

Original article

Color Doppler Sonography of the gastroduodenal and superior pancreaticoduodenal artery as an early method for the differential diagnosis of the dilation of the head of the pancreas

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SUMMARY

OBJECTIVE: The visualization of the pancreas is difficult and findings are usually missed at the early stages of the disease. Dilatation of the head of the pancreas is difficult to be differentially diagnosed on admission of the patient at hospital emergencies. The objective of this study is the use of Color Doppler Sonography flow parameters of the gastroduodenal and the superior pancreaticoduodenal artery as a tool in the differential diagnosis of the dilatation of the head of the pancreas. **METHOD:** 45 individuals were enrolled in the study and divided into three Groups. Group A consisted of 15 healthy volunteers. Group B, 15 patients with diagnosis of acute edematous pancreatitis with edema of the head of the pancreas of approximately 5 cm and Group C, 15 patients with a diagnosis of tumor of the head of the pancreas of diameter 1.5-3 cm. The diagnosis of acute pancreatitis was established by the Baltazaar and Apache criteria. All were examined by using Color Doppler Sonography and Ultrasonography of upper abdomen. Pulsatility and resistance index values were measured in the gastroduodenal and superior pancreaticoduodenal arteries. **RESULTS:** Pulsatility (PI) and resistance indices (RI) of the gastroduodenal and superior pancreaticoduodenal artery were higher in Group C (PI of GDA: 3.20-4.15 PI of sup PDA: 3.5-4.8, RI of GDA: 0.82-0.89, RI of sup PDA: 0.86- 0.94 in patients with pan-

creatic tumor of the head of the pancreas) than in Group A and B (PI of GDA: 2.10-2.50, PI of sup PDA: 2.20-2.70, RI of GDA and sup PDA: 0.7-0.8 in patients with acute pancreatitis). PI and RI in patients with acute pancreatitis assemble to those of healthy individuals. **CONCLUSION:** In our study there seems to be strong correlation between increased values of PI and RI in gastroduodenal and superior pancreaticoduodenal arteries and the presence of tumor of the head of pancreas.

Key Words: Color Doppler ultrasonography, Gastroduodenal artery, Superior pancreaticoduodenal artery, Pancreatitis, Pancreatic tumor, Pulsatility index, resistance index.

INTRODUCTION

Pancreatic dilatations are usually difficult to differentiate at the early stages of disease. Pancreatic tumors sometimes have the same appearance using imaging methods as acute pancreatitis at the early stages of disease and patients usually complain of the same symptoms. Focal pancreatitis may present as a discrete pancreatic mass. Pancreatic tumors and inflammatory pancreatic masses (pancreatitis) appear as hypoechoic areas in the pancreas. The characteristics of these masses with sonography and Computed Tomography (CT) are difficult to be differentiated at the early stages of pancreatitis or when the tumor is still small. The assessment of the pulsatility index and the vascular resistance is of great interest in various fields. Multiple factors like inflammation, tumor, calcification of vessels may influence these parameters, the resistance and the flow volume. Modern flowmeters are widely used in medical practice.

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Purpose

The aim of this study is the evaluation of the measurement of the flow parameters of the gastroduodenal and superior pancreaticoduodenal arteries as a tool for early differential diagnosis of pancreatitis and tumor of the head of the pancreas.

Subjects and Method

Our study concerned 45 patients who were encountered during a 14 month period. Their age ranged from 35 to 69 years old with a median of 55 years old. (30 men and 15 women). All individuals were divided into three groups. Group A consisted of the 15 healthy individuals. The volunteers were selected from subjects visiting our hospital for a health screening program who agreed to participate in this study after the purposes, risks and potential benefits were explained to them. Group B consisted of 15 patients with diagnosis of acute mild pancreatitis with edema of up to the head of the pancreas with a diameter 5 cm. These patients were classified by using the Apache and the Baltazaar scores and CRP. Group C included 15 patients diagnosis with an approximately 1.5-3 cm tumor of the head of the pancreas by using dynamic Computed Tomography. All the patients and healthy volunteers were examined with Color Doppler Sonography. The examination concerned the gastroduodenal and superior pancreaticoduodenal arteries at admission after the diagnosis. We used type ge vivid 4 ultrasound equipment with standard settings. The gastroduodenal artery blood flow was detected in 43 of 45 individuals with longitudinal scanning and in 30 with transverse scanning. The corresponding PI (flow amplitude/mean flow) was calculated together with RI. The pancreas was better visualised with sections of 3mm before and after adminis-

