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Original Research Article

Sphlanchic nerve radiofrequency ablation for chronic pancreatitis

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ABSTRACT

Background: Chronic pancreatitis (CP) is defined as a progressive inflammatory response of the pancreas leading to irreversible changes in the parenchyma (fibrosis, loss of acini and islets of langerhans, and pancreatic stone formation) and pancreatic duct (stenosis and pancreatic stones).
Methods: This was a retrospective observational study and was conducted in Rushmono pain clinic at Rushmono Specialized Hospital, Dhaka, Bangladesh during the period from January 2018 to January 2024. In our study, we included 50 hospitalized patients who had undergone splanchnic nerve RFA ablation for pain of chronic pancreatitis.
Result: We found the mean age was 32.8±9.3 years. Most of our patients were male (78%) compared to female (22%). Among our patients, 78% were smokers, 62% of patients consumed alcohol and 42% had a history of hypertension. All of our patients (100%) had bilateral RFSN. At baseline, the mean VAS score was 9.84±1.02 and in 1st postoperative day, the mean VAS score was 4.14±1.03 with a significant p value (0.021). At the 12th month of follow-up, the mean VAS score slightly increased to the last follow-up and the difference was not significant. The majority (84%) of our patients had no complications.
Conclusion: Our findings suggest that RFSN is likely a safe, minimally invasive way to manage pain in people with chronic pancreatitis. In the current study, our patients' mean VAS scores of pain levels significantly dropped after RFSN procedures.

Keywords: Chronic pancreatitis, Pain management, Sphlanchic nerve, Radiofrequency ablation

INTRODUCTION

Chronic pancreatitis is defined as a progressive inflammatory response of the pancreas leading to irreversible changes in the parenchyma (fibrosis, loss of acini and islets of Langerhans, and pancreatic stone formation) and pancreatic duct (stenosis and pancreatic stones).[1] The incidence of chronic pancreatitis in the Western world amounts to 10/100,000. It is more common in men (3:1), and presents mostly between ages 40 and 50.[2-4] Chronic pancreatitis is associated with (excessive) alcohol use in 70% to 80% of the patients. The mechanism of how alcohol causes pancreatitis is not yet clear. A large number of alcoholics do not develop pancreatitis, so a genetic factor may also be involved.[5] One of the most significant signs of chronic pancreatitis is pain. Since the pathogenesis of chronic discomfort is only partially understood, treating this condition is frequently challenging. Pain in pancreatitis may be caused by different mechanisms like nociceptive pain, neuropathic pain and neurogenic inflammation.[1]

Factors that may cause nociceptive pain in chronic pancreatitis include infiltration of the retroperitoneum, pseudocyst formation with compression of the surrounding organs, obstruction of the ductus pancreatic

due to fibrosis/stones/protein plugs, and pancreatic ischemia.[6,7] Neuropathic pain involves a change of the sensory nerves or the central nervous system itself. This change or damage is caused by nociceptive activation.[8] Neurogenic inflammation is another proposed mechanism for pain. Neurogenic inflammation itself induces the production and increased release of neuropeptides, which then reinforces the inflammatory reaction in the tissues.[9]

Pain is one of the major problems for chronic pancreatitis (CP) patients and has a substantial impact on their health-related quality of life.[10,11] Pain management is often complicated by frequent visits to the emergency department and even hospitalization.

In many cases, special pain management teams are required. Pain management in CP usually proceeds with a stepwise approach. In general, analgesics are the first step. Further interventions are required in case of an insufficient response to opioid analgesics and adjuvants.

In patients with a dilated pancreatic duct as a result of stones and/or strictures, endoscopic treatment and surgery are indicated to decompress the obstructed pancreatic ductal system. Patients with severe pain, without pancreatic duct dilatation and an inflammatory mass, and the small group of CP patients (15%) who are unresponsive to the aforementioned surgical procedure, are considered potential candidates for denervation of the splanchnic nerves.[1,12] The afferent splanchnic nerves of the celiac plexus mediate pain signals during periods of pancreatic inflammation.[13] Various techniques exist to impede the splanchnic nerves from signaling.

