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Abstract

Endoscopic shock-wave lithotripsy (ESWL) and endoscopic procedures are useful treatment for symptomatic patients with pancreatic stones distributed in the main pancreatic duct. When pancreatic exocrine function can be preserved by removing the stones, even patients without pain can benefit. In patients with large or multiple stones, following ESWL with endoscopic treatment may reduce duration of the course treatment. Reported stone clearance rates range from 42% to 89%, pain relief rates from 15% to 91.1%, and recurrence rates from 12% to 22%. Recurrence is among the most important problems encountered with non-surgical treatment. In several studies, recurrence was observed in about 20% of patients, sometimes requiring surgery. Non-surgical treatment is safe. ESWL combined with endoscopic treatment is the usual first option for pancreatolithiasis, largely limiting the need for surgery to patients with treatment failure or multiple recurrences.

Key words: Extracorporeal shock-wave lithotripsy (ESWL), endoscopic pancreatic sphincterotomy, endoscopic minor papilla sphincterotomy

1. Introduction

If pancreatic stones develop in the main pancreatic duct during the clinical course of chronic pancreatitis, pancreatic ductal hypertension may cause pain, acute pancreatitis, and pseudocysts. To avoid further exacerbating the disease condition, pancreatic stone removal is extremely important. Surgical treatment has been recognized as the most effective treatment of pancreatolithiasis. However, since extracorporeal shock-wave lithotripsy (ESWL) first was reported by Sauerbruch et al. [18] in 1987, many authors have reported its usefulness [1,3,10,17,19]. Endoscopic treatment of pancreatolithiasis was reported by Inui et al. [9] and Fuji et al. [7], and endoscopic lithotripsy combined with ESWL yields better results than ESWL alone [10,19]. We reported that combined treatment with extracorporeal shock-wave lithotripsy and endoscopic lithotripsy is a useful, minimally invasive, first-line treatment approach that can preserve pancreatic exocrine function [11,12]. We reviewed the current status of non-surgical treatment for pancreatolithiasis according to recent reports.

2. Indications for non-surgical treatment ESWL

ESWL is indicated in symptomatic patients with stones in the main or accessory pancreatic duct [1,3,10,17,19]. ESWL is also indicated in asymptomatic patients in whom preservation of pancreatic exocrine function is expected by pancreatic stone removal [3,10,17]. ESWL is indicated for pancreatic stones in the head and body of the pancreas, but it can also be performed for stones that are diffusely present from the pancreatic head to the tail [12]. When radiographs show stones exceeding 5-6 mm in diameter, ESWL represents the first option [6].

Endoscopic treatment

Endoscopic lithotripsy after endoscopic pancreatic sphincterotomy (EPST) requires that the stone be small and not impacted. When the stone diameter is less than 5 or 6mm, endoscopic lithotripsy sometimes may be performed without pancreatic

sphincterotomy, but care must be taken the stone does not become incarcerated and that it remains removable endoscopically. However, for stones with diameter exceeding 5 or 6mm, one should undertake endoscopic lithotripsy only after performing endoscopic pancreatic sphincterotomy [12]. According to Sherman, et al. [21], factors favoring endoscopic stone removal include 3 stones or fewer, stones confined to the head and/or body of the pancreas, absence of a downstream stricture, stone diameter less than or equal to 10 mm, and absence of impacted stones.

Combined treatment with ESWL and endoscopic lithotripsy

Although patients with large stones or multiple stones may require a greater number of ESWL treatments, combination with endoscopic treatment may reduce the duration of treatment. Endoscopic treatment is needed following ESWL in patients with a severe stricture of the main pancreatic duct between the stones and the papilla, because ESWL alone may leave residual fragments [12,17]. If the stone is less than 5mm in diameter and not evident in radiographs, endoscopic lithotripsy should be considered before turning to ESWL [12].

Contraindications

ESWL is contraindicated in pregnant women, patients with abdominal aortic aneurysm, those with a marked bleeding tendency, and those with implanted cardiac pacemakers [3,12,17,19]. We cannot perform ESWL and endoscopic lithotripsy in patients with stenosis of the duodenum, severe bile duct stricture, or known or suspected pancreatic cancer. Surgical treatment at the outset in may be preferable in some patients, according to comparative studies. Patients ineligible for non-surgical include those with stones filling the pancreatic duct and those with complicating pancreatic duct strictures, pancreatic pseudocysts, or pleural effusion and ascites [6,12].

3. Outcomes of non-surgical treatment Stone clearance

Many studies have reported that ESWL has a good stone fragmentation effect (71% to 100%: (Table 1) [[1,3,10,17,22,23]. Patients whose stones are not completely cleared by

ESWL alone need additional endoscopic treatments such as EPST, lithotripsy with a basket catheter, pancreatic duct stenting, or endoscopic pancreatic duct balloon dilation

[12]. Additional use of these endoscopic treatments has been reported to yield good results, with complete stone clearance rates of 71% to 100% (Table 1).

Table 1. Outcomes of treatment of ESWL and/or endoscopic treatment

Authors (ref.)	No. of pts	Fragmentation (%)	Stone clearance (%)	Pain relief (%)	Recurrence (%)	Complications (%)	Requiring Surgery (%)
Sauerbruch (18)	24	87.5	42	50			8.3
Delhaye (3)	123	99.2	59	85			8
Ohara (17)	32	100	75	79	19	25	
Brand (1)	48	100	44	82		10	4.2
Inui (10)	555	92.4	72.6	91.1	22	6.3	4.1
Suzuki (22)	479	92	74.3	90.9	22.5	6.1	
Tandan (23)	636		76.9	65.1	17.8		8.8

ref., reference, no. number, pts, patients

Symptom relief

Many studies have been reported that ESWL can relieve symptoms (50% to 91.1% (Table 1). Tandan et al. [23] reported that after ESWL, pain was absent after procedure in 68.7% of patients (250/364) in their intermediates follow-up group and 60.3% (164/272) in their long-term follow-up group. Thus, performing ESWL, sometimes followed by endoscopic treatment, is useful in treating pain from pancreatolithiasis.

