

V.N. Najafova

Azerbaijan Medical University, Baku, Azerbaijan

## DIAGNOSTIC SIGNIFICANCE OF VARIOUS RADIOLOGICAL METHODS IN THE DETECTION OF PATHOLOGICAL CHANGES IN THE LIVER AGAINST OF BACKGROUND OF DIABETES MELLITUS

e-mail: vafa.nadjafova@bk.ru

The purpose of the study was to assess the sensitivity and specificity of different radiological methods in the diagnosis of various pathologies of the liver in patients with diabetes. In the 162 patients with diabetes mellitus with foci of metastasis in the liver, the above parameters (sensitivity and specificity) were calculated according to the results obtained by different methods. ultrasound, computed tomography and magnetic resonance imaging for determination of localization of foci in different lobes of liver. At the next stage of study out of 155 patients with liver metastases, 96 people were examined by ultrasound, 43 were examined by computed tomography and 16 patients were examined by magnetic resonance imaging to find out changes in the contours of the liver. Sensitivity, specificity, accuracy, positive predictive value and negative predictive value were studied for each diagnostic methods. According to results, diagnostic value parameters for patients with metastatic foci in the liver examined by ultrasound, were sensitivity=1, specificity=0.9642, accuracy=0.9791, positive predictive value=0.9523 and negative predictive value=1. For magnetic resonance imaging, the parameters of diagnostic value were as following: sensitivity=1, specificity=0.8888, accuracy=0.9375, positive predictive value=0.8750 and negative predictive value=1. For multispiral computed tomography, the parameters of diagnostic value were as following: sensitivity=1, specificity=0.9200, accuracy=0.9534, positive predictive value=0.9 and negative predictive value=1. Thus, in patients with diabetes mellitus and fatty dystrophy with liver metastases and other pathological foci, along with the combination of several radiological methods, their specificity and sensitivity indicators should be taken into account.

**Key words:** diabetes mellitus, liver steatosis, metastasis, magnetic resonance imaging, computed tomography, ultrasound

В.М. Наджафова

## ДІАГНОСТИЧНЕ ЗНАЧЕННЯ РІЗНИХ РАДІОЛОГІЧНИХ МЕТОДІВ ДЛЯ ВИЯВЛЕННЯ ПАТОЛОГІЧНИХ ЗМІН У ПЕЧІНЦІ НА ФОНІ ЦУКРОВОГО ДІАБЕТУ

Метою дослідження було оцінити чутливість та специфічність різних радіологічних методів у діагностиці різних патологій печінки у хворих на цукровий діабет. У 162 хворих на цукровий діабет з осередками метастазування в печінку чутливість та специфічність розраховували за результатами, отриманими різними методами (ультразвукове дослідження, комп'ютерна томографія та магнітно-резонансна томографія). На наступному етапі дослідження 96 осіб зі 155 хворих із метастазами у печінку було обстежено за допомогою ультразвукового дослідження, 43 – за допомогою мультиспіральної комп'ютерної томографії та 16 – за допомогою магнітно-резонансної томографії для виявлення змін контурів печінки. Для кожного методу були вивчені чутливість, специфічність, точність, позитивна прогностична цінність та негативна прогностична цінність. Згідно з результатами, параметри діагностичної цінності для пацієнтів із метастатичними осередками в печінці, обстежених за допомогою ультразвукового дослідження, склали: чутливість = 1, специфічність = 0,9642, точність = 0,9791, позитивна прогностична цінність = 0,9523 та негативна прогностична цінність = 1. Для магнітно-резонансної томографії параметри діагностичної цінності були наступними: чутливість = 1, специфічність = 0,8888, точність = 0,9375, позитивна прогностична цінність = 0,8750 та негативна прогностична цінність = 1. Для мультиспіральної комп'ютерної томографії параметри діагностичної цінності були такими: чутливість = 1, специфічність = 0,9200, точність = 0,9534, позитивна прогностична цінність = 0,9 та негативна прогностична цінність = 1. Таким чином, у хворих на цукровий діабет та жирову дистрофію з метастазами в печінку та іншими патологічними осередками поряд з комбінацією кількох радіологічних методів слід враховувати їхню специфічність та показники чутливості.

