

Patient's Selection for Extracorporeal Shock Wave Lithotripsy for Treatment of Common Bile Duct Stones Resistant to Endoscopic Extraction

— 체외충격파쇄석술 적용을 위한 총담관결석의 선택 —

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— Abstract —

Background/Aim : Common bile duct (CBD) stones may cause jaundice, cholangitis, or pancreatitis. Extracorporeal shock wave lithotripsy (ESWL) may be needed whenever endoscopic procedure are failed to extract common bile duct stones. The aim of this study is to provide the standard for patient's best choice on ESWL for treatment of CBD stones resistant to endoscopic extraction.

Materials and Methods : Forty-six patients failed in endoscopic stone extraction including mechanical lithotripsy were treated by ESWL. In all patients, endoscopic sphincterotomy and nasobiliary drainage tube was done before ESWL using the ultrasonography for stone localization with a spark-gap type lithotripter. Patients were sedated with an intravenous injection of 50 mg of Demerol. None were treated under general anesthesia.

Results : Overall complete clearance rate of CBD stone was 89.1% (41/46). In 82.6% of the patients, the stones were extracted endoscopically after ESWL, and spontaneous passage was observed in 6.5%. In the clearance rate after ESWL, there were no noticeable differences with regard to number (single: 82.8%, two or three: 100%, more than three: 100%) and size of the stone (less than 33 mm: 92.9%, 33 mm or larger: 83.3%), whereas there were significant differences with regard to the ratio of sum of long-axis length of the all stones to sum of long-axis length of the CBD excluding stone (1 : 2.4, 1 : 2.1) and diameter of the largest stone to diameter of CBD excluding stone (1 : 0.9, 1 : 0.4) for patients with complete clearance compared with those without.

Conclusion : We propose that stones without the fragments are travelable sufficient space in CBD or extractable sufficient diameter of CBD regardless of stone size and number should be treated by other technique to prevent time and cost consuming, such as percutaneous transhepatic cholangioscopy-lithotomy.

Key words : ESWL, CBD stones

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I. Introduction

Common bile duct (CBD) stones may cause jaundice, cholangitis, or pancreatitis. When mechanical lithotripsy is added, endoscopic extraction of CBD stones after endoscopic sphincterotomy has a success rate of up to 95 %^{1,2)}. If the endoscopic procedures are failed to extract common bile duct stones due to impacted or extremely large stones and the presence of CBD stricture, alternative techniques are needed. Since its first introduction by Sauerbruch T et al.³⁾ in 1985, extracorporeal shock wave lithotripsy (ESWL) of bile duct stones has proved to be a protocol in nonsurgical therapy in almost all patients with CBD stones resistant to endoscopic extraction. Mild and transitory adverse effects (hematuria, petechiae, hemobilia, and pain) are found in about 40% of patients, whereas severe complications are rare⁴⁾. Also ESWL has high clearance rate of up to 95%⁵⁾. Therefore, ESWL is a safe and effective treatment method for CBD stones. However, as a result, it is time and cost consuming, if the stones are not extracted by ESWL. This study is to provide the standard for patient's best choice of ESWL for treatment of CBD stones resistant to endoscopic extraction.

II. Materials and Methods

Forty-six patients with CBD stones failed in endoscopic stone extraction including mechanical lithotripsy have been treated by ESWL at our institution from 1998 to 2003.

The patients were 22 men and 24 women, and the mean age was 61.9 years (ranged 29 to 90). The following criteria were analyzed by endoscopic retrograde cholangiograms of pre-ESWL from both of the successful group and the failed group : number of stones, long-axis length of the largest stone, ratio of sum of long-axis length of the each stone to long-axis length of the CBD, and of diameter of the largest stone to diameter of the thinnest CBD excluding stone (Table 1). For all patients, endoscopic

Table 1. Characteristics of stone and definition of applied criteria.

