Original Article

Triphasic CT and FDG-PET in Hepatocellular Carcinoma

Comparison between Efficacy of Triphasic CT and FDG-PET in the Follow-Up Evaluation of Hepatocellular Carcinoma

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ABSTRACT

Objective: To analyze the efficacy of FDG PET as compared to triphasic CT in diagnosing the residing or reoccurred tumor lesions of HCC following TACE therapy.

Study Design: A cross-sectional study

Place and Duration of Study: This study was conducted at the department of radiology and oncology department of Nishtar Medical University & Hospital Multan from April 2020 to April 2021 for a period of 01 year.

Materials and Methods: After passing through the inclusion and exclusion criteria, 35 patients diagnosed with hepatocellular carcinoma and undergoing TACE were evaluated for residing or reoccurred tumor lesions through FDG-PET and triphasic-CT. Image analysis for each imaging modality was done by following a standard protocol. Imaging, clinical, and laboratory findings were used as a reference for validating the accuracy of the data. SPSS was used for statistical analysis.

Results: Analysis of reference data demonstrated proved 23 (65.7%) true positive cases. Whereas FDG-PET had shown positivity in 26 (74.2%) and triphasic-CT had positivity in 27 (77.1%) patients. FDG-PET has a sensitivity of 100%, specificity of 65.7%, a positive predictive value of 88.4%, and a negative predictive value of 100%. Whereas, triphasic-CT has a sensitivity of 80.5%, specificity of 65.2%, a positive predictive value of 85.1%, and a negative predictive value of 66.6%.

Conclusion: The study found better accuracy of FDG-PET in detecting residing or reoccurred HCC tumor lesions than triphasic CT.

Key Words: Triphasic-CT, FDG PET, hepatocellular carcinoma, TACE

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INTRODUCTION

Hepatocellular carcinoma (HCC) is one of the most reported primary malignancies of the liver. It is ranks fifth among the most common malignancies and the third most frequent cause of tumor-related death (1). However, the recent decades have witnessed a sudden rise in the incidence of HCC which is majorly related to the increased frequency of disorders that pose a risk of hepatic cirrhosis like alcohol abuse, obesity, and viral hepatitis (2).

Surgical interventions such as liver transplants and hepatic resection are deemed as the most effective treatment strategy.

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However, patients presenting with inoperable HCC are managed through conventional treatment schemes(3). Among these schemes, Transarterial chemoembolization (TACE) is a reliable non-surgical approach that involves the blockage of blood supply to the tumor through injecting chemotherapeutic agents to the tumorous area (4). It is found that around 15-55% partially respond to TACE management and therefore regular assessment of the therapy is compulsory to decide the future treatment plan (5).

In this regard, in recent years, Positron emission tomography (PET) with 18F-2-fluoro-2-deoxyglucose (18F-FDG) has increasingly being utilized for initial staging and assessing the treatment response in multiple malignancies. 18F-FDG PET monitors the glucose metabolic activity of cancers and provides a critical assessment that is usually not provided by conventional imaging technologies (6, 7).

However, 18F-FDG PET has still not completely replaced the Computed tomography (CT) scan in most of the setups in Pakistan. This study, therefore, is designed to analyze the efficacy of FDG PET as compared to triphasic CT in diagnosing the residing or reoccurred tumor lesions of HCC following TACE therapy. The study will help to adopt better imaging modalities for the management of HCC.

MATERIALS AND METHODS

A cross-sectional study was conducted from 30th April 2020 to 30th April 2021 at the department of radiology and oncology department of Nishtar Medical University & Hospital Multan. The Patients aged between 35 to 60 years, having clinically proved HCC and managed by TACE were included in the study. Whereas, the patients who had a history of allergic reactions to contrast material, who had never undergone a locoregional treatment for HCC, or were on treatment protocol other than TACE were excluded from the study. Patients were informed of the study objectives and their consent was sought. The study was approved by the ethical committee of the hospital.