**Ключові слова:** цукровий діабет, стеатоз печінки, метастаз, магнітно-резонансна томографія, комп'ютерна томографія, ультразвукове дослідження

Although focal fatty infiltration of the liver has a higher incidence of 25.6 % among young adults, focal fatty dystrophy accounts for 13–77.6 % of patients with hepatic steatosis and affects 20–30 % of the adult population in western countries. [6, 9, 11]. Recent developments provided new tools for diagnosis and monitoring of liver diseases based on ultrasound (US), computed tomography (CT), and magnetic resonance imaging (MRI), as applied for assessing steatosis, fibrosis, and focal lesions [13]. Diagnostic methods such as ultrasound and computed tomography have no diagnostic value in determining focal fatty infiltration and dystrophy in the differentiation of focal benign and malignant liver tumors, therefore it is recommended to use diagnostic methods such as MRI and biopsy [2, 5, 10]. Contrast computed tomography (CCT) is used to further clarify the diagnosis. Nevertheless, during this technique, the radiation is relatively high, and a number of undesirable conditions may arise as a result of the injection of contrast material [13, 15]. As a result of the development of technical capabilities in ultrasonography and contrast agents, the application of the contrast agent ultrasonography (CUS) method has expanded [4, 7].

Fatty change of the liver, often occurring in cancer patients undergoing chemotherapy and presenting with different patterns of deposition and sparing, may further hamper the proper assessment of

these patients by means of US. In particular, geographic fatty liver disease is a frequently encountered variant, sometimes occurring in the right lobe of the liver and related to lipogenic alimentary factors or to an insult to the liver parenchyma, such as cholangitis or chemotherapy [1].

Hepatic metastases are typically well-defined, solid, hypoechoic lesions and hypovascular on Doppler ultrasound, and occasionally present a peripheral halo ("target" or "bull's-eye" appearance). This broad spectrum of appearance makes the distinction between benign and malignant lesions difficult, reducing its specificity [12].

Taking into account all factors above mentioned, it is obvious that revealing diagnostic abilities of various radiological methods in determining liver lesions have high practical value.

**The purpose** of the study was to assess the sensitivity and specificity of different radiological methods in the diagnosis of various pathological changes of the liver in patients with diabetes mellitus.

**Materials and methods.** In the 162 patients with diabetes mellitus with foci of metastasis in the liver, the above parameters (sensitivity and specificity) were calculated according to the results obtained by different methods. US, CT and MRI for determination of localization of foci in different lobes of liver were used. At the next stage of study out of 155 patients with liver metastases, 96 people were examined by ultrasound, 43 were examined by multispiral (multislice) computed tomography (MSCT) and 16 patients were examined by MRI to find out changes in the contours of the liver. During the study, for each method, the number of patients with positive results (P), the number of patients with negative results (N), the number of patients who were true positive for this parameter (TP), the number of patients who were true negative (TN), the number of false positive patients (FP) and the number of false negative patients (FN) for that symptom were determined.

Then, indicators of diagnostic value, such as sensitivity (true positive rate–TPR), specificity (true negative rate–TNR), accuracy (ACC), positive predictive value (PPV) and negative predictive value (NPV) were studied for each diagnostic methods. The obtained numerical data were processed by statistical methods taking into account modern requirements. The statistical processing of the results obtained during the research was carried out with the Statistica 7.0 application computer program.

**Results of the study and their discussion.** Determination of the distribution of metastases and cysts in different lobes of the liver was carried out by MRI, CT and US in patients with fatty foci in liver and without them.

When using MRI in the group in which fatty degeneration was not recorded (n=40), 47.5 % of metastases were localized in the left lobe of the liver, and in the group of patients with grade II fatty degeneration, in which we used the same (n=23), this indicator was determined at the level of 43.5 %.

In the group of patients who were studied by CT and no signs of fatty dystrophy in the liver (n=50), localization of metastatic foci in the left lobe of the liver was observed in 34 % of cases. Despite this, in the group of patients (n=37) with grade II liver steatosis, CT revealed the presence of foci of metastasis in the left lobe of the liver in 29.7 % of patients.

