JOP. J Pancreas (Online) 2009 Sep 4; 10(5):543-546.

CASE REPORT

Solid Appearance of Pancreatic Serous Cystadenoma Diagnosed as Cystic at Ultrasound Acoustic Radiation Force Impulse Imaging

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ABSTRACT

Context Acoustic radiation force impulse imaging is an emerging imaging modality. The study of the pancreas is a new and promising application of ultrasound acoustic radiation force impulse imaging. **Case report** We present the first case of pancreatic serous cystadenoma which mimics a solid neoplasm at conventional imaging (US and CT), correctly diagnosed as cystic at ultrasound acoustic radiation force impulse imaging. **Conclusion** The "XXXX" values always measured at Virtual Touch^{TM} tissue quantification allow the diagnosis of a pancreatic cystic lesion with simple fluid content suggesting the diagnosis of serous cystadenoma.

INTRODUCTION

Acoustic radiation force impulse (ARFI) imaging is an emerging imaging modality which depends on tissue stiffness and provides information about tissue strain properties [1, 2, 3]. By using short-duration (less than 1 ms) acoustic radiation forces, it produces localized displacements in deep tissues without the need for an external compression [4]. ARFI imaging generates shear waves (Figure 1) through a "target" region of interest [1, 5], adding complementary qualitative and quantitative information to conventional ultrasound (US) [6, 7]. The response is monitored with US and is a function of Young's modulus, the local magnitude of the radiation force, and the generation and propagation of shear waves [1, 5].

In recent decades, the evaluation of superficial tissue stiffness, by applying subtle compression, has given some promising results in the study of fibrotic liver [8], myocardial tissue [9], vascular structures [10, 11], lymph nodes [12], prostate [13] and thyroid gland [14].

Virtual Touch^{TM} tissue quantification (Siemens, Erlanger, Germany) is a new quantitative implementation of ARFI imaging which provides numerical values (wave velocity measurements, m/s) of the tissue stiffness at a precise image-based anatomical location.

We present the first case of a cystic pancreatic lesion resembling a solid neoplasm at conventional imaging and correctly diagnosed as cystic at ultrasound ARFI imaging.

CASE REPORT

During an ultrasonographic (US) examination performed in another hospital, for right upper quadrant pain in a 67-year-old Caucasian woman, gallstones

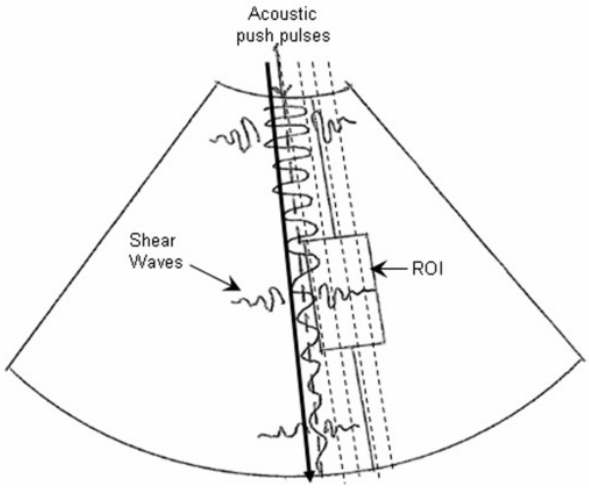

Figure 1. Virtual Touch^{TM} tissue quantification consists of three steps. First, on a conventional ultrasound image, an anatomical location is selected and identified utilizing a region of interest (box with fixed dimension of 1.0x0.5 cm); second: an acoustic push pulse is transmitted through the tissue, inducing shear waves through the region of interest and third: a numeric value proportional to tissue stiffness and expressing the sound wave speed (measured in m/s) is reported.

Received April 25th, 2009 - Accepted July 14th, 2009

Key words Cystadenoma, Serous; Elasticity Imaging Techniques; Pancreas; Ultrasonography

Abbreviations ARFI: acoustic radiation force impulse

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Document URL http://www.joplink.net/prev/200909/08.html

