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# Role Of Abdominal Computerized Tomography In Early Detection Of Peritoneal Malignancy

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ORIGINAL ARTICLE

# Role of Abdominal Computed Tomography in Early Detection of Peritoneal Malignancy

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**Abstract**

*Background*: **Patients having suspected or a confirmed diagnosis of peritoneal malignancy benefit greatly from imaging studies. Tumor staging is impacted by the existence of peritoneal metastases (PM), which in turn affects treatment options and prognosis. Extended life and even cure have been achieved in some cases with PM by combining cytoreductive surgery with hyperthermic intraperitoneal chemotherapy.**

*Objectives*: **To assess the diagnostic utility and efficacy of high-resolution computed tomography (CT scan) in the early diagnosis of peritoneal tumor seeding.**

*Patients and methods*: **This prospective research was performed in Radio-Diagnosis Department, Faculty of Medicine, Al-Azhar Assiut University. It conducted on 20 participants; patients suspected clinically with PM newly diagnosed or recurrent disease from Al-Azhar Assiut University hospital.**

*Result*: **There was high statistically substantial elevate prevalence of nodularity and thickening in diseased group in contrast to control group ($P < 0.001$). There was no statistically substantial among our studied groups concerning demographic characteristics, validity of CT in prediction of peritoneal lesion due to Hepatocellular carcinoma (HCC), validity of CT in prediction of peritoneal lesion due to cancer colon, and validity of CT in prediction of peritoneal lesion due to cancer ovary.**

*Conclusion*: **In comparison to primary tumors, PM are quite prevalent. Multidetector CT allows the creation of three-dimensional pictures with minimal artifact and the acquisition of thin-section abdominopelvic images for the evaluation of subcentimeter implants.**

*Keywords:* Abdominal computed tomography, Peritoneal carcinomatosis, Peritoneal malignancy

## 1. Introduction

The peritoneum is a membrane that lines the inside of the abdomen and pelvis. Two anatomical layers that are mutually uninterrupted. The inner surfaces of the abdominal and pelvic wall are protected by the parietal peritoneum, while the organs and tissues that support them in the abdominopelvic cavity are enveloped by the visceral peritoneum.[1] The greater omentum, or gastrocolic ligament, is a prominent peritoneal fold that is sometimes called the 'policeman of the abdomen' due to its function in limiting the spread of infection and inflammation throughout the abdominal and pelvic areas. Because of its unique anatomy, the omentum is vulnerable to local disease dissemination from any abdominal malignancy.[2]

Cases with suspected or confirmed peritoneal cancer benefit greatly from imaging as part of their diagnostic workup. Evaluation of peritoneal disease is difficult, despite major developments in imaging equipment and methods. There is a lot of overlap in the imaging appearances of different peritoneal disorders, and the structure of the peritoneum is complicated, so it is possible that tumor deposits may be located anywhere on its surface. Multidetector computed tomography (MDCT) with contrast

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enhancement continues to be the most flexible imaging modality for peritoneal malignancy.[3]

In most cases, the term 'peritoneal carcinomatosis' (PC) indicates that the peritoneum has been affected by metastases. Sampson created the term in 1931 for his detailed description of ovarian cancer cells that had spread and invaded the peritoneal stroma. Metastatic cancer to the peritoneum is more prevalent than initial peritoneal cancer, and the term 'metastatic peritoneal deposits' has come to apply to almost all metastatic deposits found there.[4] It is common in cases with malignant gastrointestinal or gynecological cancers that have spread to other parts of the body.[5]

When cancer spread to the peritoneal cavity, surgical treatment was no longer a possibility and the condition was considered terminal. The disease's progression has shifted considerably due to recent advances in surgical procedures and medicinal care tactics. Disease-free and overall survival rates have increased as a result of the development of more effective treatment methods.[6]

This work aimed to evaluate the diagnostic value and efficacy of high-resolution CT scan in early diagnosis of peritoneal tumor seeding.

