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US or CT when it Comes to Monitoring Hepatic Metastases in Patients with Primary GIT and Breast Cancer? Comparative Results of Sensitivity and Specificity of CT and US

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Abstract

Malignant diseases are one of the greatest health challenges at the global level and a major social, public health and economic problem in the 21st century with the three most common types of cancer: lung cancer, breast cancer and colorectal cancer. Radiodiagnostics plays a major role in detecting the primary disease, its stage, the presence or absence of secondary deposits, response to therapy, and monitoring for possible relapses. The current challenge for radiodiagnostic methods is to provide aaccurate, non-invasive method that is highly sensitive and specific and well-tolerated by the patient. We conducted a prospective comparative study over a period of 12 months, which included 82 subjects, patients with metastatic liver disease with primary gastrointestinal tract cancer and breast cancer. Two CT contrast examinations were performed in three phases, as well as four US examinations over a period of 3 months, both examinations within 12 months.The aim of the study was to determine the sensitivity and specificity of ultrasound in relation to all phases of CT taken as the gold standard for detection of hepatic metastases.

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From the results obtained, US showed the highest sensitivity (100%) and specificity (92.31%) in patients with GIT cancer in hyperechoic changes compared to the arterial phase of CT, while in patients with breast cancer, the sensitivity of US is highest in ring changes (85.71%), and the specificity in isoechoic changes (95%). Regarding the venous phase, US did not show sensitivity for the detection of hepatic lesions in patients with cancer originating from the GIT, while in patients with breast cancer it showed maximum sensitivity (100%) in the detection of ring lesions, and maximum specificity for hypoechoic lesions (100%). US was shown to be sensitive compared to late-phase CT in detecting isoechoic changes in patients with breast cancer (83.33%), but insufficiently sensitive for changes in patients with GIT cancer. The specificity of US is maximum for hypoechoic changes in patients with GIT cancer (100%), and isoechoic changes in patients with breast cancer (88.57%).

Keywords: breast cancer; CT; GIT cancer; liver metastases; US.

1. Introduction

Malignant diseases are one of the greatest health challenges at the global level and a major social, public health and economic problem in the 21st century with the three most common types of cancer: lung cancer, breast cancer and colorectal cancer. According to the latest official data from WHO, there are about 20 million newly diagnosed cases worldwide [1]. Hematogenous dissemination of cancer with the appearance of secondary metastatic deposits, and not the primary disease, is responsible for more than 90% of deaths.Breast cancer as a heterogeneous disease in which, in addition to the well-known factors that influence the formation of metastatic deposits, such as: tumor size, histological grade, receptor status, as well as the affinity of the cancer itself to disseminate, it also depends to a large extent on the molecular type of the cancer, firstly described by Perou and his collaborators [2]. Despite the good prognostic signs due to early detection and multidisciplinary treatment in these patients, however, approximately 20-30% of them develop secondary deposits [3].

Colorectal cancer, the third most common cancer worldwide, is the leading cause of death in men under the age of 50. More than half of the diagnosed cases are due to today's modifiable risk factors [4] .Approximately 20–25% of patients diagnosed with colorectal cancer develop hepatic metastases, of which 15–25% are synchronous metastases, i.e. they are discovered when diagnosing the primary tumor [5].

Radiodiagnostics plays a major role in detecting the primary disease, its stage, the presence or absence of secondary deposits, response to therapy, and monitoring for possible relapses. The current challenge for radiodiagnostic methods is to provide aaccurate, non-invasive method that is highly sensitive and specific and well-tolerated by the patient.

Non-invasiveness, cost, non-ionization, good patient acceptance, and global availability make ultrasound the most common first choice for screening patients with malignant diseases and/or suspected hepatic metastases and is widely used for their evaluation. Numerous studies have shown that the sensitivity of ultrasound varies from 50-76%, and depends mostly on the size of the lesion.

Multidetector computed tomography is a relevant imaging method allowing volumetric acquisition with high-quality multiplanar reformatted images and the basis for staging and follow-up of this group of patients as it

provides high-resolution images, with slice thicknesses in millimeters resulting in an isotropic pixel size, which allows images to be reformatted in different planes that will still have the same resolution as the axial slice images. This advantage improves the detection of smaller lesions.

2. Material and Methods

At PHI Clinical Hospital Shtip, Department of Radiology, we conducted a prospective comparative study over a period of 12 months, which included 82 subjects, patients with metastatic liver disease, 41 patients with primary gastrointestinal tract cancer and 41 patients with primary breast cancer.

Patients with metachronous metastases were excluded from the study.

Two CT contrast examinations were performed in three phases – arterial (25sec), portal (60 sec) and late phase (140 sec), as well as four US examinations over a period of 3 months, both examinations within 12 months.

The aim of the study was to determine the sensitivity and specificity of ultrasound in relation to all phases of CT taken as the gold standard for detection of hepatic metastases.

This study had certain limitations in terms of the time frame and the disease stage in the patients. Regarding the time period during which the study was conducted, the period of one year was unfortunately too long for some of the patients. On the other hand, all the patients who were included in the study were in stage IV. Perhaps in a subsequent study the time frame will be longer, and patients in the early stages of the disease will be included, which would provide more complex results in terms of the sensitivity of both methods and in terms of overcoming these limitations.

