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【 ORIGINAL ARTICLE 】

Survey on Awareness and Implementation Rate of Ultrasound Elastography and Attenuation Imaging

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Abstract:

Objective Recent developments in ultrasound elastography (UE) and ultrasound attenuation imaging (UA) have enabled the detection of advanced liver fibrosis and steatosis in patients with steatotic liver disease (SLD), which is prevalent worldwide. In patients with SLD, the presence of advanced liver fibrosis determines the risk of hepatocarcinogenesis, and UE and UA are expected to play important roles in liver cancer surveillance. We conducted a questionnaire survey among medical facilities in Saga Prefecture regarding the actual status of awareness and implementation of UE and UA.

Methods A 16-item questionnaire was sent to 275 facilities that employed members of the Liver Cancer Control Medical Association in Saga Prefecture. The response rate was 56% (153 facilities), and data from 142 facilities were analyzed after excluding 11 facilities.

Results The most common facilities were outpatient clinics (60%) followed by hospitals with ≥100 beds (14%). In 48% of the facilities, an average of 10-49 abdominal ultrasound examinations were performed monthly. The rates of recognition that UE and UA are useful for fibrosis and steatosis were 65% (92/142) and 41% (58/142), respectively. The actual availability of UE and UA in facilities with ultrasound machines was 21% (30/142) and 12% (17/142), respectively; UE and UA were used in 90% (27/30) and 88% (15/17) of these facilities, respectively.

Conclusion Even among medical facilities in Saga Prefecture that are active in liver cancer surveillance, awareness of UE and UA is not high. The availability of UE and UA may be inadequate, considering the high prevalence of SLD.

Key words: liver cancer, liver fibrosis, liver steatosis, ultrasonography

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Introduction

The evaluation of liver fibrosis and steatosis is important for diagnosing liver disease, determining treatment indications, assessing carcinogenesis risk, and predicting prognosis (1, 2). A liver biopsy is the gold standard technique for evaluating liver fibrosis and steatosis; however, it has several limitations in terms of invasiveness and other factors (3, 4).

Ultrasound elastography (UE) for the assessment of liver fibrosis and ultrasound attenuation imaging (UA) for the assessment of steatosis are gaining popularity as alternatives to a liver biopsy. These noninvasive and inexpensive methods for detecting advanced fibrosis, which is associated with high risks of carcinogenesis and steatotic liver disease (SLD) and is increasing in frequency globally (5), are expected to play an important role in liver cancer surveillance. However, the actual availability of UE and UA in real-world settings has not been investigated.

In Japan, the crude mortality rate for liver cancer is particularly high in Saga Prefecture, which is now taking measures to reduce the mortality of liver cancer. Awareness of the risks of chronic liver disease and liver cancer, as well as the importance of examinations, including blood tests and ultrasound, have been promoted by the prefectural government.

