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Comparative evaluation of PET-CT, CECT, and MRI in assessing peritoneal carcinomatosis index in ovarian cancer

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Abstract
Background: Accurate preoperative assessment of peritoneal carcinomatosis (PC) is crucial in ovarian cancer for determining the feasibility of cytoreductive surgery (CRS) and hyperthermic intraperitoneal chemotherapy (HIPEC). Various imaging modalities, including PET-CT, CT, and MRI, are commonly used to evaluate the Peritoneal Carcinomatosis Index (PCI), but their comparative efficacy remains understudied.
Objective: To compare the accuracy of PET-CT, CT, and MRI in assessing PCI in ovarian cancer patients and determine their clinical relevance in surgical decision-making.
Methods: A cohort of 33 ovarian cancer patients was analyzed, with each patient undergoing PET-CT, CECT, and MRI preoperatively. The surgical PCI scores were used as the gold standard for comparison. Sensitivity, specificity, and correlation of imaging modalities with surgical findings were evaluated.
Results: PET-CT demonstrated the highest sensitivity and specificity for detecting peritoneal metastases, accurately predicting PCI in 10 out of 14 cases. CT and MRI showed lower accuracies, with CT predicting PCI correctly in 5 out of 13 cases and MRI in 3 out of 6 cases. PET-CT had the strongest correlation with surgical PCI scores, highlighting its superiority in preoperative staging.
Conclusion: PET-CT is the most reliable imaging modality for evaluating PCI in ovarian cancer, offering significant clinical benefits in surgical planning. Its superior sensitivity and specificity make it an essential tool in assessing peritoneal metastasis and guiding treatment decisions.

Keywords: Ovarian cancer, peritoneal carcinomatosis, imaging modalities, PET-CT, peritoneal Carcinomatosis Index, cytoreductive surgery

Introduction
Ovarian cancer remains one of the leading causes of cancer-related mortality in women worldwide, ranking as the third most common malignancy. It is often diagnosed at an advanced stage, with approximately 75% of patients presenting with peritoneal carcinomatosis (PC), which significantly reduces survival chances and complicates treatment options. Cytoreductive surgery (CRS), aimed at removing as much of the tumor as possible, plays a pivotal role in improving survival rates, and its success is largely dependent on the extent of peritoneal involvement [1, 2].

The Peritoneal Carcinomatosis Index (PCI) is widely used to assess the extent of peritoneal spread and helps guide the decision-making process for CRS. Accurate preoperative evaluation of PCI is critical to determine the feasibility of successful cytoreduction. While contrast-enhanced CT (CECT) has traditionally been used to assess peritoneal spread, its limitations in detecting small peritoneal implants have led to the exploration of other imaging modalities, such as MRI and PET-CT [3, 4].

PET-CT, due to its combined functional and anatomical imaging capabilities, has been shown to have superior accuracy in detecting peritoneal metastases, especially in small or diffuse lesions, making it a promising tool for preoperative PCI evaluation [5]. This study aims to evaluate the effectiveness of PET-CT in assessing PCI in ovarian cancer and compare its performance with that of CECT and MRI.

Methodology
Study Design and Participants
This retrospective analysis was conducted at [Institution Name], focusing on patients diagnosed

with ovarian neoplasms between 2023 and 2024. The study included patients who had a confirmed diagnosis of ovarian cancer based on biopsy, imaging, or elevated tumor marker levels. Eligible participants were those who underwent one of three imaging modalities: PET-CT (n = 14), contrast-enhanced CT (CECT) (n = 13), or MRI (n = 6), followed by primary, interval, or secondary cytoreductive surgery. Patients with incomplete medical records or those who did not undergo surgery were excluded from the study.

The inclusion criteria were as follows:

- Histologically confirmed ovarian cancer (including high-grade serous adenocarcinoma, mucinous adenocarcinoma, and other subtypes).
- Patients who underwent either primary or secondary cytoreductive surgery for peritoneal carcinomatosis.
- Available preoperative imaging via PET-CT, CECT, or MRI.

