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Extracorporeal shock wave lithotripsy for clearance of refractory bile duct stones

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Abstract

Background and study aims. Following endoscopic sphincterotomy, 90% of bile duct stones can be removed with a Dormia basket or balloon catheter. The removal can fail in patients with large stones, intrahepatic stones, bile duct strictures or a difficult anatomy. The aim of this retrospective study is to investigate the efficacy and safety of extracorporeal shock wave lithotripsy in fragmenting and allowing the extraction of bile duct stones that could not be cleared by routine endoscopic means including mechanical lithotripsy.

Patients and methods. From 1989 to January 2005, we treated with extracorporeal shock wave lithotripsy 376 patients (133 males and 243 females, median age 71.4 years) with bile duct stones that were not removable following endoscopic sphincterotomy, using the extracorporeal shock wave lithotripsy Lithostar Plus machine built by Siemens Co. of Erlangen, Germany. Stone targeting was performed fluoroscopically following injection of contrast via nasobiliary drain or T-tube in 362 patients and by ultrasonography in eight patients. Residual fragments were cleared at endoscopic retrograde cholangiopancreatograhy. Two hundred and ten of the 370 patients treated (56.7%) showed only 1 stone, 57 (15.4%) showed 2, 45 (12.1%) showed 3, 58 (15.6%) showed more than 3 stones. The median diameter of the stones was 21 mm (range 7–80 mm).

Results. Complete stone clearance was achieved in 334 of the 376 patients who underwent the extracorporeal shock wave lithotripsy procedure (90.2%). Six patients (1.5%) dropped out of treatment during their first sessions, mainly because of intolerance. Each patient averaged 3.7 treatments (1–12), at an average rate of 3470 shocks per session (1500–5400), at an average energy level of 3.4 mJ (1–7). Complications were recorded in 34 patients (9.1%); 22 patients experienced symptomatic cardiac arrhythmia, 4 haemobilia, 2 cholangitis, 3 haematuria, 3 dyspnoea; no deaths were associated with the procedure.

Conclusions. Extracorporeal shock wave lithotripsy is a safe and effective therapy in those patients in whom endoscopic techniques have failed with a clearing rate of 90.2% of refractory bile duct stones with a low rate of complications.

Keywords: Bile duct stones; Endoscopic sphincterotomy; Extracorporeal shock wave lithotripsy

1. Introduction

Endoscopic sphincterotomy (EST) with or without mechanical lithotripsy followed by stones extraction with Dormia basket or with Fogarty-type balloon is presently the treatment of choice for bile duct stones, and it is effective in about 90% of the cases [1–5].

The most frequent causes, which can hinder the endoscopic extraction of bile duct stones, are the presence of impacted or large stones, the stenosis of the biliary tree or the presence of intrahepatic stones. To treat patients with refractory stones after sphincterotomy and mechanical lithotripsy, some techniques have been developed which include, besides extracorporeal shock wave lithotripsy (ESWL), electrohydraulic or laser intraductal lithotripsy [6–8], chemical dissolution [9–10] and percutaneous transhepatic removal [11–13].

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Table 1
Criteria for admission to ESWL treatment for refractory bile duct stones

- Endoscopic papillotomy already performed
- No severe coagulative disorders
- Good patient compliance
- Successful positioning of patient
- Successful localisation of stones (with radiologic and/or echographic targeting)
- Shock wave focal zone devoid of:
  - Aneurism
  - Bone tissue
  - Lung tissue
  - Calcified vessels

Immediate endoscopic drainage can also be achieved by the insertion of an endoprosthesis.

ESWL was first used to treat bile duct stones in 1985 using kidney lithotriptor machines [14].

The first generation of lithotriptors required the patient's immersion in water, and the treatment was performed under general anaesthesia. With second-generation machines, the treatment is carried out without immersion and only under sedation.

In this study, we present the results obtained with this technique in the treatment of bile duct stones which EST and mechanical lithotripsy failed to eliminate.

2. Patients and methods

ESWL treatment has been the only conservative option considered for all patients with 'refractory bile duct stones' referred to our unit since November 1989. 'Refractory stones' are by definition those bile duct stones which did not clear spontaneously from the papilla after EST and which could not be removed with a Dormia basket or balloon catheter, or even by mechanical lithotripsy. The admission criteria for ESWL treatment are listed in Table 1.

From November 1989 to January 2005, 376 patients (133 males and 243 females) were referred to our centre to undergo ESWL. Of these, 224 (59.5%) came from several North Italian Centers, while the rest came from our local/regional referral area. The characteristics of the patients are reported in Table 2. The reasons for admission to the hospital for these patients are listed in Table 3.

Table 2
Patient characteristics

Patients eligible for treatment	376
Dropouts	6
Patients treated	370
Women/men (*N*%)	239/131 (64.6–35.4%)
Age (median, range)	71.4 (18–94)
Cholecystectomised patients	258 (69.7%)
ASA risk group I	7 (1.8%)
II	223 (60.2%)
III	119 (32.1%)
IV	21 (5.6%)

Table 3
Main reasons for hospital admission

Reason	*N*%
Jaundice	126
Cholangitis	121
Colics	112
Acute pancreatitis	6
Pruritus	1
Asymptomatic (incidental finding)	10

In 362 patients, the targeting was accomplished through a nasobiliary drainage catheter whose proximal tip was positioned above the stones in order to ensure the external biliary drainage. Echographic targeting was achieved in eight patients in whom it was not possible to place the nasobiliary catheter.

If fluoroscopy demonstrated the presence of bone tissue in the target area, the patient's positioning was changed.

The shock waves were produced by an electromagnetic lithotripter (Lithostar Plus, Siemens, Erlangen, Germany). Targeting was done under fluoroscopic control after the injection of contrast medium via nasobiliary or percutaneous drainage, or under ultrasonographic control.

For the most part, the treatment was carried out with the patients in the prone position, while recumbent on the left side (96%), although in some cases (4%) it was administered in the supine position. During treatment, the following parameters were monitored: p02, arterial pressure and EKG. During each session, a maximum of 5400 shock waves were delivered at a mean energy level of 3.4 mJ (range 1–7). The interval between sessions was kept as short as possible, compatible with the availability of the equipment and patient compliance, but in no case it was less then 24 h or more than 5 days.

The average number of treatments for each patient was 3.7 (range 1–12), with a mean number of 3470 shock waves (range 1500–5400) per session (Table 4). ESWL treatment

Table 4
Average numbers of shock waves per session administered to the various groups of patients in relation to the number of treatments necessary to obtain fragmentation of the biliary tract stones

Treatment number	No. of patients	Shock waves average per session	Range
1	51	3420	700–5400
2	70	3240	1800–5000
3	68	3360	1500–5000
4	49	3390	2800–5000
5	36	3405	3100–5000
6	31	3425	2900–5000
7	18	3495	2200–5000
8	12	3505	2900–5000
9	12	3555	3500–5000
10	5	3590	3000–5000
11	2	3600	3200–5000
12	5	3650	3000–5000