Original Article

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Cooccurrence of Capsular Liver Lesions Along with Peritoneal Carcinomatosis and Hematogenous Metastases in Ovarian Cancer Patients on Consecutive ^{18}F-FDG PET/CT Studies

Ardışık ^{18}F-FDG PET/BT İncelemeleri Olan Over Kanseri Hastalarındaki Kapsüler Karaciğer Lezyonlarının, Peritoneal Karsinomatozis ve Hematojen Metastazlar ile Birlikteliği

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Abstract

Objectives: The aim of our study was to evaluate the cooccurrence of capsular liver lesions along with peritoneal carcinomatosis and hematogenous metastases in other regions of the body in ovarian cancer patients on follow-up F-18 fluorodeoxyglucose (^{18}F-FDG) positron emission tomography/computed tomography (PET/CT) studies.

Methods: Consecutive ^{18}F-FDG PET/CT studies of 54 women with ovarian cancer between August 2012 and January 2020 and a total of 192 scans were analysed retrospectively. All patients had at least one hepatic and/or capsular lesion with high ^{18}F-FDG uptake and at least two PET/CT examinations.

Results: According to interpretation, of 54 patients with hepatic or capsular lesions, 44 (81.4%), 5 (9.3%) and 5 (9.3%) of them were concluded as perihepatic implants, hematogenous liver metastases and both, respectively. Accompanying peritoneal carcinomatosis on follow-up PET/CT images was found in 42 (95.4%) and 3 (60%) patients with solely capsular lesions and solely hematogenous liver metastases, respectively. Extrahepatic hematogenous organ metastases on follow-up PET/CT images were seen in 4 (9.0%) and 3 (60%) patients with solely capsular lesions and solely hematogenous liver metastases, respectively. Lungs, bones, spleen and brain were detected metastases sites.

Conclusion: Cooccurrence of peritoneal carcinomatosis in other regions of abdomen was found to be higher in comparison to hematogenous organ metastases on consecutive PET/CT studies of ovarian cancer patients with capsular liver lesions. The primary opinion of the nuclear medicine physician is essential along with the other patient data for differential diagnosis and treatment approach in this particular patient group.

Keywords: Ovarian cancer, implants, liver metastasis, PET/CT

Öz

Amaç: Bu çalışmanın amacı over kanseri hastalarının ardışık F-18 florodeoksiglukoz (^{18}F-FDG) pozitron emisyon tomografisi/bilgisayarlı tomografi (PET/BT) çalışmalarında görülen kapsüler karaciğer lezyonlarının, peritoneal karsinomatozis ve diğer vücut bölgelerindeki hematojen metastazlar ile olan birlikteliğini değerlendirmektir.

Yöntem: Over kanseri tanısı olan 54 kadının Ağustos 2012 ile Ocak 2020 tarihleri arasındaki toplam 192 ardışık^{18}F-FDG PET/BT incelemesi retrospektif olarak değerlendirildi. Tüm hastaların yüksek düzeyde ^{18}F-FDG tutulumu gösteren en az bir adet hepatik ve/veya kapsüler lezyonu ve en az iki tane PET/BT incelemesi vardı.

Bulgular: Değerlendirme sonrası hepatik veya kapsüler lezyonları olan 54 hastadan 44 tanesi (%81,4) perihepatik implant, 5 tanesi (%9,3) hematojen karaciğer metastazı ve 5 tanesi de (%9,3) her iki patolojiye de sahip olarak yorumlandı. Sadece kapsüler lezyon saptanan hastaların 42

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tanesinde (%95,4) ve sadece hematojen karaciğer metastazı saptanan hastaların da 3 tanesinde (%60) takip PET/BT incelemelerinde eşlik eden peritoneal karsinomatozis görüldü. Sadece kapsüler lezyon saptanan hastaların 4 tanesinde (%9,0) ve sadece hematojen karaciğer metastazı saptanan hastaların da 3 tanesinde (%60) ise takip PET/BT incelemelerinde eşlik eden ekstrahepatik hematojen organ metastazı görüldü. Akciğerler, kemikler, dalak ve beyin tespit edilen metastaz sahaları idi.

Sonuç: Ardışık PET/BT incelemeleri olan over kanseri hastalarında, kapsüler karaciğer lezyonlarına eşlik eden peritoneal karsinomatozis, hematojen organ metastazlarına oranla daha sık saptandı. Bu hasta grubu özelinde nükleer tıp uzmanının görüşü, ayırıcı tanı ve tedavi yaklaşımı açısından önemli bir role sahiptir.

