Pancreatic stone, ERCP and ESWL – a case study and review.

Abstract

Introduction

Pancreatic duct stones are found in 22 to 60 per cent of patients with chronic pancreatitis (CP). The stones can lead to obstruction of the outflow of pancreatic secretions causing increased intraductal pressure. The pancreas is relatively noncompliant. Therefore the rise in intraductal pressure can induce tissue hypertension and ischemia. This can be a major factor causing pain in patients with CP. This hypothesis is supported by the observation that symptoms may improve following pancreatic duct drainage.

Case Presentation

A 62 year old woman presented with persistent epigastric pain. Investigations revealed calcifications within the main pancreatic duct and head of the gland. Treatment with Endoscopic retrograde cholangiopancreatography (ERCP) and extracorporeal shock wave lithotripsy (ESWL) achieved a good outcome.

Conclusion

Standard endoscopic removal of the stones proved impossible so treatment with ESWL was undertaken. Following fragmentation, the calculi and fragments passed spontaneously or were removed endoscopically. If pancreatic stones cannot be removed endoscopically, ESWL should be considered prior to surgery.
Background

A 62 year old Caucasian woman presented with 4 months of persistent epigastric, central abdominal and left iliac fossa pain. The pain radiated to the back and could be severe. There was associated nausea, retching and anorexia with an unspecified amount of weight loss. She had intermittent diarrhoea with previous constipation and pain in response to stress. Past history included hysterectomy complicated by adhesions and bowel obstruction, rectal bleeding and a right knee replacement. She had no personal or family history of pancreatitis, dyslipidaemia or malignancy. She took one standard unit of alcohol daily and paracetamol and a paracetamol-codeine phosphate compound for severe pain but no other regular medications. Physical examination revealed moderate epigastric tenderness. There was no guarding and no masses or organs were palpable.

Investigations showed CRP 93 mg/l (NR <5), total white cell count 11.3 x 10^9/l (neutrophils 8.7, monocytes 1.1) and amylase 74 u/l (NR 8-53). Liver function tests, amylase, CA 19-9, CEA and IgG4 were all within normal reference range. She underwent upper and lower GI endoscopy revealing mild reflux oesophagitis LA grade A and Helicobacter pylori associated gastritis and mild sigmoid diverticular disease. Abdominal ultrasound showed calcified stone/s within the head of the pancreas associated with main duct dilatation to 7mm. There was no fluid collection or mass lesion. The liver, biliary tree and gallbladder were normal. CT confirmed a 7mm stone within the main pancreatic duct in region of the neck with dilation of the duct downstream from this (Figure 1). There was a cluster of calcification superiorly within the pancreatic head.

![Figure 1. CT scan - pancreas](image-url)
Case

ERCP was performed 2 months after initial presentation (Figures 2, 3, 4). The pancreatic duct was selectively cannulated with a sphincterotome followed by guidewire and found to be mildly dilated to 7-8mm. The guidewire was obstructed at the neck, presumed to be secondary to the stone (although the stone was not visualized). A pancreatic sphincterotomy was performed and a 5fr 5cm length plastic removable stent was placed. MRCP therefore performed (Figure 5) to further evaluate pancreatic duct anatomy. This showed partial pancreas divisum and confirmed the stones. The pancreatic duct appeared to be decompressed with calibre reduced to 5mm.

Figure 2. ERCP - pancreatogram
Figure 3. ERCP - normal major ampulla

Figure 4. ERCP – plastic pancreatic stent
Figure 5. MRCP

Figure 6. Abdominal radiograph pre ESWL.
A surgical opinion was obtained and it was decided that pancreatic duct bypass and resection were not to be pursued. Six weeks later, she underwent ESWL. This was performed with a modern Dornier S II on Mobile Medical Technology’s lithotripsy bus. The system is equipped with dual imaging modalities which permits fluoroscopy or ultrasound localisation of stones. Fluoroscopy was used in this instance (Figure 7).

The shock rate was set to 1 Hz and the power increased from a minimum of 12kV to a maximum of 15.1 kV. A rate of 1 Hz provides superior fragmentation. During the procedure, the patient lay on the lithotripter table in a prone right anterior oblique position. Treatment was performed under conscious sedation, administered by a specialist anaesthetist. Total duration of treatment was one hour and was well tolerated. The patient stayed in hospital for 1 night to receive supportive care and was discharged well the following morning. There were no complications.