At the stage of ultrasound detection of metastases in the left lobe of the liver in the group of patients without fatty degeneration of the liver (n=35), localization of metastatic foci in the corresponding lobe of the liver was observed in 37.1 % of cases. However, in the group of patients examined by ultrasound, who had stage II fatty liver dystrophy, 44.4 % of patients had metastases in the left lobe of the liver.

When detecting metastatic foci in the right lobe of the liver by the MRI, in the group of patients without hepatic steatosis (n=40), the location of metastatic foci in the corresponding lobes was observed in 30 % of cases. At the same time, in the group of patients diagnosed with steatosis of the degree II (n=23), examined by the MRI method, localization of metastatic foci in the right lobe of the liver was observed in 30.4 % of cases.

Despite the fact that in the group of patients without signs of fatty liver dystrophy (n=50) examined by the CT method, metastatic foci were detected in the right lobe of the liver in 24 % of cases, in the group of patients with fatty liver dystrophy of the degree II (n=37), examined by the CT, in 21.6 % of patients localization of metastatic foci in the right lobe of the liver was determined.

When determining the localization of metastatic foci in patients with grade II liver steatosis by ultrasound, in 25.9 % of cases they were located in the right lobe of the liver. At the same time, in the group of patients without signs of liver steatosis examined by US, this index was equal to 25.7 %.

When detecting metastatic foci in the right lobe of the liver by the MRI method in patients with and without fatty dystrophy, in the group of patients without hepatic steatosis (n=40) and examined by MRI, the location of metastatic foci in the corresponding lobes was observed in 30 % of cases. At the same time, in the group of patients with fatty degeneration of the liver and examined by MRI (n=23), the location of metastatic foci in the corresponding lobe of the liver was 26.1 %.

The results obtained by different radiological methods were presented in Table 1.

**Distribution of patients by localization of metastases in different lobes of the liver during examination by MRI, CT and ultrasound (%)**

Liver lobes with detected metastases	Radiological examination methods					
	MRI		CT		US	
	Foci of metastases	Foci of metastases and fatty degeneration	Foci of metastases	Foci of metastases and fatty degeneration	Foci of metastases	Foci of metastases and fatty degeneration
Left	47.5	43.5	34.0	29.7	37.1	44.4
Right	30.0	30.4	24.0	21.6	25.7	25.9
Caudate	22.5	26.1	20.0	24.3	20.0	14.8
Square	0.0	0.0	22.0	24.3	17.1	14.8

When metastatic foci were detected in the caudate lobe of the liver by CT, in the group of patients (n=37) with grade II steatosis, metastatic foci in the corresponding lobe of the liver were observed in 24.3 % of patients, while in the group of patients without fatty degeneration of the liver, metastatic foci were detected in 20 % of cases.

The observation of caudate lobe of the liver by ultrasound showed that in a group of patients without fatty liver dystrophy, localization of metastatic foci in the corresponding lobe were found in 20 % of cases. However, in the group with the II degree of fatty liver dystrophy (n=27), this indicator was lower and amounted to 14.8 %.

At the next stage of study, out of 155 patients with liver metastases, 96 people were examined by ultrasound, 43 were examined by MSCT and 16 patients were examined by MRI to find out changes in the contours of the liver. On the basis of results obtained, the following indicators were studied: sensitivity (TPR), specificity (TNR), accuracy (ACC), positive predictive value (PPV) and negative predictive value (NPV).

Although 40 patients out of 96 examined by ultrasound had changes in liver size, the remaining 56 did not have these changes, which indicates P=40 and N=56 in the corresponding groups. Of the 56 patients who did not have real changes in the size of their liver, 54 were confirmed by ultrasound that there were no changes in the size of the liver.

Summarizing the obtained results, when identifying the parameters of changes in the size of the liver by ultrasound, the following results were revealed: TP=40, FP=2, FN=0 and TN=54. Based on these values for ultrasound, TPR=1, TNR=0.9642, ACC=0.9791, PPV=0.9523 and NPV=1 were calculated.