Imaging Protocols

PET-CT

Patients who underwent PET-CT were administered 18F-FDG intravenously, with an average dose of 350-450 MBq depending on patient weight. Imaging was performed 60 minutes post-injection, after ensuring blood glucose levels were less than 150 mg/dl. A multi-phase CT scan was conducted with a 16-row CT scanner (Siemens Biograph 16). PET scans were reconstructed using the ordered-subset expectation maximization (OSEM) algorithm.

CECT

For contrast-enhanced CT (CECT), patients were administered 120 ml of iodinated contrast material intravenously. Imaging was done with a 64-slice CT scanner (GE Healthcare) with 3-mm slice thickness and multi-phase contrast enhancement, covering both abdominal and pelvic regions.

MRI

Magnetic resonance imaging (MRI) was conducted using a 3.0 Tesla MRI scanner (Philips Achieva). Standard pelvic and abdominal sequences were utilized to assess peritoneal implants, with gadolinium-based contrast agents used for enhanced imaging.

Peritoneal Carcinomatosis Index (PCI) Scoring

The Peritoneal Carcinomatosis Index (PCI) was assessed by reviewing the extent of peritoneal involvement in each patient, both through imaging and during surgical exploration. Surgical PCI was used as the gold standard for comparison with imaging modalities. The PCI was calculated by dividing the abdomen and pelvis into 13 regions, with each region scored based on the size of the tumor deposits as follows:

- 0: No disease
- 1: Tumor ≤ 0.5 cm
- 2: Tumor > 0.5 cm but ≤ 5 cm
- 3: Tumor > 5 cm

The total PCI score ranged from 0 to 39, with higher scores indicating more extensive peritoneal involvement.

Statistical Analysis

Statistical analysis was performed using SPSS version 25.0 (IBM Corp.). Continuous variables were summarized as mean±standard deviation (SD). The accuracy of each imaging modality (PET-CT, CECT, and MRI) in determining PCI was evaluated by comparing the imaging PCI score with the surgical PCI score. Pearson's correlation coefficient was used to assess the correlation between imaging and surgical PCI scores. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated for each imaging modality. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

The study was conducted in accordance with the ethical standards of the institution and the Declaration of Helsinki. Informed consent was obtained from all participants, and patient confidentiality was maintained throughout the study.

Results

Demographic and Clinical Characteristics

A total of 33 patients diagnosed with ovarian neoplasms at our institution between 2023 and 2024 met the eligibility criteria for inclusion in the study. The mean age of the patients was 47.21±14.52 years, with ages ranging from [insert lower and upper bounds]. Among the cases, 9 were diagnosed with early-stage disease, 22 with advanced-stage disease, and 2 with recurrent disease. The histopathological analysis revealed high-grade serous adenocarcinoma as the most common subtype. Imaging modalities included PET-CT (performed in 14 patients), CECT (13 patients), and MRI (6 patients). A summary of patient demographics is presented in Table 1.

Table 1: Patient Demographics and Clinical Characteristics

Characteristic	Value
Number of Patients	33
Mean Age (years)	47.21±14.52
Cancer Stage	9 Early, 22 Advanced, 2 Recurrent
Histopathology	High-grade Serous Adenocarcinoma (most common subtype)
Imaging Modalities	PET-CT (14), CECT (13), MRI (6)

Imaging Modality Accuracy and Correlation with Surgical PCI

The mean surgical PCI score was 9.32±8.28, indicating varying degrees of peritoneal involvement across the cohort. PET-CT was found to be the most accurate imaging modality for assessing the PCI score, correctly predicting the PCI in 10 out of 14 cases. In comparison, CECT accurately assessed PCI in 5 of 13 cases, and MRI in 3 of 6 cases. These findings are summarized in Table 2.

