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Original Research Article

Efficacy of extracorporeal shock wave lithotripsy of pancreatic stone in chronic pancreatitis

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ABSTRACT

Background: To study overall outcome of ESWL therapy in large pancreatic duct stone as first line therapy in chronic pancreatitis.
Methods: A prospective, observational study which took place in MGM medical college and the patient were admitted in general surgery department. Patients were selected based on the inclusion criteria composed of upper abdominal pain, weight loss, oily stools and presence of pancreatic stones or ductal irregularity/ parenchymal atrophy determined by various radiological investigations.
Results: In this study 11 patients with pancreatic stones were recruited in duration of 2 years. Among 11 patients included in this study 63.33% were males and 36.375% were females. The mean age of males and females were 35.57 and 40.50 years respectively. It was observed that all study subjects had abdominal pain and history of pancreatitis. 36% patient had single calculi and 64% patient had multiple calculi. 18% calculi were present in the body of pancreas and 46% calculi in head of pancreas. All these patient had undergone ESWL procedures with minimum number of 400 shocks and maximum number of 4600. Among the patients it was noted that 73% had successful complete clearance of calculi, 18% had partial clearance and 9% had no clearance
Conclusions: ESWL is efficient tool for the treatment of pancreatic calculi but can be used alone it is adjunct tool to ERCP. Endoscopy, etc.

Keywords: Extracorporeal shock wave lithotripsy, Pancreatic stones

INTRODUCTION

Chronic pancreatitis is a disease of diverse aetiology characterized by progressive and irreversible changes in the pancreas, resulting in loss of exocrine and endocrine functions. Pain either continuous or episodic, is the dominant feature of this illness and significantly worsens the quality of life.[1] Alcohol, smoking, genetic factors, metabolic disturbance, and defects in immunity are some of the known etiological agents.[2] Alcohol is the most common etiological agent in industrialized countries. Non-alcoholic idiopathic type of CP is more prevalent in some countries.[3-5] Pancreatic calculi are sequelae of CP and occurs in about 50% of patients.[6] These calculi aggravates or produce the typical pain experienced by patients by obstructing pancreatic duct and producing upstream ductal hypertension.[7-8] Decompression of duct by clearing the stones leads to relief of pain in many patients. Small pancreatic duct stones can be extracted by routine technique of endoscopic pancreatic spincterectomy and basketing. Stones >5 mm in diameter are often impacted in the main pancreatic duct and require fragmentation to facilitate their expulsion. ESWL has been successfully used at many centres for

fragmentation of large PD calculi followed by spontaneous or endoscopic clearance with resultant pain relief. Extracorporeal shock wave lithotripsy was first introduced in the 1980s for fragmentation of renal and ureteric calculi. Its application was quickly extended to include large biliary and pancreatic calculi.[9] Over the last three decades, ESWL has been used at many centres worldwide for fragmentation of biliary and pancreatic calculi that are not amendable to routine endoscopic therapy. ESWL is based on the principle of shock wave energy. When energy is released in an enclosed space shock waves are generated. The passage of these shock waves through substances of different acoustic impendence generate compressive stresses on the boundary of the outer surface of these objects. The stress overcomes the tensile strength of targeted objects and the anterior surface of the calculi crumbles with the impact.[10,11] The present day lithotripters consist of electromagnet wave generator, a focusing system for targeting the calculi, and coupling device. During ESWL, the focal point targets the calculi. The generated shockwaves are transmitted via a coupling device, to the skin surface and then through the body tissue to the calculi. The earlier lithotripter used a "water bath" for this purpose. The newer machines use a small water-filled cushion covered with a silicone membrane to transmit the shock waves to the patient's skin. ESWL is indicated in all patients of uncomplicated CP with large painful PC not amenable to routine endotherapy and extraction.[12,13] The aim is to fragment the calculi to <3 mm in size or to demonstrate a decrease in stone density or heterogeneity of the stones, which occupy the MPD or the side branches.[3,14] ESWL should not be performed with extensive calculi in head, body and tail. Isolated tail calculi are not targeted at ESWL because of greater chance of collateral damage to the spleen. Patients with multiple strictures, head mass under evaluation, ascites or coexistent pseudo cysts are not taken up for ESWL. Any existing cholangitis or coagulopathy due to a concomitant biliary stricture should be treated prior to subjecting the patient to ESWL.[3,13] Common bile duct (CBD) stone fragmentation rates of 71 to 95% have been reported with ESWL, leading to final duct clearance rates of 70 to 90%. While complete clearance of 76% and partial clearance of 17% of pancreatic duct calculi have been documented with ESWL, our study was undertaken to investigate the efficacy and safety of ESWL in clearance of difficult bile duct and large pancreatic duct calculi. The third generation lithotripter uses electromagnetic generator and focus shock waves to smaller zones, thus minimizing damage to surrounding soft tissue. First generation lithotripter was based on electrohydraulic shock wave generator; the shock waves were focused via an ellipsoid metal water-filled tub in which both the patient and the generator were submerged. Second generation lithotripters use piezoelectric or electromagnetic generators as energy source. It is coupled with a focusing device to concentrate shockwaves on smaller focal zone. Intraductal lasers used for bile duct stones include pulsed solid-state lasers (q-switched neodymium YAG, alexandrite, and holmium YAG lasers) or flash lamp-pumped pulsed dye lasers (coumarin dye and rhodamine-6G lasers). Single operator cholangioscopy is the most convenient approach for effective biliary laser lithotripsy.[15] Extracorporeal shock wave lithotripsy (ESWL) is an established modality in the management of large pancreatic ductal calculi. A few serious and rare compilations have also been described following ESWL. These include perirenal hematoma, biliary obstruction, splenic rupture, bowel perforation, liver trauma as well as necrotizing pancreatitis. However these severe complications are few and occur infrequently.[16,17]

