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Potential use of point shear wave elastography for the pancreas: A single center prospective study

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ABSTRACT

Aim: Clinical use of point shear wave elastography for the liver has been established, however, few studies demonstrated its usefulness for the pancreas. A prospective study was conducted to clarify its feasibility for the pancreas and its usefulness for the identification of high risk group for pancreatic cancer.
Patients and methods: Consecutive eighty-five patients underwent point shear wave elastography for the pancreas. The success rate of shear wave velocity (SWV) measurement, that is the number of successful measurements over total 10 measurements, was recorded. The SWV of the pancreas measured at non-tumorous area was compared between patients with and without pancreatic cancer. Factors associated with high SWV were determined by logistic regression model.
Results: Sixty patients were included, of these 18 had pancreatic cancer. The success rate of 100% was achieved at the head, the body and the tail of the pancreas in 80%, 83%, and 68% of the patients, respectively. The success rate of ≥80% was achieved in 100%, 100%, and 96% of the patients, respectively. Although mean SWV of the pancreas harboring pancreatic cancer tended to be higher compared with that of the pancreas without cancer (1.51 ± 0.45 m/s vs 1.43 ± 0.28 m/s), they did not reach statistical significance. Multivariate analysis showed that increased amount of alcohol intake was associated with high SWV.
Conclusion: The SWV of the pancreas was measured with excellent success rate. However, tendency of higher SWV obtained from the pancreas harboring pancreatic cancer needed to be further investigated.

1. Introduction

Point shear wave elastography (former acoustic radiation force impulse elastography) is a technology which estimates the elasticity of target tissue by measuring the speed of shear wave using ultrasound [1,2]. Shear wave is generated by acoustic radiation force impulse, so-called push pulse, emitted from ultrasound probe through the target tissue. The shear wave subsequently propagates through surrounding tissue. Then, the shear wave velocity is measured automatically in meter per second, and is displayed on the screen. The shear wave velocity is known to depend on the hardness of the target tissue: the harder the target tissue is, the faster the shear wave velocity is shown.

Clinical use of point shear wave elastography has been established to some extent as a non-invasive assessment of liver fibrosis in the field of gastroenterology [3–6]. Because most hepatocellular carcinomas develop from cirrhotic liver, liver fibrosis is considered to be treated. It is clinically important to evaluate the grade of fibrosis prior to initial treatment, or the improvement of fibrosis after the treatment. The grade of fibrosis had ever been assessed by liver biopsy. A recent international multicenter study reported that there was positive correlation between the shear wave velocity measured by point shear wave elastography and the grade of liver fibrosis evaluated by liver biopsy [2]. Thus, point shear wave elastography is expected to be a standard method for the assessment of

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liver fibrosis instead of liver biopsy. However, there are few studies evaluating the clinical used of point shear wave elastography for the pancreas [7,8].

Pancreatic cancer is one of the malignancies with miserable prognosis, therefore, early detection is considered to be crucial. However, the facts that most patients with pancreatic cancer in early stage do not complain any symptoms and pancreatic cancer grows very rapidly make it difficult to diagnose pancreatic cancer in early stage. Many efforts have been made, such as development of novel serum markers specific for pancreatic cancer in early stage [9–12], there have not been any established methods contribute to early detection of pancreatic cancer yet.

The identification of high risk group for pancreatic cancer from numerous asymptomatic patients is proposed, because it is not realistic to examine every asymptomatic patient focusing on the pancreas. Regular follow-up of the high risk group will also enable precise examinations of the pancreas without delay. Trans-abdominal ultrasound is a non-invasive examination, and hence it is appropriate to screen for asymptomatic patients. Tanaka et al. reported that patients with pancreatic cyst of 5 mm or larger in size and/or slightly dilated main pancreatic duct which were detectable by trans-abdominal ultrasound had increased risk of pancreatic cancer [13]. If the elasticity of the pancreas measured during ultrasound examination could identify the high risk group for pancreatic cancer, its clinical implication would be abundant. Thus, a prospective study was conducted to clarify the feasibility of point shear wave elastography for the pancreas, as well as its usefulness for the identification of high risk group for pancreatic cancer.

2. Materials and methods

2.1. Patients

Consecutive patients who underwent trans-abdominal ultrasound examination followed by point shear wave elastography for the pancreas at Osaka Medical Center for Cancer and Cardiovascular Diseases were subjected. Written informed consent for the additional point shear wave elastography was obtained from all patients.