## 2. Patients and methods

The local Medical Ethics Committee gave approval to this analytical observational research, which took place among January 2019 and May 2021 at the Diagnostic Radiology Department of the Faculty of Medicine at Al-Azhar Assiut University. Forty cases having a new or recurring diagnosis of peritoneal metastases (PM) at our institution will be enrolled in the trial. Abdominal CT with contrast was performed on all cases, and they were all monitored in the laboratory.

Exclusion criteria for patients were: pregnancy (first trimester) and history of allergy to iodinated contrast medium.

All recruited patients were submitted to the following: thorough clinical history of primary lesion taking with analysis of symptoms, post-contrast CT scan imaging was performed through the abdomen and pelvis after treatment, and correlation with radiological features and tumor marker.

### 2.1. Ethical considerations

Every participant was briefed about the study's goals before any data is collected; those who were interested in taking part were asked for their verbal and written consent; and all data were kept confidential.

### 2.2. Computed tomography technique

The Toshiba 16-row scanner was used to acquire the CT images, and the settings for the detector collimation, section thickness, and section reconstruction interval were all set to 1.5, 3, and 2 mm, respectively. Before the research, cases were given 500–1000 ml of water to drink orally 15–20 min beforehand. Water helps distinguish calcified implants from intestinal loops, although unopacified loops might look like cystic tumor if they are not properly removed. The intravenous injection rate was 3 ml/s, and the total volume of nonionic contrast material used was 2 ml/kg. After 30 and 60 s of injecting contrast, arterial and venous phase pictures of the abdominal cavity and pelvis were obtained. Since the intestine mucosa improves first and the liver parenchyma enhances later, images were taken at two different times for evaluation of the liver and bowel implants. The pictures, both axial and multiplanar, were examined on a workstation.

### 2.3. Computed tomography protocol

Contrast material, scanning, reconstruction, and image analysis.

### 2.4. Statistical analysis

The obtained data will be tabulated and statistically assessed with SPSS software, version 26.0 (New York), Microsoft Excel 2016 (Redmond, Washington), and MedCalC software, version 19.1 (Ostend Belgium).

For numerical parametric data, descriptive statistics were determined to be mean ± SD and minimum and maximum of the range; for numerical nonparametric data, descriptive statistics were calculated as median and first and third interquartile range; and for categorical data, descriptive statistics were determined to be number and percentage.

For quantitative variables, inferential analyses were done with the independent *t*-test for two independent groups with parametric data and the Mann–Whitney *U* for two independent groups with nonparametric data.

Receiver operating characteristic (ROC) analysis was performed to determine the overall productivity of the parameter and to determine the optimal cut-off value for sensitivity and specificity detection at this value.

For qualitative data, inferences were drawn using the $c^2$ test for independent groups. The significance

level was set at $P$ value less than 0.05; alternatively, the result was deemed insignificant. The $P$ value is a statistical measure of the probability that the observed results of an experiment are due to random chance.

## 3. Results

Table 1 shows contrast among the two groups concerning demographic characteristics. The mean age of diseased and control group was 54.3 ± 7.69 and 58.33 ± 5.46, respectively, with no statistical substantial variance among the two groups ($P = 0.059$). Male predominance was found in both groups (70 and 68.25, respectively) with no statistical substantial variance among the two groups ($P = 0.889$) (Fig. 1).

Table 2 shows comparison among the two groups concerning CT findings. There was great statistically substantial increase prevalence of nodularity and thickening in diseased group contrasted with control group ($P < 0.001$). Likewise, there was high statistically substantial increase prevalence of ascites and dirty fat in diseased group contrasted with control group ($P = 0.02$ and $P < 0.001$ respectively).

Table 3 shows that by using ROC curve analysis, CT predicted patients with Hepatocellular carcinoma (HCC) with accuracy, sensitivity, specificity, PPV, and NPV was 65.7, 64.71, 66.67, 25, and 91.7 %, respectively ($P = 0.376$).

Table 4 shows that by using ROC curve analysis, CT predicted patients with peritoneal lesion due to cancer colon with accuracy, sensitivity, specificity, PPV, and NPV was 63.7, 94.12, 33.33, 88.89, and 50 %, respectively ($P = 0.417$).