Anahtar kelimeler: Over kanseri, implantlar, karaciğer metastazı, PET/BT

Introduction

The second most common gynaecological cancer among women is ovarian cancer. Early diagnosis is important, but mostly difficult due to low symptom rates. Most of the patients are diagnosed at advanced stage (1). It is more common in older women. Ovarian cancer has a high mortality rate with local and distant spread characteristics. Peritoneal, hematogenous and lymphatic metastases can be detected with several imaging modalities. Positron emission tomography/computed tomography (PET/CT), magnetic resonance imaging (MRI), CT, ultrasonography and bone scan are widely used for imaging. Each modality has its own advantages and limitations. Tumour markers can monitor disease progression. Surgical staging and interventional diagnostic procedures are also used for diagnostic and therapeutic approaches.

Cytoreductive surgery plays an important role in the treatment of ovarian cancer. Therefore, accurate staging or restaging should be done precisely. Implants can be seen especially in diaphragmatic, perihepatic, omental and paracolic regions (2). Hematogenous metastases are seen commonly in liver, lungs, bones and brain (3). Lymphatic spread is seen in pelvic, retroperitoneal, thoracic and supraclavicular stations.

^{18}F-fluorodeoxyglucose (^{18}F-FDG) is a glucose analogue with positron emission, which is used for PET/CT imaging. It is useful especially in detecting aggressive and poorly differentiated tumours. Whole-body scanning allows accurate imaging of cancer patients by detecting occult metastases or ruling out known suspicious lesions. Tissues with high metabolism have high glucose transporter activity, therefore, high ^{18}F-FDG uptake is seen in these lesions. ^{18}F-FDG PET/CT also allows to point the accurate biopsy site for lesions with faint borders or large necrotic components. High ^{18}F-FDG uptake is generally informative about poor prognosis. Lymphatic metastases without pathological enlargement can be detected by ^{18}F-FDG PET/CT. However, due to resolution characteristics of PET devices, subcentimeter foci may be missed, especially the lesions with low ^{18}F-FDG avidity. False positive findings include infectious, inflammatory diseases and various benign pathologies. CT component of the device may be useful in differential diagnosis in these cases. Since ^{18}F-FDG is excreted via kidneys, lesions near bladder or ureters can be masked by these adjacent radiation sources. Intravenous diuretics, bladder catheterization and dual-phase images help reduce this limitation.

Peritoneal metastases adjacent to liver and subcapsular liver metastases are not rare conditions. Therefore, it is essential to differentiate peritoneal and hematogenous spread for accurate disease staging and decide treatment options.

The aim of our study was to evaluate the cooccurrence of capsular liver lesions along with peritoneal carcinomatosis and hematogenous metastases in other regions of the body in ovarian cancer patients on follow-up ^{18}F-FDG PET/CT studies.

Materials and Methods

Consecutive ^{18}F-FDG PET/CT studies of 54 women with ovarian cancer between August 2012 and January 2020 and a total of 192 scans were analysed retrospectively. All patients had at least one hepatic and/or capsular lesion with high ^{18}F-FDG uptake and at least two PET/CT examinations. Since all lesions in this particular group have high ^{18}F-FDG avidity, possible false negative PET studies were not evaluated in this paper. The median age of the patients was 58 years in our study (ranging 22-85). Imaging was performed 45-60 minutes after the intravenous injection of 0.1 mCi/kg FDG. Maximum standardized uptake value (SUV_{max}) measurement of the hottest lesion was calculated by volume of interest. Informed consent, patient preparation, imaging and reconstruction were made properly according to the European Association of Nuclear Medicine guideline (4). Follow-up PET/CT studies were performed after a minimum interval of three months (Figure 1). The mean number of PET/CT imaging per patient was 3.56 (ranging 2-12).

This study protocol was reviewed and approved by the Ankara Bilkent City Hospital Clinical Studies Ethics Committee (decision no.: E2-24-8598, date: 10.07.2024).