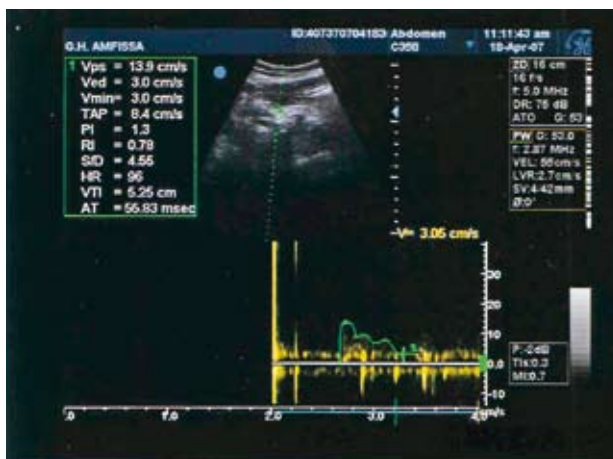


Fig 1. Measurement of flow parameters of healthy individuals

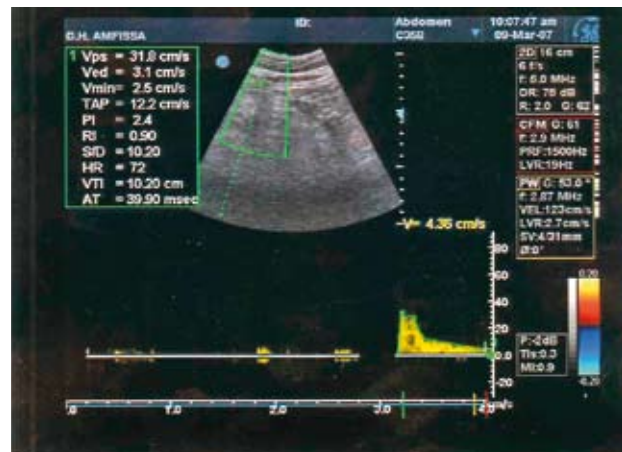


Fig 2. Measurement of flow parameters of individuals with mild acute pancreatitis

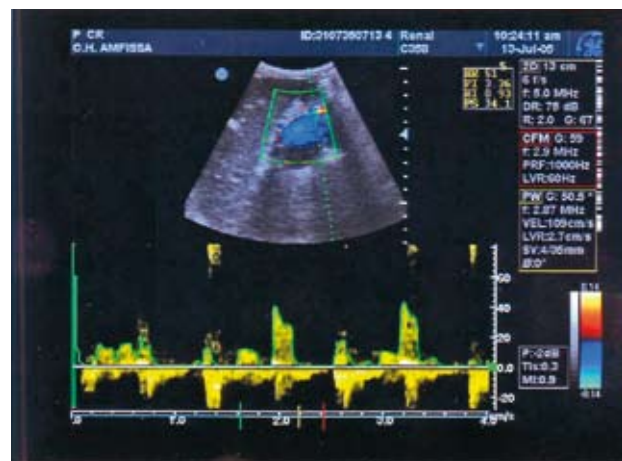


Fig 3. Measurement of flow parameters in patients with tumor of the head of the pancreas

tration of intravenous contrast material. All patients underwent laboratory blood tests.

Data was analyzed using a SPSS statistical package. Continuous data are presented as median and range. Patients and non patients were of similar age. Patient demographics (age, sex, ect) were taken from the case notes. The two sample t-test was used to assess differences in the mean values of age. The one tailed test for proportion was used to confirm or refute any apparent differences in proportions (demographics). Chi square statistic was employed to assess the association between the groups of interest and the incidence of pulsatility flow index and resistance index of the the gastroduodenal and superior pancreaticoduodenal artery.

Results:

In Group A consisting of healthy individuals, normal values of Pulsatility Index (PI) and Resistance Index (RI) were found:

PI of gastroduodenal (GDA) and sup pancreaticoduodenal artery (sup PDA): 1.75-2.30

RI of GDA and sup PDA: 0.65-0.78

In Group B, 15 patients with acute pancreatitis:

PI of GDA: 2.10-2.50

PI of sup PDA: 2.20-2.70

RI of GDA and sup PDA: 0.7-0.9

Results were almost the same as those of normal subjects.

In Group C, 15 patients in whom pancreatic tumor was diagnosed:

PI of GDA: 3.20-4.15

PI of sup PDA: 3.5-4.8

RI of GDA: 0.82-0.99

RI of sup PDA: 0.86- 0.94

This group showed significantly elevated values.