3. Results

The gender structure of patients with cancer originating from the GIT consisted of 27 (65.85%) male patients and 14 (34.15%) female patients. The patients were mostly aged 70-79 and 60-69 years – 16 (39.02%) and 16 (34.15%), respectively. In the group of primary GIT tumors with hepatic metastases, the most common were: rectal carcinoma – 15 (36.58%) and colon carcinoma – 14 (34.15%), followed by 7 (17.07%) pancreatic carcinomas, 4 (9.76%) gastric carcinomas and 1 (2.44%) of GIST. In terms of the degree of differentiation, moderately differentiated carcinomas dominated – 25 (60.98%).

Patients with primary breast cancer were mostly aged 60-69 years – 18 (43.90%). All of them had pathohistologically proven ductal carcinoma, with localization in the left breast in 21 (51.22%) and in the right breast in 20 (48.78%) female patients. In terms of the degree of differentiation, the carcinomas were more often poorly differentiated - 21 (51.22%)

Table 1 shows the sensitivity and specificity of each of the methods in each of the changes in the arterial, venous and late phase, where CT was taken as the gold standard.

Table 1: Accuracy of US in detecting hepatic lesions in primary GIT and breast cancers

Hepatic lesions in primary GIT and breast cancer	Sensitivity (%)		Specificity(%)	
	GIT	Breast	GIT	breast
isoechoic US (gold standard CT in arterial phase)	73.33	38.1	69.23	95.0
hypoechoic US (gold standard CT in arterial phase)	44.44	69.23	91.3	60.71
hyperechoic US (gold standard CT in arterial phase)	100		92.31	78.05
ring-shaped US (gold standard CT in arterial phase)	57.14	85.71	91.18	85.29
isoechoic US (gold standard CT in venous phase)			53.66	78.05
hypoechoic US (gold standard CT in venous phase)	24.39	52.63		100.0
hyperechoic US (gold standard CT in venous phase)			87.80	78.05
annular US (gold standard CT in venous phase)		100.0	82.93	78.38
isoechoic US (gold standard CT in late phase)	50.0	83.33	53.85	88.57
hypoechoic US (gold standard CT in late phase)	25.64	54.29	100	83.33
hyperechoic US (gold standard CT in late phase)			87.80	78.05
annular US (gold standard CT in late phase)			82.93	73.17

4. Discussion

Breast and gastrointestinal malignancies are a large, heterogeneous group of diseases that show great variation in the clinical presentation, the method and possibility of timely diagnosis, the time of onset of first symptoms, as well as the occurrence of hepatic metastases.

Accurate detection of metastatic disease at the time of diagnosis of the primary disease or during therapeutic treatment remains crucial for the overall management of the disease. Early identification of hepatic metastases expands the options and possibilities for different treatment.

Imaging diagnostics should provide a detailed evaluation of hepatic metastases as well as an assessment of their resectability [6,7].

The ideal diagnostic examination should provide high sensitivity and specificity, non-invasiveness, low cost, and wide availability. No study conducted so far fits this profile. Factors such as availability, technical and clinical expertise, cost, and patient tolerance influence the decision to select a study. The clinical indication has the greatest influence on the choice of imaging method. Oncological goals for the presentation of liver changes include screening for the presence or absence of focal changes, anatomical localization, and evaluation of the interval over which changes occur during chemotherapy.

Computed tomography, which is widely available and well-known, is the mainstay of hepatic imaging. In correlation with ultrasound, this is the basis for most clinical indications.

This is precisely the subject of research of this study, i.e. to optimize the choice of diagnostic method by

minimizing the negative consequences of ionization and overexposure of the patient.

At the very beginning of the research itself, we started from the main working hypothesis that there is a statistically significant difference between ultrasound and computed tomography as separate imaging techniques and differences in their agreement.

Through the numerous studies available in the literature, we have come across different results. Most of the studies have been done in the form of comparative studies between US and CT, where intraoperative US and pathohistological analysis have been taken as the gold standard in most of them.

Comparative studies between computed tomography and ultrasound begin with Suramo and his colleagues, according to which lesions larger than 3 cm are detected by both methods, while for smaller lesions, especially those localized in the right ventrocranial lobe, caudate lobe and intercostal spaces, the ultrasound has not been proven as an appropriate method for diagnosis [8].

A prospective study by Wernecke and his colleagues [9]. conducted in patients with synchronous metastases from tumors of gastrointestinal origin in lesion-lesion analyses proved that 68% of metastases were detected on CT, 53% on US, with 100% sensitivity of both methods for lesions larger than 2 cm. Lesions smaller than 2 cm have a sensitivity of 74% for CT and only 61% for US, while for lesions smaller than 1 cm, CT has a sensitivity of 49% and US of only 20% (7/35 lesions). The combined use of both methods CT and US showed an overall sensitivity of 75%, where, despite the high sensitivity of CT, the importance of US should not be underestimated when it comes to detecting larger lesions. In patient-patient analyses, the superiority of CT comes to a greater expression despite statistically insignificant differences in sensitivity between the two methods.