In this study, patients with pancreatic cancer represented patients with invasive ductal adenocarcinoma, and the diagnosis of adenocarcinoma was confirmed by either pancreatic juice cytology or endoscopic ultrasound guided fine needle aspiration in all patients. Patients underwent point shear wave elastography prior to initial therapy including stent insertion.

This study protocol was approved by the institutional review board of Osaka Medical Center for Cancer and Cardiovascular Diseases.

2.2. Point shear wave elastography

Virtual Touch Quantification called point shear wave elastography was performed on ACUSON S2000 (Siemens Medical Solutions, Mountain View, USA). Probes used in this study were 1–6 MHz convex probe (6C1HD) and 1–4 MHz convex probe (4C1). Virtual Touch Quantification is the technology based on the measurement of shear wave velocity. The harder a tissue is, the higher velocity of shear wave is shown [1].

The shear wave is caused by acoustic radiation force pulses emitted from the probe through the target tissue. The shear wave extends transversally in the tissue at a speed of around 1–10 m/s, which is slow enough to be well sampled by detection pulses. The detection pulses are subsequently applied from the probe in multiple locations and reveal arrival time of the shear wave, allowing calculation of the shear wave propagation speed. In sum, once the operator generates acoustic radiation force pulses by pushing one button, the shear wave velocity is calculated automatically within a second and displayed on the screen (Fig. 1).

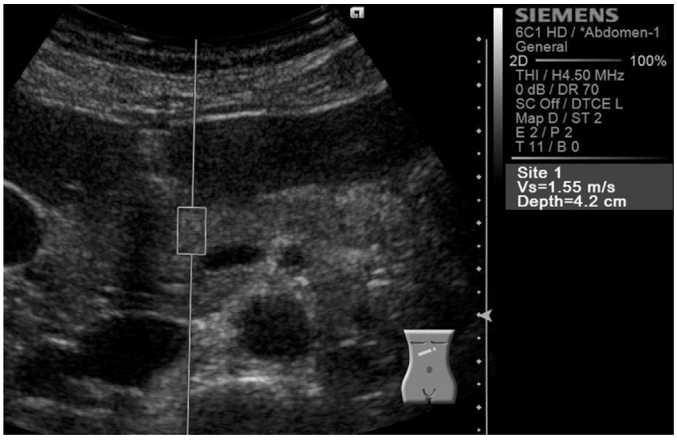

Fig. 1. Point shear wave elastography performed for the pancreas. A representative case. Thirty-years-old healthy woman voluntarily underwent point shear wave elastography for the pancreas. B-mode image showed a homogeneous pancreas and no suspicious features of chronic pancreatitis including hyperechoic foci and irregular contour of the main pancreatic duct. Region of interest was set at the head of the pancreas. The shear wave velocity was successfully measured in all 10 measurements i.e. success rate was 100%. The median shear wave velocity was measured as 1.61 m/s. This patient had no history of pancreatitis, but was a habitual drinker of >60 g ethanol/day and 4–5 days per week frequency.

Patients were set in Fowler position during the procedure. We used Fowler position because the pancreas is better visualized in Fowler position compared with supine position. In Fowler position, the pancreas can move down to pedal side and be less affected by gastric gas which interferes with the clear visualization of the pancreas. Region of interest (ROI) was set on the section where the pancreas is the most clearly visualized on B-mode image. For the patients with pancreatic cancer, ROI was generally set at downstream of the cancer in order to eliminate the possible effects of obstructive pancreatitis caused by cancer. For the patients with pancreatic uncal cancer whose main pancreatic duct was not affected by cancer, ROI may exceptionally be set at upstream of the cancer.

The shear wave velocity was measured 10 times for each patient, while natural breathing. The median of the measured shear wave velocity was used for analysis. We considered the shear wave velocity was reliable only when the interquartile range (IQR) over the median resulted with less than 40%. And only these data were used for analysis [3,4]. All examinations were performed by a single operator who was a Board Certified Fellow of the Japan Society of Ultrasonics in Medicine and a certified gastroenterologist (N.K.).

2.3. Feasibility of point shear wave elastography

Because the shear wave velocity is determined by detecting the peak amplitude of shear wave, it is not necessarily determined for every measurement, for example, in case of indistinct peak amplitude. Also, the exposed push pulse may attenuate before it arrives at the pancreas by internal organs including stomach or liver, which usually locate between the probe and the pancreas. If shear wave velocity could not be calculated appropriately, X,XX m/s was displayed on the screen as a warning. The success rate of shear wave velocity measurement, that is the number of successful measurements over total 10 measurements, was recorded.