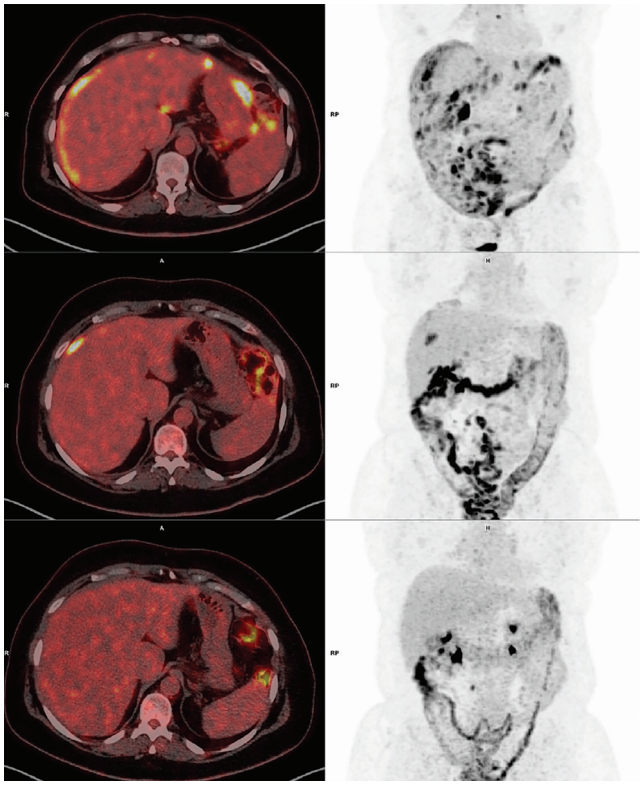

Figure 1. Fusion and maximum intensity projection images of ^{18}F-FDG PET/CT studies. No sign of capsular lesion on the bottom row images, which are the oldest dated. Development of hypermetabolic lesion on mid row. Progression and peritoneal carcinomatosis on top row, which are the most recent

^{18}F-FDG: F-18 fluorodeoxyglucose, PET/CT: Positron emission tomography/computed tomography

Statistical Analysis

Statistical analysis was performed by International Business Machines (IBM) Statistical Package for the Social Sciences Statistics for Windows (version 23.0, IBM Corp, Armonk, New York) software. For all analyses a p-value <0.05 was considered statistically significant. In this retrospective analysis, mean±Standard deviation of groups was calculated. Student's t-test was used to compare measurements of metastatic patient groups.

Results

According to interpretation, of 54 patients with hepatic or capsular lesions, 44 (81.4%), 5 (9.3%) and 5 (9.3%) of them were concluded as perihepatic implants, hematogenous liver metastases and both, respectively. Mean SUV_{max} measurements were calculated as 13.8 [standard deviation (SD)± 7.1] for capsular lesions and 16.2 (SD± 11.9) for liver metastases. No significant SUV_{max} difference was noted between these lesion groups (p=0.2).

Accompanying peritoneal carcinomatosis in other regions of abdomen on follow-up PET/CT images was found in 42 (95.4%) and 3 (60%) patients with solely capsular lesions and solely hematogenous liver metastases, respectively.

Lymphatic metastases on follow-up PET/CT images were detected in 31 (70.4%) and 3 (60%) patients with solely capsular lesions and solely hematogenous liver metastases, respectively.

Extrahepatic hematogenous organ metastases on follow-up PET/CT images were seen in 4 (9.0%) and 3 (60%) patients with solely capsular lesions and solely hematogenous liver metastases, respectively (Table 1). Lungs, bones, spleen and brain were detected metastases sites.

The ratio of "peritoneal carcinomatosis in other regions of abdomen" to "extrahepatic hematogenous organ metastases" in patients with solely capsular lesions were 42/4 (10.5). This ratio was found to be 3/3 (1) for patients with solely hematogenous liver metastases.

The ratio of "peritoneal carcinomatosis in other regions of abdomen" to "lymphatic metastases" in patients with solely capsular lesions were 42/31 (1.35). This ratio was found to be 3/3 (1) for patients with solely hematogenous liver metastases.

Discussion

Hypermetabolic lesion on ^{18}F-FDG PET/CT imaging in capsular region of liver can be a challenging diagnosis to locate, if it is an extracapsular implant or a subcapsular hematogenous metastasis. CT images of the study may even seem normal, especially when intravenous contrast agent is not used. We do not routinely inject intravenous contrast like most of the PET/CT facilities in our country. MR or PET/MRI may

Table 1. Cooccurrence of hepatic and extrahepatic lesions in ovarian cancer patients on ^{18}F-FDG PET/CT studies

