Extracorporeal Biliary Lithotripsy and Uncorrected Hyperlipidemia

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Patients with cholelithiasis are treated by the method of extracorporeal lithotripsy. The technique of the combined use of two lithotriptors with different modes of shock wave generation (electrohydraulic and electromagnetic) is described. As a result of treatment the number of skin petechiae decreases as do transitory hematuria and manifestations of hepatic colic and acute pancreatitis, whereas mechanical jaundice and acute cholecystitis develop with the same frequency. The number of recurrences of cholelithogeny in patients with hyperlipidemia is 8 times higher than in the control, which indicates a clear connection between hyperlipidemia and stone formation in patients after extracorporeal biliary lithotripsy.

Key Words: *cholelithiasis; extracorporeal biliary lithotripsy; hyperlipoproteinemia*

Extracorporeal biliary lithotripsy (ECBL) has proven to be a rather effective and sparing treatment of cholelithiasis. We showed that ECBL is the treatment of choice for some 15% of patients with gallstones. Successful treatment with ECBL depends on a careful choice of patients who are to undergo the procedure. Candidates were chosen on the basis of ultrasound scanning as well as findings of peroral cholecystography in addition to a general clinical examination. This allowed us to work out clear guidelines for selecting patients to undergo ECBL.

We used two lithotriptors with different modes of generation of shock waves (electrohydraulic and electromagnetic) to achieve a favorable combination of these apparatuses, which are considered comparable in terms of the intensity of the shock wave [4,7,10,11]. It was noted, however, that the Sonolith 3000 possesses a more powerful destructive ability.

Analysis of the long-term results of the treatment revealed that new stones form in 23% of patients 4-12 months after ECBL. Detailed analysis of recurrences disclosed changes in the serum lipid spectrum, namely hyperlipidemia, in the majority of such patients. Disturbance of lipid metabolism is considered by various authorities to be one of the key pathophysiological mechanisms of lithogeny [5,6,8,9]. We thus proposed that hyperlipidemia plays a significant role in the formation of gallstones after ECBL.

MATERIALS AND METHODS

Initially patients were treated using the electrohydraulic lithotriptor Sonolith 3000 (Technomed International) with ultrasonic focusing with transducers of 3.5 and 5 MHz. Since 1991 two apparatuses have been used, the second one being the electromagnetic lithotriptor Lithostar Plus with x-ray and ultrasonic focusing using a 3.5 MHz transducer (Siemens).

Gallbladder concrements 10-20 mm in size were fragmentized on a Sonolith 3000 apparatus usually in a single session with 3000 pulses of maximal intensity, whereas such a procedure on the

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TABLE 1. Spectrum of Plasma Lipids in Patients

Index	Norm	1st group		2nd group	
		initially	after 12-18 months	initially	after 12-18 months
Cholesterol	209.38±6.87	193.80±4.40	164.50±9.40	272.50±16.00*	297.80±19.40*
Triglycerides	109.17±7.46	79.20±5.31	101.90±16.80	192.20±13.20*	196.20±12.20*
HDL cholesterol	51.52±3.29	66.40±2.47	52.30±8.20	47.80±4.70	57.30±6.20
Dyslipoproteinemia coefficient	3.00	2.02±0.10	2.33±0.21	4.78±0.49*	4.67±0.51*

Note: *$p<0.05$ as compared to the norm.

Lithostar Plus required 2-3 sessions with 2000-3000 pulses of maximal intensity.

The Lithostar Plus was most suitable for handling gallbladder concrements of less than 10 mm. The process of cleavage was controlled ultrasonically in real time and the pulses were able to be synchronized with the respiratory movements of the patient. All this made it possible to aim each shock wave pulse right on the concrement, allowing for its rapid, effective fragmentation. One ECBL procedure consisting of 800-1200 pulses of moderate intensity was usually sufficient. Concrements of less than 10 mm were fragmentized on the Sonolith 3000 in one or several procedures with 3000 pulses of maximal intensity. The system of periodic localization of the concrement used in this lithotriptor does not permit the pulses to be aimed accurately on a small gallstone, which readily shifts around in the gallbladder and changes its coordinates depending on the patient's respiratory movements. This is also true in the case of several small concrements (less than 10 mm), which are more effectively fragmentized on a Lithostar Plus.