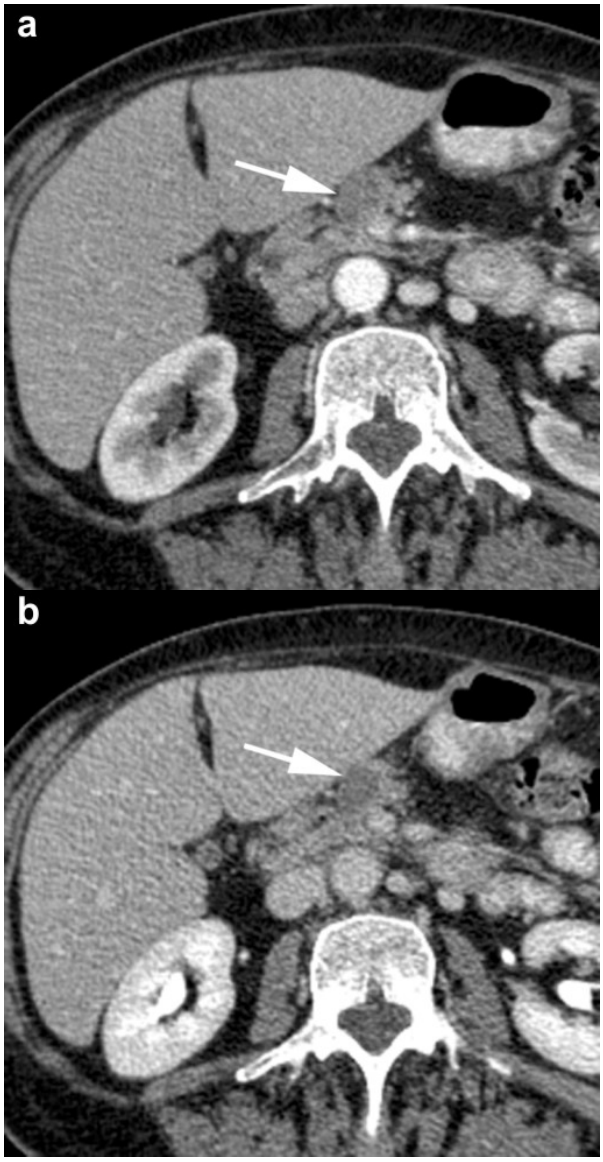

Figure 2. CT scans show a small pancreatic lesion (arrow) at the pancreatic neck, hypodense during pancreatic (**a.**) and venous (**b.**) phases.

were detected and a focal solid hypoechoic lesion in the pancreatic neck, with a diameter of about 2 cm, was incidentally found. The main pancreatic duct, and intra- and extra-hepatic bile ducts were not dilated. No abnormalities involving the laboratory data were found. Tumor markers were also normal. A computed tomography (CT) scan confirmed the presence of a well-demarcated focal pancreatic mass, hypodense in the pre-contrast phase and hypo-vascularized after the administration of iodinated contrast agent, suspected as a solid neoplasm (Figure 2).

The patient presented at our hospital for a pre-surgical re-evaluation. A complete ultrasound study was again performed confirming the presence of a solid hypoechoic pancreatic lesion (Figure 3ab).

The new implementation of ARFI imaging, called Virtual Touch^{TM} tissue quantification, was performed on a S2000 ultrasound system (Siemens, Erlanger, Germany). Undetectable measurements which resulted in "XXXX" values of tissue stiffness were always obtained (Figure 3ab), probably as a consequence of the excessive molecular motion inside the region of interest located within the pancreatic mass and related to the non-solid nature of the lesion.