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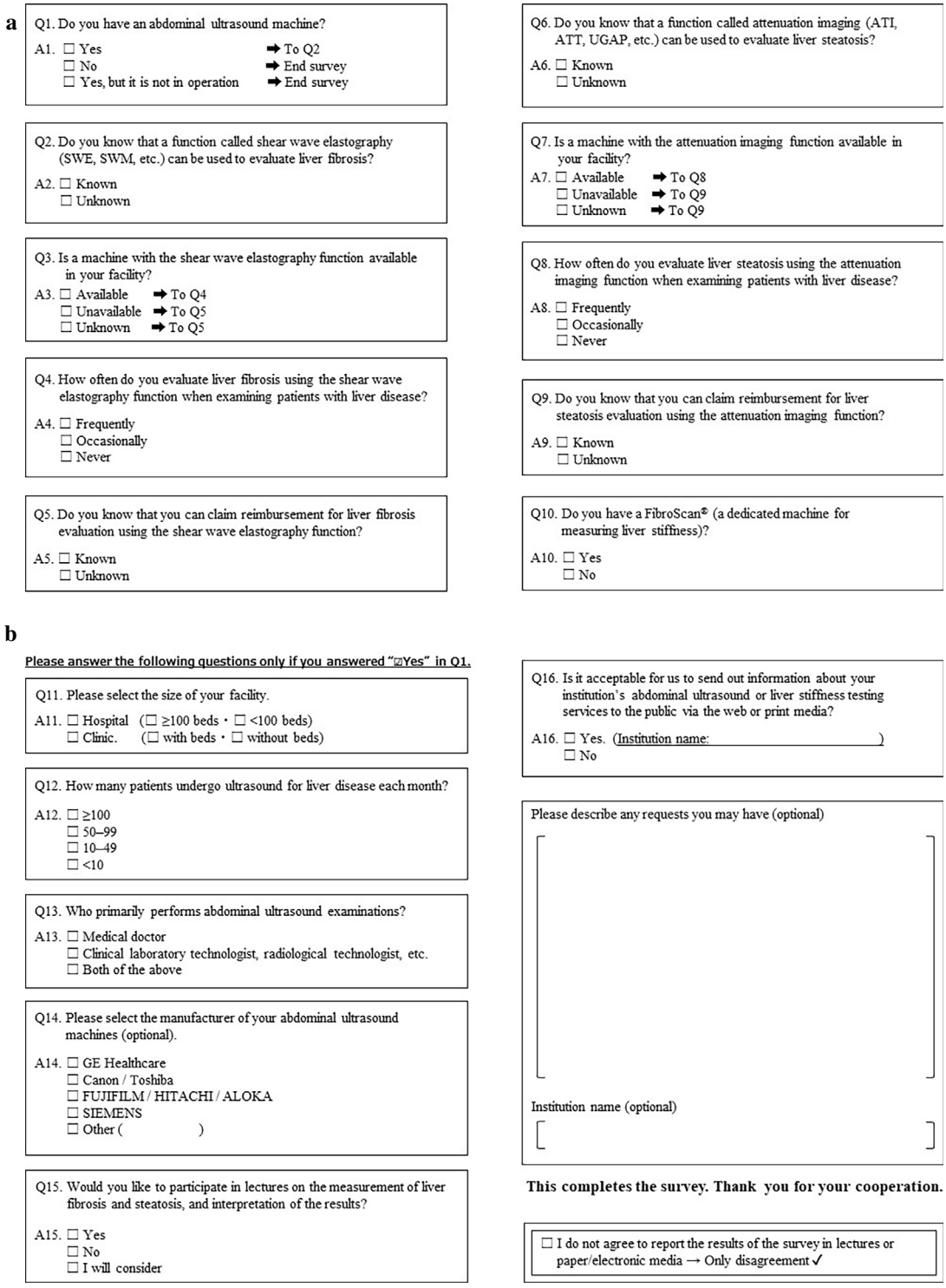

Figure 1. **Sixteen-question survey on ultrasound elastography and attenuation.**

We performed a questionnaire survey of medical facilities that own ultrasound machines in Saga Prefecture to clarify the actual status of abdominal ultrasonography, including UE and UA.

Materials and Methods

Of the 788 medical facilities in Saga Prefecture (as of March 31, 2023), 275 facilities employing members of the Liver Cancer Control Medical Association in Saga Prefecture were mailed a questionnaire comprising 16 questions (Fig. 1a, b), and the responses were collected by mail. The requirement for membership in the Liver Cancer Control Medical Association is attendance at two lectures on chronic liver disease and liver cancer every year.

Responses to the questionnaire were obtained from 153 facilities (56%) between January 18 and March 31, 2023. Data from 142 facilities that owned ultrasound machines were analyzed after excluding 11 facilities (5 facilities that did not consent to the analysis of the questionnaire results, 3