Table 5 shows that by using ROC curve analysis, CT predicted patients with peritoneal lesion due to cancer colon with accuracy, sensitivity, specificity, PPV, and NPV was 55.9, 11.76, 100, 100, and 16.67 %, respectively ($P = 0.144$).

*Table 1. Comparison among the two groups as regard demographic characteristics.*

| | Group I (diseased group) ($N = 20$) [$n$ (%)] | Group II (control group) ($N = 20$) [$n$ (%)] | Test value | $P$ value |
|---|---|---|---|---|
| Age (years) | | | | |
| Mean ± SD | 54.30 ± 7.69 | 58.33 ± 5.46 | $t = 1.94$ | 0.059 |
| Median | 54.0 | 58.0 | | |
| Range | 38–68 | 50.0–69.0 | | |
| Sex | | | | |
| Male | 14 (70.0) | 15 (68.2) | $\chi^2 = 0.016$ | 0.889 |
| Female | 6 (30.0) | 6 (31.8) | | |

Interquartile range, comparison between groups done by test and Student's $t$-test and $\chi^2$ test.
$P$ value less than or equal to 0.05 is considered statistically significant, $P$ value less than or equal to 0.01 is considered high statistically significant.

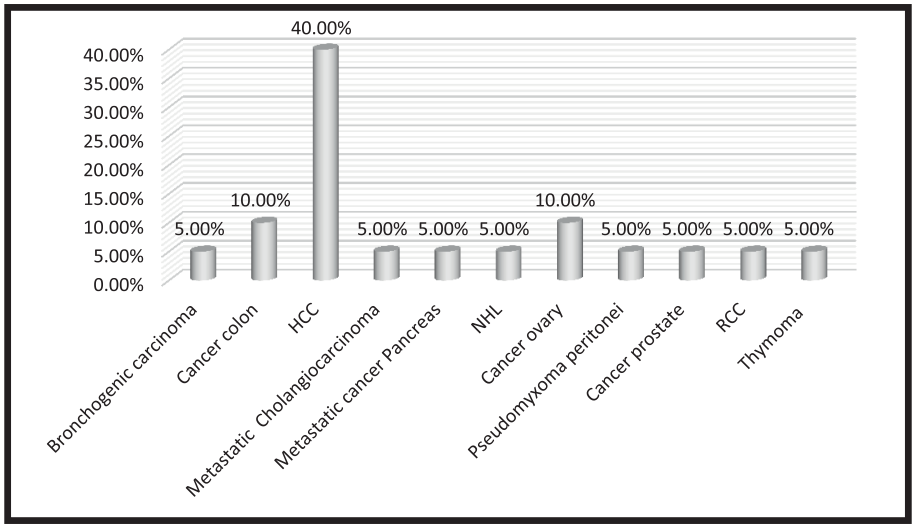


*Fig. 1. Bar chart showing distribution of primary cancer in the study group.*

*Table 2. Contrast among the two groups concerning computed tomography results.*

| | Group I (diseased group) ($N = 20$) [$n$ (%)] | Group II (control group) ($N = 20$) [$n$ (%)] | Test value | $P$ value |
|---|---|---|---|---|
| Nodularity | | | | |
| No | 3 (15.0) | 20 (100.0) | $\chi^2 = 29.57$ | <0.001[FET] |
| Yes | 17 (85.0) | 0 | | |
| Thickening | | | | |
| No | 4 (20.0) | 20 (100.0) | $\chi^2 = 26.67$ | <0.001[FET] |
| Yes | 16 (80.0) | 0 | | |
| Mass | | | | |
| No | 17 (85.0) | 20 (100.0) | $\chi^2 = 3.24$ | 0.231[FET] |
| Yes | 3 (15.0) | 0 | | |
| Ascites | | | | |
| No | 14 (70.0) | 20 (100.0) | $\chi^2 = 7.06$ | 0.02[FET] |
| Yes | 6 (30.0) | 0 | | |
| Dirty fat | | | | |
| No | 7 (35.0) | 20 (100.0) | $\chi^2 = 19.26$ | <0.001[FET] |
| Yes | 13 (65.0) | 0 | | |