Seven, et al. [20] reported improvement of pain in 85% and complete abolition of pain in 50% in a questionnaire survey of 120 patients with pancreatolithiasis after ESWL and endoscopic treatment. Korpela et al. [15] reported that less narcotic pain medication was needed in patients who quit smoking after the treatment was more improvement than in those who continued smoke. Lifestyle modification after treatment such as tobacco or alcohol abstinence sometimes can be an important factor in improving pain.

Recurrence

Recurrence is one of the most important concerns with non-surgical treatment. In several studies, recurrence was observed in about 20% (Table 1). Suzuki et al. [22] reported that total incidences of stone recurrence after ESWL and endoscopy were significantly higher than after surgery. On the other hand, Moole, et al. [16] reported a recurrence rate was 18.84% in a meta-analysis of 17 articles from 1996 to 2015 including 3,189 patients with pancreatolithiasis who underwent ESWL. In order to improve recurrence rate, abstinence and smoking cessation are principles. Because patients with strictures of the main pancreatic duct tend to have a higher stone recurrence rate [10], pancreatic duct stenting after non-surgical treatment may reduce recurrence.

Requirement of surgery

Surgical treatment is required in patients who are ineligible for endoscopic treatment and ESWL. Several studies reported that 2.1% to 4.1% of patients were required

surgery (Table 1). Hong et al. [8] reported that 4 patients required surgery for refractory pain or stone recurrence, among a total of 19% or 5/27 requiring surgery after endoscopic treatment, the fifth operation was needed after failure of stone clearance. Kim et al. [14] reported also stressed the need for surgery after failure of endoscopic treatment. We agree with the need to perform open surgery in such instances.

4. Complications

Complications including acute pancreatitis, acute cholangitis, hematuria, hepatic or renal subcapsular hematoma, headache and low back pain [12] developed in 6.1% to 25% of patients undergoing non-surgical treatment (Table 1). Joo YW, et al. [13] reported that among 46 patients performed endoscopic treatment, early complications included acute pancreatitis (10.9% of patients), acute cholangitis (2.2%), while late complications included stricture of the pancreatic duct (2.2%, at 38 months following the procedure).

5. Selection of treatments

Dumonceau et al. [5] reported that in a randomized controlled trials including 19 patients, frequency of pain recurrence over 2 years following treatment was 38% (10/26) in those undergoing only ESWL as opposed to 45% (13/29) with combined treatment also including endoscopy, representing no significant difference between groups. Pain recurrence was 35.2% vs. 42.6% by 1 year, 39.3% vs. 46.7% at 2 years, and 43.3% vs. 46.7% by 3 to 7 years for ESWL only vs. combined treatment including endoscopy.

Combined treatment with endoscopy is safe and useful, but questions persist since improvement of pain appears similar to ESWL only and the procedure could increase medical care costs. In a retrospective study of 916 patients managed in Japanese 34 Japanese institutions over more than 5 years, treatment methods were ESWL in 479 patients, surgery in 133, and endoscopy alone in 68 [22]. Early complications rates (within 2 weeks) were 6.1% for combined treatment with ESWL and endoscopy, 9.6% for endoscopy only, and 13.3% for surgery (Table 2). Surgical complications were relatively severe, including anastomotic leakage, pancreatic pseudocyst formation, intraperitoneal hemorrhage, and acute respiratory distress syndrome. Surgery was superior to endoscopy for long-term pain relief, but endoscopy was preferred as a first-line treatment because of being less invasive. In a randomized controlled trial, Dita et al. [4] reported better success with pain relief in the surgery group (34%) than with non-surgical treatment (15%, Table 2). In another randomized controlled trial, Cahen et al. [2] reported that the pain relief rate was 75% in the surgery group higher than in the non-surgical treatment group (32%), while duration of retreatment with non-surgical treatment was greater than with surgery (Table 2). In patients with strictures of the main pancreatic duct and pancreatolithiasis without tumor, no difference in complications, hospitalization, and change of exocrine pancreatic function was evident between groups. Those authors concluded that surgery is useful for chronic pancreatitis with strictures of the main pancreatic duct.

Table 2. Comparison between treatments

Authors (ref.)	Treatment	No. of pts.	Stone clearance (%)	Pain relief (%)	Complications (%)
Dite (4)	Endoscopy alone	36		15 (complete) 46 (partial)	
	Surgery	36		34 (complete) 52.1 (partial)	
Cahen (2)	Combined treatment with ESWL and endoscopy	19	89	32	58
	Surgery	20		75	35
Suzuki (22)	ESWL alone/combined treatment with endoscopy	479	74.3	90.9	6.1
	Endoscopy alone	68	87.9	95.8	9.6
	Surgery	133		98.5	13.3
Hong (8)	Endoscopy alone	27	78	47	22
	Surgery	35	89	77	14

ref., reference, no. number, pts, patients

5. Conclusions

Non-surgical treatment with ESWL and endoscopic procedures is safe and effective for patients with pancreatolithiasis. The first-line treatment of pancreatolithiasis should be ESWL alone or with endoscopy because of minimal invasiveness and low

incidence of early complications. Surgery should be performed in patients with treatment failure or multiple recurrences.

Conflict of interest

The authors declare that they have no conflict of interest.

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