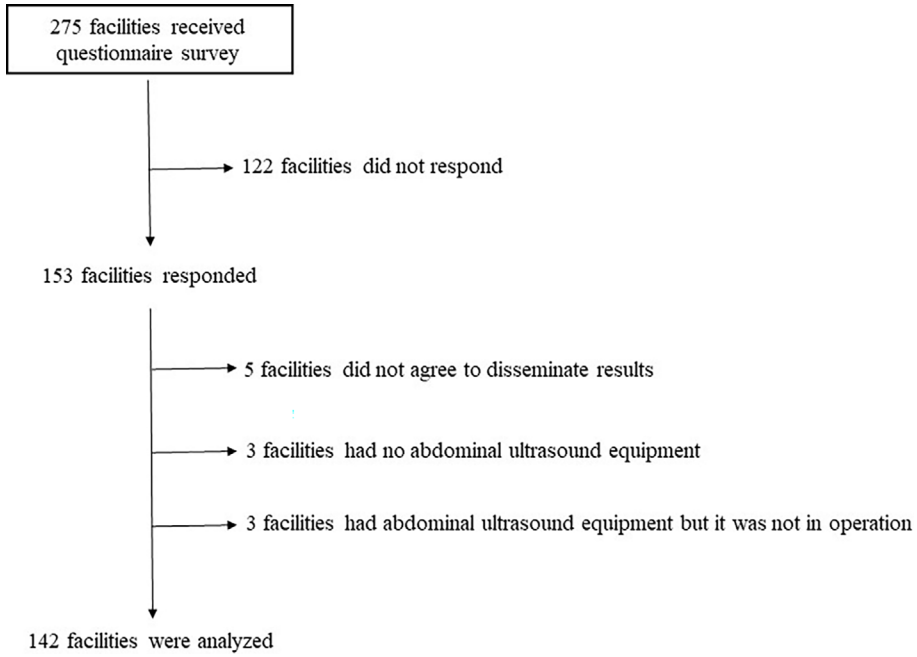

Figure 2. **Flowchart of 142 analyzed facilities.**

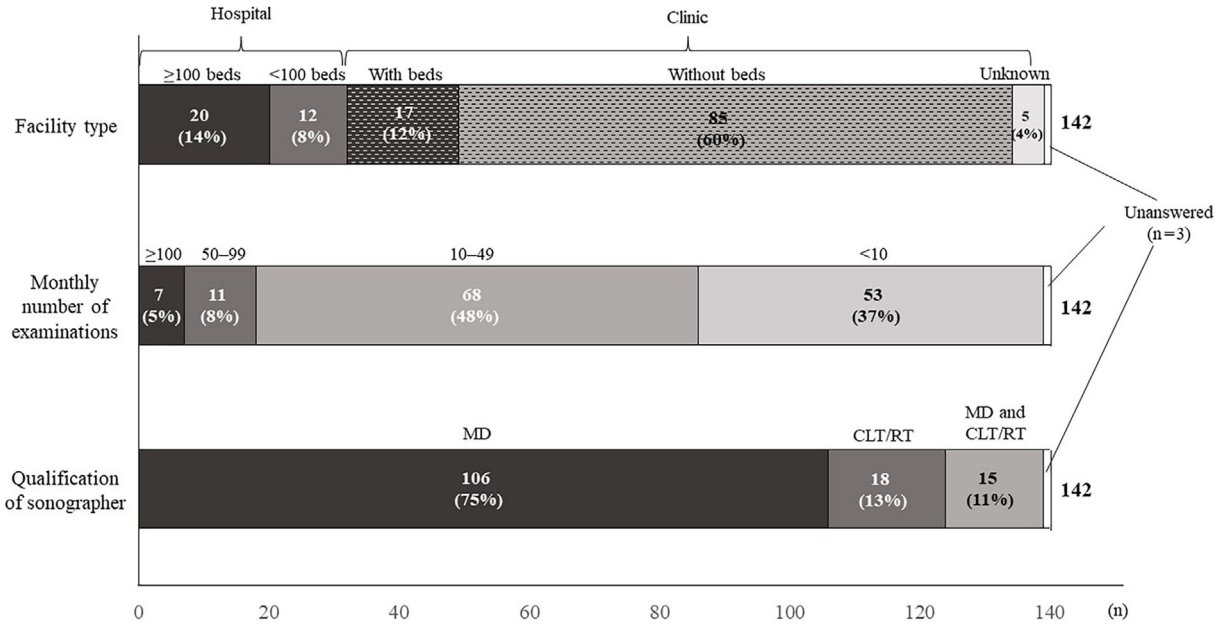

Figure 3. **Distributions of facility types, monthly number of examinations, and qualifications of sonographers. MD: medical doctor, CLT: clinical laboratory technician, RT: radiological technologist**

facilities that did not own an abdominal ultrasound machine, and 3 facilities that owned an abdominal ultrasound machine but did not operate it) (Fig. 2).