All patients were guided to maintain a low-carbohydrate and a high protein diet for at least 24 hrs. before the scan whereas fasting state was asked to maintain 6 hrs. before the scan. The diabetic patients, however, were allowed to take early breakfast with their anti-diabetic medicine. This was done to achieve recommended glucose levels before the scan. i.e. ≤150 mg/dl. Similarly, physical activity was guided to be kept minimal a day before the study, and water intake was kept high to keep the bladder full before the scan. Patients were kept in a warm environment to avoid fat uptake and beta-blockers were also administered to those where keeping in a particular environment was not adequate. The muscular activity was restricted before the scanning such that patients were not allowed to talk. Lastly, metal objects accompanying patients were removed to avoid their interference in the results. PET and triphasic CT scans were done for all patients to evaluate the occurrence of newly developed focal lesions and assess the management of old ones.

Negative oral contrast was administered to all patients 1 hour before the examination. Then, the radioactive tracer, 18F-FDG, was administered with a dose of .1-.4 mCi/kg. For one hour patients were kept in a dark hot environment and were restricted to talk or take any physical movement. In both examination types, scans were taken from the skull base to the mid-thigh. Both imaging protocols were preceded by low-dose CT without contrast. Afterward, FDG PET [(8)] and contrast-enhanced triphasic CT [(9)] was performed according to recommended protocols. Following the examination, the patients were advised to avoid contact with infants, pregnant women, and high-risk individuals and to drink plenty of water to pass out the tracers.

The image analyses were conducted by two independent consultant radiologists who were kept blinded to study objectives. However, they were informed of the patient's history of TACE management, including management routine and focal lesion characteristics. For analysis of FDG-PET scans, axial, coronal, and sagittal reconstructed images were first visually analyzed. The standard cutoff value was based on uptake by normal hepatic parenchyma which ranged from 2.4 to 4.5 standardized uptake value (SUV). So pathology was attributed to any area with FDG greater than these values. Maximum standardized value (SUVmax) represented FDG uptake quantitatively. Similarly, the CT sagittal, coronal, and axial reconstructed images were first visually analyzed. Then characteristics of focal lesions such as size, site, contrast enhancement, unilobar or bilobar lipiodol retention, and pattern of contrast in three phases. CT scans were also looked for new lesions.

Patients were then followed up clinically, through serum level measurement of Alfa-fetoprotein, and radiologically through various imaging technologies such as MRI, ultrasonography, or PET/CT. This was done to confirm the accuracy of our analyzed techniques.

SPSS (version 18) was used for the statistical analysis of the data. We utilized the follow-up data (imaging, laboratory, and clinical) as a reference for determining the accuracy of CECT as compared to FDG/PET in detecting recurrence or development of any new lesion. In this regard, specificity, sensitivity, negative predictive value, and positive predictive value were calculated.

RESULTS

A total of 35 patients, 30 males (85.7%) and 5 females (14.2%) and aged from 35 to 60 were enrolled in the study. The reference data collected through clinical, laboratory, and imaging analysis demonstrated new focal lesions development or tumor recurrence in 23 patients at TACE-managed HCC. The maximum diameter of an individual HCC lesion was 6.5cm while those residing in multiple forms ranged from 4.1cm to 7.5 cm. All lesions were unipolar.

PET examination showed enhanced pathological uptake of tracer in 26 (74.2%) patients at the TACE bed while 9 (25.7%) patients had no pathological uptake. Whereas, triphasic-CT examination demonstrated typical pathological images of contrast enhancement at the HCC site in 17 (48.5%) patients. The pathological pattern depicted arterial phase wash in and wash out in both delayed and portal phases. 8 (22.8%) patients had atypical contrast enhancement either faint or marginal arterial enhancement presenting with no washout whereas 8 (22.8%) patients had no enhancement at all. Among these 14 patients, 5 were positive for pathological uptake of FDG in PET scans (Table I).

Comparison with the reference data showed PET gave accurate positive results in 23 patients, true negative results in 9 patients, false-positive results in 3 patients while no false-negative result. Whereas, CECT reported accurate positive results in 23 patients, true-negative in 8 patients, false-negative in 4 patients, and false-positive results in 4 patients. Table 2 shows a comparison of reference data with the findings of

CCET and PET for the detection of local residue or recurrence of HCC.