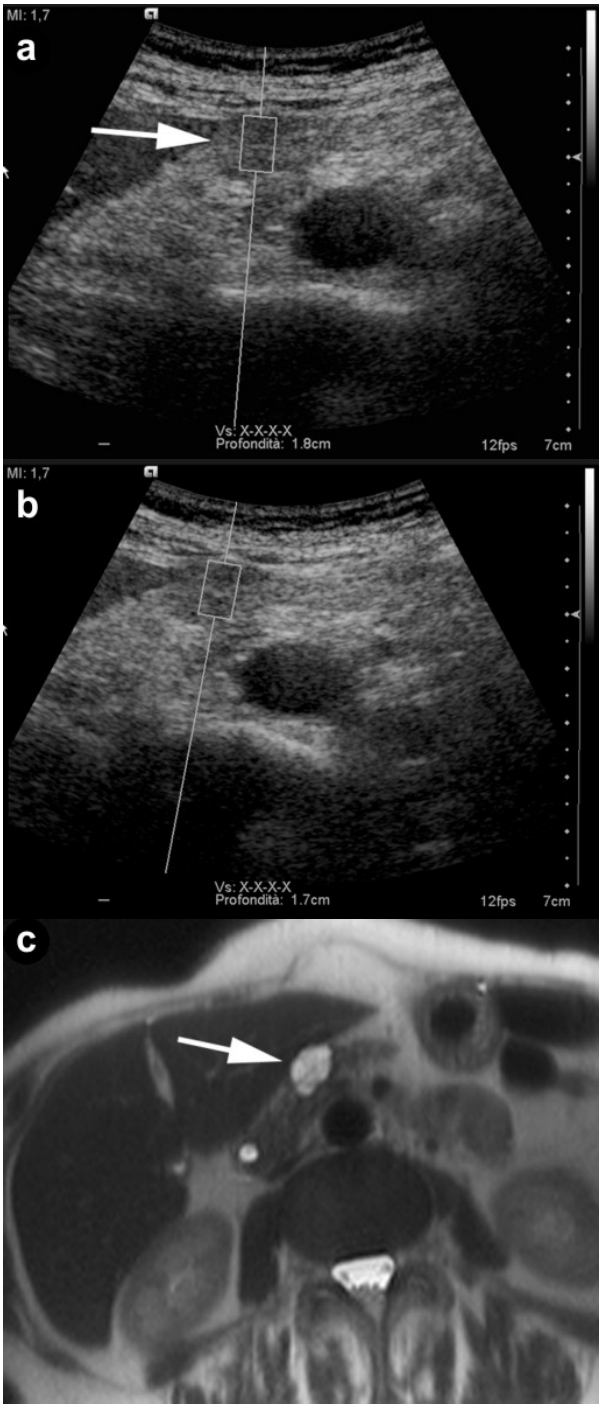

Figure 3. Virtual Touch^{TM} tissue quantification (**a.**, **b.**) of a small pancreatic lesion (arrow) appearing solid slightly hypoechoic at conventional US. On a conventional image based anatomical location (**a.**, **b.**) a small box (region of interest) for ARFI analysis is placed inside the pancreatic lesion (arrow). An acoustic push pulse is transmitted through the lesion and unreliable values ("XXXX") were obtained as in cystic lesions with simple fluid suggesting the diagnosis of a serous cystadenoma confirmed at MRI (arrow in **c**).

Magnetic resonance imaging (MRI) confirmed the presence of a microcystic multicystic lesion of the pancreas without pancreatic ductal communication, typical of a microcystic serous cystadenoma (Figure 3c).

DISCUSSION

Serous cystadenoma is a benign cystic tumor of the pancreas, usually asymptomatic. Although the microcystic, macrocystic and oligocystic forms could be encountered, the typical aspect is characterized by a cluster of microcysts (few mm to 2 cm) separated by thin enhancing septations, sometimes forming an enhancing central scar which may calcify, without pancreatic ductal communication. In 5% of cases, it resembles a solid lesion due to the enhancing septa and the absence of visualization of the tiny cysts [15, 16]. Typically, the cysts are anechoic at US, hypodense at CT and hyperintense on T2-weighted MR images and surrounded by hypoechoic/dense/intense septa which enhance after the administration of contrast agents [17]. At imaging, a serous cystadenoma, if extremely microcystic, may simulate a hypervascular solid lesion, resembling an endocrine tumor [18].

We present the first case of pancreatic serous cystadenoma which mimics a solid neoplasm at conventional imaging (US and CT), correctly diagnosed as a cystic lesion at ultrasound ARFI imaging. In this case, the role of ultrasound ARFI imaging was twofold allowing the characterization of both the nature and the content of the pancreatic lesion. By obtaining unreliable ("XXXX") values at Virtual Touch^{TM} tissue quantification the misdiagnosis of a solid lesion was corrected to a cystic lesion with simple fluid suggesting the diagnosis of serous cystadenoma.

ARFI imaging is a new method which provides qualitative and quantitative information about the local mechanical properties of tissues [1]. Over elastography and sonoelasticity, ARFI imaging and its new implementation called Virtual Touch^{TM} tissue quantification, allows the evaluation of deep tissues without the need for external compression [2, 3]. "Pushing" only the target region of interest, the response reflects the viscoelastic properties of tissues and is proportional to the tissue stiffness [4, 19]. In solid tissues, the stiffer a tissue is, the greater the shear wave speed (wave velocity value) will be. In fluid tissues, the response is related to the molecular motion inside the region of interest. In simple fluids, the excessive motion probably determines a too great variation of the individual velocity estimates between tracking beams, and an unreliable measurement, expressed as "XXXX" values, is always obtained. In viscous fluids, where the molecular motion is reduced owing to the complex content, a greater mechanical wave speed is measured. Extending these results to pancreatic cystic lesions, we believe that the content of different pancreatic cystic lesions should generate different wave velocity values. *In vivo*, the biological composition of fluids can be very different. Today, all the imaging modalities available characterize and classify pancreatic cystic lesions on the basis of their morphology and content [15, 16, 17, 18]; the invasive analysis of the content still remains the last choice for making a definitive diagnosis.