Statistical analyses were performed using the JMP software program, ver. 16.1.0 (SAS Institute Japan, Tokyo, Japan). The chi-square test was used for comparisons between the groups, and $p<0.001$ was considered statistically significant.

Results

The type of each of the 142 facilities, number of abdominal ultrasound examinations performed per month, and examiners' qualifications are shown in Fig. 3. Most of the facilities were clinics without inpatient care capabilities [85 (60%)], followed by hospitals with ≥100 beds [20 (14%)], clinics with inpatient care capabilities [17 (12%)], and hospitals with <100 beds [12 (8%)]. The number of monthly examinations was 10-49 at 68 (48%) facilities, <10 at 53

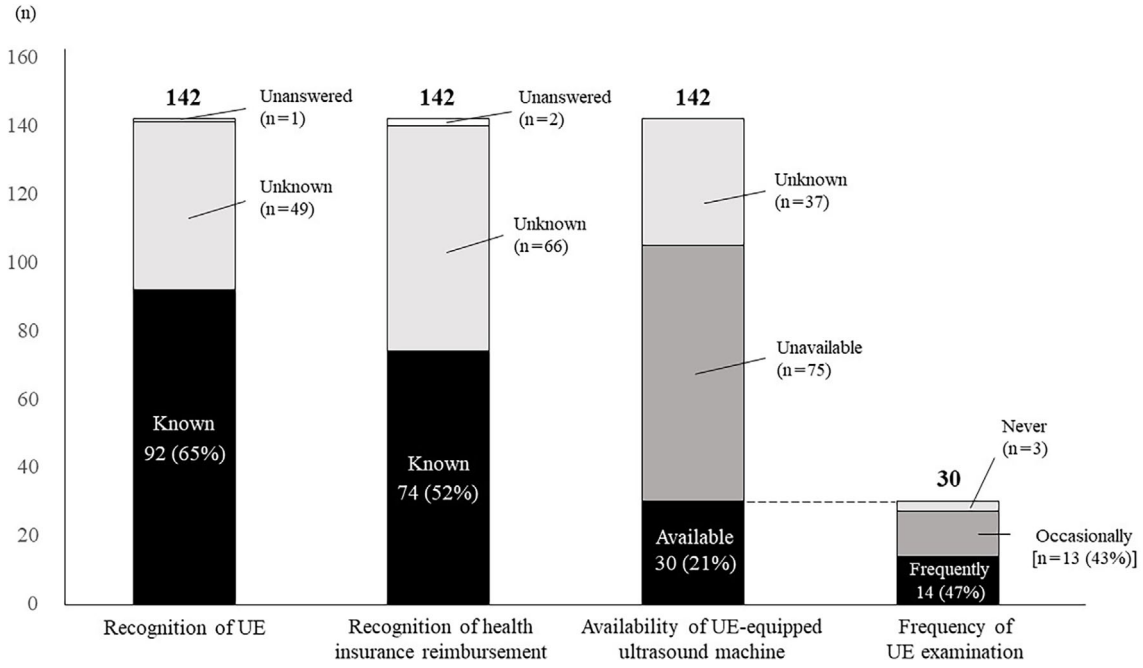

Figure 4. Distribution of recognition of UE, recognition of health insurance reimbursement, availability of UE-equipped ultrasound machine, and frequency of UE examinations. UE: ultrasound elastography

(37%) facilities, 50-99 at 11 (8%) facilities, and ≥100 at 7 (5%) facilities. Ultrasound examinations were performed by physicians [medical doctors (MDs)] in 75% of the facilities and by technicians (clinical laboratory technicians or radiologic technicians) in 13% of the facilities. Canon Medical Systems (formerly known as Canon Medical Systems) was the most common ultrasound system manufacturer (56 facilities), followed by Fujifilm Medical Corporation (formerly known as Fujifilm Healthcare, Hitachi Medical Corporation, and Hitachi-Aloka Medical) (41 facilities), GE Healthcare (27 facilities), Fukuda Denshi (10 facilities), and Philips Healthcare (7 facilities). Five facilities owned a FibroScan® machine (Echosens, Paris, France) (duplicate responses were possible).