(Table 1)

DISCUSSION

The pancreas lies retroperitoneally which sometimes makes its visualization difficult. Ultrasonography and Computed Tomography are usually used for its visualization. Findings of the pancreas are usually missed at the early stages of the disease, for example pancreatic cancer when the foci are small. Pancreatic cancer was the fourth common cause of death as reported in 1993. Pancreatic tumors located at the head of the pancreas are the most

common. Most pancreatic tumors benign or malignant or inflammatory pancreatic masses appear as hypoechoic areas in the head of pancreas. Color Doppler flow imaging can characterize tumor vascularity. Early diagnosis is essential for improving survival rates.^{1,2,3,4,5}

The two major arteries which supply the head of the pancreas are the superior pancreaticoduodenal artery, a branch of the gastroduodenal artery which arrives from the common hepatic artery and the inferior pancreaticoduodenal which arrives from the superior mesenteric artery.⁶

In our study pulsatility and resistance indices of the gastroduodenal and superior pancreaticoduodenal artery in acute pancreatitis showed no substantial difference from normal values whereas in cases of tumor of the head of the pancreas the values of these indices were elevated. According to the above results there seems to be a strong correlation between the increased values of PI and RI in cases of tumor of the head of pancreas. It seems that performing this examination routinely on admittance of patients with symptoms of acute pancreatitis can aid the investigation for the presence of malignancy before computed tomography and surgery/biopsy.

Color Doppler Sonography is a convenient, harmless and non invading imaging modality. Its an easily available tool. The only disadvantage is that the patient should be calm and cooperation because visualization of the region is difficult. The procedure be performed by an experienced radiologist.

There are few studies referring to the measurement of the flow of the gastroduodenal and superior pancreaticoduodenal artery.

Investigation of the detection rate of gastroduodenal arterial blood flow using Doppler Color imaging has been recorded by Uzawa M et al. The authors revealed a tumor of the head of the pancreas in one patient and a ductal cell cancer in another patient by using noninvasive Doppler ultrasonography.⁷

Another study in 1996 reports the assessment of arterial invasion of pancreatic cancer and the relationship between tumors and surrounding major splanchnic arteries (among them superior mesenteric and gastroduodenal artery) in 33 patients with pancreatic cancer.⁸

Sakagami et al reported the ultrasonographic splanchnic artery flow measurement in severe acute pancreatitis. They used Doppler sonography to investigate how splanchnic hemodynamics vary during the early stage of severe acute pancreatitis in 6 patients, but referred to proper hepatic, celiac and superior mesenteric artery.⁹

Table 1. The range of values of Pulsatility Indices (PI) and Resistance Indices (RI) of gastroduodenal artery (GDA) and superior pancreaticoduodenal artery (sup PDA) among the individuals of the three groups.

	Group A	Group B	Group C
PI of GDA	1.75-2.30	2.10-2.50	3.20-4.15
PI of sup PDA	1.75-2.30	2.20-2.70	3.5-4.8
RI of GDA	0.65-0.78	0.7-0.8	0.82-0.89
RI of sup PDA	0.65-0.78	0.7-0.8	0.86-0.94

Endoscopic ultrasonography which can reliably diagnose and stage pancreatic cancer is widely used but it is difficult to differentiate between vascular compression and invasion.¹⁰

Echo enhanced power Doppler sonography according to Rickes S et al is a useful tool for differentiation of pancreatic tumors according to their vascularization characteristics.^{11,12}

A recent study from Scialpi M et al reports the use of contrast enhanced power Doppler ultrasonography for differentiation of the pancreatic carcinoma from chronic focal pancreatitis evaluating the number, morphology and course of vessels within the lesion in 26 patients, 16 with ductal carcinoma and 10 with focal pancreatitis. A number of studies use Echo enhanced color and Power Doppler, and also endoscopic ultrasound for discrimination between inflammatory focal lesions of pancreas and pancreatic carcinoma.^{13,14,15,16}

In our study we have used a noninvasive method (Color Doppler Ultrasound) to assess the values of pulsatility index and resistance index in the gastroduodenal and superior pancreaticoduodenal artery. There was a limited number of patients with pancreatitis at its onset and patients with tumor of the pancreas but these first results show that the measurement of these flow parameters can differentiate pancreatitis from tumors of the head of pancreas. Of course further studies have to be performed to confirm the above results.

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