Percutaneous radiofrequency ablation of the splanchnic nerves (RFSN) is a relatively new method for nerve destruction. In RFSN, a high-frequency current is used to induce nerve lesioning. It can create a predictable and accurate lesion of the nerve without a destructive effect on surrounding motor or sensory fibers.[14] Radiofrequency ablation (RFA) is an electrosurgical technique utilizing high-frequency alternating current to heat tissues leading to thermal coagulation. When cells are heated above 45°C, cellular proteins denature and cell membranes lose their integrity as their lipid component melts.[15]

Due to the accuracy of lesions produced by RFA ablation, there has been growing interest in the use of this technique for neurolysis of splanchnic nerves as it offers the potential of accurate nerve destruction ablation, with a predictable and controlled ablative lesion. Another advantage of RFA ablation is that it has an immediate effect unlike alcohol and phenol, which may take up to 1 week or 10 days to achieve neurolysis.[16]

RFA of the splanchnic nerves is an established method of pain relief in patients with chronic pancreatitis. Data on RFSN as a treatment for severe pain in CP are very limited. Therefore, in this study, we aimed to evaluate 50 patients undergoing splanchnic nerve RFA ablation for chronic pancreatitis pain.

METHODS

Study design

This was a retrospective observational study and was conducted at Rushmono Pain Clinic in Rushmono Specialized Hospital, Dhaka, Bangladesh.

Study duration

The study was conducted from January 2018 to January 2024. In our study, we studied data from 50 hospitalized patients who were undergoing splanchnic nerve RFA ablation for chronic pancreatitis pain.

Inclusion criteria

These are the following criteria to be eligible for enrollment as our study participants these are patients aged more than 18 years, patients with chronic pancreatitis pain, patients who were willing to participate were included in the study.

Exclusion criteria

Patients with recent (within 4 weeks) gastrointestinal (GI) hemorrhage, patients with coagulopathy or received anticoagulant within 3 days before RFA, patients with ampullary tumor, and pancreatic malignancy, patients with ASA grading 3 and above were excluded from the study.

Radiofrequency ablation technique

Before the treatment, all patients had a test block of their splanchnic nerves to make sure that their pain levels were decreased. Every patient had IV access before RFA ablation, and their vital signs were continuously monitored by an expert anesthesiologist. A 14-G, 5 cm needle was placed on either side of the T11 and T12 vertebral body using a fluoroscope.

Next, a 150 mm 20-G curved tip RF needle was inserted in tunnel vision to reach the anterior 1/3rd of the vertebral body. Then a non-ionic radio-opaque contrast agent was injected to verify the needle position. Motor and sensory test stimulation was conducted utilizing 2 Hz (to 2 V) and 50–100 Hz (to 1 V) respectively before RFA of splanchnic lesioning.

The appropriate patient reaction to sensory stimulation would be an epigastric area stimulation. To make sure that no contraction of the intercostal muscles was seen, motor stimulation was used. At each level, 2 lesions were created at 80°C for 60 seconds. Vital signs monitoring and cautious observation of the patients continued for 4-6 hours after the procedures.

Pain scoring and follow-up

The effect of RFSN on pain was determined by an eleven-point visual analogue scale (VAS) i.e., the numbers 0 to 10, with 0 representing no pain at all and 10 representing "the worst imaginable pain". Patients were asked to complete the VAS before the procedure and at every visit to the outpatient clinic. The eventual pain-free period was based on the VAS scores reported at every visit.

A reduction of > 75% in the VAS pain scale concerning the initial score was considered excellent; 75–50% was considered good; 50–10% was considered fair, and less than 10% was considered poor. The period of follow-up started from the 1st post procedural day of the RFSN procedure and extended until the last visit.

To evaluate the short-term effect, patients were requested to attend the outpatient department between 1 and 2 weeks after the procedure. Long-term information regarding the level of pain was obtained by telephone asking the VAS for pain at 1 month, 3 months, 6 months, and 12 months.

Statistical analysis

All data were recorded systematically in preformed data collection form. Quantitative data was expressed as mean and standard deviation and qualitative data was expressed as frequency distribution and percentage. A p-value <0.05 was considered as significant. Statistical analysis was performed by using SPSS 23 (Statistical Package for Social Sciences) for Windows version 10.

RESULTS

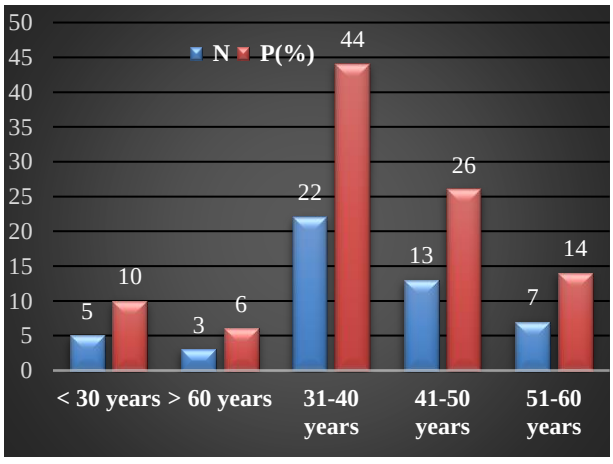

Figure 1: Age distribution of our study patients.

