Original Article

Ultrasonography Detection of Liver Lesions: A Pilot Comparison Study between Radiologists and Sonographers

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Background: Liver ultrasonography in chronic hepatitis-B patients can help detect liver cancer lesions in initial stage, leading to early diagnosis and opportunity for cure for patients. In Thailand, ultrasonography examinations are mostly performed by radiologists. Limited numbers of cases can thus be performed in the rural areas due to the shortage of radiologists to perform this examination.

Objective: To compare the detection rate of liver lesions by ultrasonography between radiologists and sonographers.

Materials and Methods: This research was a pilot study of 30 chronic hepatitis-B patients who were recruited into the liver cancer screening project and underwent abdominal computed tomography [CT] or magnetic resonance imaging [MRI]. The ultrasonography results from radiologists and sonographers were compared to results from CT or MRI.

Results: The result of liver lesion detection by radiologists and radiographers was 26 (81.25%) and 29 (91%) from 32 lesions, respectively. There are 7 lesions mismatched with CT/MRI due to limitation of lesion detection by ultrasonography. The rate of liver lesion detection by ultrasonography was over 80% in both radiologists and sonographers.

Conclusion: Radiologists and sonographers could comparably detect liver lesions. Trained radiographers can help radiologists perform liver cancer screening by ultrasonography, particularly in areas facing with radiologist shortage.

Keywords: Ultrasound, Radiologist, Sonographer, Computed tomography, Magnetic resonance imaging

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In 2015, World Health Organization [WHO] estimated 257 million people were living with hepatitis B virus infection[1] that attacks the liver and causes acute and chronic liver diseases. Chronic hepatitis B is the most common cause of hepatocellular carcinoma [HCC][2,3] which is one type of the liver cancers, a cause of death in 78,000 people per year[4]. The lethal rate from liver cancer is accounted for 20 to 25 percent in every year[5]. It has been recognized that diagnostic radiology department is a front-line of diagnosis in particular liver cancer in patient who has hepatitis-B virus infection [HBV] by using across modalities in department including ultrasonography [US], computed tomography [CT], and magnetic resonance imaging [MRI]. Nicrolas T[6] reported that MRI is superior to US and CT scan in liver imaging in terms of tissue contrast and characterization. Although US is a modality of choice for liver cancer screening, it still has some limitations in diagnosis such as patient size, experience

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of operators, location of lesions, and image artifacts. As a result of these limitations, patients who were detected to have lesions in the liver by US were frequently sent to further investigate the lesions by CT or MRI.

Thailand is one of the countries severely affected by the morbidity and mortality of liver cancer[7]. The Royal Charity Project on hepatocellular carcinoma screening and surveillance in Thai patients with chronic hepatitis B infection was thus established to help improve the quality of life of Thai people. US was chosen as a medical imaging tool for liver cancer screening in this project. Consequently, the number of patients who were waiting for this examination dramatically increased and work load of radiologists in our department had also inclined at the same time. To overcome this critical situation, sonographers were assigned to join the project and helped radiologists perform US of the liver. Patients who were found to have liver lesions by US were sent to CT or MRI unit for further investigation and diagnosis. This study was a pilot project to compare the capability of radiographers to radiologists in liver lesion detection by US. The result of this study would be a challenging topic for Thai public health policy in terms of how to manage manpower for liver cancer screening in Thailand.

Materials and Methods

Subject

Thirty cases of patients attending the liver cancer screening project who were screened by US and CT/MRI were randomly selected in prospectively controlled study approved by the Chulabhorn Research Institute Ethical committee for Human Research (EC No. 006/2559). All subjects underwent ultrasonography examination of the liver by both of over 5-year experienced Radiologists and Sonographers receiving certificate in US from The International Accreditation Board for Special Radiological Technologist [IABSRT] organized by The Society of Thai Radiological Technologist [TSRT]. Radiologists and sonographers were blinded to CT/MRI reports or subject's history. The ultrasonography data of liver examinations were collected and recorded in an electronic case record form [e-CRF].

Imaging techniques

Ultrasonography [US]

Multiple transverse and longitudinal grayscale images of the abdomen were acquired using commercially available equipment (Aplio 500, Japan) with a 1 to 6 MHz vector transducer. Patients were scanned in the supine and left lateral decubitus position, utilizing subcostal and intercostal approaches. Sonograms were performed under fasting conditions. The time-gain compensation was set to adjust the tissue echogenicity as constant as possible regardless of depth.

Computed tomography [CT]

CT upper abdomen was performed with multi-phase technique (arterial, venous and equilibrium phases) through the upper abdomen using helical 64-slice CT scanner (Somatom, Erlangen, Germany). Contrast bolus monitoring was employed in arterial phase. The venous and equilibrium phases were fixed delay timing at 90 seconds and 5 minutes after contrast media administration, respectively.

Magnetic resonance imaging [MRI]

Liver imaging was performed by using multi-phase technique (arterial, portal venous, and delayed phases) with torso coil at 3 Tesla MR System (Magnetom Trio, Erlangen, Germany). The scanning protocol included acquisitions of volumetric interpolated breath hold examination [VIBE] pulse sequence with single breath hold. The following parameters were employed in the scanning; 9 degrees of flip angle, 3 mm of slice thickness, no gap, 320 to 370 mm of field of view [FOV], 3.59 msec of time of repetition [TR], 1.33 msec of time of echo, 72 to 80 slices of slice number, and single average or number of excitation [NEX]. Gadobenatedimeglumine was used as a contrast media agent for enhancement phases using 15 ml, 3 ml/sec of flow rate.