In the course of the study, in 43 patients with metastatic foci in the liver examined by MSCT, we found that the liver size of 18 people actually underwent changes deviating from the norm (P=18). Deviations from the measurement intervals in the liver were not recorded in 25 patients of the corresponding group (N=25). As a result of our study of the liver sizes of the patients by the appropriate radiological method, we revealed that 2 patients had no changes in liver size, but were mistakenly registered as positive for the corresponding parameter. The following results were obtained: TP=18, FP=2, FN=0 and TN=23. In patients with metastatic foci in the liver, which we examined by MSCT, also the parameters of diagnostic value were determined: TPR (sensitivity)=1, TNR (specificity)=0.9200, ACC (accuracy)=0.9534, PPV (positive predictive value)=0.9 and NPV (negative predictive value)=1.

In the study of a group of patients with metastatic foci in the liver, examined by MRI, we revealed that the size of the liver really changes in 7 people (P=7). At the same time, accompanied by other methods of examination, it was noticed that the liver sizes of patients with foci of metastasis in the liver of 9 people are within the normal range (N=9). 1 patient who did not have changes in liver size was also "identified" as having changes in size. Taking into account above mentioned, it is recorded that TP=7, FP=1, FN=0 and TN=8. In patients with metastatic foci in the liver examined by MRI, the following parameters of changes in liver size were calculated: TPR (sensitivity)=1, TNR (specificity)=0.8888, ACC (accuracy)= 0.9375, PPV (positive predictive value)= 0.8750 and NPV (negative predictive value)=1.

The results we obtained during the study showed that different radiological methods have various diagnostic value for different parameters, and it should be taken into account depends on purpose of the study.

In some articles the similar statements were described. Thus, Zhang YN, et al indicated that US may be appropriate in some clinical instances as a screening modality to identify the presence of abnormal liver morphology. However, it lacks sufficient specificity and sensitivity to constitute a diagnostic modality for instigating and monitoring therapy. The sensitivity and specificity of ultrasound at detecting moderate to severe steatosis, using histology as reference standard, are 80–89 and 87–90%, respectively. In this article was noted that MRI demonstrated superior diagnostic accuracy compared to other noninvasive

methods for detecting mild steatosis with sensitivity and specificity ranging 77–95 and 81–97 %, respectively [14]. But the authors did not study the diagnostic value of US and MRI for visualising metastatic foci.

In the other study (Bartolotta TV, et al) the role of contrast-enhanced ultrasonography (CEUS) in the detection of liver metastases in cancer patients with geographic liver fatty deposition was assessed. Based on observation of thirty-seven consecutive cancer patients (24 women and 13 men; age, 33 to 80 years; mean, 58.1 years) with geographic liver fatty deposition the authors noted that CEUS improves the detection of liver metastases in cancer patients with geographic liver fatty deposition. As well as in our study, sensitivity, specificity, positive and negative predictive values (PPV and NPV), and accuracy were calculated. According to results was determined that no statistically significant differences were found between CEUS and MRI in the detection of focal liver lesions ( $P=0.480$ ), whereas both of them performed better than baseline US ( $P<0.001$ ) [1]. But there was no information about diagnostic values of other methods in this work.

A study by Kong et al, including 240 patients with liver metastases, showed that diffuse homogeneous hyperenhancement followed by rapid washout was the most common pattern on CEUS (55.4 % and 96.2 %, respectively) [3]. Sahani DV et al, noted that CT shows a specificity of 77.3 % and sensitivity up to 73.5 % for the detection of liver metastases [8]. Although in the both studies diagnostic methods were assessed separately without comparison.

### Conclusions

1. Diagnostic value parameters for patients with metastatic foci in the liver examined by US, were TPR=1, TNR=0.9642, ACC=0.9791, PPV=0.9523 and NPV=1.

2. In patients, examined by MRI, the parameters of diagnostic value were as following: TPR=1, TNR =0.8888, ACC= 0.9375, PPV=0.8750 and NPV=1.

3. In patients, examined by MSCT, the parameters of diagnostic value were as following: TPR=1, TNR=0.9200, ACC =0.9534, PPV=0.9 and NPV=1.

Thus, in patients with diabetes mellitus and fatty dystrophy with liver metastases and other pathological foci, along with the combination of several radiological methods, their specificity and sensitivity indices should be taken into account.

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