*Table 3. Validity of computed tomography in prediction of peritoneal lesion due to HCC.*

| HCC | No (12 [$n$ (%)] | Yes (8) [$n$ (%)] | Test value | $P$ value |
|---|---|---|---|---|
| No | 1 (8.3) | 2 (25) | 1.05 | 0.376 |
| Yes | 11 (91.7) | 6 (75) | | |
| AUC (95 % CI) | 0.657 (0.414–0.851) | | | |
| Sensitivity | 64.71 | | | |
| Specificity | 66.67 | | | |
| PPV | 25.0 | | | |
| NPV | 91.7 | | | |
| Accuracy | 65.7 | | | |

AUC, area under the curve; CI, confidence interval; NPV, negative predictive value; PPV, positive predictive value.

*Table 4. Validity of computed tomography in prediction of peritoneal lesion due to cancer colon.*

| Cancer colon | No (18) [$n$ (%)] | Yes (2) [$n$ (%)] | Test value | $P$ value |
|---|---|---|---|---|
| No | 2 (11.1) | 1 (50) | 2.14 | 0.417 |
| Yes | 16 (88.9) | 1 (50) | | |
| AUC (95 % CI) | 0.637 (0.396–0.837) | | | |
| Sensitivity | 94.12 | | | |
| Specificity | 33.33 | | | |
| PPV | 88.89 | | | |
| NPV | 50.0 | | | |
| Accuracy | 63.7 | | | |

AUC, area under the curve; CI, confidence interval; NPV, negative predictive value; PPV, positive predictive value.

## 4. Case presentation

### 4.1. Case 1

Clinical presentation: patient with history of cancer ovary during follow up.

Laboratory findings: elevated CA125 > 60.

*Table 5. Validity of computed tomography in prediction of peritoneal lesion due to cancer ovary.*

| Cancer ovary | No (18) [$n$ (%)] | Yes (2) [$n$ (%)] | Test value | $P$ value |
|---|---|---|---|---|
| No | 3 (16.7) | 0 | 0.293 | 0.144 |
| Yes | 15 (83.3) | 2 (100) | | |
| AUC (95 % CI) | 0.559 (0.396–0.837) | | | |
| Sensitivity | 11.76 | | | |
| Specificity | 100 | | | |
| PPV | 100 | | | |
| NPV | 16.67 | | | |
| Accuracy | 55.9 | | | |

AUC, area under the curve; CI, confidence interval; NPV, negative predictive value; PPV, positive predictive value.

CT findings: nodularity, peritoneal thickening, and dirty peritoneal fat planes (Fig. 2).

### 4.2. Case 2

Clinical presentation: patient with history of cancer colon during follow up.

Laboratory findings: elevated CEA.

CT findings: nodularity, peritoneal thickening, and dirty peritoneal fat planes (Fig. 3).

## 5. Discussion

Tumors inside or outside the peritoneal cavity, and even primary peritoneal tumors, can cause PM, the definition of which is the seeding and implantation of neoplastic cells in the peritoneum. Cases treated with cytoreductive surgery and hyperthermic intraperitoneal chemotherapy have shown enhanced survival during the past two decades, sparking a renewed interest in the disease PM.