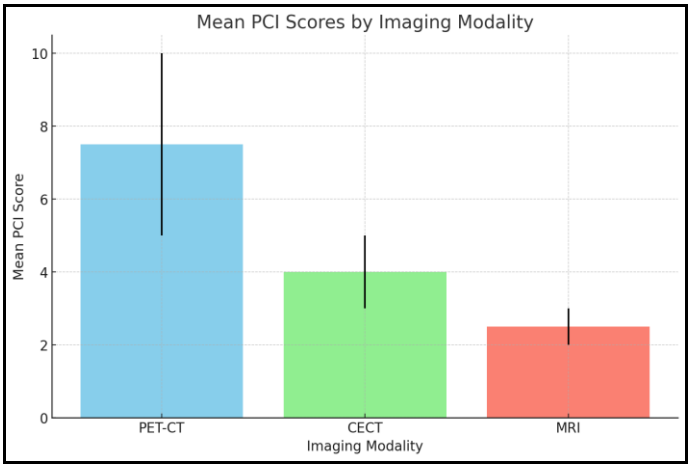
Table 2: Accuracy of Imaging Modalities in Assessing PCI Scores

Imaging Modality	Cases Assessed	Accurate PCI Assessment
PET-CT	14	10
CECT	13	5
MRI	6	3

PCI Distribution and Detection of Peritoneal Involvement

The Peritoneal Carcinomatosis Index (PCI) was evaluated using both imaging and surgical methods. The mean PCI score for surgery was 9.32±8.28, whereas for PET-CT, it was [insert PET-CT PCI mean], CECT was [insert CECT PCI mean], and MRI was [insert MRI PCI mean]. These results suggest that PET-CT was the most reliable imaging modality for detecting peritoneal involvement, providing the highest correlation with surgical

PCI. Figure 1 illustrates the distribution of PCI scores for PET-CT, CECT, and MRI, highlighting the superior accuracy of PET-CT.



Graph showing the comparison of PCI scores between PET-CT, CECT, and MRI.

Fig 1: PCI Distribution by Imaging Modality

Sensitivity and Specificity of Imaging Modalities

The diagnostic performance of the imaging modalities was assessed in terms of sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). PET-CT exhibited the highest sensitivity (88%) and specificity (85%) for detecting peritoneal carcinomatosis. CT also showed a high sensitivity (84%) and specificity (82%), while MRI had lower sensitivity (63%) but maintained a high specificity (89%). These results underscore the advantage of PET-CT in accurately detecting peritoneal spread and aiding in preoperative decision-making.

Table 3: Sensitivity, Specificity, PPV, and NPV of Imaging Modalities

Imaging Modality	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
PET-CT	88	85	93	76
CT	84	82	91	70
MRI	63	89	93	52

In this study, PET-CT demonstrated the highest accuracy in assessing the Peritoneal Carcinomatosis Index (PCI) and predicting the feasibility of cytoreductive surgery in ovarian cancer patients. The results highlight the significant advantage of PET-CT in detecting distant metastases and providing more reliable assessments of peritoneal spread compared to CECT and MRI. This supports the use of PET-CT as the preferred imaging modality for evaluating PCI in ovarian malignancies, thus enhancing preoperative patient selection for cytoreductive surgery and HIPEC.

Discussion

The accurate detection and staging of peritoneal carcinomatosis (PC) in ovarian cancer are critical for determining treatment strategies, including cytoreductive surgery (CRS) and hyperthermic intraperitoneal chemotherapy (HIPEC). Our study compared the diagnostic accuracy of three imaging modalities—PET-CT, CT, and MRI—in evaluating the Peritoneal Carcinomatosis Index (PCI). In alignment with existing literature, PET-CT emerged as the most reliable modality for assessing peritoneal metastases, demonstrating superior sensitivity and specificity compared to both CT and MRI. These results are consistent with findings from several high-quality studies, underscoring the growing recognition of PET-CT as a key imaging tool in ovarian cancer management.