Bernatic and his colleagues [10] demonstrated that conventional US detected 59% of the total number of lesions seen on post-contrast CT in 28 patients with pathohistologically proven gastrointestinal cancer.

Regarding the role of US-CT fusion imaging compared to US and CT alone, and CT alone for correct staging in patients with hepatic metastases from colorectal cancer, out of 109 lesions, 45 of which were smaller than 1 cm, 64 patients underwent these examinations the day before undergoing resection of the primary tumor, and all of them also underwent intraoperative US. Stang and his colleagues obtained results that CT has the highest sensitivity -80%, (36/45), followed by US-CT fusion imaging 77.8% (35/45) and the least US and CT (64.4% 29/45).

According to the study by Quaia and his colleagues [12], where in the investigation of each patient, US and then CT were performed in the first act, the general sensitivity and specificity of US were shown to be 40%, 63%, and of CT 89%, 89%.

Cantisani and his colleagues [13] in their study, according to the results obtained by two independent readers, proved that the sensitivity of US in patient-patient analyses varies from 67.4-71.6% (of CT 93.4-95.8%) while in lesion-lesion analyses 60.9-64.9% (CT 85.3-92.8%) with a specificity of 50-60%.

The evaluation of the results of our study conducted on patients with hepatic metastases of primary cancer originating from the GIT showed that the sensitivity and specificity of ultrasound in relation to the arterial phase of CT in the detection of isoechoic metastases is 73.33% and 69.23% respectively, it is lower in hypoechoic changes 44.44% and 91.30% respectively, and the highest in hyperechoic changes in relation to the arterial phase of CT where it is 100% and 92.31% respectively. As for annular lesions it was 57.14% and 91.19% respectively.

In relation to the venous phase of CT, ultrasound was not sensitive for the detection of isoechoic changes where it showed a specificity of 53.66%. While it was not specific for hypoechoic changes, but it had a sensitivity of 24.39%. The detection of hyperechoic changes on ultrasound in relation to the venous phase of CT was insensitive and 87.80% specific, and for annular changes, it showed insensitivity and specificity of 82.93%.

The sensitivity and specificity of ultrasound in relation to the late phase of CT for the detection of isoechoic changes in patients with primary carcinoma of the GIT was 50% and 53.85%, for hypoechoic changes 25.64% sensitivity, at a maximum specificity of 100%. For hyperechoic and annular changes, US in relation to the late phase of CT was not sensitive, but had a specificity of 87.80% and 82.93% for annular changes.

For the second group of patients with hepatic metastases originating from breast cancer, the sensitivity and specificity of ultrasound in relation to the arterial phase of CT in detecting isoechoic hepatic changes were 38.10% and 95.0% respectively, higher in hypoechoic changes, 69.23% and 60.71% respectively. US was shown to be insensitive for hyperechoic changes in relation to the arterial phase of CT, where it showed a specificity of 78.05%, while for annular changes it had a high sensitivity of 87.71% and a specificity of 85.29%.

For isoechoic changes, ultrasound in relation to the venous phase of CT was not sensitive, while the specificity was 78.05%. For hypoechoic changes, ultrasound compared to the venous phase of CT of hepatic metastases in patients with breast cancer showed a sensitivity of 52.63% and a specificity of 100%. Ultrasound compared to the venous phase of CT showed absolute insensitivity for the detection of hyperechoic changes, with a specificity of 78.05%, and showed maximum sensitivity in the detection of annular changes and a specificity of 78.38%.

The correlation of ultrasound with late-phase CT in the detection of isoechoic hepatic metastases in patients with breast cancer showed a sensitivity of 83.33% and a specificity of 88.57%, which for hypoechoic changes were 54.29% and 83.33% respectively. For hyperechoic and annular changes, ultrasound was not sensitive compared to late-phase CT, while its specificity was 78.05% and 73.17%, respectively.

5. Conclusion

From the results obtained, US showed the highest sensitivity (100%) and specificity (92.31%) in patients with GIT cancer in hyperechoic changes compared to the arterial phase of CT, while in patients with breast cancer, the sensitivity of US is highest in ring changes (85.71%), and the specificity in isoechoic changes (95%).

Regarding the venous phase, US did not show sensitivity for the detection of hepatic lesions in patients with cancer originating from the GIT, while in patients with breast cancer it showed maximum sensitivity (100%) in the detection of ring lesions, and maximum specificity for hypoechoic lesions (100%). As for the specificity in

the group of patients with cancers originating from the GIT, it was shown to be the highest in detecting hyperechoic changes (87.80%).

US was shown to be sensitive compared to late-phase CT in detecting isoechoic changes in patients with breast cancer (83.33%), but insufficiently sensitive for changes in patients with GIT cancer. The specificity of US is maximum for hypoechoic changes in patients with GIT cancer (100%), and isoechoic changes in patients with breast cancer (88.57%).

6. Conflict of interest

The author declares that she has no conflict of interest.

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