• Number
Solitary
Two or three
More than three
• Long-axis length of the largest stone
< 33 mm
≥ 33 mm
• Ratio of sum of long-axis length of the each stones to long-axis length of the CBD
• Ratio of diameter of the largest stone to diameter of CBD excluding stone

stone extraction including mechanical lithotripsy with endoscopic sphincterotomy had failed before, and nasobiliary drainage tube had inserted before ESWL in all patients. Spark-gap type (MPL9000, Dornier, Germany) was used as a lithotripter using the ultrasonography for stone localization. The mean number of performed sessions was 2.9 (ranged 1 to 6). The mean number of shock waves applied per patient was 4855 (ranged 1415 to 10040). The discharge energy was 14 to 18 kV (mean value of 16 kV). An intravenous injection of 50 mg of Demerol, helped relieve the pain during ESWL. However none were treated under general anesthesia. The evaluation of post-ESWL was performed by nasobiliary drainage tube cholangiography in one or two days, and then endoscopic retrograde cholangiography was performed for the stone extraction when fragments were detected. Statistical analysis was performed with the SPSS for PC, running the Chi-square test and Student's *t*-test, and *p* values of less than 0.05 were obtained and it showed significant correlation.

III. Results

Overall complete clearance rate of CBD stones by ESWL was 89.1% (41/46). In 82.6% of the patients, the stones were extracted endoscopically (including mechanical lithotripsy, *n* = 4) followed by ESWL, and spontaneous passage was observed in 6.5%.

1. Number of stones

Twenty-nine of the 46 patients had solitary, 13 patients two or three, and 4 patients more than three CBD stones. The complete clearance rate in the 29 patients with a single stone was 82,8% (24/29), 13 patients with two to three 100% (13/13), and 4 patients with more than three 100% (4/4) (Table 2).

Table 2. Stone clearance rate with respect to the number of stone.

No. of stone	No. of cases	No.(%) of stone cleared patients
Solitary	29	24 (82,8)
Two or three	13	13 (100)
More than three	4	4 (100)
Total	46	41 (89,1)

2. Long-axis length of the largest stone

The mean long-axis length of the largest stone per patient treated in our study was 33 mm (ranged 9,0 to 68,1). Twenty-eight of the 46 patients had stone less than 33 mm, 18 patients 33 mm or larger size. The complete clearance rate in the 28 patients with less than 33 mm was 92,9% (26/28), and 18 patients with 33 mm or larger size 83,3% (15/18) (Table 3).

Table 3. Stone clearance rate with respect to the long-axis length of the largest stone.

Long-axis length	No. of cases	No.(%) of stone cleared patients
< 33 mm	28	26 (92,9)
≥ 33 mm	18	15 (83,3)
Total	46	41 (89,1)

3. Ratio of sum of long-axis length of the each stones to long-axis length of the CBD

The ratio of sum of long-axis length of the each

stones to long-axis length of the CBD was 1:2,4 (38 mm:90 mm) and 1:2,1 (35 mm:72 mm) for patients with complete clearance rate compared with those without it ($p < 0,05$) (Table 4).

Table 4. Ratio of sum of long-axis length of the each stones to long-axis length of the CBD.

Group	Ratio (length-mm)
Complete clearance	1:2,4 (38:90)
Not complete clearance	1:2,1 (35:72)

4. Ratio of diameter of the largest stone to diameter of the thinnest CBD excluding stone

The ratio of diameter of the largest stone to diameter of CBD excluding stone was 1:0,9 (23 mm:21 mm) and 1:0,4 (23 mm:10 mm) for patients with complete clearance rate compared with those without it ($p < 0,05$) (Table 5).

Table 5. Ratio of diameter of the largest stone to diameter of the thinnest CBD excluding stone.

Group	Ratio (diameter-mm)
Complete clearance	1:0,9 (23:21)
Not complete clearance	1:0,4 (23:10)

IV. Discussion

When the endoscopic procedure are failed to extract CBD stones due to extremely large, impacted, or located proximal to a stricture, ESWL is used as an alternative technique.