The objectives of this study were to: Study the average amount of energy transferred and number of shocks required for defragmentation of PC as indicated and calculated by the ESWL device. Study complications of ESWL, post procedural pancreatic enzyme level changes in patients undergoing ESWL and to study the efficacy of ESWL in decompressing the main pancreatic duct.

METHODS

All cases satisfying the inclusion criteria were chosen which were upper abdominal pain, weight loss (>10kg in 12 months), oily stools, recurrent attacks of pain in abdomen. The presence of pancreatic calculi or ductal irregularity/parenchymal atrophy determined at imaging using ultrasonography, CT scan, MRI, magnetic resonance cholangio-pancreatography (MRCP), endoscopic retrograde cholangio-pancreatography (ERCP). The presence of any one or all the above clinical symptom and with the above radiological findings will be diagnosed to have chronic pancreatitis. Informed consent were taken from the patients. Data was collected with the help of a proforma which had the following details: age, gender, mode of presentation of illness, family history, history of diabetes and its complications, history of alcohol, smoking, details of clinical examination, results of investigations, imaging study results, mode of treatment of diabetes, analgesics, the use of pancreatic enzyme supplements, frequency of endotherapy, surgery, coeliac axis block and epidural analgesia. The following investigations were done in all cases: Hemoglobin, Total Leucocyte counts, Platelet Counts, Random blood sugar, renal function tests, Liver function tests, Serum amylase and lipase tests. Study was conducted at the department of surgery between October 2017 and November 2019 at MGM hospital and medical college, Aurangabad. A prospective and time bound hospital based observational study.

Statistical analysis

Collected data were compiled in MS excel sheet. For analysis SPSS version 21 software was applied. Qualitative data was represented in the form of frequency and percentile.

RESULTS

Table 1 shows the age and sex distribution of the study subjects. It was observed that 63.33% were males and 36.37% were females. The mean age of male and female was 35.57 and 40.50 years respectively; whereas, the overall mean of all the study subjects was 37.36 years.

Table 1: Age and sex distribution of the study subjects.

Sex	N (%)	Mean age (years)	Std deviation
Male	7 (63.63)	35.57	11.70
Female	4 (36.37)	40.50	6.40
Total	11 (100)	37.36	10.03

Table 2: Distribution of study subjects based on symptoms and history of pancreatitis.

Variable	Abdominal pain N (%)	Nausea and vomiting N (%)	History of pancreatitis N (%)
Present	11 (100)	2 (18.2)	11 (100)
Absent	0 (0)	6 (54.5)	0 (0)
Intermittent	0 (0)	3 (27.3)	NA

NA-Not applicable

Table 2 depict the distribution of study subjects based on symptoms and history. It was seen the all study subjects had abdominal pain and history of pancreatitis. Nausea and vomiting was present in 18.2%, intermittent in 27.3% and absent in 54.5% of the study subjects.

Table 3: Distribution of study subjects based on type pancreatic calculi.

Type of calculi	Frequency (N)	Percent (%)
Single	7	63.6
Multiple	4	36.4
Total	11	100

Table 4: Distribution of study subjects based on location of pancreatic calculi.

Location of calculi	Frequency (N)	Percent (%)
Body	2	18.2
Head	5	45.5
Body and head	4	36.4
Total	11	100

Table 3 describe the type of pancreatic calculi among the study subjects; it was found that 36% had single calculus and 64% had multiple calculi.

Table 4 show the distribution of study subjects based on location of the pancreatic calculi. 18% and 46% subjects had the calculi in body and head region of the pancreas respectively and 46% subjects had calculi in body as well as head region.

Table 5: Mean number of shocks given and energy transferred in study subject.

Variable	Min	Mean	Max	SD
Number of shocks	400	3625	4600	1124.8
Energy transferred (Joules)	38	132.27	160	33.90

Table 6: Distribution of study subjects based on clearance of MPD after extracorporeal shock wave lithotripsy.

Clearance	Frequency (N)	Percent (%)
Complete clearance	8	72.7
Partial clearance	2	18.2
No clearance	1	9.1

Table 7: Correlation between type of calculi and clearance of MDP by extracorporeal shock wave lithotripsy procedure.

