi et al.* noted that stone location and laterality significantly affected ESWL efficacy (15). They also found that stones in patients with diabetes mellitus and hypertension exhibited lower fragmentation rates (15). In our study, the median age across gender groups was relatively consistent at 37.0 years (IQR: 32.0 to 44.2), suggesting that age-related effects on ESWL outcomes may be negligible within this range. Furthermore, the gender distribution was predominantly male (99.7%), limiting the applicability of gender as a predictive factor. The distribution of comorbidities, particularly diabetes mellitus and hypertension, did not exhibit significant discrepancies, indicating minimal influence on stone clearance. Although our median BMI was 26.0 kg/m² (IQR: 24.0 to 29.0), which is within typical ranges, we acknowledge that previous reports suggest a relationship between BMI and successful stone fragmentation (16). The discrepancies between our findings and past literature highlight the need for future investigations with larger, more diverse cohorts to explore the impact of a broader range of patient characteristics on ESWL success rates. Comprehensive methodologies, including multi-center studies, may better delineate these relationships, ultimately enabling refinement of patient selection criteria for ESWL.

In our report, the influence of stone characteristics on treatment outcomes in ESWL is pronounced, with multiple stones and increased stone density, measured in HU, identified as key predictors of treatment failure.

Specifically, stones with higher HU values (mean 1074.2 ± 303.2 in non-clearance cases) correlate with diminished ESWL efficacy, indicating that denser stones are more resistant to shock wave fragmentation (17, 18).

Furthermore, an increased SSD negatively affected clearance rates, with failed cases exhibiting a mean distance of 10.4 ± 2.3 cm compared to 9.6 ± 2.1 cm in successful cases. Conversely, our report found the presence of multiple stones to be a significant predictive factor for ESWL failure. In contrast, stone location and size did not achieve statistical significance in multivariate analysis, with kidney and ureter stone locations yielding similar outcomes (upper: 88.46% clearance; lower: 86% clearance, p = 0.241). Median stone sizes demonstrated marginal significance (median size: 9.0 mm, p = 0.052). Factors such as hydronephrosis also showed no significant influence on treatment outcomes (p = 0.602). These individual results may be attributed to the use and technical characteristics of the new Dornier Compact Delta® III Pro ESWL machine resulting in enhanced fragmentation efficacy. Comparative Performance of Modern ESWL Systems in different reports are mentioned in Table 3 (8, 19-24).

Table 3.
Comparative performance of modern Extracorporeal Shock Wave Lithotripsy (ESWL) systems.

System (Study, year)	Sample size (n)	Initial Stone-Free Rate (SFR)	Final SFR	Follow-up period	Auxiliary procedures	Major complications*	Key technological features	Additional significant findings
Storz Modulith SLX-F2 *(Elkoushy et al., 2011)* (19)	474	82.7%	77%	3 months	14.7%	0.8% (subcapsular hematoma)	Dual-focus electromagnetic	· Lower pole stones had 12% lower success rate (p = 0.03) · Stented patients showed 14.5% reduced efficacy
Storz Modulith SLX-F2 *(Suzuki et al., 2010)* (20)	361	-	EQ** = 0.646	-	22%	1.7% (hematoma)	Adjustable focal zones (6-9 mm)	· Standard focus (6 mm) improved ureteral stone outcomes by 17% · SMLI*** > 0.65 correlated with complications
Siemens Lithoskop *(Neisius et al., 2013)* (8)	183	-	91%	3 months	7.1%	0.5% (hematoma)	Acoustic pressure monitoring	· Pediatric SFR = 94% (n = 13) · No difference by stone location (p = 0.41)
Dornier Compact Delta II *(Lv et al., 2016)* (21)	336	-	78.2% (renal) 81.7% (ureteral)	3 months	11.5-14%	None reported	Optical coupling control (OCC)	· OCC improved SFR by 15.4% (p < 0.01) · Reduced skin ecchymosis by 60%
EDAP-Sonolith Praktis *(Lee et al., 2005)* (22)	703	-	95.3%	4 weeks	30.6%	None major	Ultrasound localization	· Efficiency quotient (EQ) = 0.71 · Treatment time < 45 mins for 89% cases
Dornier MFL 5000 *(Sheir et al., 2003)* (23)	347	-	82.4%	4 weeks	51.6%	4% (steinstrasse)	Electrohydraulic source	· 23% longer treatment time vs electromagnetic · Higher re-treatment rate for > 10 mm stones
Dornier Compact Delta *(Yang & Hyun, 2007)* (24)	614	-	95.9%	6 weeks	18%	26.4% hematuria	Electromagnetic with ultrasound	· 37% faster than electroconductive models · Better for obese patients (BMI > 30)