By analyzing the data, we could calculate the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of the two analyzed modalities, CECT, and PET. FDG-PET has a sensitivity of 100%, specificity of 65.7%, PPV of 88.4%, and NPV of 100%. Whereas, triphasic-CT has a sensitivity of 80.5%, specificity of 65.2%, PPV of 85.1%, and NPV of 66.6% (Table 3).

Table No.1: Imaging features of lesions under management

Imaging modality	Managed lesion criteria	Patients count	age (%)
FDG PET	Enhanced tracer uptake	26	74.2%
	No uptake	9	25.7%
Triphasic CT	Contrast enhancement	17	48.5%
	Atypical contrast enhancement	8	22.8%
	No contrast enhancement	8	22.8%

Table No.2: Comparison of findings of PET and CECT with true reference cases

	Positive cases	age (%)	Negative case	age (%)
Accurately diagnosed Reference cases	23	65.7%	12	34.2%
PET	26	74.2%	9	25.7%
CECT	27	77.1%	8	22.8%

Table No.3: Comparison of statistical analysis of PET and CECT hepatic tumorous lesions under TACE management

Imaging modality	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
CECT	80.5%	65.2%	85.1%	66.6%	77.3%
PET	100%	65.7%	88.4%	100%	92%

DISCUSSION

Imaging technology has a critical role in managing HCC, and response to any adopted treatment strategy is mostly assessed and monitored radiologically [10]. Usually, the recommended therapies aim to reduce the tumor vascularization, enhance the necrotic area, and often produce cavities in large tumors [11]. To analyze these changes following any locoregional intervention procedure imaging modalities like dynamic MRI, CECT, and ultrasound are utilized. However, the deposition of lipiodol in patients under TACE management hinders efficient evaluation through imaging [12].

In HCC patients under TACE management, contrast-enhanced triphasic CT examination provides significant details regarding tumor vascularity and its size which may influence the viability or recurrence of the tumor. However, the existence of hyperdense lipiodol and their masking effect of intra-le tumor tissues mainly limits the diagnostic capacity of CT [13]. FDG-PET evaluates glucose metabolism of the cancers that are managed by TACE, the frequent therapeutic strategy in oncology. It also gives the advantage of investigating the entire body so that intra- and extra-hepatic tissue examination can be made which is critical in planning for hepatic transplantation [14]. Several studies have been conducted to evaluate the role of PET in assessing the locoregional treatment of HCC. This study aimed to compare the potency of FDG-PET against triphasic-CT in evaluating the local tumor recurrence and new lesion formation of hepatic tumor following TACE.

The results demonstrated that the triphasic-CT had a specificity of 65.2%, a sensitivity of 80.5%, PPV of 85.1%, an NPV of 66.6%, and accuracy of 77.3%. However, PET had specificity and sensitivity of 65.7% and 100%, respectively. Moreover, PPV and NPV were 88.4% and 100%, respectively. Contrastingly, Jinpeng et al, who studied recurrence of HCC in 29 patients who underwent TACE, reported that sensitivity of CECT was 63.8% and that of PET was 95.4% [11]. Similarly, Song et al, also reported dominance of FDG-PET, performed in conjunction with CT, over CECT in the detection of HCC following TACE [15]. Azab et al evaluated patients undergoing local therapy including TACE and radiofrequency for HCC. The authors reported higher sensitivity and specificity of FDG-PET/CT when compared with contrast CT, regardless of tumor vascularity [16]. Similarly, Wenhui et al proved the diagnostic value of 18F-FDG PET/CT in diagnosing viable HCC. Also, it was concluded that the accuracy of PET is directly related to the grade of the tumor i.e. low-grade tumors are better evaluated.

The study was limited in terms of smaller sample size and lesser study period. Moreover, the study depended upon follow-up data for determining the accuracy of data which might have produce bias in the results. The bias could have been removed by referring to histopathological findings.

CONCLUSION

The study found better accuracy of FDG-PET in detecting residing or reoccurred HCC tumor lesions than triphasic CT.

Author's Contribution:

Concept & Design of Study:	Soban Shahid
Drafting:	Arooma Rasheed
Data Analysis:	Muhammad Wasim Sattar
Revisiting Critically:	Soban Shahid, Arooma Rasheed
Final Approval of version:	Soban Shahid

Conflict of Interest: The study has no conflict of interest to declare by any author.

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