Figure 1 shows that the majority (44%) of our patients were aged 31-40 years old, followed by 26% were 41-50 years old, 14% were 51-60 years old and 10% and 6% were aged less than 30 and above 60 years old respectively.

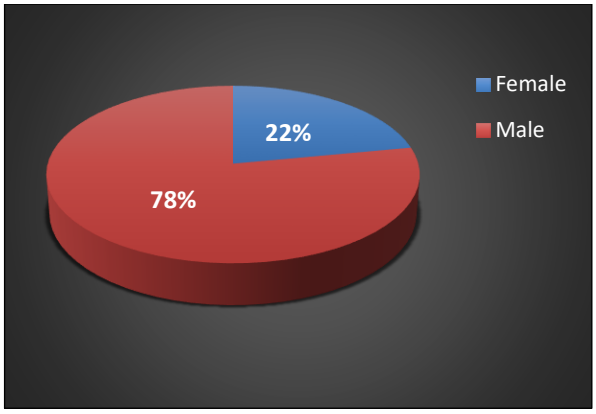

Figure 2: Sex distribution of our study participants.

The pie chart shows that most of our patients were male (78%) compared to female (22%). The male and female ratio was found 3.54:1 in this study.

Table 1: Baseline characteristics of our study patients.

Baseline	(n=50)	N (%)	P value
Mean age (years)		32.8±9.3	0.486
Duration of symptoms (months)		12.7±6.3	0.125
Number of RFSN			
Bilateral	50	100.00	
Smoking	39	78.00	
Alcohol consumption	31	62.00	
History of hypertension	21	42.00	
History of asthma	7	14.00	
History of COPD	4	8.00	
BMI (kg/m^2)		27.67±4.24	0.614
Heart rate (per minute)		76.0±11.9	0.474
Systolic blood pressure (mmHg)		155.24±20.78	0.641
Diastolic blood pressure (mmHg)		95.94 ±11.69	0.162
Comorbidities			
DM	9	18.00	
Dyslipidemia	11	22.00	
Fibrosis	4	8.00	
Depression	7	14.00	
Duration of procedure (min)		51.8±12.4	0.413
Follow-up (months)		15.4±7.9	0.061

Table 1 shows the baseline characteristics of our patients. We found the mean age was 32.8±9.3 years. Among our patients, 78% were smokers, 62% of patients consumed alcohol and 42% had a history of hypertension. All of our patients (100%) had bilateral RFSN. The mean BMI was

27.67±4.24 kg/m2, heart rate was 76.0±11.9 beats /min. At baseline, the mean SBP and DBP were 155.24±20.78 and 95.94±11.69 respectively. As comorbidity, we found DM (18%) and dyslipidemia (22%) in our patients. The mean follow-up is 15.4±7.9 months.

Table 2: Distribution of our patient's pain level by visual analogue scale (VAS) score.

Pain level	Mean	P value
At baseline (Pre-procedure)	9.84±1.02	0.251
Post-procedure		
1st postoperative day	4.14±1.03	0.021
1 month	3.73±1.21	0.034
3 months	3.14±0.41	0.064
6 months	3.05±0.27	0.072
12 months	4.91±1.79	0.142

Table 2 shows the distribution of our patient's pain level by VAS score. At baseline, the mean VAS score was 9.84±1.02 and in 1st postoperative day, the mean VAS score was 4.14±1.03 with a significant p value (0.021). At the 3rd and 6th month follow-up, the mean value of the VAS score was not significant whereas at the 12th month of follow- up the mean VAS score slightly increased than the last follow-up and the difference was not significant.

Table 3: Distribution of our study patients by complications.

Complications	N	%
Bleeding	4	8.00
Infection	2	4.00
Temporary weakness/numbness	8	16.00
Swelling/Bruising	7	14.00
Temporary diarrhea	5	10.00
No complications	42	84.00

Table 3 shows the distribution of our study patients by complications. The majority (84%) of our patients had no complications. The most common complication was temporary weakness/numbness (16%), followed by swelling/bruising (14%) and temporary diarrhea (10%).