Type of clearance of MPD	Type of calculi	
	Single	**Multiple**
Complete clearance	6	2
Partial clearance	0	2
No clearance	1	0
P value (Chi-square)	0.101*	

*Statistically not significant

Table 5 shows the number of shocks and energy transferred through Extracorporeal Shock Wave Lithotripsy during the procedure. The minimum number of shocks given was 400 and maximum was 4600. Mean number of shocks were 3625 and mean energy transferred was 132.27 Joules.

Table 6 show the outcome of the extracorporeal shock wave lithotripsy procedure based on clearance of pancreatic calculi. It was observed that 73% of the study subject had successful complete clearance of the calculi, 18% had partial clearance and 9% (only 1 study subject) there was no clearance.

Table 7 shows the correlation between type of calculi and clearance of MDP by Extracorporeal Shock Wave Lithotripsy procedure. It was found that from the 7 single calculi 6 were completely cleared and 1 was not cleared; however, out of the total 4 multiple calculi 2 were

completely cleared and 2 were partially cleared. On statistical analysis by Chi-square test it was found that there was no significant correlation (p>0.05) between the type of pancreatic calculus and clearance of MDP. Thus through this study it can be stated that the clearance of MDP does not depend on the number/type of calculus in the pancreas.

DISCUSSION

Although not many studies are conducted similar results were obtained in the study conducted by Guido et al. In Rome Italy on thirty-five patients with severe chronic pancreatitis. Patients were treated by ESWL for endoscopically irretrievable obstructive stones. The procedure was well tolerated by the majority of patients. Fragmentation of stones was obtained in all cases while complete clearance and decompression of pancreatic duct were obtained in 26 of 35 (74.3%) and in 30 of 35 (85.7%) cases, respectively. There was no mortality related to the procedure. Morbidity was observed in 8 of 35 patients (22.8%). Guido et al concluded that ESWL should be considered complementary and not an alternative to endoscopic drainage. Combined with endoscopy, extracorporeal shock wave lithotripsy may increase the success rate of nonsurgical treatment of patients with chronic pancreatitis.[18]

Another study conducted on 214 Chinese patients by Hu et al have similar observations as this study. Hu et al states that the study was conducted with an aim to evaluate prospectively the safety and efficacy of ESWL in Chinese patients at Changhai Hospital.

The results of the study were as follows total of 473 ESWL procedures were performed in 214 patients. Stones were fragmented in all cases. Complete clearance of main pancreatic duct stones and successful endoscopic decompression were achieved in 155 (72.4%) and 188 (90.8%) of 214 patients, respectively. The study came up with the conclusion that ESWL is a safe and effective method to treat Chinese patients with pancreatic stones. This procedure can significantly improve the success rate of endotherapy.[19] In a study conducted by Manu et al on patients presenting with pain and large pancreatic duct (PD) calculi (>5 mm diameter) not amenable to extraction at routine endoscopic retrograde cholangio pancreatography (ERCP). These patients were taken up for ESWL, stones in the head and body of pancreas was targeted at ESWL; 5,000 shocks were given per session. The calculi were fragmented to <3 mm size and then cleared by endotherapy. Pancreatic duct stents were deployed when indicated. A total of 1,006 patients underwent ESWL. The study resulted as a complete clearance achieved in 762 (76%), partial clearance in 173 (17%) and unsuccessful in the rest. Complications were mild and minimal. The study was concluded as ESWL is an effective and safe modality for fragmentation of large PD calculi. The conclusion derived was similar to the present study.

Among the 11 patients included in the study 63.33% were males and 36.37%were females. The mean age of male and female was 35.57 and 40.50 years respectively; whereas, the overall mean of all the study subjects was 37.36 years. It was observed that all study subjects had abdominal pain and history of pancreatitis. Nausea and vomiting was present in 18.2%, intermittent in 27.3% and absent in 54.5% of the study subjects. It was also observed that 36% of the patients had single calculus and 64% of the patients had multiple calculi located at different sites in pancreas. Among the locations 18% patients had the calculi in body and 46% of patients presented with calculi in head region of the pancreas, 46% patients had calculi in body as well as head region. All these patients had undergone the ESWL procedure with minimum number of 400 shocks given and maximum number of 4600. Mean number of shocks were 3625 and mean energy transferred was 132.27 Joules. Among the patients it was noted that 73% had successful complete clearance of the calculi, 18% had partial clearance and 9% was no clearance. It was found that from the 7 single calculi 6 were completely cleared and 1 was not cleared; however, out of the total 4 multiple calculi 2 were completely cleared and 2 were partially cleared.[20]

Limitations

The study was conducted in a single hospital with small sample size. So the result may not represent the whole community. The study was conducted in a short period of time. These were the limitation of present study.

CONCLUSION

The above studies have observed similar results to the present study and have concluded that the ESWL is an efficient tool for the treatment of pancreatic calculi but cannot be used alone it is an adjunct tool to ERCP, endoscopy etc.

Recommendations

Large sample size needed for better understanding of ESWL use in chronic pancreatitis.

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