The results of the questionnaire regarding the UE are shown in Fig. 4. Ninety-two (65%) facilities knew that UE could be used to evaluate liver fibrosis, and 74 (52%) knew that reimbursement for UE was covered by Japanese universal medical insurance. Among the facilities that recognized the purpose of the UE, the recognition rate of insurance coverage was 80% (74/92). Thirty (21%) facilities owned UE-equipped ultrasound machines, 75 (53%) facilities had no UE capabilities, and 37 (26%) facilities responded "unknown" for this item. Of the 30 facilities with UE-equipped machines, 14 (47%) frequently evaluated liver fibrosis with UE, and 13 (43%) occasionally evaluated liver fibrosis with UE, indicating that 27 (90%) facilities used UE for clinical practice, and 3 (10%) never used UE. Among the facilities with ultrasound, the actual occupancy rate of UE was 19% (27/142).

The results of the UA questionnaire are shown in Fig. 5. Fifty-eight (41%) facilities knew that UA could be used to evaluate liver steatosis, and 45 (32%) facilities knew that reimbursement for UA was covered by Japanese universal medical insurance. Among the facilities that recognized the purpose of UA, the insurance coverage recognition rate was 78% (45/58). Seventeen (12%) facilities owned UA-equipped ultrasound machines, 82 (58%) had no UA capabilities, and 42 (30%) facilities answered this item "unknown." Of the 17 facilities with UA-equipped machines, 9 (53%) frequently evaluated liver steatosis with UA, and 6 (35%) occasionally evaluated liver steatosis with UA, indicating that 15 (88%) facilities used UA for clinical practice and that 2 (12%) facilities never used UA. Among facilities with ultrasound, the actual implementation rate of UA was 11% (15/142).

The questionnaire responses are summarized according to the availability of UE and UA (Table). Sixteen facilities owned both UE- and UA-equipped machines, 14 had only UE-equipped machines, 1 had only UA-equipped machines, and 111 had neither UE nor UA capabilities. Compared with the facilities with neither UE nor UA (n=111), the facilities with UE and/or UA (n=31) recognized the purpose of UE and UA and were aware of the insurance coverage ($p<0.001$). Facilities with UE and/or UA were larger and performed more ultrasound examinations than those with neither UE nor UA ($p<0.001$). Most sonographers were MDs, regardless of the availability of UE and UA, but clinical laboratory technicians and radiologic technicians were more frequently responsible for ultrasound examinations in facilities with UE and/or UA than in those with neither UE nor UA ($p=0.003$).