In view of the above, more often than not we combined both lithotriptors (42.8%), exploiting the advantages of each. Patients with gallbladder concrements larger than 10 mm underwent the first ECBL procedure on a Sonolith 3000. If the concrement became partially fragmentized and the gallbladder contained sand and fragments larger than 5 mm, a second procedure was performed the next day using the Lithostar Plus until satisfactory fragmentation was achieved.

The correlation between hyperlipidemia and the formation of gallstones was examined in a group of patients treated in our clinic before methods of correcting hyperlipidemia had been devised for patients after biliary lithotripsy. In all, ECBL was performed in 143 patients with cholelithiasis during this period. Among them hyperlipidemia was found in 68 patients (47.5%). Subsequent analysis of the data was based solely on the results obtained in patients regularly followed up during 12-18 months after ECBL. Forty patients without hyperlipidemia were the control (the first group). The second group (n=31) consisted of patients with cholelithiasis and uncorrected hyperlipidemia exposed to ECBL.

The content of total plasma cholesterol, triglycerides, and high density lipoprotein (HDL) cholesterol was determined using the automatic biochemical analyzer Express-560 (Ciba Corning Diagnostics), and the dyslipoproteinemia coefficient was measured using a described formula [2]. The parameters of lipid metabolism were measured during the whole period of elimination of fragments along with control ultrasound scanning.

RESULTS

Combining the two lithotriptors with different modes of action and different ways of concrement localization lowered the number of complications related to the elimination of sand and fragments, because small pieces passing through the biliary tract encounter fewer obstacles and therefore do less damage to the walls. The number of skin petechiae dropped by 18.8%, the number of cases of transitory hematuria decreased by 13.4%, that of hepatic colic by 8%, and that of acute pancreatitis by 1.5%. The frequency of appearance of mechanical jaundice and acute cholecystitis remained the same.

Thus, by using both lithotriptors, we achieved optimal fragmentation of concrements with just a few lithotripsy procedures and minimal damage to the surrounding tissues.

The results of the biochemical study of plasma lipids in each group at the start of treatment and at the last monitoring. When the ECBL results were evaluated (12-18 months after lithotripsy), are listed in Table 1.

The data show that the lipid indexes in the first group did not change significantly during the whole period of observation and did not differ from the physiological norm. The percentage of recurrences in this group was very small (3 persons, 7.5%). The cholesterol and triglyceride con-

tent were markedly elevated in the second group as compared to normal indexes, whereas HDL cholesterol did not differ from normal. It should be noted that these indexes had not changed by the follow-up at the end of observation. The control ultrasound exam revealed concrements of various size and number in 24 patients of the second group (77%) 12-18 months after lithotripsy. Such a manifest difference in the results of treatment of cholecystolithiasis cannot be related to any peculiarities of treatment performed in each group. The only cardinal difference between these groups, was the state of lipid metabolism prior to ECBL.

The follow-up 12-18 months later revealed an 8-fold increase of recurrences of stone formation in the hyperlipidemia group as compared to the control. Such a difference points to a clear correlation between hyperlipidemia and lithogeny in patients after ECBL.

The findings show that careful selection of patients for ECBL is a sine qua non for good results. The clinical examination must include a blood test of lipid metabolism. Effective lithotripsy with minimal side-effects and complications can be achieved by the combined use of lithotriptors with different types of shock wave generation and different modes of concrement localization. The identification of patients with hyperlipidemia among those stated to undergo ECBL is extremely important for the prognosis of treatment.

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