Virtual Touch^{TM} tissue quantification is able to show the differentiation between solid and cystic lesions resulting in numerical and unreliable ("XXXX") values, respectively. Moreover, this new implementation of ARFI imaging seems capable of non-invasively differentiating between simple (i.e. serous cystadenoma) and more complex (i.e. mucinous cystadenoma, necrosis, intraductal-papillary mucinous tumors and endocrine tumors) fluids; an unreliable ("XXXX") value is always obtained in the first while numerical measurements resulted in the second one. These preliminary findings suggest that Virtual Touch^{TM} tissue quantification could hold considerable clinical promise. However, further studies are needed.

Conflict of interest The authors have no potential conflicts of interest

References

1. Nightingale K, Soo MS. Acoustic radiation force impulse imaging: in vivo demonstration of clinical feasibility. Ultrasound Med Biol 2002; 28:227-235.

2. Melodelima D, Bamber JC. Transient elastography using impulsive ultrasound radiation force: a preliminary comparison with surface palpation elastography. Ultrasound Med Biol 2007; 33:959-969.

3. Garra BS. Imaging and estimation of tissue elasticity by ultrasound. Ultrasound Q 2007; 23:255-268.

4. Nightingale KR, Bentley R, Trahey G. Observations of tissue response to acoustic radiation force: opportunities for imaging. Ultrason Imaging 2002a;24(3):129-138.

5. McAleavey SA, Menon M, Orszulak J. Shear-modulus estimation by application of spatially-modulated impulsive acoustic radiation force. Ultrason imaging 2007;29(2):87-104.

6. Fahey BJ, Nelson RC, Bradway DP, Hsu SJ, Dumont DM, Trahey GE. In vivo visualization of abdominal malignancies with acoustic radiation force elastography. Phys Med Biol 2008;53(1):279-293.

7. Nightingale K, Palmeri M, Trahey G. Analysis of contrast in images generated with transient acoustic radiation force. Ultrasound Med Biol 2006;32(1):61-72.

8. Talwalkar JA, Kurtz DM. Ultrasound-based transient elastography for the detection of hepatic fibrosis: systematic review and meta-analysis. Clin Gastroenterol Hepatol 2007; 5:1214-1220.

9. Hsu SJ, Bouchard RR . In vivo assessment of myocardial stiffness with acoustic radiation force impulse imaging. Ultrasound Med Biol 2007; 33:1706-1719.

10. Dumont D, Behler RH. ARFI imaging for noninvasive material characterization of atherosclerosis. Ultrasound Med Biol 2006; 32:1703-1711.

11. Rubin JM, Aglyamov SR. Clinical application of sonographic elasticity imaging for aging of deep venous thrombosis: preliminary findings. J Ultrasound Med 2003; 22:443-448.

12. Lyshchik A, Higashi T . Cervical lymph node metastases: diagnosis at sonoelastography--initial experience. Radiology 2007; 243:258-267.

13. Pallwein L, Mitterberger M. Sonoelastography of the prostate: Comparison with systematic biopsy findings in 492 patients. Eur J Radiol 2007.

14. Lyshchik A, Higashi T . Thyroid gland tumor diagnosis at US elastography. Radiology 2005; 237:202-211.

15. Lewin M, Hoeffel C . Imaging of incidental cystic lesions of the pancreas. J Radiol 2008;89:197-207.

16. Gabata T, Terayama N . Solid serous cystadenoma of the pancreas: MR imaging with pathologic correlation. Abdom Imaging 2005;30:605-609.

17. Demos TC, Posniak HV, et al. Cystic lesions of the pancreas. AJR Am J Roentgenol 2002;179:1375-1388.

18. Casadei R, D'Ambra M, Pezzilli R, Ricci C, Calculli L, Lega S, Antonacci N, Monari F, Minni F. Solid serous microcystic tumor of the pancreas. JOP 2008; 9(4):538-40.

19. Nightingale KR, Palmieri ML. On the feasibility of remote palpation using acoustic radiation force. J Acoustic Soc Am 2001;110:625-634.