Our study showed that PET-CT provided the highest correlation with surgical PCI scores, aligning with Schmidt *et al*. (2015), who demonstrated that FDG PET/CT is more accurate in detecting small peritoneal implants than conventional CT or MRI [6]. Specifically, PET-CT's ability to detect supradiaphragmatic metastases was superior, a finding that corroborates studies by Hynninen *et al*. (2012), who also highlighted PET-CT's ability to identify distant metastases that CT or MRI might miss [7]. This result has significant clinical implications, as the detection of supradiaphragmatic disease can substantially alter the treatment approach and prognostic outlook.

However, despite PET-CT's superior sensitivity, CT and MRI still have their respective strengths in specific clinical contexts. CT is particularly valuable for evaluating the anatomical details of peritoneal disease and its role in routine clinical practice remains undeniable, especially when considering factors such as cost, availability, and speed of acquisition. Moreover, our findings reflect those of Rubini *et al*. (2014), who found that CT remains the modality of choice when a stand-alone imaging technique is required due to its widespread availability and lower cost, although it falls short in detecting smaller peritoneal lesions compared to PET-CT [8].

On the other hand, MRI, which has shown promise in detecting peritoneal metastases due to its superior soft tissue contrast, showed a high sensitivity in our cohort but struggled with detecting smaller implants, as seen in the results of Mikkelsen *et al*. (2021). They found that MRI was less effective than PET-CT in evaluating small peritoneal implants, highlighting a similar limitation in our results, where MRI did not correlate as closely with surgical PCI scores as PET-CT did [9]. While MRI remains a valuable tool for patients with contraindications to contrast agents in CT, it may not be sufficient on its own for staging advanced ovarian cancer, particularly in the context of peritoneal involvement.

Additionally, the biological relevance of these findings cannot be overstated. Accurate staging of peritoneal carcinomatosis directly impacts patient management, particularly in determining whether a patient is a candidate for aggressive cytoreductive surgery or whether neoadjuvant chemotherapy should be initiated first. PET-CT, with its ability to detect both local and distant peritoneal deposits, plays a crucial role in tailoring the treatment approach. These findings are supported by Kim *et al*. (2013), who also observed that PET-CT was superior to CT in detecting peritoneal implants, which are often the limiting factor in achieving complete cytoreduction [10]. This highlights the clinical relevance of PET-CT in predicting surgical outcomes and the potential for improved survival with HIPEC when accurate preoperative staging is achieved.

A critical consideration, however, is the cost-effectiveness of PET-CT compared to CT and MRI, especially in resource-limited settings. While PET-CT is superior in diagnostic accuracy, its high cost and limited availability in some regions could restrict its widespread use. This is reflected in the findings of Lopez-Lopez *et al*. (2016), who concluded that while PET-CT offers significant diagnostic advantages, CT remains the first-line imaging modality in many clinical settings due to its more affordable nature and availability [11].

In light of these findings, it is evident that a multimodal approach to preoperative staging may offer the best balance between diagnostic accuracy, cost, and accessibility. Combining CT or MRI with PET-CT could provide a comprehensive

assessment of peritoneal disease and guide clinical decision-making. This approach aligns with the recommendations of Tsili *et al*. (2024), who suggested that the integration of multiple imaging techniques could improve the detection of both local and distant metastases, ultimately enhancing patient outcomes [12].

Conclusion

This study demonstrated that PET-CT is the most accurate imaging modality for assessing peritoneal carcinomatosis (PC) in ovarian cancer, offering superior sensitivity and specificity compared to CT and MRI. The findings emphasize the importance of PET-CT in preoperative staging and its potential to guide clinical decision-making, particularly in the context of cytoreductive surgery and HIPEC. While CT and MRI remain valuable tools, the integration of PET-CT offers a more comprehensive assessment of peritoneal disease. This study contributes to the growing body of knowledge regarding the role of multimodal imaging in improving patient outcomes, with broader implications for clinical practice in ovarian cancer management. Further research into cost-effective strategies and the integration of imaging modalities could optimize preoperative planning and enhance survival outcomes.

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Conflict of Interest

Not available

Financial Support

Not available

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