Overall complete clearance rate of CBD stones under endoscopic procedure for the stone extraction including mechanical lithotripsy (n = 4) by ESWL was 89,1% (41/46) in our study. This rate is comparable to the results by Meyenberger et al.⁶(83%, 45 of 54), Sauerbruch T et al.⁷(88%, 91 of 103), Sackman et al.⁸(90%, 281 of 313), and Binmoeller et al.⁵(95%, 71 of 75).

With regard to number of the stones there were no noticeable differences in clearance rate among the results from our study, Although the solitary stone showed 82.8%, which might be caused by the size of stones (mean size, 37 mm) larger than overall mean size of stones with 33 mm (Table 2). This similar results have been also reported by Meyenberger et al.⁶⁾ and Sackman et al.⁸⁾.

The mean size of the stones in our study was 33 mm. There was no noticeable difference in the complete clearance rate between patients with less than 33 mm and those with 33 mm or larger size (92.9%, 83.3%). Our result in the size of the stones is similar to reports by Sackman et al.⁸⁾, whereas Meyenberger et al.⁶⁾, Sauerbruch T et al.⁹⁾, Barkun et al.¹⁰⁾ and Ponchon et al.¹¹⁾ have reported the importance of stone size.

The spontaneous passage rate after ESWL of CBD stones is low, so that additional endoscopic stone extraction is required^{6,8)}. The each fragments by ESWL may need the travelable sufficient space above or below those to be captured by basket for stone extraction. The space in CBD can be ascertained by ratio of sum of long-axis length of the each stones to long-axis length of the CBD and ratio of diameter of the largest stone to diameter of CBD excluding stone.

The ratio of sum of long-axis length of the each stones to long-axis length of the CBD was 1:2.4 (38 mm:90 mm) for patients with complete clearance rate, and 1:2.1 (35 mm:72 mm) for those without complete clearance rate in our study. The difference of these significant ratios between the two shows that the sufficient long-axis length of the CBD compared to the size of the stones are necessary for the complete extraction of CBD stones (Fig. 1, 2).

The ratio of diameter of the largest stone to diameter of the thinnest CBD excluding stone was 1:0.9 (23 mm:21 mm) for patients with complete clearance rate, and 1:0.4 (23 mm:10 mm) for those without complete clearance rate. The difference in these significant ratios between the two shows also that the sufficient dilated diameter of CBD compared

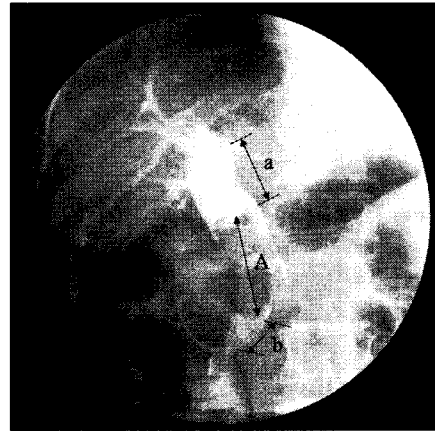


Fig. 1. Case with complete clearance rate. The cholangiogram showing a large stone in the common bile duct before ESWL (A, 55.7 mm).

Travelable sufficient space in CBD for the fragmented stones during ESWL is showed (a+b).

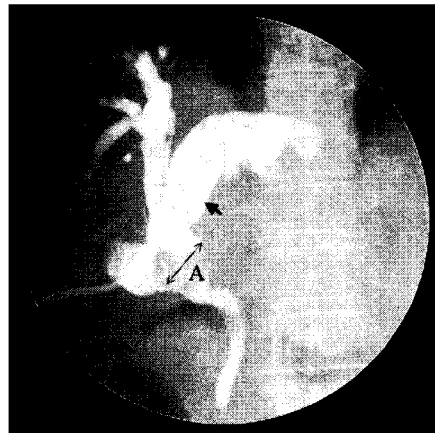


Fig. 2. Case with complete clearance rate. The cholangiogram showing a stone in the common bile duct before ESWL (A, 35.8 mm).