DISCUSSION

Chronic pancreatitis is described by fibrosis and mononuclear infiltration. Fibrosing of the parenchyma accompanied by the loss of acini and islets of Langerhans eventually leads to loss of function. This functional loss can be both exocrine (resulting in lipase deficiency with steatorrhea, diarrhea, and weight loss) and endocrine (causing diabetes mellitus [DM] in case of insulin deficiency). Two to three percent of the patients with chronic pancreatitis ultimately develop pancreatic carcinoma. The most common symptoms, however, are exocrine pancreatic insufficiency and pain.[17-20] Radiofrequency neurotomy (RFN) has proven to be a very useful tool in achieving successful long-term pain relief in a wide variety of conditions in chronic pain since the 1960s. However, it is not bereft of complications. Infection, hematoma formation, and inadvertent burns, including third-degree skin burns, have occurred with this technique.[21] Neural damage leading to cutaneous dysesthesia and hypoaesthesia have also been described .[22] A possible complication of RFN is an irreversible injury of nontarget nerves.[23] Splanchnic nerve RFA is a proven method of successful pain alleviation in patients suffering from chronic pancreatitis. It has been found to provide pain relief up to a median period of 45 weeks.[14] Splanchnic nerve RFA is a relatively safe procedure, as the predictable relationship of the splanchnic nerves to other structures allows for accurate needle placement, resulting in accurate radiofrequency lesioning.[16]

The first percutaneous approach to splanchnic nerve block was described by Kappis in 1914.[24] The first splanchnectomy for intractable pancreatic pain was performed in 1942 by Mallet Guy.[25] In a series of 215 patients by the same author, 89% of patients treated obtained prolonged pain relief.[26] Splanchnic nerve interruption can be performed at open operation, thoracoscopically, or percutaneously.[27-31] Due to the development of a minimally invasive technique, there has been a resurgence of interest in splanchnectomy. There has been a growing realization that although splanchnic nerve interruption offers relief of pain for most patients, in certain individuals neurolysis can result in no effect or indeed in exacerbation of pain levels. Hence, local anesthetic blockade, has been advocated as a means of predicting patient response before the use of neurolytic nerve blockade.[30-32]

Raj et al reported excellent pain relief (defined as a reduction in the VAS-score by 50-75%) by RFSN in 40% of patients with chronic abdominal pain including an undefined number of patients with chronic pancreatitis. Poor results (reduction of less than 10%) were obtained in 15% of patients.[33] Garcea et al evaluated pain reduction after RFSN in Chronic Pancreatitis patients specifically. These authors observed a significant pain reduction in all patients.[16] The current study was undertaken to evaluate the effect of RFSN on pain reduction in Chronic Pancreatitis patients suffering from severe pain. Apart from the reduction in pain scores, attention was given to the occurrence of complications.

At present, there exists a marked lack of data regarding the efficacy of percutaneous splanchnic nerve blocks, particularly RFA blocks. There are reports following percutaneous splanchnic nerve blocks with alcohol showing a reduction in pain following the procedure in around 70% of treated patients.[34-36] In the current study of RFSN, we found that the mean VAS score of our patients reduced significantly with a p value of 0.002 within 12 months of their follow-up. Data on the RFA of splanchnic nerves is limited. The largest report is by Prithiv Raj et al in a series of 107 patients. The seres reported that up to 40% of patients had excellent pain relief (defined as a

reduction in pain using a visual analogue scale of between 50 and 75%), with only 15% of patients achieving poor results (pain reduction of less than 10%).[37] Marra et al have reported that splanchnic nerve blocks are associated with a better success rate than coeliac plexus blocks.[35]

Minor complications like diarrhea and intestinal colic or pneumothorax may occur following splanchnic nerve blocks, but these are temporary and can be easily managed.[38] Several studies recorded complications like severe cardiac arrhythmias induced by phenol and diaphragmatic paralysis in splanchnic nerve blocks.[39,40] There were no major complications in the majority of our study patients. However, the current study had some minor complications like weakness/numbness, swelling/bruising, and temporary diarrhea. Major complications including injury to the pleura or kidneys are rare but warrant a mandatory check via X-ray of the chest following the procedure. Injury to the intercostal nerves is a feared complication while performing splanchnic nerve RFA when the tip of the probe is positioned slightly more posterior to the desired target site.[41]

The limitations of the study were a single-center study. We took a small sample size due to our short study period. After evaluating those patients, we did not follow up with them for the long term and did not know other possible interference that may happen in the long term with these patients.

CONCLUSION

RFA of the nerves is a widely accepted and popular method for giving people with chronic pain long-term pain relief. Our findings suggest that RFSN is likely a safe, minimally invasive way to manage pain in people with chronic pancreatitis. In the current study, our patients' mean VAS scores of pain levels significantly dropped after RFSN procedures. The majority of the patients in our study did not experience any significant problems. So further study with a prospective and longitudinal study design including a larger sample size needs to be done to validate these findings and to ensure a clear understanding of the procedure by the patient.

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