** Major complications defined as: Steinstrasse requiring intervention, subcapsular hematoma > 2 cm, or sepsis;*
*** EQ (Efficiency Quotient) = [% Stone-Free/(100 + % Re-treatment + % Auxiliary Procedures)] × 100;*
**** SMLI (Storz Medical Lithotripsy Index) = Energy × Number of Shocks/1000.*

Technological advancements in shock wave technology have positioned ESWL as the primary treatment for most renal and ureteric stones (3). The Dornier Compact Delta® III Pro exemplifies these innovations, featuring enhanced shock wave generation and dual imaging systems that enable precise targeting while minimizing radiation exposure (4). With the capability to deliver up to 1000000 shock waves, this device surpasses the efficiency of ordinary lithotripters, facilitating outpatient procedures with reduced analgesia requirements and lower morbidity. Additionally, the Dornier Compact Delta® III Pro integrates advanced imaging, maximal energy delivery, and improved operational efficiency, supporting urologists to achieve effective stone management. Recent developments in lithotripters, such as the Modularis Vario, have further optimized key components, enhancing patient comfort and imaging quality (4). These technological advancements not only improve stone comminution but also elevate success rates in treating renal and ureteric stones, consequently decreasing the need for auxiliary interventions. Notably, the Dornier Compact Delta® III Pro's superior capabilities contribute to increased SFRs and lower complication rates, as demonstrated by a low postoperative emergency rate of only 4.6%. Future research is warranted with this device and compare its efficacy and outcome measures across various clinical settings.

Clinical implications

The results of this study provide valuable insights into the efficacy of the newly introduced ESWL machine, the Dornier Compact Delta® III Pro, highlighting its significant role in the management of renal and ureteric stones, as evidenced by a commendable stone-free rate of 87.3%. The identification of critical predictors of treatment failure, including prior urologic interventions, the presence of multiple stones, increased *stone-to-skin distance* (SSD), and stone density, enables clinicians to conduct more nuanced preoperative evaluations and implement tailored therapeutic strategies. However, it is important to note that these findings align with those already described in the existing literature and are well-established within the international medical community.

Limitations of the study

This study acknowledges several limitations that may impact the interpretation of the findings. Firstly, the moderate sample size, monocentric design, and retrospective nature of the investigation present inherent challenges, as reliance on secondary data may introduce variability due to inconsistencies in documentation and the potential for bias in the results. Additionally, technical limitations in the methodologies employed to define stone clearance could affect the accuracy and reliability of the findings. The single-center design further restricts the generalizability of the results to broader populations, and the three-month follow-up duration may not adequately capture delayed treatment failures that could occur over an extended period.
Despite these challenges, this investigation represents the inaugural report correlating stone clearance with the newly launched ESWL machine, the Dornier Compact Delta® III Pro, at our institution. Consequently, our results underscore the critical need for further research involving larger sample sizes and, ideally, multicentric approaches that incorporate institutions utilizing and operating the same machine. Such studies would enhance the robustness of the findings and contribute to a more comprehensive understanding of the effectiveness of this ESWL system in diverse clinical settings.

Conclusions

The Dornier Compact Delta® III Pro has demonstrated considerable efficacy in the treatment of renal and ureteric stones, achieving a stone-free rate of 87.3%. This study identified several key predictors of treatment failure, including prior urologic interventions, the presence of multiple stones, increased skin-to-stone distance, and higher stone density. These findings affirm the continued relevance of ESWL as a mainstay in the contemporary management of renal and ureteral stones. Future multicenter randomized controlled trials are warranted to validate these preliminary results and further evaluate the performance of the Dornier Compact Delta® III Pro lithotripter in diverse clinical settings.

Declarations

Ethical approval: *The study adhered to the principles of the Helsinki Declaration and was approved by the Ethics Committee of Hazm Mebaireek General Hospital, Hamad Medical Corporation, Doha, Qatar (ID MRC-01-25-167).*

Availability of data: *Data is available upon request.*

Competing interests: *The authors declare no conflicts of interest.*

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