Travelable sufficient space above the stone for the fragmented stones during ESWL is showed (arrow mark).

to the size of the stones are necessary for the complete extraction of CBD stones (Fig. 3).

In conclusion, ESWL turns out a safe and an effective treatment method for CBD stones not treatable by endoscopic extraction including mechanical lithotripsy. The stone number and size had not important influence on the complete clearance rate in our study, whereas the long-axis length of the CBD and the diameter of the thinnest CBD

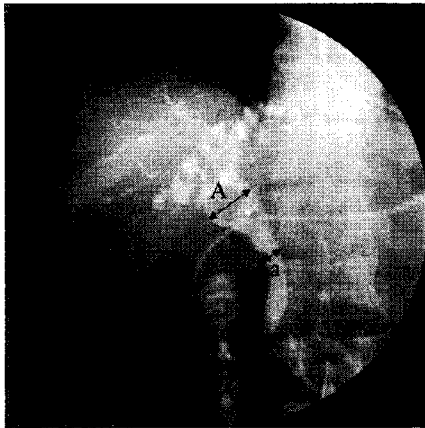


Fig. 3. Case without complete clearance rate. The cholangiogram showing a stone in the common bile duct before ESWL (A, 20.1 mm).

There is not travelable sufficient space above or below the stone in CBD for the fragmented stones during ESWL (a, 8.2 mm)

excluding stone against the CBD stone had a significant influence. Therefore, we propose that stones without sufficient long-axis length and dilated diameter of CBD, that is, without sufficient dilated space (travelable space) above or below the stones in CBD regardless of stone size and number should be treated by other technique to save time and cost, such as percutaneous transhepatic cholangioscopy-lithotomy.

V. References

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• 국문초록

체외충격파쇄석술 적용을 위한 총담관결석의 선택

이원홍 · 손순룡 · 박천규 · 김창복 · 강성호 · 류명선 · 이용문

서울아산병원 방사선과

담관 결석은 동통뿐만 아니라 황달이나 담도염 또는 췌장염 등을 유발할 수 있다. 결석에 대한 내시경적 제거가 실패할 경우 체외충격파쇄석술이 요구될 수 있는데, 이 논문은 담관 결석환자에 대한 체외충격파쇄석술 적용에 있어 보다 더 적절한 선택 기준을 정하는데 도움을 주기 위함이다.

총담관 결석 환자 중 기계적 쇄석술을 포함한 내시경적 제거에 실패한 46명이 체외충격파쇄석술을 받았다. 46명 모두 체외충격파쇄석술 전에 내시경적 유두괄약근 절개술을 받았으며, 경비담도배액관의 삽입이 이루어 졌다. 사용된 쇄석기는 초음파 유도하에 결석을 포착하는 시스템으로 spark-gap type이었다.

쇄석 후 추가적인 내시경적 제거술이 이루어 졌으며, 결석이 완전 제거된 경우는 89.1%(41/46)였으며, 자연 배출된 경우는 6.5%였다. 쇄석 후 결석제거율은 결석의 수(단일: 82.8%, 둘-셋: 100%, 넷 이상: 100%)와 크기(33 mm 미만: 92.9%, 33 mm 이상: 83.3%)에서는 큰 차이가 없었으나, 결석들의 장축 길이 합과 결석이 위치하지 않는 부분의 총담관 길이 합을 비교하였을 때 완전 제거된 경우와 그렇지 않은 경우의 비가 1:1.4와 1:1.1, 그리고 가장 큰 결석의 직경과 결석하방의 총담관 직경을 비교한 경우는 그 비가 1:0.9와 1:0.4로 의미 있는 차이를 보였다.

결론적으로, 결석의 수나 크기보다는 총담관 내에 분쇄된 결석이 충분히 움직여 바스켓으로 포획될 수 있는 공간이 있을 경우에 체외충격파쇄석술 적용이 상당히 유용하나 그렇지 않은 경우는 경피적 담도경을 이용한 제거가 유용할 것으로 보인다.

중심 단어 : 체외충격파쇄석술, 총담관결석