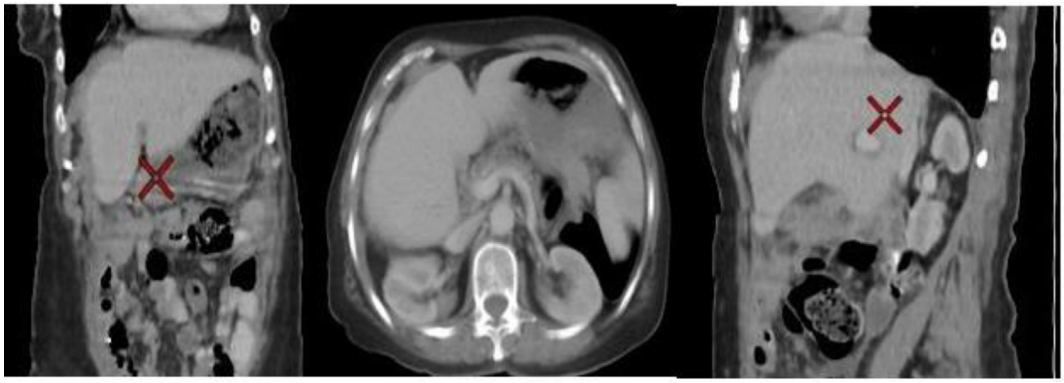

*Fig. 2. A 50-year-old woman with cancer ovary and suspected with peritoneal carcinomatosis. Coronal, axial, and sagittal reformatted portal venous phase. CT images showed multifocal discrete nodules in the peritoneal cavity mainly at the surface of the diaphragm, peritoneal enhancement, and thickening and omental haziness.*

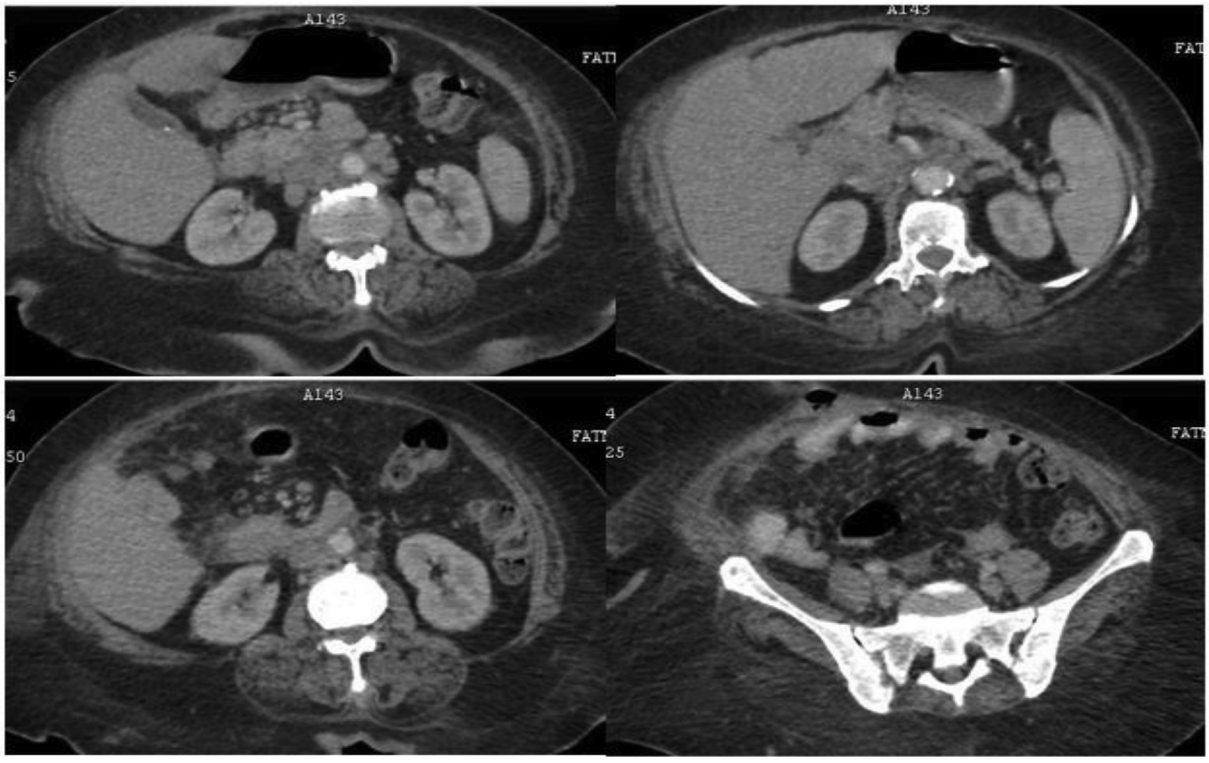


*Fig. 3. A 46-year-old woman with cancer colon with suspected peritoneal carcinomatosis. Axial arterial phase. CT images revealed multifocal discrete nodules in the peritoneal cavity with peritoneal thickening and dirty fat planes.*

When it comes to identifying and treating PM, imaging is crucial.[7]

With regards to the research population's demographics, the median age was 54, with a range of ages from 38 to 68 years old (mean ± SD = 54.3 ± 7.69). The male-to-female case ratio was 2.33: 1, with 14 (70 %) males and six (30 %) females receiving treatment.