Figure 7 ESWL – fluoroscopic localisation of stone
A second ERCP was performed five days after ESWL (Figure 8). By this stage she had already had reduction in pain. The pancreatic stent was removed with a snare and pancreatic duct cannulated with a sphincterotome. A pancreatogram was obtained showing dilatation of the main duct to 8mm, but complete filling to the tail. There was no stone, stricture or obstruction evident. The duct was trawled with a 9mm extraction balloon confirming a clear duct. A single pigtail stent 7fr 7cm length was then placed to ensure drainage and reduce the risk of pancreatitis (Figure 9) associated with pancreatic instrumentation. The pancreatic stent was removed 2 weeks later at upper GI endoscopy.
At follow-up about five weeks after ESWL, abdominal pain and anorexia had resolved and she was feeling stronger on a daily basis.

Discussion

It was initially thought that this patient’s symptoms represented a combination of gastro-oesophageal reflux, Helicobacter gastritis and irritable bowel syndrome. Although she did have these problems, her on-going epigastric pain and abnormal pancreas drew attention to the pancreas. Despite evidence for chronic pancreatitis, there was no history of preceding acute pancreatitis. It was assumed her pain and systemic symptoms arose from stone obstruction of the main pancreatic duct. It was anticipated that there may be residual fragments and a stricture following ESWL. However at the second ERCP the pancreatic duct was mildly dilated with no other pathology present. The stone was very effectively treated by ESWL. The patient is doing very well with need for further intervention. She is however at increased risk of pancreatic cancer and on-going surveillance with tumour markers and imaging is planned.

ERCP can be technically challenging and pancreatic endotherapy is usually performed by advanced endoscopists only. Endoscopic stone removal alone can have limited success, due to stone location, burden, and presence of strictures in the pancreatic duct. In chronic calcific pancreatitis, the main goals of therapy are to relieve pain by decompression of the main pancreatic duct, primarily by removing stones or treating strictures. Endoscopic decompression has been shown to be effective in some nonrandomised studies. Endoscopic stone extraction and duct decompression is limited by the size of the pancreatic calculi and presence of strictures. ESWL overcomes the problem of the stone size by fragmenting the stones and reducing the stone burden, therefore allowing endoscopic clearance of the duct facilitates or spontaneous stone passage.

Focused shock waves administered during ESWL cause stone fragmentation. The shockwaves propagate through the body with little dissipation of energy (and therefore damage to tissues) due to the minimal difference in density of the soft tissues. At the stone-tissue interface, the large difference in density, in addition to the concentration of numerous shockwaves in a small area, produces a large dissipation of energy. Various mechanisms (compressive and tensile forces, erosion, shearing, spalling, and cavitation), cause energy
to overcome the tensile strength of the crystalline structure of the calculi, leading to fragmentation. Repetition of this process eventually leads to pulverization of the calculi.\textsuperscript{11}

Treatment of calculi by ESWL was first used for the treatment of kidney stones in 1980.\textsuperscript{12} The technique has since been applied to gallstones \textsuperscript{13} and pancreatic stones. \textsuperscript{11}

Current data suggest that ESWL is effective in complete duct clearance in up to 50\% of patients and in duct decompression and symptomatic improvement in up to 70\% of patients. Therefore ESWL should be considered a useful adjunct in the treatment of pancreatic duct calculi.\textsuperscript{14,15}

Choi and Kim review ESWL for pancreatic duct stones in patients with chronic pancreatitis and find that ESWL is an effective and safe procedure for endoscopically irremovable main pancreatic duct stones, and, in selected patients, ESWL alone may be effective.\textsuperscript{16} Furthermore in the first meta-analysis evaluating ESWL with or without endoscopic therapy in pancreatic duct clearance and symptom relief, seventeen studies published between 1989 and 2002 were reviewed. Results show that ESWL is useful in reducing the stone burden in the main pancreatic duct and also for improvement of pain.

The effect of ESWL on pain relief is significant. The potential mechanism for this improvement in pain is possibly due to main pancreatic duct decompression and relief of obstruction by stone fragmentation. Failure to relieve pain can be due to incomplete stone clearance, persistent strictures, or parenchymal pancreatic pain due to a diseased organ and not related to ductal hypertension. All studies showed homogeneity suggesting similar effect size irrespective of the combinations of therapy.\textsuperscript{17} All studies were case series with a total of 588 subjects. Outcomes of therapy are best studied in randomized, placebo controlled trials. Meta-analyses typically include data from randomized controlled trials to calculate the effect size. Unfortunately, there are no randomized trials of therapy for pancreatic duct stones.

ESWL is an excellent therapeutic modality for large pancreatic calculi. The high efficacy, non-invasive nature of the procedure, along with the low complication rate make it a procedure of choice and can be offered as first-line therapy for selected patients with large pancreatic and CBD calculi.\textsuperscript{18-20}
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References


Abbreviations

CA 19-9 carbohydrate antigen
CEA carcinoembryonic antigen
GI gastrointestinal

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