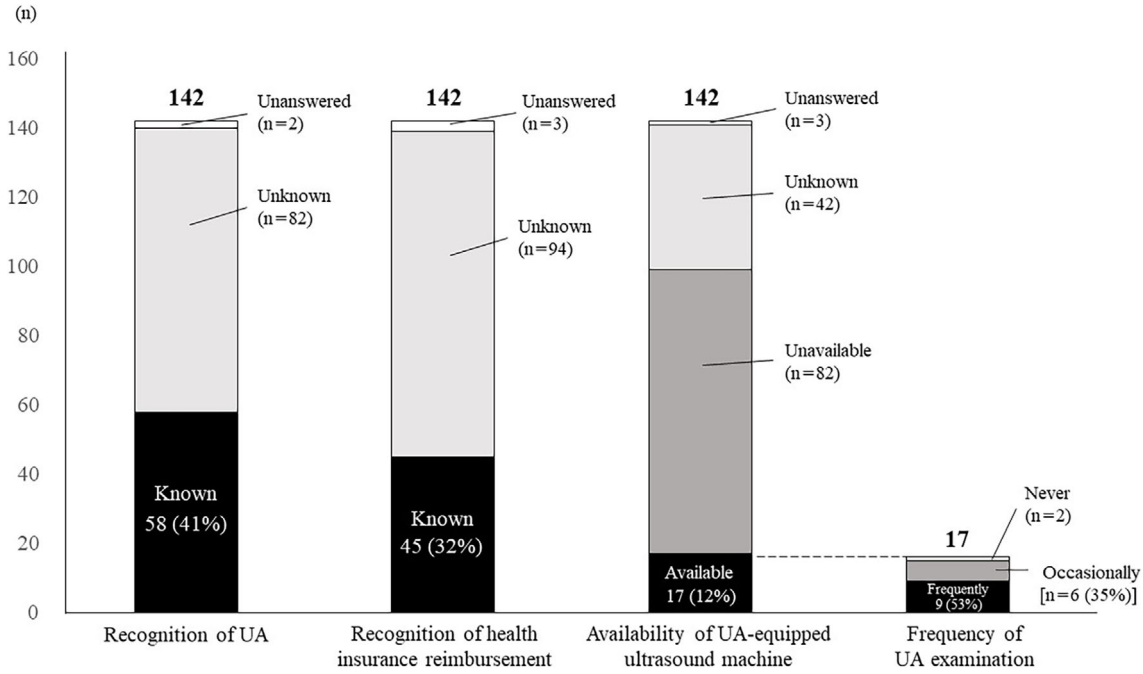

Figure 5. **Distribution of recognition of UA, recognition of health insurance reimbursement, availability of UA-equipped ultrasound machine, and frequency of UA examinations. UA: ultrasound attenuation imaging**

Table. **Summary of Questionnaire Responses Stratified by Availability of UE and UA.**

Parameter	UE and/or UA available (n=31)	UE and/or UA unavailable (n=111)	p value
Use of UE and UA to assess liver fibrosis and steatosis			<0.001
Known	31 (100)	63 (57)	
Unknown	0 (0)	48 (43)	
Coverage of UE and UA by health insurance			<0.001
Known	28 (90)	48 (43)	
Unknown	3 (10)	63 (57)	
Category of facility			<0.001
Hospital with ≥100 beds	10 (32)	10 (9)	
Hospital with <100 beds	5 (16)	7 (6)	
Clinic	16 (52)	91 (82)	
Unanswered	0 (0)	3 (3)	
Number of examinations per month			<0.001
≥100	7 (23)	0 (0)	
50-99	3 (10)	8 (7)	
10-49	16 (52)	52 (47)	
<10	5 (16)	48 (43)	
Unanswered	0 (0)	3 (3)	
Sonographer			0.003
MD	17 (55)	89 (80)	
CLT/RT	9 (29)	9 (8)	
MD and CLT/RT	5 (16)	10 (9)	
Unanswered	0 (0)	3 (3)	

Data are presented as n (%).

UE: ultrasound elastography, UA: ultrasound attenuation, MD: medical doctor, CLT: clinical laboratory technician, RT: radiological technologist

Discussion

This questionnaire-based analysis of the medical facilities with ultrasound machines in Saga Prefecture showed that the recognition rate of the purpose and insurance coverage of UE were 65% and 52%, respectively (Fig. 4), and those of UA were 41% and 32%, respectively (Fig. 5). The availability of UE- or UA-equipped machines was 21% and 12%, respectively. Among the facilities that recognized the purpose of UE or UA, the recognition rate of insurance coverage was relatively high, at 80% and 78%, respectively. Among facilities that owned UE- or UA-equipped machines, 90% and 88%, respectively, used UE or UA in daily practice. Because no reports have addressed the awareness of UE and UA or the availability of ultrasound machines for UE and UA, it is difficult to compare our findings with those in other regions and determine sufficiency or insufficiency. However, considering the prevalence of chronic liver disease, especially SLD (6), awareness of UE and UA and the implementation rate of machines in Saga Prefecture might be insufficient.

Fibrosis is a prognostic factor in all chronic liver diseases (7, 8). Furthermore, the proportion of liver cancers derived from non-viral chronic liver diseases, such as SLD, has increased in recent years (9). Therefore, a noninvasive evaluation of fibrosis and steatosis is required for the management of chronic liver disease. Guidelines from various academic societies have highlighted the usefulness of noninvasive testing. The NAFLD/NASH Practice Guidelines 2020 (10, 11) established by the Japanese Society of Gastroenterology and the Japanese Society of Hepatology mention the usefulness of UE in evaluating liver fibrosis progression and recommend the performance of UE. Furthermore, according to the Ultrasound Diagnostic Criteria for Fatty Liver (12) established by the Japanese Society of Ultrasonics in Medicine, conventional B-mode ultrasound alone has limitations in evaluating steatosis of 5-20%, let alone the 5% threshold defining SLD, so the usefulness of UA is discussed according to these criteria.