As far as study group clinical and analytical results go, hepatocellular carcinoma was discovered in 40 % of our study participants, with colon cancer coming in as a distant second at 10 %.

Incidence rates per 100 000 were 166.6 for both sexes, 175.9 for men, and 157.0 for women, when adjusted for age. The liver (33.6 %) and bladder (10.7 %) among men, while the breast (32.0 %) and liver (13.5 %) among women.[8]

As regard distribution of CT findings among the study group. The most common finding in CT was peritoneal nodularity (17, 85 %) followed by

peritoneal thickening (16, 80 %) then dirty fat (13, 65 %). The least common finding was peritoneal mass (3, 15 %).

Metser et al.[9] support our study that while both MDCT and operation were equally effective in finding lesions 1 cm or larger (89.3 and 84.9 %, respectively; $P = 0.31$), MDCT was fewer sensitive than operation at finding disease sites smaller than 1 cm (65.5 and 92.3 %, respectively; $P = 0.001$).

In our study by using ROC curve analysis, CT predicted patients with HCC with accuracy, sensitivity, specificity, PPV, and NPV was 65.7, 64.71, 66.67, 25, and 91.7 %, respectively ($P = 0.376$).

By utilizing ROC curve analysis, CT predicted patients with peritoneal lesion due to cancer colon with accuracy, sensitivity, specificity, PPV, and NPV was 63.7, 94.12, 33.33, 88.89, and 50 % respectively ($P = 0.417$).

Our study supported by Mazzei et al.[10] analyzing CT's performance at the patient level reveals 100 % sensitivity, 40 % specificity, 93 % PPV, 100 % NPV, and 93 % accuracy in diagnosing PC.

Also Ahmed et al.[11] support our study by showing that 930 (84.2 %) of the 1105 regions had peritoneal deposits at exploratory laparotomy. CT and laparoscopy sensitivity were 94.9, 98.3 %, specificity 86.7, 80.4 %, PPV 97.9, 96.8 %, NPV 72.2, 88.8 %, and accuracy 93.8, 95.7 %.

By using ROC curve analysis, CT predicted patients with peritoneal lesion due to cancer ovary with accuracy, sensitivity, specificity, PPV, and NPV was 55.9, 11.76, 100, 100, and 16.67 %, respectively ($P = 0.144$).

Our research, led by Delvallée et al.,[12] found that of the 980 women treated for epithelial ovarian cancer throughout the study period, 90 (9.2 %) also underwent a PET CT. When compared to a regular CT scan, PET CT performed poorly.

Ten females were diagnosed with PC by Schmidt et al.[13] (67 %). In all, 135 abdominal and pelvic locations were studied. The sensitivity of MDCT was 96 %, that of MRI 98 %, and that of FDG PET/CT 95 %, while the specificity was 92, 84, and 96 %. There was no statistically substantial distinction in the ROC area among the three groups ($P = 0.12$), with the values being 0.94, 0.90, and 0.96.

In contrast to our research, Michielsen et al.[14] reveal that 91, 75, and 71 % accuracies were recorded by CT, PET-CT, and whole-body DW MRI, respectively, when evaluating peritoneal staging in cases with ovarian cancer in the first prospective investigation of its kind. Specifically, DW MRI provided a more accurate description of mesenteric and serosal deposits, as well as subcentimetric lesions, than CT did.

### *5.1. Conclusion*

Compared with primary tumors, PM are by far the most prevalent form of peritoneal malignancy. Cancer metastasis and growth are facilitated by the peritoneal fluid environment. Miliary or massive lesions may manifest as low-attenuation masses of soft tissue. MDCT allows for the creation of three-dimensional pictures with minimal artifact, as well as the acquisition of thin-section abdominopelvic images for the evaluation of subcentimeter implants.

## Conflicts of interest

There are no conflicts of interest.

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