Statistical analysis

The number of liver lesions presented in percentage of lesion detection on ultrasound images detected by radiologists and sonographers was analyzed using quantitative and descriptive statistical analysis in the present study. The capability of lesion detection between radiologists and sonographers was compared by using agreement, 95% confidence interval and percentage of concordance.

Results

The result shows the number of lesion detection on US compared with CT/MRI examinations between radiologists and sonographers in Table 1. Radiologists and sonographers detected 26 lesions (81.25%, 95% CI: 64.69 to 91.11%) and 29 lesions

Table 1. Liver lesions detected between radiologists and sonographers comparing with CT/MRI

Medical professions	Number of hepatic lesions in		Agreement US (%)	95% CI for agreement US (%)
	Ultrasound	CT/MRI		
Radiologist	26	32	81.25	64.69 to 91.11
Sonographer	29	32	91.00	75.78 to 96.76

Table 2. Lesion number concordance between radiologists and sonographers

	Radiologists	
	Yes	No
Sonographers		
Yes	13*	2
No	3	14*

* Concordance is 84.37% (95% CI: 68 to 93%)

(91.00%, 95% CI: 75 to 96%) from 32 lesions in total, respectively.

According to Table 2, there were 27 lesions which were detected by both radiologists and sonographers, accounted for 84.37% (95% CI: 68 to 93%) of agreement by US. However, this study found that there were 7 lesions mismatched with CT/MRI. First 2 lesions were not found in CT/MRI, but it was detected in US. On the other hand, remaining 5 lesions showed positive results in CT/MRI, but it was negative by US as shown in Table 3. Lesion size ranged from 1.1 to 2.0 cm and some lesions were found in the sub-capsular region of the liver.

Discussion

The liver lesions detected by radiologists and sonographers matched with CT/MRI at a rate of 81.25% and 91%, respectively. The 7 mismatched lesions might occur from artifacts such as reverberation and patient motion artifacts, locations, or patient diseases. This limitation affects to lesion detection in US that conforms Charoenrat et al[8] who reported the sensitivity of liver lesion detection by US of 85.7%. Moreover, Khan et al[9] reported that the accuracy of transabdominal US was 84% in their study. Radiologist and sonographer findings were in agreement by 27 matched lesions from a total of 32 lesions (84.37%). This study conforms to the study of Dawkins et al[10] that there was no statistically significant difference between radiologists and sonographers. However, they also concluded that the limitation of US not only depended on the patients, but also depended on experience in practice of operators[11]. Two lesions were found in US examination, but not found in CT or MRI, because both lesions were likely pseudo-lesions such as fat sparing or fat deposit which was supported by Schneider et al[12]. On the other hand, there was an isoechoic lesion which was not detected by both professions because an isoechoic lesion is difficult to detect by US and no doubt the sensitivity of liver lesions detection in US is lower than CT and MRI. Although the number of lesion detection by sonographers is slightly higher than radiologist, the sample size in this research is still too small to conclude that sonographers are able to detect lesions on US better than radiologists. Besides the number of patients, limitations of lesion detection on US such as fatty liver and obese patient should be also considered because these limitations might affect the capability of lesion detection of operators[13,14].

Conclusion

The study revealed that trained sonographers are as capable of liver lesion detection as radiologists. Sonographers should be considered as an alternative profession to help radiologist perform abdominal US examination in Thailand, particularly for chronic hepatitis-B patients residing in the areas encountering radiologist shortage problem.

What is already known on this topic?

The role of radiographer, development of sonographer profession, the occupational syndrome in sonographer, continuing education of sonographer, and capability of sonographer in lesion interpretation were previously reported[15-17]. Although the accuracy of sonographers compared with advanced radiologists in liver lesion detection was studied by other investigator[18], their studies did not compare focal lesions detected in US with CT and MRI. According to Noone et al, US has the lowest capability of lesion detection (54%) and characterization (52%) compared

Table 3. Locations, sizes and echogenicities of liver lesions from ultrasound detection by radiologists and sonographers mismatched with CT/MRI in 7 lesions

Lesions	Hepatic lesion properties			
	Segment	Max. diameter size (cm)	Echogenicity in Ultrasound	Remark
1	S8	1.1	Hypoechoic nodule	-
2	S7	1.3	Hyperechoic nodule	-
3	S5	2.0	Isoechoic nodule	Surrounding with digestive tract
4	S3	1.3	-	Subcapsular regionin CT/MRI
5	S7	1.2	-	Subcapsular region in CT/MRI
6	S6	1.5	-	Subcapsular regionin CT/MRI
7	S6	1.5	-	Subcapsular regionin CT/MRI

with CT and MRI[19].

What this study adds?

In Thailand, the research topic concerning to capability of sonographers has never been studied because most of US examinations are performed by radiologists. Sonographer profession, particularly body imaging, has recently been included in the radiological technology profession and license. Sonographer is counted as a part of radiological technologist's function. This research is the first study on Thai sonographers role and their capability of liver lesion detection. The result from this work should be useful information to support sonographer school establishment in Thailand to help produce and train radiographers to promote public health in Thailand, especially in the endemic areas encountering radiologist shortage problem.

Potential conflicts of interest

The authors declare no conflict of interest.

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