Considering that the present survey targeted medical facilities involved in regional liver cancer surveillance, the awareness of both UE and UA is insufficient. Furthermore, awareness of UA was lower than that of UE, and awareness of insurance coverage was lacking. These findings might be attributed to the fact that fibrosis, as a prognostic factor for chronic liver disease, has garnered more attention from medical providers than steatosis has. Insurance approval generally promotes awareness within medical practice, and a UA evaluation for steatosis was approved in April 2022. Thus, the timing of our survey might have been too short for this approval to be widely recognized. In addition, because UA using only FibroScan® was covered by the Japanese universal medical insurance at the time of the survey, respondents who were unaware of the utility of FibroScan® might have answered "unknown" to Q6 (Fig. 1a), resulting in a low level of awareness of UA. Notably, the attenuation measurement technology (iATT) provided by Fujifilm Healthcare was covered by Japanese universal medical insurance in 2024.

The availability of both UE- and UA-equipped machines was low in the present study. Furthermore, UA availability was lower than that of UE. One reason for this may be that UA-equipped machines were sold later than UE-equipped machines. In Saga Prefecture, MDs are making efforts to promote cooperation between hospitals and clinics in the management of liver disease. Therefore, an MD in a facility without UE and UA might ask a hepatologist, gastroenterologist, or sonographer certified by the Japanese Society of Ultrasonics in Medicine in a facility with UE and UA to perform these examinations. Indeed, according to our results, UE and UA are more widely available in large hospitals than in clinics, because hospitals generally receive referrals from clinics. Regional medical cooperation and patient referral between facilities may affect the implementation rates of UE and UA. Specifically, the provision of information at medical lectures and workshops and the introduction of medical newsletters have increased awareness of UE and UA recognition among healthcare professionals (MDs, clinical laboratory technicians, and radiological technologists) and are expected to stimulate medical collaboration and patient referrals between facilities.

Although the evaluation of fibrosis and steatosis was performed in facilities with UE- and UA-equipped machines in this survey, most of the facilities did not own UE- and UA-equipped machines. However, facilities with UE- and UA-equipped machines had a high level of awareness of UE and UA and knew that reimbursement was covered by Japanese universal medical insurance. Therefore, to improve regional surveillance for the detection of high-risk populations for liver cancer and/or SLD, it is necessary to (1) raise awareness of the importance of fibrosis and steatosis evaluation, (2) publicize the fact that insurance coverage is available, and (3) further approve insurance coverage for UA-equipped machines other than FibroScan® and iATT. Notably, the machine implementation rate was not equal to the regional numbers of UE and UA measurements. Active medical cooperation and patient referral between facilities can complement the insufficient availability of UE and UA.

The present study was limited by selection bias because the survey was limited to Saga Prefecture and targeted medical facilities that employed members of the Saga Prefecture Liver Cancer Control Medical Association. Indeed, the number of reimbursements for UE in Saga Prefecture standardized by age composition was approximately three times higher than the average throughout Japan in 2021 (13), suggesting that UE is more frequently performed in Saga Prefecture than in other regions. Another limitation is that only facilities with an available ultrasound machine were included in the analysis. We excluded six facilities without an abdominal ultrasound machine or an out-of-operation machine. Therefore, the actual availability of UE

and UA among all medical facilities is unknown and may be much lower than that depicted in our results.

Despite these limitations, no previous detailed surveys have focused on the awareness of UE and UA, their regional availability, and their implementation rates. Thus, our findings provide insight into the real-world situation of UE and UA. More effective surveillance of liver cancer will be possible if the implementation rate is increased by educating people about the importance of UE and UA, or if actual measurement is promoted through medical cooperation.

Conclusion

The regional status of UE and UA was surveyed in the medical facilities. The availability of UE and UA is considered insufficient, and the awareness of UE and UA requires improvement.

Informed consent for the analysis and publication was obtained via the questionnaire, and responses were obtained from all centers. This study was based on a survey of the actual status of medical institutions and did not include personal information. Thus, the Ethical Review Committee of Saga University determined that this study did not require an ethics review.

The authors state that they have no Conflict of Interest (COI).

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