	Number of patients	Peritoneal carcinomatosis in other regions of abdomen	Extrahepatic hematogenous organ metastases	Lymphatic metastases
Solely capsular lesions	44	42 (95.4%)	4 (9.0%)	31 (70.4%)
Solely hematogenous liver metastases	5	3 (60%)	3 (60%)	3 (60%)
Both capsular and parenchymal lesions	5	5 (100%)	1 (20%)	3 (60%)

^{18}F-FDG: F-18 fluorodeoxyglucose, PET/CT: Positron emission tomography/computed tomography

be helpful in these cases. Surgical staging also plays an important role in ovarian cancer (5). Since ovarian cancer tends to spread through peritoneal fluid and cytoreductive surgery plays an important role in treatment, differential diagnosis of peritoneal and hematogenous lesions are essential. Capsular region is the intersection of these two entities. Furthermore, patients with liver metastases have a poorer prognosis than patients with peritoneal implants. Our goal in this study was not to verify the exact location of capsular lesions of our patients. We used our data to identify the cooccurrence of these lesions along with peritoneal carcinomatosis and hematogenous metastases in other regions of the body on follow-up ^{18}F-FDG PET/CT studies.

In the literature, ^{18}F-FDG PET/CT was reported to alter the management of 60% of recurrent ovarian cancer patients by detecting especially subdiaphragmatic occult lesions (6). ^{18}F-FDG PET/CT is known to be valuable when detecting peritoneal carcinomatosis (7). Better diagnostic performance than MRI is also reported in the literature (8).

Most of the patients with capsular lesions had peritoneal carcinomatosis on follow-up PET/CT examinations in our study. On the contrary, few of these patients developed extrahepatic metastatic disease on follow-up PET/CT studies. The high cooccurrence of capsular lesions with peritoneal carcinomatosis may be helpful when concluding PET/CT reports. This might also alert the nuclear medicine physician to acquire additional images to detect more implants in abdomen (9).

Furthermore, same cooccurrence was not found with lymphatic metastases. Since the mechanism of lymphatic spread is different than peritoneal and hematogenous metastases, it should be accurate to define hypermetabolic lymph nodes in comparison with previous studies and according to patient's clinical info, like histopathological type of tumour or infection and surgery history.

Study Limitations

The major limitation of our study is the lack of surgical and histopathological confirmation of lesions. However, unlike lymphatic or pulmonary lesions, few false-positive results have been found in literature (10,11) in perihepatic region, especially a long interval after surgery. The number of patients with solely hematogenous liver metastases were low. This may be another limitation of the study. However, our main purpose was to evaluate and follow-up capsular lesions.

Since the liver has moderate metabolic activity, it is obvious that capsular lesions must have higher ^{18}F-FDG uptake than adjacent parenchyma. This is one of the main limitations of ^{18}F-FDG PET/CT especially in small lesions with no significant mass formation on CT images. Perihepatic implants in our study had variable SUV_{max} measurements, all of which were higher than liver activity. No significant SUV_{max} difference was noted between perihepatic implants and hematogenous liver metastases. Literature results also reported variable ^{18}F-FDG uptake in these patient groups (12,13,14).

Extrahepatic hematogenous metastases sites in our study were consistent with the literature (3). ^{18}F-FDG PET/CT has also the capability of diagnosing second primary tumours (15). However, all extrahepatic lesions in our study were concluded as metastases related to ovarian cancer.

Conclusion

Hypermetabolic lesions in capsular region of liver on ^{18}F-FDG PET/CT imaging may be related to perihepatic implants or hematogenous liver metastases in ovarian cancer patients. The primary opinion of the nuclear medicine physician is essential along with the other patient data for differential diagnosis and treatment approach in this particular patient group. Cooccurrence of peritoneal carcinomatosis in other regions of abdomen was found to be higher in comparison to hematogenous organ metastases on follow-up PET/CT studies of these patients. Further studies with surgical and histopathological confirmation may help describing uptake patterns and the most common locations of perihepatic implants.

Ethics

Ethics Committee Approval: This study protocol was reviewed and approved by the Ankara Bilkent City Hospital Clinical Studies Ethics Committee (decision no.: E2-24-8598, date: 10.07.2024).

Informed Consent: Retrospective study.

Authorship Contributions

Surgical and Medical Practices: K.Ü., L.G., E.V., Concept: K.Ü., E.V., Design: K.Ü., L.G., Data Collection or Processing: K.Ü., L.G., Analysis or Interpretation: K.Ü., E.V., Literature Search: K.Ü., Writing: K.Ü.

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